GREENWICH DEPARTMENT OF HEALTH

LYME DISEASE AND OTHER TICK-BORNE/TICK-ASSOCIATED DISEASES

Lyme disease is recognized as the major tick-borne disease in the country with the number of cases increasing every year.

Lyme disease is the most commonly reported vector-borne illness in the U.S. The disease does not occur nationwide; however, it is concentrated heavily in the Northeast and upper Midwest.

In 2013, according to the Centers for Disease Control and Prevention (CDC), 27,203 confirmed and 9,104 probable cases of Lyme disease were reported. Overall, the incidence rate of Lyme disease was 8.6 cases per 100,000 persons, with Connecticut listing 58.7 cases per 100,000 persons.

Recently, the CDC conducted several studies about how many people are actually diagnosed. As a result, preliminary findings suggest that around 300,000 people in the U.S. get diagnosed with Lyme disease yearly.

In 2013, according to the CDC, the state of Connecticut ranked fifth among states reporting Lyme disease with a total of 2,925 cases (confirmed and probable). In 2014 the state reported a total of 2,346 (confirmed and probable) cases of Lyme disease. Among the eight counties in Connecticut, New Haven County reported the highest number of confirmed cases of Lyme disease followed by Fairfield County. In Greenwich, a total of 4 cases (confirmed and probable) of Lyme disease were reported in 2014; a number which reflects under-reporting.

In the northeastern part of the U.S., three tick-associated diseases — *Lyme disease, human ehrlichiosis and human babesiosis* — are of greatest concern. However, other diseases in North America caused by a tick bite are Bartonella, Rocky Mountain Spotted Fever, Colorado tick fever, Q fever and Tick paralysis. To raise the level of awareness about the human health risk associated with tick-borne diseases, this booklet has been developed as a guide for recognizing and preventing tick-borne illnesses. The information offered does not cover all tick-borne diseases or known facts but does try to present important material the reader should know. In addition, the booklet references scientific findings; however, it should be noted that the Centers for Disease Control and Prevention (CDC) has questioned some study results for their accuracy and clinical usefulness in aiding the diagnosis of Lyme disease. Finally, the material within this booklet should be viewed objectively as new research will hopefully contribute to more answers, better testing methods to support a diagnosis and more effective, less costly treatments that can keep patients well.

Resources and websites of interest have been included. Content material does not necessarily represent the viewpoint of the Greenwich Department of Health or Time For Lyme, Inc. who gave some input. The information should be used for educational purposes only and is not intended to replace or supersede patient care by a healthcare provider.

THE "DEER" TICK AND DISEASE TRANSMISSION

Ticks are blood-feeding external parasites that require a host animal to survive and reproduce. They are totally dependent on the blood/tissue fluids of the host and over time have caused a problem to both humans and animals. Although ticks cannot fly or jump, they do attach themselves aggressively and frequently go undetected. Ticks can also be the cause of single or multiple infections in the human body. Worldwide, there are over 850 tick species in the U.S. Of those known nationwide, less than 15% of the total are considered a public health concern.

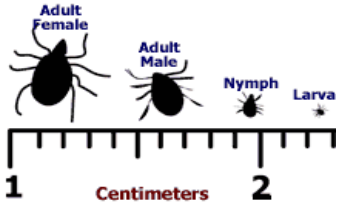
Humans acquire tick-associated diseases when the causative agent of disease (such as viruses, bacteria, toxins and parasites) is transmitted by a bite from an infected tick. For example, Lyme disease is caused by the spirochete ***Borrelia burgdorferi (Bb)***, a corkscrew-shaped bacterium that can live in a blacklegged tick commonly known as the "deer" tick ***(Ixodes scapularis***). Blacklegged ticks are found in many areas throughout the United States; however, in the northeastern part of the country, this tick can transmit not only ***Borrelia burgdorferi (Bb)***, but also other disease causing organisms. Among the most common other diseases transmitted are human babesiosis and human granulocytic anaplasmosis (HGA) – formerly known as human ehrlichiosis. In the southeastern part of the United States only a few ***Ixodes scapularis*** ticks have been found infected with the Lyme bacterium, thus making the risk of disease from this tick relatively low.

Ticks have four stages in their life cycle (egg, the 6-legged larva, the 8-legged nymph & adult male or female):

Stage	Animal Host
1: Larvae	White-footed mouse, birds or other small animals, e.g., chipmunks
2: Nymph	
3: Adults (male and female)	White-tailed deer
4: Egg	None (Adult female tick dies after laying eggs)

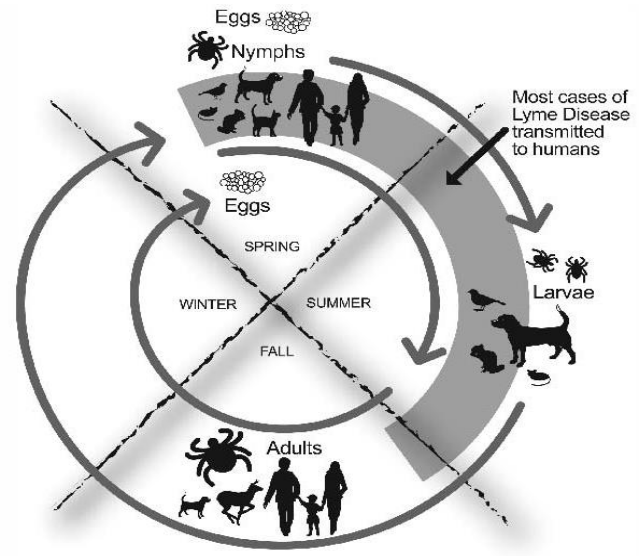
Most ticks, including ***Ixodes*** ticks, have a 3-host life cycle, where each of the active life stages feed on a different host animal for nourishment (blood meal). The immature stages of the tick, larvae and nymphs feed on small to medium sized host animals (mice, chipmunks, birds, etc.) while adult ticks feed on larger animals such as deer. Ticks feed on the host animal for only a few days and seek out the next host by way of odor attraction (carbon dioxide, lactic acid, etc.).

The blacklegged tick or "deer" tick, ***Ixodes scapularis,*** feeds from 3 to 7 days on a wide variety of host mammals as well as birds. The larval and nymph stage of this tick typically become infected with ***Borrelia burgdorferi*** (bacterium that causes Lyme disease) when they feed on a reservoir competent host animal that carries the bacterium. The white-footed mouse is the principal reservoir competent host (source of infection) for ***Borrelia burgdorferi***. This mouse also carries ***Babesia microti*** (a disease causing agent that causes human babesiosis) and ***Anaplasma phagocytophilum***, the bacterium that causes human granulocytic anaplasmosis (HGA).

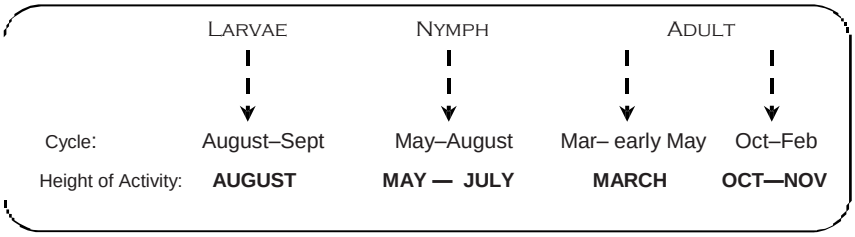


In a study where white-footed mice were tested for several disease causing agents, ***Borrelia burgdorferi*** was found in 90% of the mice, while the pathogen agents causing human babesiosis and human ehrlichiosis were found in almost 50% of the mice. Birds are the major animal host for immature blacklegged ticks and have been implicated in long-distance dispersal of ticks and ***Borrelia burgdorferi***. Although white-tailed deer are the primary animal host for adult stage ticks, they are not the reservoir competent host (source of infection) for the Lyme bacterium. The white-tailed deer are responsible for a large number of ticks getting dispersed and support a perfect breeding site for ticks to multiply. According to the literature, hundreds of blacklegged ticks can be found on a single ear of a white-tailed deer. In the year 2000, the deer population in the U.S. was estimated between 35-40 million. However, with the increasing changes in climate, the deer population could very well escalate. According to a deer management study conducted in 2004 by the Town of Greenwich, approximately 120 deer per square mile were estimated on large acre properties while 85.4 deer per square mile were sited on smaller lots. In comparison, normal deer populations in the state for this year averaged between 10 to 20 deer per square mile.

Two-Year Life Cycle for I. scapularis – "Deer" Tick



Height of Activity for Ixodes scapularis – "Deer" Tick



Note: Episodes of warm days during the year will promote hatches of ticks

COMMON TICK-ASSOCIATED DISEASES

HUMAN BABESIOSIS

Human babesiosis is a malaria-like infection that may cause severe illness and death. Babesiosis in the U.S. is caused by a parasite called ***Babesia microti*** and is spread to humans by the bite of the infected blacklegged tick or "deer" tick, ***Ixodes scapularis.*** The disease causing agent, ***Babesia microti,*** lives within and alters red blood cells of many wild domestic animals. White-footed mice, as well as chipmunks, voles and shrews are the principal reservoir competent host (source of infection) for ***Babesia microti***.

Human babesiosis has been recognized since the early 1970s in several states including Rhode Island, parts of Massachusetts and New York. Babesiosis was initially discovered in 1888 in cows and was first reported in humans in 1957. The first Connecticut case of human babesiosis was identified in 1988 with case reporting starting in 1991. Today, Babesia is enzootic in southern New England (i.e. it occurs everywhere) , especially in areas with moderate to high rates of Lyme disease. Like Lyme disease, babesiosis is a reportable disease.

Most human cases of babesiosis occur during the summer months (June and July) when the nymphal stage of the blacklegged tick is more active. Babesia can also be acquired through the placenta (mother to child) and transmitted through blood transfusions. Those who have an active case of babesiosis should not donate blood. According to literature resources, the parasite, ***Babesia microti***, may require 54 hours to enter the human body from an attached infected tick. However, some sources of information discuss shorter times.

A diagnosis of ***Babesia*** infection can often be made by direct testing (whole blood and serum, blood smear, fluorescent in-situ hybridization) and indirect testing (immunofluorescent assay (IFA) and Western blots). Although babesiosis can be treated effectively with antibiotics and other medications, this parasite can hide itself in the body for months or possibly years following recovery. In some cases disease relapse may occur even after treatment.

Signs and Symptoms of Babesiosis

Infection caused by ***Babesia microti*** is often accompanied by no symptoms or only mild flu-like symptoms in healthy children and younger adults. The majority of symptoms usually start within 1 – 4 weeks after a bite from an infected tick. Illness associated with this disease can be severe or fatal in the elderly, immunocompromised individuals and those with no spleen. The highest incidence rate of severe disease occurs in patients over 40 years of age. Clinical symptoms involving the eyes, teeth and brain are often the direct result of infection with Babesia, while deaths have been reported in about 5% of the cases. The following is a list of reported signs and symptoms associated with Babesia: fatal in the elderly, immunocompromised individuals and those with no spleen. The highest incidence rate of severe disease occurs in patients over 40 years of age. Clinical symptoms involving the eyes, teeth and brain are often the direct result of infection with ***Babesia***, while deaths have been reported in about 5% of the cases. The following is a list of reported signs and symptoms associated with ***Babesia***:

- Mental dullness and slowness of reactions / responses
- Cough – dry
- Muscle or joint pain (1 – 6 wks after a bite)
- High fever
- Anemia
- Chills
- Severe headache – dull, global
- Day and night sweats

Other symptoms that may occur:

- Gastrointestinal problems (nausea, vomiting, diarrhea, abdominal pain)
- Sleep disturbances
- Weight loss
- Dark urine
- Respiratory problems (cough, shortness of breath)
- Poor appetite

It is estimated that in Connecticut, 10-32% of Lyme disease patients have ***Babesia***.

HUMAN GRANULOCYTIC ANAPLASMOSIS (HGA) FORMERLY KNOWN AS HUMAN GRANULOCYTIC EHRLICHIOSIS

Ehrlichiosis is a disease which is caused by a group of bacteria that affects both humans and animals. There are two principal forms of ehrlichiosis in humans currently recognized in the nation – human monocytic ehrlichiosis (HME) and human granulocytic anaplasmosis (HGA) formerly know as human granulocytic ehrlichiosis. The latter of the two types accounts for about two-thirds of all ehrlichiosis cases in the United States. Most cases of HGA have been reported from states where Lyme disease is highlyendemic such as in Connecticut and New York. Additional states such as Rhode Island, Massachusetts, Minnesota and Missouri also have a high number of cases. Similar to Lyme disease, HGA is a reportable disease.

Lone Star Tick

The blacklegged tick or "deer" tick, ***Ixodes scapularis,*** is the principal carrier in the northeasternstates for HGA and the Lone Star Tick, ***Amblyomma americanum***, is the vector in southeastern regions. White-tailed deer are the reservoir competent host (source of infection) for the causal agent of human monocytic ehrlichiosis (HME), while white-footed mice and possibly deer are reservoir competent hosts (source of infection) for ***A. phagocytophilum***, the bacterium that causes human granulocytic anaplasmosis (HGA). Cases of HME and HGA occur during May, June or July, with 80-90% of cases occurring between April and September. It is estimated that the bacterium that causes HGA can be transmitted into the human body within 24 hours once an infected tick is attached. Most cases are mild, self-limiting and resolve themselves without treatment in about 30 days. There are some cases, however that are moderate to severe. A patient co-infected with ***B. burgdorferi*** and the bacterium that causes HGA can exhibit symptoms of a more severe disease. Human cases of HME in Connecticut are also possible, as the causative agent has been detected in Lone Star Ticks.

Signs and Symptoms of Human Ehrlichiosis

The following is a list of reported signs and symptoms associated with HME and HGE:

- High fever
- Chills
- Headache (knife like)
- Muscle pain
- Swelling in feet and hands (common in children)
- General achiness
- Rash – Smaller and raised in areas (common in children)
- Illness may be mild, moderate or severe
- Fatalities in children and those over 50 years of age
- Fatigue

Late Stage Symptoms include:

- Nausea and vomiting
- Diarrhea or constipation
- Loss of appetite
- Confusion
- Weight loss
- Stiff neck
- Cough

A diagnosis of human ehrlichiosis should be considered when patients exhibit flu-like illnesses and when exposure to the blacklegged tick or "deer" tick, ***Ixodes scapularis*** is likely. Confirmation of ***Ehrlichia*** infection can be obtained by a serology test or by identifying the pathogen organism in culture. In the early stages of disease, test results may be negative, however, most patients identified with early infection can be successfully treated with antibiotic therapy. Overall, there is a 5% fatality rate among patients.

ROCKY MOUNTAIN SPOTTED FEVER

Rocky Mountain Spotted Fever (RMSF) is caused by the bacterium ***Rickettsia rickettsi,*** which is widely distributed throughout the continental United States, Southern Canada, Mexico, Central America and parts of South America. In the U.S., most cases of RMSF occur in the southeastern and south central states. The majority of RMSF cases are associated with the American dog tick, ***Dermacentor variabilis*** and up until recently, only about 800 cases were reported annually. Some rickettsia are not infectious to humans.

RMSF is relatively uncommon in New England, however, it is most often reported from Cape Cod and surrounding islands. Children are particularly at risk for RMSF with about two-thirds of the cases in patients under 15 years of age. Like Lyme disease, RMSF is reportable in Connecticut and the highest rate of infection is in children 5 to 9 years of age.

Signs and Symptoms of Rocky Mountain Spotted Fever (RMSF)

Symptoms usually appear within 2 to 9 days after a bite from an infected tick. Although early disease is difficult to diagnose (due to the absence of distinct symptoms), the classic spotted rash of RMSF will appear after about 6 days. Some patients (about 15%) never develop a rash. Although RMSF can be fatal in 20-30% of untreated cases, in recent years, up to 4% of the cases in the United Sates have been fatal. A clinical diagnosis may be confirmed by doing a PCR (Polymerase Chain Reaction) test and an immunofluorescent assay (IFA) test. Although antibodies in the body may not yet be present early in the illness, those who are diagnosed respond quickly to treatment. The following is a list of reported signs and symptoms associated with RMSF:

- Fever – sudden onset
- Severe headache
- Low white blood cells (WBC) and elevated liver enzymes
- Muscle pain
- Rash (palms and soles of feet, but it can migrate to forearms and hands). Classic spotted rash appears after 6 days.

BARTONELLA HENSELAE

Bartonella henselae (***B. henselae)*** was first described in 1992 as the causative agent of cat scratch disease (CSD). The disease is bacterial in nature and cats are considered the reservoir competent host animal (source of infection) that carries the bacterium. Infected cats (about 40%) are believed to be healthy carriers of ***B. henselae*** with no symptoms exhibited. The bacterium ***B. henselae*** resides in red blood cells and has recently been identified in the "deer" tick ***Ixodes scapularis***. Cat scratch disease is not a reportable disease, however about 22,000 cases occur in the U.S. yearly. The disease affects mostly children, with no deaths being reported in healthy individuals.

Bartonella henselae can cause prolonged fever and bacteremia in immunocompromised individuals, with 5 – 10% of the cases resulting in death. Cases of Bartonella can be identified by serology (antibody test) and a PCR (Polymerase Chain Reaction) test. The following is a list of reported signs and symptoms associated with ***B. henselae*** infection:

Signs and Symptoms of Bartonella

- Fatigue, Malaise
- Muscle aches
- Headache
- Poor sleep
- Flu-like symptoms
- Fever (mostly in AM)
- Chills
- Dizziness
- Swollen lymph nodes
- Anxiety and poor appetite
- Skin rash – looks like streaks
- Nausea/vomiting
- Local papule – pustule (7-12 days)
- Decreased attention / confusion
- Neurological symptoms
- Seizures (occasional)
- Irritability
- Visual problems

LYME DISEASE

Despite its identification 30 years ago, Lyme disease has continued to spread. Currently reported in 50 states and the District of Columbia, Lyme disease is transmitted to humans through the bite of an infected blacklegged tick or “deer” tick, ***Ixodes scapularis***. Lyme disease is said to be the fastest growing vector-borne disease in the nation and is caused by the bacterium pathogen ***Borrelia burgdorferi***. The blacklegged tick or "deer" tick becomes infected with the Lyme bacterium when it feeds on specific small animals that carry the pathogen organism. As the tick continues to develop, it moves from host to host (e.g. humans, pets) where it attaches itself to feed and pass on the bacterium. Most Lyme disease cases are caused by nymphal ticks because they are tiny and go unnoticed. According to the literature, the spirochete bacterium ***Borrelia burgdorferi*** enters the human bloodstream, replicates slowly and begins to spread both locally and systemically. Although it is stated that the chance of acquiring the Lyme bacterium from an attached infected tick is greater beyond 24 hours, there is indication from some research that the organism could invade the body earlier.

Lyme disease was first recognized as a separate entity in 1975 when a geographic clustering of children in Lyme, Connecticut was being studied for juvenile rheumatoid arthritis. The emergence of Lyme disease, which is said to be associated with landscaping pattern changes (reforestation), has become more prevalent as the white-tailed deer population has increased. Although deer are the principal hosts for the adult stage blacklegged tick or “deer” tick, ***Ixodes scapularis,*** white-footed mice are considered the principal reservoir competent host (source of infection) for the spirochete ***Borrelia burgdorferi***. Other animal hosts for the “deer” tick (larval and nymphal stages mostly) include birds and small mammals such as chipmunks.

Lyme disease is considered a complex multi-system disorder that mainly affects the body’s central and peripheral nervous systems. Symptoms that occur within days or weeks of the infected tick bite reflect localized or early infection, while late manifestations of the disease can appear months or even years later. Although symptoms of disease seem to categorize the stages of infection, not everyone who is infected displays them uniformly. Lyme disease remains difficult to diagnose for various reasons, mainly due to its genetic complexity. Some scientists believe that ***B. burgdorferi*** has the ability to develop multiple forms causing itself to become resistant to antibiotics. Lyme disease has also been called the “New Great Imitator” because its symptoms often mimic other medical conditions such as Multiple Sclerosis (MS), Alzheimer’s Disease, Chronic Fatigue Syndrome and Arthritis, etc.

If Lyme disease is suspected, other co-infection diseases, particularly human babesiosis and human ehrlichiosis, should be considered. Patients that are co-infected with several disease causing organisms are likely to display more complicated clinical presentations. Recovery in these patients may often take much longer than those who are infected with a single pathogenic organism. The presence of Bartonella infection should also be investigated in patients with chronic or late stage Lyme disease.

Localized Infection

After being bitten by an infected “deer” tick, localized infection on the body may appear within 2 to 4 weeks. Less than 50% of patients diagnosed with Lyme disease remember getting a tick bite. A classic “bull’s eye” red rash (Erythema Migrans – EM) can appear at the site of the bite, although only 35-60% of all patients remember having one. Erythema Migrans can gradually expand over time and can vary in size and shape. They can occur anywhere on the body, but they are commonly seen on the thigh, groin, trunk and armpit. They are not usually painful or itchy but can feel warm to the touch. Most of the rashes resolve without treatment. Patients that present the classic “bull’s eye” red rash are readily diagnosed and exhibit mild, non-specific symptoms 80% of the time. However, individuals who do not get a rash or notice only nonspecific symptoms are often misdiagnosed. The following is a list of reported signs and symptoms associated with localized Lyme disease infection:

- Fatigue and limited stamina
- Muscle pain
- Headache
- Fever – PM
- Red eyes
- Chills
- Sore throat
- Swollen glands
- Neck stiffness with pain
- Temperature – subnormal AM
- Joint swelling (20% to 30%)
- Joint discomfort (can be migratory)
- Rash (Classic “bull’s-eye” red rash, but may vary in size and shape)
- Respiratory or possible gastrointestinal problem

Mild non-specific systemic symptoms:

- Fatigue
- Muscle and joint pain
- Headache
- Fever
- Chills
- Sore throat
- Swollen glands
- Stiff neck
- Respiratory or possible gastrointestinal problems
- Others not mentioned above

Early Disease Infection

The spirochete bacterium ***Borrelia burgdorferi*** is suspected of having the ability to cloak itself as it enters a variety of cells in the human body. If capable, the organism could deceive the body's immune system and invade multiple body tissues, particularly the epidermal, muscular, nervous or cardiac tissue. Some literature claims that the bacterium can lie dormant in a "resting" state in the body and "re-activate" itself at another time. Other diseases that are known to have this capability are Tuberculosis, Herpes and Chickenpox. The following are manifestations of early disease infection:

- Secondary rashes or hives
- Migratory joint and muscle pain
- Panic attacks
- Concentration and speech impairment
- Cardiac problems (chest pain, heart rhythm disturbances) in 8% of patients
- Malaise
- Paralysis of facial muscles (drooped eye and/or mouth) in 15% of untreated patients
- Fatigue
- Elbow and finger pain
- Severe headache
- Arthritis in the knee (mostly in children)
- Fever
- Ocular manifestations such as conjunctivitis.
- Fogginess and memory loss

Late Disease Infection

Often many months or possibly years after being exposed to an infected tick bite, symptoms of persistent infection will most likely occur in untreated or undertreated individuals. The Lyme bacterium can proliferate in the body and make its way into the brain. When the spirochete organism affects the brain, the patient is usually unaware of it. Disorders of the central nervous system have been found in 10 -15% of all Lyme disease cases and up to 40% of late stage patients. When Lyme disease affects the brain, it is often referred to as Lyme neuroborreliosis. The following is a list of symptoms that have been reported in late stage infection:

- Numbness or tingling of extremities (fingers and toes)
- Sensory loss (smell, taste)
- Unrelenting fatigue
- Weakness, chills, sweats and skin flushes
- Psychological disturbances
- Cardiovascular problems
- Stomach problems
- Vision and hearing abnormalities
- Dyslexia
- Panic attacks
- Visual and spatial processing impairment (getting lost, trouble finding things)
- Obsessive compulsive disorder (OCD)
- Irritability and aggressive behavior
- Diminished reflexes (includes balance and strength)
- Disturbances in memory (includes memory loss, "brain fog" and loss of words)
- Mood and/or sleep problems (anxiety, depression)
- Cognitive dysfunction (appearing noticeably confused and bewildered)
- Chronic arthritis intermittent with knee pain and swelling; stiff neck and pain in the elbows and fingers, etc.
- Arthritis (develops in 50-60% of untreated individuals with 10% developing chronic arthritis)

Co-Infection

When a person is exposed (by tick attachment) to an infected "deer" tick that carries multiple pathogenic organisms, the risk of acquiring disease increases. Although not always present, multiple disease causing organisms should be suspected in patients living in Lyme endemic areas. Other circumstances that should prompt an investigation into co-infection organisms are patients who do not respond well to treatment and/or have symptoms such as chills and fever and gastrointestinal conditions. Those patients who have had extensive tick exposures should always be tested. Documented in several studies, Lyme patients who have been exposed to multiple co- infection organisms have a greater risk of immune system abnormalities. Symptoms exhibited in these individuals may also appear distorted, making a diagnosis even more difficult. Finally, the serology assays used to identify disease infection may become less reliable as multiple organisms overload the body. The following primary diseases are capable of causing co-infection and should be ruled out when testing for Lyme disease: Ehrlichiosis, Babesiosis and

Bartonella.

Lyme Disease In Children and Adolescents

Children and adolescents are at a higher risk for getting Lyme disease because they spend more time in areas where they might suffer a tick bite. When Lyme disease gets misdiagnosed and goes untreated in children it has a profoundly devastating impact on the child's wellbeing. Most children begin to experience difficulty with cognitive functions and often display a noticeable decline in academic performance. Interpersonal relationships are also negatively affected. The following is a list of some signs and symptoms displayed in children and adolescents during the stages of Lyme disease:

- Loss of familiarity with people's faces
- Physically impaired or disabled
- Severe fatigue, unrelieved by rest
- Trouble sleeping, staying awake and possible eating problems
- Headaches and urinary problems
- Nausea, vomiting, diarrhea
- Abdominal pain (stomach ache), extreme PMS and constipation
- Impaired concentration, easily distracted, unorganized
- Uncharacteristic behavior (psychological problems in teens)
- Outbursts, mood swings, anxiety and panic attacks
- Fever / chills / sore throat
- Feeling of being overwhelmed and irritable
- Feeling of being isolated, alone and loss of confidence
- Difficulty reading, writing and learning
- Noticeable decline in school work (mostly coupled with other signs)
- Poor short-term memory, visual and auditory attention problems (may be seen as ADD)
- Problem with sequential tracking
- Noise and light sensitivity, dizziness
- Eye inflammation and earache
- Joint pain (commonly in knees)
- Morning stiffness and muscle weakness
- Flu-like illness (early sign) and sometimes wheezing
- Erythema Migrans (classic bull's-eye red rash - may appear just as skin rashes)

When children and adolescents are exposed to tick habitats and begin to display unusual outward signs, suspicion and concern for their health should be raised. So often, issues involving children are associated with "growing up" and are not taken seriously when presented. Discussing unusual behaviors and feelings of illness with the child should be done as soon as signs become apparent. Talking with teachers, school nurses, social workers and guidance counselors, siblings and caregivers will also give good insight into the problem. Physicians who are knowledgeable about tick-borne diseases should always be consulted, especially if tick exposures were likely.

Illness, Diagnosis and Treatment

The severity of any disease, including Lyme disease, varies among patients. Major symptoms can be displayed; however, if they are mild, they may go unrecognized. Some individuals may also experience unusual symptoms or may be asymptomatic (absent of illness). If Lyme disease goes undiagnosed and not treated, it can become a persistent illness with serious long-term negative effects. Although fatalities associated with Lyme disease are rarely recorded, untreated individuals who progress into the late stage of disease can develop psychiatric and/or neurological conditions. Many individuals can also be left with hearing and eyesight deficiencies as well as crippling arthritis. Neurological disorders and mild to chronic arthritis can also persist, even after the patient receives aggressive treatment.

Diagnosing Lyme disease without the presence of an Erythema Migrans (EM) red rash can be complicated. At this time there is no one single definitive test that is sensitive enough to "rule out" the presence of disease infection in the body. In addition, the marketed tests that are available are frequently used inappropriately. Unfortunately, when the Centers for Disease Control and Prevention (CDC) developed criteria to standardize national reporting for Lyme disease, many physicians viewed the criteria as a diagnostic tool. As a result, not only was a standard of care for patients established, the criteria before long began to set insurance guidelines for quality assurance and patient reimbursement. Recently (2008), the CDC set a new surveillance case definition for Lyme disease; however similar to the previous case definition, it is viewed as rigid and very restrictive. It

is believed that if the definition continues to be applied as a diagnostic tool and not used as intended (to support a clinical diagnosis), Lyme patients will continue to go undiagnosed and untreated. The following is the CDC's 2008 surveillance case definition of Lyme disease, with lab evidence criteria included.

2008 CDC Lyme Disease Surveillance Case Definition

CONFIRMED

Erythema Migrans (EM) rash with known exposure to Lyme disease ***or*** with lab evidence of infection **and** no known exposure to Lyme disease

Erythema Migrans (EM) rash with at least one late manifestation of Lyme disease and lab evidence of infection

PROBABLE

Lyme disease diagnosed by healthcare provider in a patient with lab evidence of infection

SUSPECTED

Erythema Migrans (EM) rash with no known exposure to Lyme disease and no lab evidence of infection

Patient with lab evidence of infection, but no clinical information (lab report) is available

LAB EVIDENCE

Isolation of ***Borrelia burgdorferi*** from a clinical sample or demonstration of IgM or IgG antibodies to ***B. burgdorferi*** in serum or CSF. A two-test approach using a sensitive ELISA or IFA, followed by Western Blots

It should be noted that States and territories send the CDC case data for confirmed and probable cases only.

Treatment of Lyme disease varies among patients (according to the stage of the infection), especially if co-infection is likely. There are a variety of laboratory tests available to determine ***B. burgdorferi*** infection; however, the CDC and the Federal Drug Administration (FDA) only approve certain serologic assays to aid in the diagnosis of Lyme disease. The initial testing that is recognized by these agencies includes a Lyme IgG/IgM antibody serology test, an ELISA (Enzyme Linked Immunoassay) or IFA (Immunofluorescent Antibody), followed by a standard Western Immunoblot Assay. Although the controversy continues about the clinical usefulness of other tests used to aid in diagnosing Lyme disease (PCR (Polymerase Chain Reaction) tests for ***B. burgdorferi***, DNA in blood and urine for ***B. burgdorferi,*** an Assay for Lyme Antigen Detection in urine test and Lyme-C6 Peptide for ***B. burgdorferi)***, their results present convincing evidence to many in identifying disease infection.

Although a person may have active Lyme disease they could still test negative. According to literature, the body makes antibodies to fight infection caused by the bacterium when it enters the bloodstream. However, antibodies may not be present in detectable levels at the time of testing for many reasons. For example, in the early stages of disease, antibodies may not be developed enough in the body to be detected, while in the late stages of disease, antibodies may be bound in the body, evading detection. In the end, identifying a person's exposure to ***B. burgdorferi*** can be challenging, often requiring tests to be repeated at different times and samples being sent to multiple laboratories that provide extended testing parameters. Unfortunately, there are no standardized testing procedures among laboratories that conduct Lyme disease analysis.

In most patients, Lyme disease can be treated successfully with oral antibiotic therapy if caught early. However, it has been shown, although debated, that patients with extended illnesses must be treated longer and more aggressively. Although the length of treatment for Lyme disease patients is controversial, if treatment is discontinued before active infection has cleared, illness will most likely persist and relapse will occur. Early disease infection is usually treated for 4 to 6 weeks, while late disease Infection requires extended treatment (4 to 6 months or more). All patients respond differently to treatment, so each therapy plan is individualized. The treating physician will select the best medication or combination of medications for each patient. Whatever is prescribed, patients are advised to follow their physician's instructions very carefully, especially getting proper rest.

Chronic/Post Lyme Disease

Post-Lyme Syndrome and Chronic Lyme disease (CLD) are terms often used interchangeably to describe patients who have received standard or acceptable (expected to be effective) antibiotic treatment and continued to have residual symptoms for months or even years later. These symptoms are occurring in the absence of clinical or laboratory evidence and often include chronic fatigue, disabling musculoskeletal pain and neurocognitive disorders. Today, there is much controversy in the medical and socio-political fields over whether there is a chronic or persistent form of Lyme disease. As it stands, the majority of physicians and scientists do not support a diagnosis of Chronic Lyme disease because they believe there is no clear biological evidence that shows a definitive linkage between residual symptoms and past or persistent disease infection. In fact, some believe that the cause of patient symptoms is from psychiatric disorders, fibromyalgia or chronic fatigue syndrome.

However, in spite of the position of the majority, there are physicians as well as scientists and suffering patients who believe Chronic Lyme disease exists. Scientists and many physicians state that there has been mounting evidence, past and present, that supports the diagnosis of Chronic Lyme disease, especially studies that indicate the survival of ***B***. ***burgdorferi*** organisms after antibiotic treatment. Although observations of abnormality continue to surface when studying this disease, the medical community still finds it difficult to see this complicated infection's potential.

With respect to patient symptoms, most supporters agree that they are real and disruptive, however multiple theories have been offered on what is causing them. As an example, some believe that patient symptoms are the result of persistent infection in which the disease-causing organism is present in a cyst form that is protected from antibiotic treatment. Another theory is that the bacterium is hidden in the cells of the body in places where antibiotics cannot go. Lastly is an autoimmune (self-resistant) response by the body. In simple terms, this is where the body attacks itself and facilitates the disease process rather than the healing process. This process is said to occur in the absence of infection and is essentially prompted by a particular gene a person may have. Those who have this gene are said to be more prone to severe joint disease and Lyme arthritis.

In the end, it seems that the argument about Chronic Lyme disease revolves around what is believed to be biological evidence connecting residual symptoms to past or present infection. It also touches on the unwillingness to accept the possibility that false-negative test results can be associated with infectious etiology. Perhaps with additional research, the answers will become more defined. The following is a list of reported symptoms associated with Chronic Lyme disease:

- Neurological presentations are characteristic and may include headache, stiff neck, tremors, light-headedness, wooziness, numbness in the body, tingling, weakness or partial paralysis, burning or stabbing pain, gait disturbance.
- Arthritic presentations are characteristic and may include joint pain or swelling, muscle pain or cramps, stiffness of joints, elbows, knees, back and neck, muscle weakness

The following symptoms can also emerge in Chronic Lyme patients:

- Mental Capacity – some memory loss, confusion, deficits in attention and concentration, difficulty in material sequencing, problems with reasoning and thinking, deficits in mental and motor processing, expressive language planning and organization, difficulty in understanding written and spoken language.
- Neuropsychiatric – anxiety, unusual depression, irritability, mood swings, obsessive compulsiveness, overemotional reactions, disorientation, defiant behavior, too much sleep or insomnia.

A person's outward symptoms will greatly depend on the extent of infection. Most Chronic Lyme patients demonstrate a measurable and significant decline in intellectual acuity. The nature and severity of the cognitive impairment is such that it interferes with all aspects of normal functioning: employment, home life, marriage, social interactions and general emotional well being. Unfortunately, even with aggressive treatment, some patients never return to a normal way of living.

Personal Protection Measures

Although the use of personal protection measures should be considered year-round, they should be applied when the most active cases of tick-associated illness occur (May-July). Human infection most commonly occurs in persons aged 5 to 14 and 30 to 59. The following is a list of personal protection measures and principles to follow:

- Avoid tick-infested areas to prevent tick bites.

- Perform frequent body tick checks and promptly remove attached ticks for testing. When bathing, use fingers to check for ticks, especially in the hair and use a washcloth to remove any unattached ticks on your skin.
- Wear light colored clothing and long sleeved shirts and pants. Always tuck pant legs into socks and shirt into pants.
- Wear a hat, secure long hair and hike in the middle of trails.
- Wear windbreakers to reduce the likelihood of ticks grabbing on.
- Apply tick repellents containing "permethrin" onto clothing only. Wash all affected skin.

- Apply insect repellents containing DEET concentrations to exposed skin by carefully following manufacturers' instructions. (e.g., OFF, 3M Ultrathon, Cutter Bens 30) Never apply any repellent over wide areas of the body or to the face. Apply no more than 40% DEET concentrations for adults, 10% for children and NEVER apply a repellent to an infant. If a reaction develops, wash affected area, remove treated clothing and contact your physician and/or poison control center (1-800-343-2722)
- Dry clothing in dryer set on high for 30 minutes when exposed to a tick habitat. Heat will kill ticks.
- Avoid areas under decks and porches.

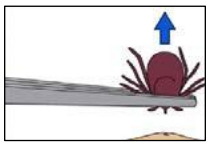
- Check pets that go outdoors daily since they are 50% more likely to get bitten by a tick than humans. Apply monthly tick treatment and use a tick collar (e.g. Frontline® and Preventic® collar) as recommended by veterinarians. Lyme disease is treatable in dogs and a vaccine is available. Other tick-borne diseases (Ehrlichiosis and Anaplasmosis) also are problematic for dogs. Ticks carried indoors may survive depending on humidity.

Important Steps and Effective Methods of Preventing Disease

#1. Tick Removal and Testing Procedure

The probability of getting Lyme disease or other tick-associated diseases such as Babesia is directly related to the length of time an infected tick is attached to the body. In North America, removing ticks within 24 hours of attachment can greatly reduce the risk of disease. In addition, studies indicate that fully engorged ticks are more likely to transmit the pathogen into the bloodstream. In the year 2011/2012, a total of 517 ticks were submitted from Town residents to the Department of Health Laboratory for analysis. Of the 511 ticks tested in-house, 20% were positive for the Lyme bacterium ***B. burgdorferi***. The following steps should be followed when removing a tick from the skin surface:

1. *Promptly remove the tick by using a pair of pointed tweezers to grasp the tick at the place of attachment. Go close to the skin and never use your fingers.*
2. *Avoid squeezing or crushing the tick. This can increase the risk of disease transmission.*
3. *Gently and with a firm upward movement, pull the tick straight out. Do not use petroleum jelly or heat from a match to dislodge the tick.*
4. *Place the tick in a small tightly sealed plastic sandwich bag. Mark the date and the site of the tick bite on the bag. Bring the tick (dead or alive) to the Greenwich Lab for testing.*



5. *Wash the site of the tick bite with soap and water. Apply antiseptic.*
6. *Watch for early symptoms of Lyme disease and other tick-associated diseases during the next 30 days. Contact your physician immediately should you feel ill.*

Contact the Greenwich Lab for more information about tick testing, at 203-622-7843.

#2. Measures To Reduce Tick Habitats Around the Home

The majority (75%) of Lyme disease cases are associated with activities around the home. Children between the ages of 5 and 14 are particularly at risk for tick bites because of outdoor play. To provide protection against tick-borne diseases, tick habitats must be avoided. Tick populations around the home and in recreational areas can be diminished by 50% to 90% through a combination of simple practical landscaping changes. The following strategies will assist in reducing tick populations:

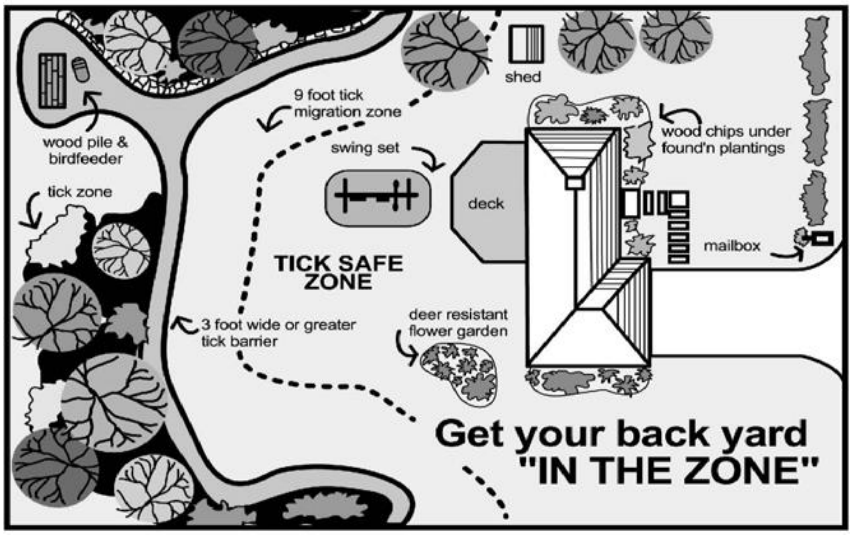
1. Remove leaf litter, wood piles and birdfeeders, as they attract tick-carrying small animals such as mice and chipmunks.
2. Keep lawns short, let dry between watering and increase areas with sunshine. About 70% of ticks found are within 9 feet of the woodland area edge.
3. Eliminate moist, shady environments by pruning overgrown shrubs and trees.
4. Eliminate ornamental ground cover plants such as pachysandra near walkways and recreation areas.
5. Plant deer resistant shrubs such as barberry, needle-bearing evergreens, forsythia, bee balm, foxglove and ornamental grasses.
6. Keep flowering plants away from the house and play areas.
7. Screen under porches and decks to eliminate nesting of mice, chipmunks, etc. that carry ticks.
8. Eliminate stone walls used for nesting near the home and play areas. Mice can breed every 25 days in the spring and fall.
9. Use deer fencing to control nuisance deer where practicable. (Beneficial when used with 15-18 acres or more.)

#3. Creating A "Tick Safe Zone" to Reduce Tick Abundance

Create a "Tick Safe Zone" on your property to reduce the number of ticks near and around your home. Areas used by the family, such as playgrounds should be well maintained when ticks are most active. The following steps should be followed

when creating a "Tick Safe Zone:"

- Secure an area no less than 9 feet from the edge of a wooded section.
- Place recreational areas and play equipment in the sun.
- Use woodchips or gravel in shady safe zone areas.
- Use a woodchip, mulch or gravel barrier (3 feet wide) where your lawn meets the woods.



#4. Other Methods for Tick Control

Chemical:

The decision to use a chemical (Acaricide) to control ticks on private property is strictly individual. Many of the products available are restricted for use by certified commercial applicators. These pesticides or insecticides may be applied to lawns and woodland edges to kill ticks (nymphs and adults) around the home once or twice a year. Using a chemical can pose a danger to health and the environment so it is essential that pesticides be applied correctly. ***Always hire a State of Connecticut licensed professional applicator when applying a pesticide to control ticks. If you wish to apply your own pesticides, read the label carefully.*** The following steps should be implemented when using a pesticide:

- Always use an organic or synthetic product (pyrethrums) to control ticks. Pyrethrins are natural toxins produced from certain chrysanthemum plants. Natural pyrethrins are usually combined with another product to make them more effective. They also have little residual effect and break down quickly in the environment. Pyrethroids, on the other hand, are more effective and chemically modified to increase toxicity. Pyrethroids are used mostly for area-wide tick control. A single application of most ornamental-type insecticides will provide 85-90% control with some residual activity so additional applications are rarely necessary. Applications should be made in mid-Mayor early June to reduce the nymphal tick population. Both pyrethrins and pyrethroids are toxic to fish and other aquatic organisms, but are less toxic to mammals, birds, etc.
- Treat only tick habitats (including ground cover vegetation) and always follow the manufacturer's guidelines.
- Never discontinue personal protective measures.
- Avoid spraying open fields and lawns and never spray vegetable gardens.
- Always store chemicals away from children and pets.

Common Pesticides for Residential Tick Control

Carbaryl Sevin®	A carbamate insecticide. A common garden insecticide for homeowner use. Some are available for commercial use.
Cyfluthrin Tempo®; Powerforce™	A pyrethroid insecticide for commercial and homeowner use with concentrates and ready-to-spray products.

Permethrin Astro®; Ortho® Products; Bonide® Products; Tengard®; SFR; others	A pyrethroid insecticide. There are concentrates and ready- to-spray products. Most are for homeowner use, with a few for commercial use.
Bifenthrin Talstar®; Ortho® Products	A pyrethroid insecticide. Available in liquid and granular form for homeowner use. Also available for commercial applicators.

Maxforce® is a tick management system that utilizes child-resistant bait boxes for topical treatment of rodents with a product called fipronil. Bait boxes contain non-toxic food blocks and are ready to use. The system is available through licensed pesticide applicators and has been found effective when used in the spring and summer. Testing results with this system demonstrated high control of nymphal ticks after two years along with a significant decline of larvae and adult ticks.

Damminix Tick Tubes® is another tick management system that reduces the number of ticks carried by mice. It utilizes biodegradable tubes that are filled with a permethrin-treated material and placed on the property in the spring The system has low toxicity to birds, humans and other mammals, however it is toxic to fish.

Non-Chemical/Biological:

Due to concerns surrounding synthetic pesticide use, alternative methods to control ticks are being explored. According to the literature, ticks have few natural enemies, however, the use of pathogens, parasites and predators is being studied for their control. Although this work is time-consuming, the use of biopesticides could become an option for tick control in the future.

CONCLUSION

According to the Centers for Disease Control and Prevention (CDC), the number of Lyme disease cases in the U.S. continues to increase with more than 27,000 cases reported every year. Although the number of cases has exploded since 1991, the CDC estimates that the number of reports could be 8 to 10 times more. Lyme disease is endemic in the State of Connecticut, as well as other states such as New York, New Jersey, Massachusetts and Pennsylvania. Because ticks are capable of carrying and transmitting multiple pathogenic organisms, several tick-associated diseases like human babesiosis and human ehrlichiosis should be considered. All persons living in Lyme disease endemic areas are considered susceptible to tick bites; however, the highest reported incidence rate of disease is in children 5 to 14 years of age and in adults 30 to 59 years of age.

The suppression and control of tick-associated diseases in the human population have been largely unsuccessful. Because of this trend, which is likely to continue, control of Lyme disease depends primarily on preventing tick bites. Since this is difficult to do, checking the body for ticks on a daily basis is very important. The use of personal protection measures such as wearing protective clothing and applying insect repellents should also be practiced regularly. Lastly, all domestic pets should be checked for ticks since they can bring them indoors. When a tick identification and testing program is offered (tick testing is available at the Greenwich Department of Health lab), removed ticks should be analyzed promptly for disease-causing organisms.

Currently there is no available vaccine for the prevention of tick- associated diseases and producing one at this time does not look promising. However, if the risk of infection continues to escalate and if public perception changes, vaccine development may once again become a priority. In addition, at this time, there is no single test available that offers superior sensitivity to detect Lyme disease infection in the body and there is no effective approved protocol that is widely accepted to treat this disease. In an effort to reduce and possibly someday eliminate the risk of acquiring Lyme disease, it is important to first recognize how devastating this disease will have on your health and your life. Secondly, each person must take an important role to advocate for more scientific research so advances can be made in discovering more about the Lyme bacterium, improving testing techniques for standardization and treatment options that can be widely accepted. And finally, all residents, especially those living in endemic areas, should support community programs that target Lyme disease education, especially for children, educators and health care providers.

The Greenwich Department of Health supports Time For Lyme, Inc. (an affiliate of the National Lyme Disease Association), an all-volunteer, local non-profit organization that educates the community about Lyme disease and lobbies for legislation that supports funding for research, treatment opportunities, education and improved prevention techniques. Time for Lyme also conducts fundraising for scientific research in an effort to stress the importance of and need for better ways to test, diagnose and treat patients.

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PHONE NUMBERS & WEBSITES OF INTEREST

National Pesticide Telecommunications Network 1-800-858-7378
Poison Control Center 1-800-343-2722

Greenwich Department of Health www.greenwichct.org

National Institute of Allergy and Infectious Diseases http://www.niaid.nih.gov

National Institute of Neurological Disorders and Stroke http://www.ninds.nih.gov

National Institutes of Health http://health.nih.gov

National Pesticide Information Center
1-800-858-7378
http://npic.orst.edu

State Health Facts Online
www.statehealthfacts.org

Environmental Protection Agency Citizen Guide to Pest Control and Tips on Hiring a Pesticide Applicator www.epa.gov

International Lyme and Associated Diseases Society www.ilads.org

Centers for Disease Control & Prevention (CDC)
www.cdc.gov/ncidod/dvbid/lyme/index.htm

General Lyme Information www.lymeinfo.net

Arthritis Foundation www.arthritis.org

American College of Physicians
www.acponline.org/lyme

American Lyme Disease Foundation, Inc. www.aldf.com

CT Department of Public Health www.ct.gov/dph

Time For Lyme, Inc.
www.timeforlyme.org

Lyme Disease Association, Inc.
www.LymeDiseaseAssociation.org

IGeneX, Inc. – Reference Lab www.igenex.com

Columbia University Lyme Disease Research
www.columbia-lyme.org

Medscape www.medscape.com

Food and Drug Administration www.fda.gov

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