

## Tests for Tick-Borne Diseases Lyme Disease Tests:

- ★ **Antibody Response** (or Serology) - measures antibody levels produced in response to the disease. Includes: ELISA, C6Peptide, IFA (rarely used), IgG & IgM Western Blots. In the first year after a tick bite, less than 65% of patients produce antibodies, & they may not last. By year two, less than 50% of patients still have an antibody response. Antibody response tests are most effective starting 4-12 weeks after a tick bite, & accuracy rates vary considerably. If antibiotic treatment is inadequate, antibody levels may remain low causing tests to be negative.
- ★ **Antibody Capture** - an antibody test with the same problems as the test listed above.
- ★ **Culture** - grows actual organism. Difficult to do, but when positive, it confirms a Lyme infection.
- ★ **Antigen Capture** - a highly defined antibody captures pieces of the Lyme organism. Actually checks for the presence of a piece of Lyme bacteria & supports the diagnosis of active infection. Includes LDA (Lyme Dot Antigen Assay for Urine and CSF).
- ★ **Polymerase Chain Reaction (PCR)** - checks for the presence of the organism's genetic material (DNA/RNA). Positive results are highly specific but negative results are meaningless. Can be performed on all body tissues.

### Babesia, Anaplasma, Ehrlichia, Bartonella, Rickettsia Tests:

- ★ **Babesia** - blood smears, IFA (IgG & IgM), FISH (Flourescent in-situ Hybridization) and PCR may be ordered.
- ★ **Anaplasma** - blood smears, IFA (IgM & IgG), PCR. Recommended to use more than one type of test.
- ★ **Ehrlichia** - blood smears, IFA and PCR for *E. equii* (HGE) and/or *E. chaffeensis* (HME) and PCR for HGE and HME are available.
- ★ **Bartonella henselae, Bartonella quintana** - an IFA and PCR are available.
- ★ **Rickettsia spp.** - PCR available.

## Lyme Disease Association, Inc.

### Funding Research Projects from Coast to Coast

#### LDA is a national non-profit, volunteer run, 501(c)(3) charity

- On average, 97% of contributions go directly to programs
- Partnered to endow Columbia University Lyme/TBD Research Center
- Awarded 106 research grants/published in 41 journals
- Organized 18 CME conferences to educate physicians
- Awarded 115 education grants to help stop the spread of Lyme
- Provides FREE on-line Doctor Referral System
- Created LymeAid 4 Kids fund/\$1/3M awarded: families in financial need
- Provides seminars on Lyme for the public, businesses & schools.
- Educates public officials on the spread of Lyme & patient problems
- Partners with Environmental Protection Agency PESP: stop the spread of ticks
- Testified twice before Congress
- Heads a national umbrella network: LDAnet, 43+ groups nationwide

LDA

#### Suggested Resources

www.LymeDiseaseAssociation.org  
http://Columbia-Lyme.org  
http://www.IGeneX.com  
http://www.LDADS.org

Indorsed by



### Lyme & Pets



Dogs, cats, horses & cows can get Lyme & other tick-borne diseases & can be tested.

Use veterinarian recommended prevention products.

Perform tick checks to protect your pets.

Dog symptoms: lameness, fever, lethargy, swollen joints, enlarged lymph nodes & loss of appetite.

Cat symptoms: lameness (may shift leg to leg) stiffness, pain, fever, decreased appetite & lethargy.



## Tick Identification Guide\*

\*Tick Photographs: Courtesy of James L. Occi, MA, MS & Robert S. Lane, PhD.

### **Ixodes scapularis** (deer tick or blacklegged tick)

#### Found in Northeast & Upper Midwest

Transmits agents of: Lyme (*B. burgdorferi*, *B. mayonii*), *Borrelia miyamotoi*, babesiosis, anaplasmosis, Powassan encephalitis, tick paralysis, tularemia, bartonellosis, ehrlichiosis (due to *Ehrlichia muris-like*). *Ixodes scapularis* have been shown to carry *Ehrlichiosis (HME)*, but to date, transmission is still in question.

#### MAGNIFIED



Nymph—Adult Male—Adult Female

#### ACTUAL SIZE



Larvae—Nymph—Adult

### **Amblyomma americanum** (lone star tick)

#### Found throughout the Eastern part of United States

Transmits agents of: human monocytic ehrlichiosis, Heartland (Phlebovirus), STARI (Southern Tick-Associated Rash Illness), tularemia, tick paralysis, Q fever, bite may cause alpha-gal (meat) allergy.

#### MAGNIFIED



Nymph—Adult Male—Adult Female

#### ACTUAL SIZE



Larvae—Nymph—Adult

### **Dermacentor variabilis** (American dog tick)

#### Found throughout the United States

Transmits agents of: Rocky Mountain spotted fever, tularemia, tick paralysis. *Although a small percentage of dog ticks carry the Lyme bacterium, (Borrelia burgdorferi) transmission has not been proven.*

#### MAGNIFIED



Adult Male—Adult Female

#### ACTUAL SIZE



Larvae—Nymph—Adult

### **Dermacentor andersoni** (Rocky Mt. wood tick)

#### Found in Rocky Mountain States & SW Canada

Transmits agents of: Rocky Mountain spotted fever, tularemia, Colorado tick fever, tick paralysis, Q fever. *Looks similar to American dog tick (above).*

### **Ixodes pacificus** (western blacklegged tick)

#### Found in West

Transmits agents of: Lyme, babesiosis, anaplasmosis (aka human granulocytic ehrlichiosis), bartonellosis. *Ixodes pacificus* has been shown to carry *ehrlichiosis (HME)*, but to date, transmission is still in question.

#### MAGNIFIED



Larvae—Nymph—Adult Male—Adult Female

#### ACTUAL SIZE



Larvae—Nymph—Adult

### **Dermacentor occidentalis** (Pacific Coast tick)

#### Found in Northern CA & Pacific Coast

Transmits agents of: *Rickettsia phillipi* (364D) Note symptoms: fever, eschar(s).

### **Amblyomma maculatum** (Gulf Coast tick)

#### Found in Eastern & Southern U.S., esp. along coast

Transmits agents of: *Rickettsia parkeri* Rickettsiosis. Note symptoms: fever, headache, eschar(s), variable rash.

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## LymeR Primer™



## Learn About Lyme & Other Tick-Borne Diseases

- ★ Lyme disease (*B. burgdorferi*, *B. mayonii*)
- ★ Anaplasmosis
- ★ Babesiosis
- ★ Bartonellosis
- ★ *Borrelia miyamotoi*
- ★ Colorado tick fever
- ★ Ehrlichiosis
- ★ Powassan encephalitis (Powassan virus, deer tick virus)
- ★ *Rickettsia parkeri* Rickettsiosis
- ★ *Rickettsia phillipi* (364D)
- ★ Rocky Mountain spotted fever
- ★ Tick-borne relapsing fever
- ★ Sothern tick-associated rash illness (STARI)
- ★ Tick paralysis
- ★ Tularemia
- ★ Q fever
- ★ Bourbon virus
- ★ Heartland virus
- ★ Alpha-gal meat allergy

## Lyme Disease Association, Inc.



LDA/PO Box 1438

Jackson, NJ 08527

Toll Free Info: 888-366-6611

FAX: 732-938-7215

E-mail: LDA@LymeDiseaseAssociation.org

Web: www.LymeDiseaseAssociation.org

Join mailing list: textLDAto22828

## Tick Removal

- ✳ Do not burn or use any substance on tick.
- ✳ Do not grasp, squeeze or twist body of tick.
- ✳ Grasp tick close to skin with tweezers.
- ✳ Pull tick straight out.
- ✳ Save for identification.
- ✳ Use antiseptic on skin.
- ✳ Disinfect tweezers.
- ✳ Wash hands thoroughly.
- ✳ See a doctor after a tick bite & bring the tick.
- ✳ Improper tick removal increases chances of infection.
- ✳ For tick disposal place on tape & fold over.
- ✳ For tick testing, see below.



## Tick Testing for Tick-Borne Diseases

- ✳ Save tick alive if possible. Do NOT put in tape.
- ✳ Place in airtight container or zip lock bag.
- ✳ Put in with moist cotton ball (no alcohol).
- ✳ Send with check to tick-testing lab.
- ✳ Tick testing labs include:  
IGeneX Labs, Palo Alto, CA 800-832-3200  
Clongen Laboratories, LLC, Gaithersburg, MD 877-256-6436  
NJ Labs 732-249-0148  
Also check with your state/local health department.

## Prevention

Always follow manufacturer's directions.

The LDA does not make specific product recommendations or grant any warranties.

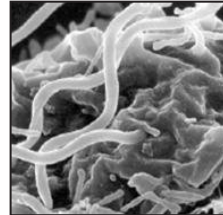
- ✳ Perform frequent, thorough tick checks.
- ✳ Wear light-colored clothes.
- ✳ Tuck pants into socks.
- ✳ Put clothes in dryer for 30 minutes to kill ticks.
- ✳ Check DEET- containing products, picaridin, IR3535 for skin.
- ✳ Check out permethrin - containing products for clothes.  
An example: Sawyer Products, Inc. www.sawyer.com
- ✳ Check out clothes which protect against ticks.  
An example: www.rynoskin.com
- ✳ Check out methods for property protection.  
An example: Connecticut Tick Control, www.nixticks.com  
An example: Tick Box Technology Corporation www.tickboxtcs.com

## Get the Facts

- ✳ You can get many tick-borne diseases from one tick bite.
- ✳ The longer a tick is attached, the greater risk of disease.
- ✳ Lyme: a clinical diagnosis based on symptoms, history & exam.
- ✳ You can test negative & still have Lyme disease.
- ✳ CDC criteria are for surveillance purposes, not diagnosis.
- ✳ According to the CDC surveillance criteria, an erythema migrans (EM) rash in an endemic area, means Lyme disease.  
In a non-endemic area, rash requires a positive test.
- ✳ Not everyone who contracts Lyme disease gets a rash.
- ✳ Lyme symptoms can develop days or months after a tick bite.
- ✳ Lyme patients often get worse before getting better while on treatment (Jarisch-Herxheimer reaction).
- ✳ Lyme bacterium can cross the placenta & infect the fetus, which may result in fetal death, & its DNA has been found in breast milk.
- ✳ Lyme can cause death.

## Lyme Bacteria: *Borrelia burgdorferi*

- ✳ Go intracellular & hide; go dormant.
- ✳ Become sequestered in sites that immune cells do not usually enter (central nervous system, joints, eyes).
- ✳ Use body's own cells to shield them.
- ✳ May switch from spirochete form to L-form (cell wall deficient) or cystic form (giant L-body) — not susceptible to antibiotics that kill spirochete form & their functions are not clearly understood.
- ✳ Have been found in patients after long-term antibiotic treatment.



A scanning electron microscope image of *Borrelia burgdorferi* penetrating a human B cell (in vitro), at a magnification of approximately 89,000. Photo Credit: David W. Dorward, Ph.D. NIH Rocky Mountain Labs, MT.

## Lyme Signs & Symptoms

**Rash:** Only about 9% get the classic bull's eye rash. Others may get another type of EM rash or may get no rash at all. Rash at other than bite site may be disseminated disease.

**Musculoskeletal:** joint/muscle pain in feet, ankle pain, shin splints, joint pain or swelling, stiffness of the joints, neck or back, muscle pain or cramps that migrate, TMJ, neck creaks & cracks, neck stiffness.

**Reproductive:** testicular pain/pelvic pain, menstrual irregularity, milk production (lactation), sexual dysfunction or loss of libido.

**Cardiac/Pulmonary:** chest pain or rib soreness, shortness of breath, heart palpitations, pulse skips, heart block, heart murmur.

**Neurological:** muscle twitching, headache, tingling, numbness, burning or stabbing sensations, facial paralysis (Bell's palsy), dizziness, poor balance, increased motion sickness, light-headedness, wooziness, difficulty walking, tremor, confusion, difficulty thinking/concentrating/reading, forgetfulness, poor short term memory, disorientation (getting lost, going to wrong place), difficulty with speech, double or blurry vision, eye pain, blindness, increased floaters, increased sensitivity to light or sound, buzzing or ringing in ears, ear pain, decreased hearing, seizure activity, white matter lesions, low blood pressure.

**Neuropsychiatric:** mood swings, violent outbursts, irritability, depression, disturbed sleep (too much, too little, early awakening), personality changes, obsessive - compulsive disorder (OCD), paranoia, panic/anxiety attacks, hallucinations.

**Gastrointestinal:** nausea or vomiting, GERD, change in bowel function (constipation, diarrhea), gastritis, abdominal cramping, cystitis, irritable bladder or bladder dysfunction, newly diagnosed irritable bowel syndrome (IBS).

**Other:** fever, sweats, or chills, weight change (loss or gain), fatigue, tiredness, hair loss, swollen glands, sore throat, difficulty swallowing, swelling around the eyes, burning in feet, swelling.

**Lyme from *Borrelia mayonii*** Early symptoms: fever, headaches, rash, neck pain Later: arthritis. Difference from *Borrelia burgdorferi* may include nausea & vomiting, diffuse rashes, higher concentration of bacteria in blood. Choice of treatment depends on length & severity of illness & potential for co-infections.

## Other Tick-Borne Diseases

One tick bite can give you many different diseases at the same time (co-infections). Treatments vary, examples provided as information only.

- ✳ **Babesiosis** - Malaria-like illness caused by a parasite, *Babesia microti*, *B. duncani*, *B. divergens*, MO-1; transmitted by deer ticks, western blacklegged ticks. Sometimes fatal in the elderly or those with no spleen. May be more severe in patients with co-existing Lyme. Symptoms include: fever, chills, fatigue, headache, muscle pain, sweats & anemia. Treatment often atovaquone with azithromycin or clindamycin & oral quinine. Can be transmitted through blood supply.
- ✳ **Bartonellosis** - caused by several *Bartonella* species transmitted either by flea or a tick bite, cat scratch or lice. When tick-borne, (carried by deer tick, transmission still being investigated), symptoms includes visual problems, headaches, significant lymph node enlargement, resistant neurological deficits, & the new onset of a seizure disorder. Diagnosis is based on acute and convalescent antibody titers (IFA) and or positive PCR analysis Treatment may be combination macrolides, TCNs, rifamycin, (also possible Bactrim or fluoroquinolones).
- ✳ ***Borrelia miyamotoi*** - this bacteria is in the relapsing fever group of *Borrelia*. Transmitted by deer tick, western blacklegged tick. Although it's not closely related to the Lyme disease bacteria, it can cause a Lyme like-illness. Symptoms include fever, headaches, muscle aches & chills. Diagnosis is by serology, all current strains available. Treatment is doxycycline.
- ✳ **Colorado tick fever** - An RNA virus transmitted by *Dermacentor andersoni* (Rocky Mt. wood tick) causes illness from the western Black Hills to the West Coast. Symptoms begin 3-5 days after the bite with an abrupt onset of fever & any of these: headaches, chills, malaise, photophobia, myalgias, nausea, vomiting, diarrhea & abdominal pain; 5-15% rash. Neurologic complications may occur. 50% of patients have single recurrence of fever ("saddleback" fever). IFA titers for diagnosis. Treatment consists of supportive care.
- ✳ **Ehrlichiosis** - Ehrlichia muris-like transmitted by the deer tick. Human monocytic ehrlichiosis is caused by *Ehrlichia chaffeensis*, transmitted by the lone star tick. *Ehrlichia ewingii*, transmitted by the lone star tick causes human granulocytic ehrlichiosis (See Anaplasmosis, below, for symptoms).
- ✳ **Anaplasmosis** - Formerly human granulocytic ehrlichiosis, is caused by *Anaplasma phagocytophilum* transmitted by deer tick & western blacklegged tick. Symptoms of both ehrlichiosis & anaplasmosis include: fever, malaise, chills, headaches, severe muscle aches; death can result. More severe illness may result if co-infected with Lyme disease. Lab tests show decreased white blood cells & platelets, elevated liver enzymes. Treatment is with doxycycline.
- ✳ **Powassan Encephalitis** - Powassan virus is comprised of two viral lineages lineage 1, classical Powassan (POW), and Lineage 2, Deer Tick Virus (DTV). Lineage 1 (classical POW) in the US is more typically associated with *Ixodes cookei* ticks, which generally do not feed on humans but on groundhogs. DTV, is usually associated with *Ixodes scapularis* and therefore more likely to be transmitted to humans. Both viruses can cause Powassan encephalitis. *Dermacentor andersoni* ticks have been shown to harbor Powassan virus. Symptoms begin suddenly 7-14 days after a bite & include headache, fever, nausea & vomiting, stiff neck & sleepiness. Confusion, tremors, seizures, paralysis & coma may follow. Death occurs in 10 to 15%; 50% of survivor have permanent neurologic problems. Supportive treatment only; no specific treatment is available.

- ✳ **Q Fever** - Caused by *Coxiella burnetti* (Cb). Disease can be tick-borne, from lone star or Rocky Mt. wood tick but most cases result from inhaling Cb-containing dust. Cattle, sheep & goats are primary reservoirs. Symptoms include high fevers up to 105°F, severe headache, malaise, myalgia, chills and or sweats, cough, nausea, vomiting, diarrhea, abdominal pain, chest pain. IFA titers for diagnosis. Usually treated with doxycycline.
- ✳ **Rocky Mountain spotted fever** - Caused by *Rickettsia rickettsii* & transmitted by *Dermacentor variabilis*, (American dog tick), *D. andersoni* (wood tick) & *Rhipicephalus sanguineus* (brown dog tick). Symptoms include fever, headaches, myalgia; characteristic spotted rash begins on wrists, ankles, palms & soles & may be absent early in disease. Treatment is usually doxycycline.
- ✳ **STARI (Southern Tick-Associated Rash Illness)** - Transmitted via a lone star tick bite, but infectious cause unknown. Symptoms very similar to Lyme disease including an EM-like rash, fatigue, headache, fever & muscle pains. No tests currently available. Treatment is usually doxycycline.
- ✳ **Tick paralysis** - Caused by a neurotoxin secreted by American dog, Rocky Mt. wood, deer & lone star ticks. Symptoms begin 2-6 days after attachment & primarily involve a paralysis that begins in the feet & spreads upward. May be fatal if respiratory muscles involved. Paralysis resolves when tick is completely removed.
- ✳ **Tularemia** - Caused by *Francisella tularensis*. Multiple transmission routes including *A. americanum*, *D. variabilis* & *D. andersoni* tick bites. Symptoms include; headache, chilliness, vomiting, aching pains, fever, swollen glands, sweating, weight loss & debility; ulcer formation at bite site. Treatment, streptomycin or gentamicin.
- ✳ **Alpha-gal meat allergy** - Caused by the bite of *Amblyomma americanum*, lone star tick. The tick saliva triggers an immune response to a carbohydrate, alpha-gal, found in red meat. Can cause anaphylaxis. Not always recognized by doctors as cause of meat allergy since symptoms may occur 3-4+ hours after tick bite. Symptoms may include hives, itchiness, anaphylaxis. Must refrain from eating certain meats such as beef, lamb, venison, pork.
- ✳ **Bourbon virus** - Caused by a thogotovirus, with first 2 cases in Kansas & Oklahoma in 2014-15. Tick type not confirmed to date. Symptoms include fever, headache, tiredness, rash, other body aches, nausea, vomiting, leukopenia, thrombocytopenia. Not tests or treatment to date except for symptoms.
- ✳ **Heartland virus** - Caused by a phlebovirus discovered in Missouri in 2009, 9 cases to date. Symptoms include fever, leukopenia, thrombocytopenia, tiredness, headaches, muscle aches, diarrhea, loss of appetite. No routine testing available but protocols for investigational diagnostic testing developed. No treatment except supportive therapy that can treat some symptoms.
- ✳ **Rickettsia phillipi** - Caused by Rickettsia species 364 D and found in California and Pacific Coast. Transmitted by *Dermacentor occidentalis*, Pacific Coast tick. Symptoms include fever, eschar(s), headache
- ✳ **Rickettsia parkeri rickettsiosis** - Caused by Rickettsia parkeri and occurs in eastern & southern US, especially along coast. Transmitted by the *Amblyomma maculatum* tick, (Gulf Coast tick), symptoms include fever, headache, myalgia, variable rash, eschar, regional lymphadenopathy. CDC suggest use of RMSF tests. Treatment with doxycycline.
- ✳ **Tick-Borne relapsing fever** - Caused by a bacteria (either *Borrelia hermsii*, turicatae, or parkeri) and transmitted by the soft bodied tick, *Ornithodoros* (either hermsi, turicata, or parkeri). The disease is characterized by recurring episodes (3days on 7 off) of high fever, can be up to 106.7° during certain phases. Each fever episode is followed by signs/symptoms which may include headache, muscle and joint aches, nausea, chills, arthralgia, vomiting, abdominal pain, dry cough, eye pain, confusion. The diagnosis is by microscopy and treatment may be with tetracycline, erythromycin, or other antibiotics.