Tests for Tick-Borne Diseases  
Lyme Disease Tests:  
- Antibody response (or serology) - measures antibody levels produced in response to the disease. Includes: ELISA, Opriﬁde, RA (rusted), IgG & IgM Western Blots. In the ﬁrst year after a tick bite, less than 65% of patients produce antibodies, but it may not be by year two.  
- less than 50% of patients still have an antibody response. Antibody response tests are most effective starting 4-9 weeks after a tick bite.  
- Accuracy rates vary considerably. If antibiotic treatment is inadequate, antibody levels may remain low causing tests to be negative.  
- Antigen 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 - 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 smear, IFA (IgG & IgM), FISH (Fluorescent in-situ Hybridization) and PCR may be ordered.  
  - Anaplasma - blood smear, IFA (IgG & IgM), PCR. Recommended to use more than one type of test.  
  - Ehrlichia - blood smears, IFA and PCR for I. canis (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, 501(c)(3) charity.  
- On average, 97% of contributions go directly to programs  
- Partnered in endow. Columbus University Lyme/TID Research Center  
- Awarded 106 research grants/published in 41 journals  
- Organized 18 one-on-one conferences for educators and physicians  
- Awarded 115 education grants to help stop the spread of Lyme  
- Provides FREE on-line Disease Diapered referral. Ixodes americanus, Ixodes scapularis  
- Created Lyme4 Kids fund $1.5M awarded families in need  
- Provides seminars on Lyme for the public, businesses & schools.  
- Educates public ofthe spread of Lyme & patient problems  
- Partners with Environmental Protection Agency PESP: stop the spread of ticks  
- Test for twice before Congress  
- Heads a national umbrella network: LDAnet, 43+ groups nationwide  

Suggested Resources  
LDA  
www.LymeDiseaseAssociation.org  
http://Columbia.Lyme.org  
http://www.Ixodes.com  
http://www.NADS.org  

Tick Identification Guide®  
*Tick Photography. Courtesy of James L. Olski, MA, MS & Robert S. Lane, PhD.  

Ixodes scapularis (deer tick or blacklegged tick)  
- Found in Northeastern & Upper South/Central  
- Transmits agents of: Lyme (B. burgdorferi), E. canis, Borrelia miyamotoi, Babesia microti, Anaplasma phagocytophilum, Babesia microti, Erlichiosis, Human mononucleosis.  
- Note symptoms: fever, rash, headache, eschar.  

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  
- Note symptoms: fever, rash(es), eschar.  

Dermacontor 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.  

Ixodes pacificus (western blacklegged tick)  
- Found in West  
- Transmits agents of: B. burgdorferi, B. miyamotoi, Ehrlichiosis, Human mononucleosis.  
- Note symptoms: fever, rash(es), eschar.  

Babesia, Anaplasma, Ehrlichia, Bartonella, Rickettsia Tests:  
- Babesia - blood smear, IFA (IgG & IgM), FISH (Fluorescent in-situ Hybridization) and PCR may be ordered.  
- Anaplasma - blood smear, IFA (IgG & IgM), PCR. Recommended to use more than one type of test.  
- Ehrlichia - blood smears, IFA and PCR for I. canis (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.
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 from skin, as close to skin surface as possible.
- Do not use household chemicals, as they are not effective against tick-borne diseases.
- 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 infections of the area.
- For tick disposal tape on & fold over.
- For tick bulletin board:

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
  - Chorgen Laboratories, LLC, Gaithersburg, MD 877-256-6436
  - NIB 722-249-1184

Also check with your state/local health department.

Prevention
Always follow manufacturer’s directions.
The LDB does make specific product recommendations or guarantees any warranties.
- Perform frequent, thorough tick checks.
- Wear light-colored clothes.
- Put ticks into locks on clothing.
- Put clothes in dryer for 30 minutes to kill ticks.
- Tuck pants into socks.
- Check out methods for property protection.
- An example: Connecticut Tick Control, www.ricketts.org
- An example: Tick Bus Technology Corporation www.tickbus.com

Get the Facts
- You can get many tick-borne diseases from one tick bite.
- The longer a tick is attached, the greater the risk of disease.
- Lyme is the most common tick-borne disease in the US.
- You can test negative and still have Lyme disease.
- QD criteria are for surveillance purposes, not diagnosis.
- According to the CDC, 35% of the population has been infected with Lyme disease.
- A person who has been bitten by a tick, even in the absence of symptoms, runs a risk of infection.
- Lyme symptoms can develop days or months after a tick bite.
- Lyme patients often get worse before getting better while on treatment (Bachmayer-Beer reaction).
- Lyme 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 established in sites that immune cells do not usually enter (central nervous system, joints, eyes).
- Use a body’s own cells to shield them.
- May switch from spirochete form to cell (which wall deficient) or cyclic form (tight body) not susceptible to antibiotics that kill spirochete form & their function is not clearly understood.
- Have been found in patients after long-term antibiotic treatment.
- A scanning electron microscope image of Borrelia burgdorferi persisting in a human cell (in vitro), at a magnification of approximately 10,000. Plate Credits: David M. Swerdlow, Ph.D.

Tick-Borne Diseases

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.
- Irregularly shaped, red, hard, warm.
- Nonsuppurative:

  - Joint/muscle pain in feet, ankle pain, shin splints, joint pain or swelling, stiffness of the neck, back, or muscle pain or cramps that migrate, TMJ, neck craks & craks, neck stiffness.

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

Cardio/Pulmonary:
- Chest pain or chest tightness, breathlessness, heart palpitations, pulse skips, cold and heat, heart murmur.

Neurological:
- Muscular twitching, headache, tingling, numbness, burning or stabbing sensations, paralytic (focal or bell’s palsy), dizziness, poor balance, increased motion sickness.
- Swelling of hands, eyes, face, mouth, feet, ankles, behind the ears, around the nose, lips, tongue.
- 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 involvement.

Neuropsychiatric:
- Mood swings, violent outbursts, irritability, depression, disturbed sleep (too much, too little, early awakening), personality changes, obsessions - compulsive disorders (OCD), parasomnia, panic attacks, hallucinations.

Gastrointestinal:
- Nausea or vomiting, GERD, change in bowel function (constipation, diarrhea), gastritis, abdominal cramping, cystitis, irritant bladder or bladder dyfunction, 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 in ankles, blurry vision, eye pain, pain in the ears, ringing in the ears.
- Muscle aches, nausea, vomiting, diarrhea, abdominal pain.

Lyme sympotms may be delayed up to 20 years.

Other-Tick-Borne Diseases
One tick bite can cause many different diseases at the same time (co-infection). Treatment, examples & protocols are listed below:

- Babesiosis - Malice-like illness caused by a parasite, Babesia microti, B. duncanii, B. divergens, M. luteus; 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, swelling & anemia.
- Treatment of amitrazum with amoxicillin & cephalexin or oral quinolone.
- Can be transmitted through blood supply.
- Bartonellosis - caused by several Bartonella species transmitted either by flies or tick bite, bed or scratch or lick. The same bite can cause spirochete infections, bartonellosis, bartonellosis autochthonous, bartonellosis transmitted by tick. Different species cause different symptoms.
- Borrelia anitamyiae - this bacteria 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, chills, headache, fatigue, macular rash, nausea. 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 bite with an abrupt onset of fever & any of these: headaches, chills, malaise, photophobia, myalgia, nausea, vomiting, diarrhea & abdominal pain. 5-15% rash. Neurologic complications may occur. 50% of patients have single recurrence of fever (“tadpole” fever). IFA titers for diagnosis. Treatment consists of supportive care.
- Erlichiosis - Ehrlichia muris transmitted by the deer tick. Human monocytic ehrlichiosis is caused by Ehrlichia chaffeensis, transmitted by the lone star tick. Erlichia 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 erlichioses & anaplasmoses include fever, chills, headache, severe muscle aches; death can result. Most severe illness may be similar to Lyme disease. Lab tests show decreased white blood cells & platelets, elevated liver enzymes.
- Rocky Mountain spotted fever - Caused by Rickettsia rickettsii & transmitted by Dermacentor variabilis, (American dog tick). D. andersoni (wood tick) & D. albipunctatus sanguineus (brown dog tick). Symptoms include fever headaches, myalgia; characteristic spotted rash begins on wrists, ankles & soles may be absent in early 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 EM-like rash, fatigue, fever & muscle pain. No travel currently available. Treatment is usually doxycycline.
- Tick paralysis - Caused by a mouse-borne secretory protein American dog tick, Rocky Mt wood, deer ticks. Symptoms include muscle weakness after attachment & partial or total paralysis that begins in feet or spreads upward. May be fatal if respiratory muscles involved. Paralysis resolves when tick is completely removed.
- Tularaemia - Caused by Franciella tularensis. Multiple transmission routes including Arthropods (ticks), contact with infected animals (rabbits, ground squirrels), consumption of infected (co-infections). Treatments vary, examples provided as information only.
- Ureaplasma urealyticum - Caused by the ureaplasma urealyticum, a coccobacillus. Symptoms include headache, fever, cough, nausea or vomiting, diarrhea, abdominal pain, chest pain. IFA titers for diagnosis. Treatment may be combination macrolides, TCNs, rifamycin, (also possible Bactrim or fluoroquinolones).
- Pseudomonas aeruginosa - Caused by Pseudomonas aeruginosa. Symptoms caused by Pseudomonas include high fevers up to 105°F, severe headache, muscle & joint pain, myalgia, chills and or fevers, cough, nausea, vomiting, diarrhea, abdominal pain, chest pain. IFA titers for diagnosis. Treatment may be combination macrolides, TCNs, rifamycin, (also possible Bactrim or fluoroquinolones).
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