

TICK-BORNE DISEASES

IN THE NEW YORK CITY AREA

A Reference Manual for Physicians





KNOW YOUR TICKS

Ticks are generally found near the ground in brushy or wooded areas. When a potential host brushes against them, they latch on to the host and feed on its blood. Ticks carrying infectious pathogens may transmit them to the host during these blood meals. This reference manual lists tick-borne diseases, vectors and general guidelines for identification and treatment. Physicians should especially watch for symptoms from spring to early fall, when ticks are most active.

Different ticks transmit different diseases, so it is important to consider travel history. The American dog tick is common in all five boroughs of New York City (NYC). Blacklegged and lone star ticks are more common on Long Island, in upstate NY and in the northeastern states, from Maine to Virginia. Travel to these endemic areas is the main risk factor for tick-borne disease in NYC residents. However, the blacklegged tick has been moving into Staten Island and the northern Bronx, and local transmission of Lyme disease has been identified in Staten Island.

For the most up-to-date information on ticks in NYC, visit nyc.gov/health and search “ticks.”



Blacklegged Tick



BLACKLEGGED TICK

Ixodes scapularis
(also called “deer tick”)

DISEASES

Lyme disease, anaplasmosis, babesiosis, Powassan disease

WHAT BITES

Nymph and adult females

WHEN

When temperatures are above freezing; greatest risk is spring through fall

COLORING

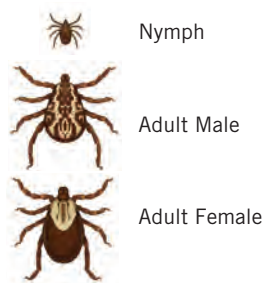
Adult females have a reddish-brown, tear-shaped body with dark brown hood

SIZE

Nymphs: Poppy seed
Unfed Adults: Sesame seed



American Dog Tick



AMERICAN DOG TICK

Dermacentor variabilis
(also called “wood tick”)

DISEASES

Rocky Mountain spotted fever (RMSF), Tularemia

WHAT BITES

Adult females

WHEN

April through August

COLORING

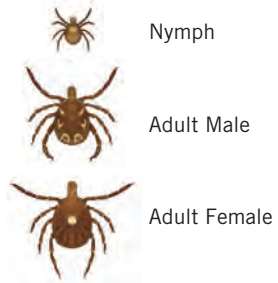
Adult females have a dark brown body with whitish markings on the hood

SIZE

Nymphs: Poppy seed
Unfed Adults: Watermelon seed



Lonestar Tick



LONESTAR TICK

Amblyomma americanum

DISEASES

Ehrlichiosis, Tularemia

WHAT BITES

Nymph and adult females

WHEN

April through September in the northeast, year-round in southern U.S.

COLORING

Adult females have a brown body with a white spot on the hood

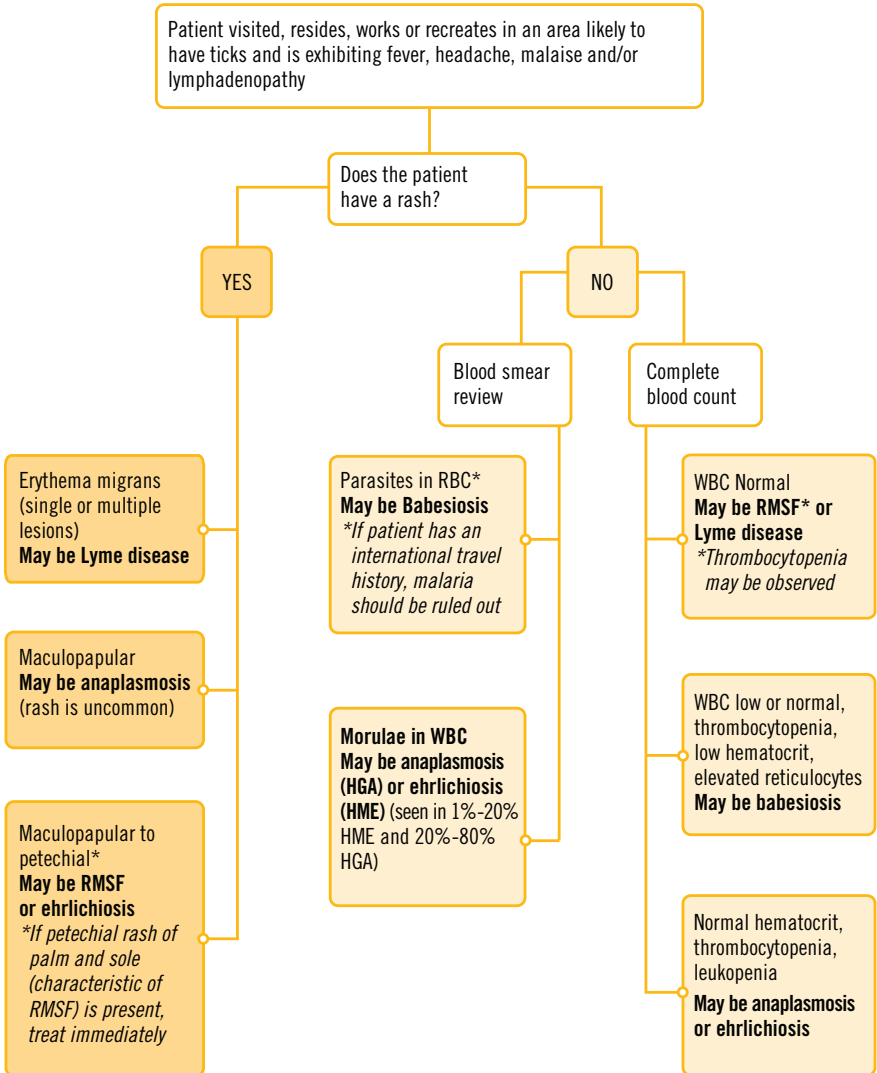
SIZE

Nymphs: Poppy seed
Unfed Adults: Sesame seed

TICK-BORNE DISEASES IN NYC

ALGORITHM FOR DIFFERENTIATING TICK-BORNE DISEASES

This algorithm is intended for use as a general guide when pursuing a diagnosis. It does not replace the physician's clinical judgment or the need for definitive laboratory testing.

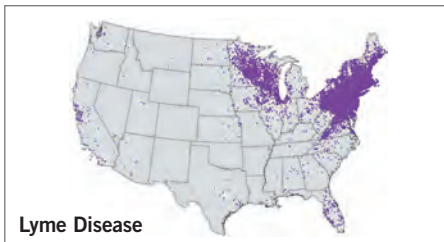
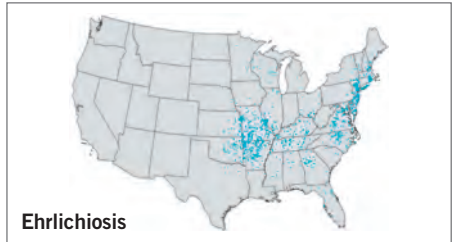
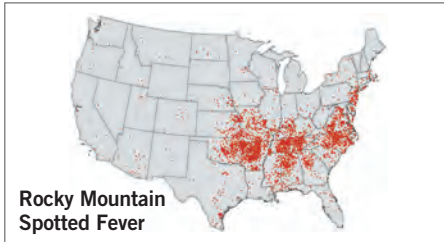
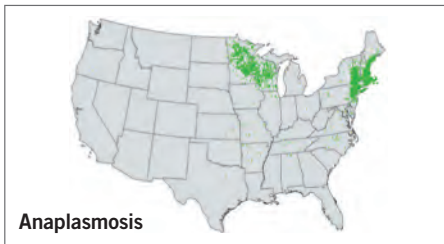




OTHER CONSIDERATIONS

- Rash occurs in 60%-80% of Lyme disease patients.
- Rash occurs in less than 10% of anaplasmosis patients.
- Rash occurs in less than 30% of adult ehrlichiosis patients, and less than 60% of children.
- Rash occurs in 70%-80% of RMSF patients but only appears several days after onset of febrile illness.
- Hyponatremia may occur with RMSF.
- Lyme disease can present as Bell's palsy; further tests needed.
- Coinfections involving Lyme disease, babesiosis, and/or anaplasmosis may occur because a single blacklegged tick may carry multiple pathogens.

SELECTED TICK-BORNE DISEASES REPORTED TO CDC, U.S., 2015



NOTE: Each dot represents one case. Cases are reported from the infected person's county of residence. For more information, visit cdc.gov.

ANAPLASMOSIS (AKA HUMAN GRANULOCYTTIC ANAPLASMOSIS)

AGENT

Bacterium: *Anaplasma phagocytophilum*
(formerly *Ehrlichia phagocytophilum*)

Tick: *Ixodes scapularis*

SIGNS/SYMPTOMS

[incubation period 1-2 weeks]

- Fever, chills
- Severe headache
- Malaise
- Myalgia
- Gastrointestinal symptoms (nausea, vomiting, diarrhea, anorexia)
- Cough
- Rash (rare cases)
- Stiff neck*
- Confusion*

* May present later (5 days after onset of symptoms) and may be prevented by early treatment.





LABS

Common Findings on Routine Laboratory Tests

Generally observed during the first week of clinical disease

- Mild anemia
- Thrombocytopenia
- Leukopenia (characterized by relative and absolute lymphopenia and a left shift)
- Modest elevations in hepatic transaminases

Diagnostic Laboratory Criteria

- Detection of DNA by PCR assay (**preferred method**), particularly early in the course of illness while bacteria are still present and serologic testing may be negative due to an absence of detectable antibodies; or
- Demonstration of a four-fold change in IgG-specific antibody titer by immunofluorescence assay (IFA) in paired serum samples; or
- Immunohistochemistry (IHC) staining of organism; or
- Isolation of organism from a clinical specimen in cell culture

NOTES

- Visualization of morulae in the cytoplasm of granulocytes during examination of blood smears is highly suggestive of a diagnosis; however, blood smear examination is insensitive and should never be relied upon solely to rule anaplasmosis in or out.
- Confirmation of the diagnosis is based on laboratory testing, but antibiotic therapy should not be delayed in a patient with a suggestive clinical presentation.
- Clinical signs of anaplasmosis and ehrlichiosis are similar, and testing for both species is indicated. Also consider the possibility of coinfection with *Babesia microti* and/or *Borrelia burgdorferi*.
- Single elevated titers do not confirm a diagnosis but may merely be indicative of a past infection. To confirm a diagnosis, repeat titers 7 to 14 days later to look for a four-fold change in IgG-specific antibody titers by IFA.
- Patients may not have a detectable antibody response during the first seven to ten days of illness, when most patients seek care. Since antibody titers are frequently negative during this time, consider dual testing using PCR and serologic methodologies.
- IgM antibodies are less specific than IgG antibodies and are more likely to generate false positives. IgM results alone should not be used for laboratory diagnosis.

ANAPLASMOSIS

TREATMENT

The regimens listed below are guidelines only and may need to be adjusted depending on a patient's age, medical history, underlying health conditions, pregnancy status or allergies. Consult an infectious disease specialist for the most current treatment guidelines or for individual patient treatment decisions.[†]

AGE CATEGORY	DRUG	DOSAGE	MAXIMUM	DURATION (DAYS)
Adults	Doxycycline	100 mg per dose, twice per day orally or IV	100 mg per dose	Patients with suspected anaplasmosis infection should be treated with doxycycline for 10 to 14 days to provide appropriate length of therapy for possible incubating coinfection with Lyme disease.
Children weighing < 100 lbs (45.5 kg)	Doxycycline	2.2 mg/kg per dose, twice per day orally or IV	100 mg per dose	



NOTE: Use doxycycline as first-line treatment for suspected anaplasmosis in patients of all ages. The use of doxycycline to treat suspected anaplasmosis in children is recommended by both the CDC and the American Academy of Pediatrics Committee on Infectious Diseases. Use of antibiotics other than doxycycline increases the risk of patient death. At the recommended dose and duration needed to treat anaplasmosis, no evidence has been shown to cause staining of permanent teeth, even when 5 courses are given before the age of 8.

NOTES

- Patients with mild illness for whom doxycycline treatment is contraindicated may be treated with rifampin for 7-10 days using a dosage regimen of 300 mg twice per day by mouth for adults and 10 mg/kg twice per day for children (maximum, 300 mg per dose).
- Treatment response is expected within 48 hours. Failure to respond in 3 days suggests infection with a different agent or coinfection with *B. microti*.
- Treatment is not recommended for asymptomatic individuals who are seropositive for antibodies to *A. phagocytophilum*.



REFERENCES

American Academy of Pediatrics. Ehrlichia and Anaplasma. In: Pickering LK, Baker CJ, Long SS, McMillan JA, eds. Red Book: 2009 Report of the Committee on Infectious Diseases. 28th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2009: 284-287.

Bakken JS, Aguero-Rosenfeld ME, Tilden RL, et al. Serial Measurements of Hematologic Counts During the Active Phase of Human Granulocytic Ehrlichiosis. *Clinical Infectious Diseases*. 2001; 32(6): 862-870.

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Centers for Disease Control and Prevention. Case Definitions for Infectious Conditions Under Public Health Surveillance. www.cdc.gov/mmwr/preview/mmwrhtml/00047449.htm. Accessed 12/10/2009.

Dumler JS, Walker DH. *Ehrlichia chaffeensis* (human monocytotropic ehrlichiosis), *Anaplasma phagocytophilum* (human granulocytotropic anaplasmosis) and Other Ehrlichiae. In: Mandell GL, Bennett JE, Dolin R, editors. *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases*. 7th ed. Philadelphia, PA: Churchill Livingstone; 2010: 2531-2538.

† Wormser GP, Dattwyler RJ, Shapiro ED, et al. The Clinical Assessment, Treatment and Prevention of Lyme Disease, Human Granulocytic Anaplasmosis, and Babesiosis. *Clinical Practice Guidelines by the Infectious Diseases Society of America. Clinical Infectious Diseases*. 2006; 43(9): 1089-1134.



BABESIOSIS

AGENT

Parasite: *Babesia microti*

Tick: *Ixodes scapularis*

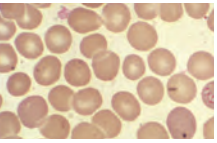
SIGNS/SYMPTOMS

[incubation period: 1-9+weeks]

- Fever, chills, sweats
- Malaise, fatigue
- Gastrointestinal symptoms (anorexia, nausea, abdominal pain, vomiting)
- Myalgia, arthralgia, headache
- Dark urine
- Less common: Cough, sore throat, depression, emotional lability, photophobia, conjunctival injection
- Mild splenomegaly and/or hepatomegaly

Babesia infection can range from asymptomatic to life-threatening. Risk factors for severe babesiosis include asplenia, advanced age and impaired immune function. Severe cases can be associated with marked thrombocytopenia, disseminated intravascular coagulation, hemodynamic instability, acute respiratory distress, renal failure, hepatic compromise, altered mental status and death.





LABS

Common Findings on Routine Laboratory Tests

- Decreased hematocrit due to hemolytic anemia
- Thrombocytopenia
- Mildly elevated hepatic transaminases
- Elevated serum BUN and creatinine
- Elevated reticulocyte counts
- Elevated erythrocyte sedimentation rate
- WBC count may be normal or mildly decreased
- Decreased serum haptoglobin
- Proteinuria
- Hemoglobinuria

Diagnostic Laboratory Criteria

- Identification of intraerythrocytic *Babesia* parasites in a peripheral blood smear (**preferred method**); or
- Positive PCR assay (**preferred method**); or
- Isolation of the parasite from a whole blood specimen by animal inoculation

Supportive Laboratory Criteria

- Demonstration of a *Babesia*-specific antibody titer by immunofluorescence assay (IFA) for IgG. In general, higher cutoff titers (> 1:256) are associated with greater diagnostic specificity.

NOTES

- If the diagnosis of babesiosis is being considered, manual (non-automated) review of blood smears should be requested explicitly. In symptomatic patients with acute infections, *Babesia* parasites can typically be detected by blood-smear examinations, although multiple smears may need to be examined.
- It may be difficult to distinguish between *Babesia* and malaria parasites and even between parasites and artifacts (such as stain or platelet debris). Consider having a reference laboratory confirm the diagnosis and the species.
- Due to the sparse parasitemia typical of most *B. microti* infections, additional diagnostic tests should be performed in suspect patients if the initial blood smear is negative. While antibody detection by serologic testing can provide supportive evidence for the diagnosis, it does not reliably distinguish between active and prior infection.
- Transmission can occur via transfusion using contaminated blood products. The incubation period for transfusion-associated babesiosis is 2 to 9 weeks. Providers are encouraged to consider babesiosis in the differential diagnosis for patients with febrile illnesses and/or hemolytic anemia who have received blood components in the preceding 3 months.
- Patients diagnosed with babesiosis are permanently banned from donating blood or blood products.



BABESIOSIS

TREATMENT

The regimens listed below are guidelines only and may need to be adjusted depending on a patient's age, clinical status, immunocompetence, splenic function, underlying health conditions, pregnancy status, medications or allergies. Babesiosis is treated for at least 7-10 days with a combination of two medications. Fewer side effects have been reported using the combination of atovaquone and azithromycin, but the clindamycin and quinine combination may be indicated for patients with more severe illness. Consult an infectious disease specialist for the most current treatment guidelines or for individual and pediatric patient treatment decisions.[†]

AGE CATEGORY	DRUG	DOSAGE	MAXIMUM	DURATION (DAYS)
Adults <i>Prescribe together</i>	Atovaquone	750 mg orally every 12 hours	N/A	7-10
	Azithromycin	500-1000 mg on day 1 and 250-1000 mg orally once per day thereafter	1000 mg per dose	7-10
OR				
<i>Prescribe together</i>	Clindamycin	300-600 mg IV every 6 hours OR 600 mg orally every 8 hours	N/A	7-10
	Quinine	650 mg orally every 6-8 hours	N/A	7-10

NOTES

- For adult patients who are immunocompromised, higher doses of azithromycin (600-1000 mg per day) may be used.
- The recommended treatment for patients with severe babesiosis, as indicated by high-grade parasitemia ($\geq 10\%$), significant hemolysis, or renal, hepatic or pulmonary compromise, is quinine and IV clindamycin, and the patient should be considered for partial or complete RBC exchange transfusion.
- Consider the possibility of coinfection with *B. burgdorferi* and/or *A. phagocytophilum* in patients with especially severe or persistent symptoms, despite appropriate antibabesial therapy.
- Asymptomatic patients with a positive babesial smear and/or PCR results should have these studies repeated. Treatment should be considered if parasitemia persists for more than 3 months.



REFERENCES

- American Academy of Pediatrics. Babesiosis. In: Pickering LK, Baker CJ, Long SS, McMillan JA, eds. Red Book: 2009 Report of the Committee on Infectious Diseases. 28th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2009: 226-227.
- Gelfand JA, Vannier E. Babesia Species. In: Mandell GL, Bennett JE, Dolin R, editors. Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. 7th ed. Philadelphia, PA: Churchill Livingstone; 2010: 3539-3545.
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- Krause PJ, Telford S 3rd, Spielman A, et al. Comparison of PCR with Blood Smear and Inoculation of Small Animals for Diagnosis of *Babesia microti* Parasitemia. Journal of Clinical Microbiology. 1996; 34(11): 2791-2794.
- Krause PJ, Lepore T, Sikand VK, et al. Atovaquone and Azithromycin for the Treatment of Babesiosis. New England Journal of Medicine. 2000; 343(20): 1454-1458.
- Persing DH, Mathiesen D, Marshall WF, et al. Detection of *Babesia microti* by Polymerase Chain Reaction. Journal of Clinical Microbiology. 1992; 30(8): 2097-2103.
- Ruebush TK, Juranek DD, Spielman A, Piesman J, Healy G. Epidemiology of Human Babesiosis on Nantucket Island. The American Journal of Tropical Medicine and Hygiene. 1981; 30(5): 937-941.
- Thompson C, Spielman A, Krause PJ. Coinfecting Deer-Associated Zoonoses: Lyme Disease, Babesiosis, and Ehrlichiosis. Clinical Infectious Diseases. 2001; 33(5): 676-685.
- †Wormser GP, Dattwyler RJ, Shapiro ED, et al. The Clinical Assessment, Treatment and Prevention of Lyme Disease, Human Granulocytic Anaplasmosis, and Babesiosis. Clinical Practice Guidelines by the Infectious Diseases Society of America. Clinical Infectious Diseases. 2006; 43(9): 1089-1134.



EHRlichiosis (AKA HUMAN MONOCYtic EHRlichiosis)

AGENT

Bacterium: *Ehrlichia chaffeensis*,
E. ewingii

Tick: *Amblyomma americanum*

SIGNS/SYMPTOMS

[incubation period 7-14 days]

- Fever, chills
- Headache
- Malaise
- Myalgia
- Gastrointestinal symptoms (nausea, vomiting, diarrhea, anorexia)
- Conjunctival injection
- Rash (in up to 60% of children, less than 30% of adults)
- Stiff neck
- Confusion

Ehrlichiosis and anaplasmosis have a similar clinical presentation, but they are transmitted by 2 different species of ticks and generally occur in different regions of the U.S.

LABS

Common Findings on Routine Laboratory Tests

Generally observed during the first week of clinical disease

- Thrombocytopenia
- Mild to moderate leukopenia
- Modest elevations in hepatic transaminases
- Mild anemia

Diagnostic Laboratory Criteria

- Detection of DNA by PCR assay (**preferred method**); or
- Demonstration of a four-fold change in IgG-specific antibody titer by immunofluorescence assay (IFA) in paired serum samples; or
- Immunohistochemistry (IHC) staining of organism

NOTES

- Confirmation of the diagnosis is based on laboratory testing, but antibiotic therapy should not be delayed in a patient with a suggestive clinical presentation.
- Patients may not have a detectable antibody response during the first 7 days of illness, when most patients seek care. Consider dual testing using PCR and serologic methodologies.
- Single elevated titers do not confirm a diagnosis but may merely be indicative of a past infection. To confirm a diagnosis, repeat titers 7 to 14 days later to look for a four-fold change in IgG-specific antibody titers by IFA.
- Visualization of morulae in the cytoplasm of monocytes during examination of blood smears is highly suggestive of a diagnosis; however, blood smear examination is insensitive and should never be relied upon solely to rule anaplasmosis in or out.
- IgM antibodies are less specific than IgG antibodies and are more likely to generate false positive results. IgM results alone should not be used for laboratory diagnosis.



TREATMENT

The regimens listed below are guidelines only and may need to be adjusted depending on a patient's age, medical history, underlying health conditions, pregnancy status or allergies. Consult an infectious disease specialist for the most current treatment guidelines or for individual patient treatment decisions.[†]

AGE CATEGORY	DRUG	DOSAGE	MAXIMUM	DURATION (DAYS)
Adults	Doxycycline	100 mg twice per day orally or IV	100 mg/dose	Patients should be treated for at least 3 days after the fever subsides and until there is evidence of clinical improvement. Minimum course of treatment is 5–7 days.
Children weighing <100 lbs (45.5 kg)	Doxycycline	2.2 mg/kg per dose twice a day, orally or IV	100 mg/dose	

[†] Wormser GP, Dattwyler RJ, Shapiro ED, et al. The Clinical Assessment, Treatment and Prevention of Lyme Disease, Human Granulocytic Anaplasmosis, and Babesiosis. Clinical Practice Guidelines by the Infectious Diseases Society of America. Clinical Infectious Diseases. 2006; 43(9): 1089-1134.

NOTES

- Because ehrlichiosis can be life-threatening and limited courses of therapy do not pose a substantial risk for tooth staining, the American Academy of Pediatrics has identified doxycycline as the drug of choice for treating ehrlichiosis in children of any age.
- Treatment response is expected within 48 hours. Failure to respond in 3 days suggests infection with a different agent.
- Treatment is not recommended for asymptomatic individuals who are seropositive for antibodies to *E. chaffeensis*.

REFERENCES

- American Academy of Pediatrics. Ehrlichia and Anaplasma. In: Pickering LK, Baker CJ, Long SS, McMillan JA, eds. Red Book: 2009 Report of the Committee on Infectious Diseases. 28th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2009: 284-287.
- Centers for Disease Control and Prevention. Diagnosis and Management of Tick-borne Rickettsial Diseases: Rocky Mountain Spotted Fever, Ehrlichiosis, and Anaplasmosis—United States: A Practical Guide for Physicians and Other Health-care and Public Health Professionals. MMWR Recommendations and Reports. 2006; 55(RR-4): 1-27.
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- Dumler JS, Walker DH. *Ehrlichia chaffeensis* (human monocytotropic ehrlichiosis), *Anaplasma phagocytophilum* (human granulocytotropic anaplasmosis) and Other Ehrlichiae. In: Mandell GL, Bennett JE, Dolin R, editors. Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. 7th ed. Philadelphia, PA: Churchill Livingstone; 2010: 2531-2538.



LYME DISEASE

AGENT

Bacterium: *Borrelia burgdorferi*
Tick: *Ixodes scapularis*

SIGNS/SYMPTOMS

Early localized stage[†] (within 3-30 days post exposure)

- Erythema migrans (EM) – red ring-like or homogeneous expanding rash (this is a pathognomonic sign) See page 19.
- Flu-like symptoms including malaise, fatigue, headache, fever, chills, myalgia, regional lymphadenopathy

Disseminated Stage

- Severe malaise and fatigue
- Multiple secondary annular rashes
- Lymphadenopathy

Rheumatologic Manifestations

- Transient, migratory arthritis and effusion in one or multiple joints. If untreated, arthritis may recur in same or different joints
- Migratory pain in tendons, bursae, muscle and bone
- Baker's cyst

Cardiac Manifestations

- Conduction abnormalities, e.g., atrioventricular node block
- Myocarditis, pericarditis

Neurologic Manifestations

- Bell's palsy or other cranial neuropathy
- Meningitis
- Motor and sensory radiculoneuropathy, mononeuritis multiplex
- Encephalitis, encephalomyelitis, subtle encephalopathy, pseudotumor cerebri (all rare)
- Subtle cognitive difficulties

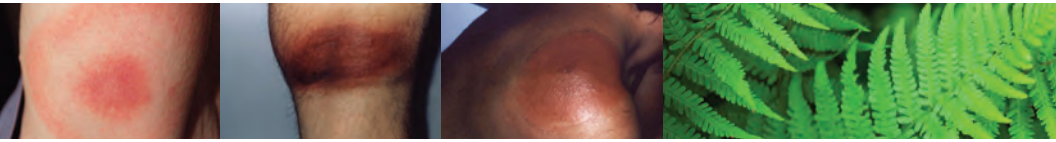
Additional Manifestations

- Conjunctivitis, keratitis, uveitis
- Mild hepatitis
- Splenomegaly

During the early, localized stage of illness, Lyme disease may be diagnosed clinically in patients who present with an EM rash. Serologic tests may be insensitive at this stage. During disseminated disease, however, serologic tests are usually positive.

[†]The IDSA guidelines support limited use of a single 200 mg dose of doxycycline as prophylaxis for Lyme disease when all of the following conditions are met:

- Patient has been in a region endemic for Lyme disease
- Tick can be reliably identified as *I. scapularis* and has been attached for ≥ 36 hours, based on engorgement or exposure history
- Prophylaxis can be started within 72 hours of tick removal
- Doxycycline is not contraindicated



LABS

Limitations to Serologic Tests for Lyme Disease:

- Serologic tests are insensitive during the first few weeks of infection. During this stage, patients with an EM rash may be diagnosed clinically. While not necessary, acute and convalescent titers may be helpful in some cases.
- In persons with illness > 1 month, only IgG testing should be performed (not IgM). A positive IgM test alone is not sufficient to diagnose current disease.
- Due to antibody persistence, single positive serologic test results cannot distinguish between active and past infection.
- Serologic tests cannot be used to measure treatment response.
- Due to their high sensitivity and low specificity, EIA and IFA tests may yield false-positive results caused by cross-reactivity with antibodies to commensal or pathogenic spirochetes, certain viral infections (e.g., varicella, Epstein-Barr virus), or certain autoimmune diseases (e.g., systemic lupus erythematosus).

Diagnostic Laboratory Criteria

- Demonstration of diagnostic IgM or IgG antibodies in serum. A two-tier testing protocol is recommended; a positive or equivocal EIA or IFA should be followed by a Western blot. See testing decision tree in Appendix, page 27.
- Isolation of organism from a clinic specimen.
- In suspect Lyme meningitis, testing for intrathecal IgM or IgG antibodies may be helpful.

Common Findings on Routine Laboratory Tests

- Elevated erythrocyte sedimentation rate
- Mildly elevated hepatic transaminases
- Microscopic hematuria or proteinuria
- In Lyme meningitis, CSF typically shows lymphocytic pleocytosis, slightly elevated protein and normal glucose

NOTE: Coinfection with *B. microti* and/or *A. phagocytophilum* should be considered in patients who present with initial symptoms that are more severe than are commonly observed with Lyme disease alone, especially in those who have high-grade fever for more than 48 hours despite appropriate antibiotic therapy or who have unexplained leukopenia, thrombocytopenia or anemia. Coinfection might also be considered in patients whose erythema migrans skin lesion has resolved but who have persistent viral infection-like symptoms.





LYME DISEASE

TREATMENT

The following guidelines for early (localized) Lyme disease may need to be adjusted depending on a patient's age, medical history, underlying health conditions, pregnancy status or allergies. Consult an infectious disease specialist for the most current treatment guidelines or for individual patient treatment decisions. Treatment guidelines for patients with disseminated or late stage Lyme disease are outlined in the references.[†]

Early Localized Stage

AGE CATEGORY	DRUG	DOSAGE	MAXIMUM	DURATION (DAYS)	
Adults	Doxycycline	100 mg twice per day orally	N/A	14 (14-21)	
	OR				
	Cefuroxime axetil	500 mg twice per day orally	N/A	14 (14-21)	
	OR				
	Amoxicillin	500 mg 3 times per day orally	N/A	14 (14-21)	
Children	Amoxicillin	50 mg/kg per day orally in 3 divided doses	500 mg per dose	14 (14-21)	
	OR				
	Doxycycline	4 mg/kg per day orally in 2 divided doses	100 mg per dose	14 (14-21)	
	OR				
	Cefuroxime axetil	30 mg/kg per day orally in 2 divided doses	500 mg per dose	14 (14-21)	

NOTE: Patients treated for Lyme disease with a two to four week course of antibiotics may have lingering symptoms of fatigue and joint and muscle pain. In a small percentage of patients, these symptoms persist for more than six months, a condition called Post-treatment Lyme Disease Syndrome (PTLDS). Studies have shown that prolonged courses of antibiotics to treat PTLDS were not more effective than placebos and have been associated with serious complications. For more information, visit cdc.gov/lyme/postlds

NOTE: For patients intolerant of amoxicillin, doxycycline and cefuroxime axetil, the macrolides azithromycin, clarithromycin or erythromycin may be used, although they have a lower efficacy. Patients treated with macrolides should be closely observed to ensure resolution of clinical manifestations.



1. Classic EM-Circular red rash with central clearing that slowly expands
2. Bluish hue without central clearing
3. Early disseminated Lyme disease — multiple red lesions with dusky centers
4. Tick bite with mild allergic reaction. Not an erythema migrans. Allergic reactions typically appear within the first 48 hours of tick attachment and are usually <5 cm in diameter.

NOTE: The erythema migrans occurs in 70–80% of patients with Lyme disease. They expand slowly over a few days after which they may develop a “bull’s-eye” appearance consisting of a red ring with central clearing. However, EM may take alternate forms; solid lesions, blue-purple hues and crusted or blistering lesions have all been documented. The rash is not painful or pruritic, but it may be warm to the touch. If early localized Lyme disease is not treated, patients may develop multiple secondary circular rashes as spirochetes disseminate throughout the body.

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American Academy of Pediatrics. Lyme disease (Lyme borreliosis, *Borrelia burgdorferi* infection). In: Pickering LK, Baker CJ, Long SS, McMillan JA, eds. Red Book: 2009 Report of the Committee on Infectious Diseases. 28th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2009: 430-435.

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† Wormser GP, Dattwyler RJ, Shapiro ED, et al. The Clinical Assessment, Treatment and Prevention of Lyme Disease, Human Granulocytic Anaplasmosis, and Babesiosis. Clinical Practice Guidelines by the Infectious Diseases Society of America. Clinical Infectious Diseases. 2006; 43(9): 1089-1134.

NOTE: Some people may develop an allergic reaction at the tick bite site. This is typically a local reaction that resolves within 24 to 48 hours and is not indicative of infection with *B. burgdorferi*.



ROCKY MOUNTAIN SPOTTED FEVER

AGENT

Bacterium: *Rickettsia rickettsii*

Tick: *Dermacentor variabilis*



SIGNS/SYMPTOMS

[incubation period 2-14 days]

- Fever, chills
- Severe headache
- Malaise
- Myalgia
- Gastrointestinal symptoms (nausea, vomiting, anorexia, abdominal pain, diarrhea, abdominal tenderness)
- Rash, 2-5 days after fever (Begins as small, blanching, pink macules on the ankles, wrists or forearms that evolve to maculopapules. May expand to the entire body including the palms and soles. The classic spotted, or generalized petechial, rash is not usually apparent until the 5th or 6th day of illness.)
- Cough
- Conjunctival injection, +/- photophobia
- Focal neurologic deficits, including cranial or peripheral motor nerve paralysis or sudden transient deafness

NOTE: Rash may be completely absent or atypical in up to 20% of RMSF cases. Rocky Mountain “spotless” fever is more likely to occur in older patients.



LABS

Common Findings on Routine Laboratory Tests

- Thrombocytopenia
- Mildly elevated hepatic transaminase levels
- Hyponatremia

Diagnostic Laboratory Criteria

- Demonstration of four-fold change in IgG-specific antibody titer by IFA in paired sera (**preferred method**);
- Immunohistochemical (IHC) staining of organism in a biopsy or autopsy specimen; or
- Isolation of organism in cell culture; or
- Detection of DNA in a clinical specimen by PCR assay (PCR is generally unreliable for blood samples, but may be considered for tissue specimens)

NOTES:

- Tests for IgM antibodies alone are generally not useful for serodiagnosis of acute disease, due to cross-reactivity and persistence of the antibody.
- Confirmation of the diagnosis is based on laboratory testing, but antibiotic therapy should not be delayed in a patient with a suggestive clinical presentation.
- Single elevated titers do not confirm a diagnosis but may merely be indicative of a past infection. To confirm a diagnosis in such patients or in those who lack an early detectable antibody response, repeat titers 7 to 14 days later to look for a four-fold change in IgG-specific antibody titers by IFA.
- Patients may not have a detectable antibody response during the first 7 days of illness, when most patients seek care.



ROCKY MOUNTAIN SPOTTED FEVER

TREATMENT

The regimens listed below are guidelines only and may need to be adjusted depending on a patient's age, medical history, underlying health conditions, pregnancy status or allergies. Consult an infectious disease specialist for the most current treatment guidelines or for individual patient treatment decisions.

AGE CATEGORY	DRUG	DOSAGE	MAXIMUM	DURATION (DAYS)
Adults	Doxycycline	100 mg twice daily, orally or IV	100 mg/dose	Patient should be treated for at least 3 days after fever subsides and until evidence of clinical improvement. Minimum course of treatment is 5-7 days.
Children weighing < 100 lbs (45.4 kg)	Doxycycline	2.2 mg/kg body weight per dose twice daily, orally or IV	100 mg/dose	

NOTES: Because RMSF can be life-threatening and limited courses of therapy do not pose a substantial risk for tooth staining, the American Academy of Pediatrics has identified doxycycline as the drug of choice for treating RMSF in children of any age.

Doxycycline is typically contraindicated for use during pregnancy but might be warranted in life-threatening situations where clinical suspicion of RMSF is high. Consult with an infectious disease specialist for guidance.

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TULAREMIA

AGENT

Bacterium: *Francisella tularensis*

Tick: *Dermacentor variabilis*,
Amblyomma americanum

NOTE: The clinical presentation of tularemia will depend on a number of factors, including the portal of entry.

SIGNS/SYMPTOMS

[incubation period 1-21 days]

- Severe headache
- Fever, chills
- Malaise, fatigue
- Anorexia
- Myalgia
- Chest discomfort, cough
- Sore throat
- Vomiting, diarrhea
- Abdominal pain

(Ulcers) Glandular

- Localized lymphadenopathy
- Cutaneous ulcer at infection site (not always present)

Oculoglandular

- Photophobia
- Excessive lacrimation
- Conjunctivitis
- Preauricular, submandibular and cervical lymphadenopathy

Oropharyngeal

- Severe throat pain
- Cervical, preauricular and/or retropharyngeal lymphadenopathy

Pneumonic

- Non-productive cough
- Substernal tightness
- Pleuritic chest pain
- Hilar adenopathy, infiltrate or pleural effusion may be present on chest x-ray

Typhoidal

- Characterized by any combination of the general symptoms

LABS

Common Findings on Routine Laboratory Tests

- Leukocyte count and sedimentation rate may be normal or elevated
- Thrombocytopenia
- Mildly elevated hepatic transaminase levels
- Hyponatremia
- Elevated creatinine phosphokinase
- Myoglobinuria
- Sterile pyuria



TULAREMIA

Diagnostic Laboratory Criteria

- Demonstration of four-fold change in paired sera; or
- Isolation of organism from a clinical specimen; or
- Detection of organism by immunofluorescence assay (IFA) test or a single elevated serum antibody titer to support diagnosis. A single antibody titer should be confirmed by either one of the methods above.

TREATMENT

The regimens listed below are guidelines only and may need to be adjusted depending on a patient's age, medical history, underlying health conditions, pregnancy status or allergies. Consult an infectious disease specialist for the most current treatment guidelines or for individual patient treatment decisions.

AGE CATEGORY	DRUG	DOSAGE	MAXIMUM	DURATION (DAYS)
Adults	Streptomycin	1g IM twice daily	2g per day	Minimum 10
	OR			
	Gentamicin	5mg/kg IM or IV daily (with desired peak serum levels of at least 5 mcg/mL)	Monitor serum drug levels	Minimum 10
	OR			
	Ciprofloxacin	400mg IV or PO twice daily	N/A	10-14
	OR			
Children	Doxycycline	100mg IV or PO twice daily	N/A	14-21
	Streptomycin	15 mg/kg IM twice daily	2 g per day	Minimum 10
	OR			
	Gentamicin	2.5 mg/kg IM or IV 3 times daily	Monitor serum drug levels and consult a pediatric infectious disease specialist	Minimum 10
	OR			
	Ciprofloxacin	15 mg/kg IV or PO twice daily	1 g per day	10



POWASSAN DISEASE

AGENT

Virus: *Powassan virus*, *deer tick virus*

Tick: *Ixodes cookei*, *Ixodes marxi*,
Ixodes scapularis

SIGNS/SYMPTOMS

[incubation period 7-28 days]

- Fever, headache, vomiting and generalized weakness
- Usually progresses to meningoencephalitis. May include meningeal signs, altered mental status, seizures, aphasia, paresis, movement disorders or cranial nerve palsies.

LABS

Common Findings on Routine Laboratory Tests

- Lymphocytic pleocytosis (neutrophils can predominate early)
- Normal or mildly elevated protein
- Normal glucose

Diagnostic Laboratory Criteria

- No commercially-available tests; testing available at CDC and the New York State Department of Health
- Measurement of virus-specific IgM antibodies in serum or cerebrospinal fluid (CSF)
- Cross-reaction with other flaviviruses (e.g., West Nile, dengue or St. Louis viruses) can occur.

- Plaque reduction neutralization tests should be performed to confirm the diagnosis.
- RT-PCR may detect viral RNA in acute CSF specimens or tissues, but the sensitivity is unknown and this method should not be used to rule out the diagnosis.

TREATMENT

No specific antiviral treatment for Powassan disease is available. Patients with suspected Powassan disease should receive supportive care as appropriate.

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ADDITIONAL RESOURCES

FOR MORE INFORMATION OR TO REPORT A CASE OF TICK-BORNE DISEASE

New York City Department of Health and Mental Hygiene

Visit nyc.gov/health (search “ticks” or “disease reporting”)

OTHER RESOURCES:

Continuing Medical Education for Clinicians

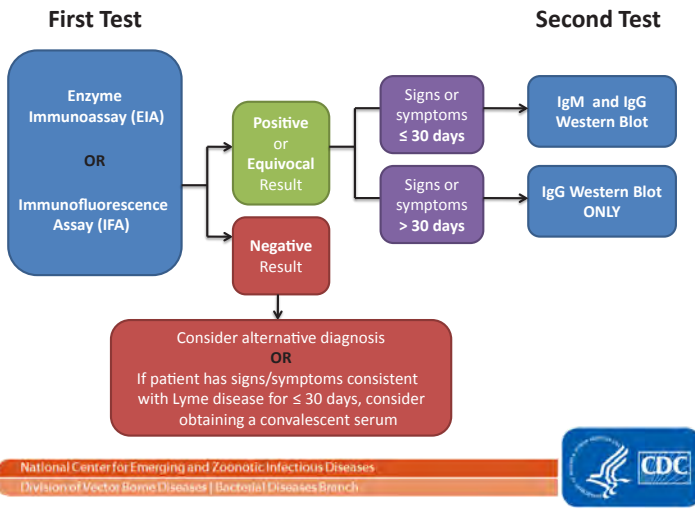
For live links go to: cdc.gov/lyme/healthcare

- The CDC offers a Clinician Outreach and Communication Activity (COCA) course to teach providers to properly identify and treat tick-borne diseases. (CME/CNE/CECH available): Little Bite, Big Disease: Recognizing and Managing Tickborne Illnesses.
- The CDC offers an online CME Case Study Course on the Clinical Assessment, Treatment and Prevention of Lyme Disease. This free, interactive course includes a series of instructional case studies. Each case is accredited for 0.25 CME credits, for a maximum of 1.5 CME. There is no cost for these credits.
- The National Association of School Nurses offers an online course titled “Tick-borne Illness: Prevention, Assessment and Care” that focuses on clinical care of tick-borne diseases in school and camp settings. CNE is available.

General Information

- **Centers for Disease Control and Prevention:**
cdc.gov (search “ticks”)
- **American Lyme Disease Foundation:**
aldf.com
- **American College of Physicians:**
smartmedicine.acponline.org (search “lyme disease”)
- **University of Rhode Island TickEncounter Resource Center:**
tickencounter.org
- **New York State Department of Health:**
health.ny.gov (search “ticks”)
- **National Institutes of Health:**
niaid.nih.gov (search “tickborne diseases”)

APPENDIX: TWO-TIERED TESTING FOR LYME DISEASE



Reprinted from Centers for Disease Control and Prevention. Two-step Laboratory Testing Process. cdc.gov/lyme/diagnosistesting/LabTest/TwoStep/index.html

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