



# City Health Information

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CHI goes paperless—  
see back for details

## PREVENTING AND MANAGING LYME AND OTHER TICK-BORNE DISEASES

- Advise patients to use tick checks, DEET, and showers to avoid tick bites; if a tick is attached, it should be removed promptly and safely.
- Ask patients with suggestive symptoms such as fever, headache, malaise, and/or rash about travel history, as most tick-borne infections are acquired outside of New York City.
- Follow recommended testing protocols, including repeat testing if indicated, because symptoms may be nonspecific and immune response is often delayed.

Lyme disease is the most commonly reported vector-borne disease in the United States (US). In New York City (NYC), there were 439 cases of Lyme disease as well as 57 of babesiosis, 36 of anaplasmosis, 12 of Rocky Mountain spotted fever (RMSF), and 4 of ehrlichiosis diagnosed in 2011. Most cases of tick-borne diseases, with the exception of Rocky Mountain spotted fever, are acquired outside NYC. In 2005-2007, 95% of infected patients had traveled to areas surrounding NYC, most commonly to upstate New York and Long Island, but also Connecticut, New Jersey, Massachusetts, and Pennsylvania. Tick-borne diseases can have serious consequences, and the only means of prevention are patient awareness, protective measures, and prompt detection and removal of ticks.

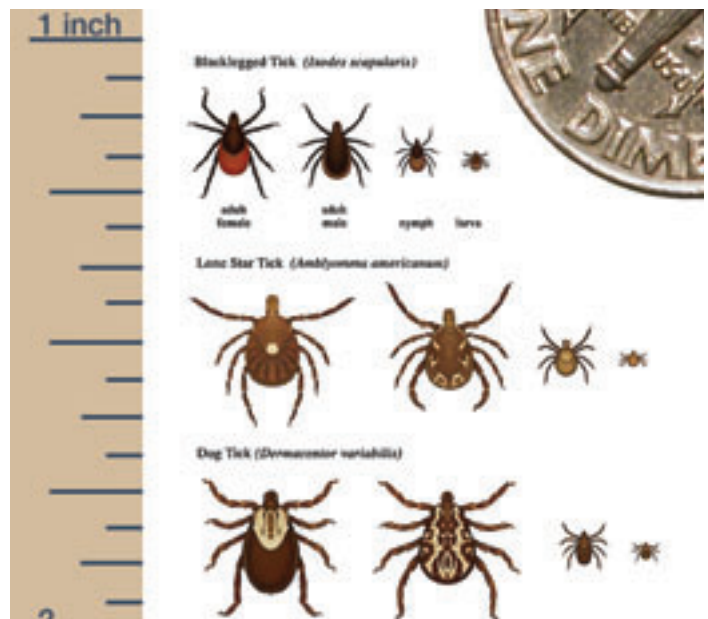
Differential diagnosis of tick-borne diseases may be challenging because of nonspecific signs and symptoms, delayed antibody responses to infection, and coinfection with other diseases. Primary care providers (PCPs) must understand the epidemiology and clinical features of these diseases to initiate prompt testing and treatment.

### NATURAL HISTORY

Most ticks go through 4 life stages: egg, 6-legged larva, 8-legged nymph, and adult, and must eat

blood at every stage after egg. Ticks will attach to a host (usually small mammals such as the white-footed mouse) and suck the blood slowly for several days. If the host has a bloodborne infection, the tick will ingest the pathogens with the blood. At the next feeding, the tick can potentially transmit the disease when attaching to a person, pet, or other animal.<sup>1,2</sup>

### VECTORS OF TICK-BORNE DISEASES IN NEW YORK CITY RESIDENTS



Source: Centers for Disease Control and Prevention.

## TICK SURVEILLANCE IN THE NYC AREA

The 3 types of hard tick that carry the diseases most commonly reported in New Yorkers are shown on page 17.<sup>1,3</sup>

**The American dog tick (*Dermacentor variabilis*),** which transmits the bacterium that causes RMSF (*Rickettsia rickettsii*), is abundant throughout the 5 NYC boroughs. Bites are most often from adult ticks.<sup>3</sup>

**The blacklegged tick or deer tick (*Ixodes scapularis*)** transmits bacteria that can cause Lyme disease (*Borrelia burgdorferi*) and anaplasmosis (*Anaplasma phagocytophilum*) and the intraerythrocytic parasite that causes babesiosis (*Babesia microti*). Most bites are from nymphs, which are typically the size of a poppy seed and are active between May and August.<sup>3</sup>

The blacklegged tick is prevalent on Long Island and in Westchester, upstate New York (particularly the lower Hudson Valley), New Jersey, Connecticut, Massachusetts, Pennsylvania, and Rhode Island. In both 2008 and 2009, there was a large increase in the number of blacklegged ticks collected in counties outside of NYC. In the Hudson Valley, infection rates in blacklegged ticks were 40% to 50% for *B. burgdorferi*, 1% to 3% for *B. microti*, and 7% to 15% for *A. phagocytophilum*.<sup>3</sup>

In recent years, very small numbers of blacklegged ticks have been found in Pelham Bay Park in the Bronx, Clay Pit Pond Park in Staten Island, Alley Pond and Highland Parks in Queens, Floyd Bennett Field in Brooklyn, and High Rock and Wolfe's Pond Parks in Staten Island. Approximately half of the ticks collected in 2009 and 2010 tested positive for *B. burgdorferi*.<sup>3</sup> The Health Department will continue to conduct surveillance to monitor the presence and range of ticks in NYC. For the most recent findings on ticks in NYC, visit the Health Department Web site at [www.nyc.gov/html/doh/html/ehs/ehstick.shtml](http://www.nyc.gov/html/doh/html/ehs/ehstick.shtml).

**The lone star tick (*Amblyomma americanum*),** which transmits the bacteria that can cause ehrlichiosis (primarily *Ehrlichia chaffeensis*, but also *E. ewingii*), is not common in NYC.<sup>3</sup> Bites are most often from adult ticks.<sup>3</sup>

**The brown dog tick (*Rhipicephalus sanguineus*)** is present throughout the United States. Recently, it has been associated with transmission of *Rickettsia rickettsii* in parts of the Southwestern US, but not elsewhere.<sup>4</sup>

## PREVENTION

Educate patients who visit, live, work, or travel in endemic areas on prevention of tick bites and tick-borne diseases (see **Box 1**) and on correct removal of an embedded tick (see **Box 2**) (**Resources**). Most infections result from an undetected tick; early detection and prompt

### BOX 1. WHAT TO TELL YOUR PATIENTS ABOUT PREVENTING TICK-BORNE DISEASES<sup>5-8</sup>

- Be aware of tick-infested areas where you live, work, or travel.
- Avoid grassy, wooded, or bushy areas and walk on cleared paths or in the center of trails.
- Keep grass cut and remove leaf litter, brush, and weeds around the home. Small amounts of acaricides (pesticides against ticks) applied at the right time of year reduce the number of ticks in the yard.
- Wear a hat and long-sleeved, light-colored shirt and long pants tucked into boots or socks when outdoors.
- For adults: Use insect repellent containing 20% or more DEET, avoiding face and hands; always follow product label instructions. In high-prevalence tick areas, product may need to be reapplied more frequently than for repelling mosquitoes.
- For children: Use repellent containing no more than 20% to 30% DEET. Parents should apply the repellent lightly to the child's skin, avoiding the eyes, hands, and mouth. Always follow product directions. Do not use DEET on children younger than 2 months old.
- Treat clothing and gear such as backpacks and tents with permethrin. Do not use permethrin on skin.
- Upon returning indoors, conduct a full-body check for ticks using a hand-held or full-length mirror. Parents should check children for ticks under arms, in and around ears, inside belly button, behind knees, between legs, around waist, and especially in hair.
- Bathe or shower as soon as possible after coming indoors (preferably within 2 hours) to wash off insect repellent and more easily find ticks.
- Speak with a veterinarian about tick preventive measures for pets.

removal reduce the chance of disease.<sup>5</sup> The interval between the tick's attachment and transmission of the infection is 24 hours or longer for Lyme disease, anaplasmosis, and babesiosis, and only 6 to 10 hours for RMSF.<sup>6</sup> For all diseases, the risk from an infected tick bite increases greatly the longer the tick is attached.<sup>7</sup> Advise patients to contact you or go immediately to the emergency department if they develop symptoms of fever, headache, confusion, weakness, paralysis, numbness, vomiting, or difficulty breathing in the days following a tick bite. Rocky Mountain spotted fever features a petechial rash (**Figure 1**) and is a medical emergency. Erythema migrans—a red ring-like or expanding rash (**Figure 2**)—is diagnostic for Lyme disease and should prompt the patient to seek medical attention, but it is not an emergency.

### BOX 2. FOR PATIENTS WHO HAVE FOUND A TICK ON THE SKIN<sup>7,9</sup>

- If the tick has not bitten you, promptly remove it using rubber gloves or tissue paper and discard it. Do not squeeze, crush, or puncture it as its body fluids may be infectious.
- If the tick is embedded, remove it carefully, using fine-tipped tweezers (see **Box 3**).
- Tumble clothes in dryer on high heat for an hour to kill any remaining ticks.
- Observe the area where the tick appeared for several days for a reaction to the bite such as a rash or signs of infection.
- Remove ticks from pets the same way you would remove a tick on a person. Protect yourself from potential exposures with gloves.
- Call a health care provider if you develop a rash or fever within several weeks of removing a tick. Tell the doctor when the bite occurred and where you most likely acquired the tick.

**FIGURE 1. PETECHIAL RASH – ROCKY MOUNTAIN SPOTTED FEVER**



**FIGURE 2. ERYTHEMA MIGRANS RASH – LYME DISEASE**



Source: Centers for Disease Control and Prevention. Public Health Image Library.

### DIAGNOSIS

The greatest challenges to the differential diagnosis of tick-borne diseases include nonspecific and variable signs and symptoms, such as chills, acute fever, headache, and myalgias, that mimic influenza or other viral illness; delayed antibody response to infected tick bites; and possible coinfection with other diseases.<sup>5,10</sup> A single tick bite can transmit multiple pathogens that may result in atypical presentations of tick-borne diseases.<sup>11</sup> Many tick bites are painless, and most people will not remember being bitten or notice the bite. Consider the patient's history and known signs and symptoms, which can be diverse in early and later stages and vary widely from person to person.

### BOX 3. HOW TO SAFELY REMOVE AN EMBEDDED TICK<sup>9</sup>

- Remove ticks on the skin as soon as possible. DO NOT use polish, petroleum jelly, or a hot match. DO NOT wait for the tick to detach.
- Use fine-tipped tweezers, if available; if not, use fingers shielded with tissue paper or rubber gloves.
- Grasp the mouthparts close to the skin and slowly pull tick straight out with steady outward pressure until it lets go.
- Do not squash, squeeze, twist, or jerk the tick during removal, as that may transmit disease.
- If the mouthparts become detached, remove them with clean tweezers; if this can't be done easily, leave the mouth alone and let skin heal.
- Thoroughly clean the bite area and hands with rubbing alcohol, iodine scrub, or soap and water.
- Clean and disinfect any instruments that touched the tick.



## Signs and Symptoms

**Lyme disease:** In the early localized stage (3 to 30 days postexposure), 70% to 80% of patients develop erythema migrans (see **Figure 2**), which is sufficient to diagnose Lyme disease and initiate treatment.<sup>10,12</sup> Erythema migrans is not always bull's-eye in appearance, but it does expand in size over time.<sup>12</sup>

Signs and symptoms of early disease also include fatigue, fever, chills, malaise, headache, myalgias, arthralgias, and lymphadenopathy.<sup>12</sup> Erythema migrans is easily distinguished from a minor allergic reaction to a tick or insect bite, which disappears in 1 to 2 days. Erythema migrans gradually expands over a period of several days and can reach up to 12 inches (30 cm) in diameter with areas of clearing near the center of the rash.<sup>12</sup> In people of color, erythema migrans can resemble a bruise.<sup>13</sup> Consider coinfection with babesiosis, anaplasmosis, or both in patients with more severe initial symptoms, especially high fever for more than 48 hours despite antibiotic therapy, or unexplained leukopenia, thrombocytopenia, or anemia after a tick bite in an endemic area, or in those with no improvement or worsening of systemic symptoms.<sup>5</sup> If Lyme disease is left untreated, other symptoms, such as additional erythema migrans (single or multiple lesions), Bell's palsy, meningitis, radiculopathy, carditis (usually AV heart block), and/or myocarditis, may appear days to weeks following exposure.<sup>13</sup> Late-stage (months to years postexposure) infections cause articular arthritis with swelling in large joints (especially the knees) affecting one to several joints, peripheral neuropathy, and, rarely, encephalopathy.<sup>5,13</sup>

About 10% to 20% of patients with Lyme disease have a phenomenon known as post-treatment Lyme disease syndrome (PTLDS), in which mild to moderate symptoms continue for months or years after treatment with antibiotics.<sup>14</sup> These symptoms, which can include muscle and joint pains, cognitive defects, sleep disturbance, or fatigue, may be caused by an autoimmune response. There is no evidence that PTLDS is caused by continuing infection. Extending antibiotic therapy past the recommended course is not helpful, and can be harmful for persons with PTLDS.<sup>14</sup> Patients may have heard or read about long-term antibiotic therapy for PTLDS. Reassure them that short-course antibiotic therapy is the recommended treatment for Lyme disease.<sup>15</sup>

**Babesiosis (incubation period 1 week to 4 weeks):** Signs and symptoms include fever, fatigue, arthralgia, chills, sweats, nonproductive cough, jaundice, and splenomegaly. Babesiosis can be asymptomatic in healthy adults and children. Adults aged  $\geq 50$  years and

immunocompromised people are at greatest risk for severe disease, which may include severe hemolytic anemia, respiratory distress, pulmonary edema, ecchymosis, petechiae, congestive heart failure, renal failure, and coma.<sup>5,16,17</sup> Transmission can also occur via blood transfusion. Consider babesiosis in patients who have received blood products in the preceding 3 months presenting with fever and hemolytic anemia; advise patients who test positive that they can never donate blood or blood products.<sup>16</sup>

**Anaplasmosis (incubation period 1 to 2 weeks):** Patients may experience chills, acute fever, headache, and myalgia. Less often seen are nausea, vomiting, diarrhea, cough, arthralgia, stiff neck, and confusion.<sup>10,18</sup> In immunosuppressed patients, severe symptoms can include respiratory insufficiency, toxic shock-like illness, rhabdomyolysis, and opportunistic infections.<sup>5,10,18</sup> Consider testing for ehrlichiosis as well as anaplasmosis because of the similarities in clinical presentation.

**Rocky Mountain spotted fever** is a severe infection.<sup>19</sup> Patients commonly require hospitalization, and up to 20% of untreated cases and 5% of treated cases have fatal outcomes.<sup>10</sup> Early stage (2 to 14 days after a tick bite) symptoms include sudden onset of fever, severe headache, myalgias, chills, malaise, cough, and gastrointestinal symptoms that mimic food-borne illness. A rash often begins within 2 to 5 days, initially as a maculopapular rash on the wrists, ankles, and arms, which then spreads inward to the trunk. The petechial rash (see **Figure 1**) usually appears on day 5 or 6, although rash may be completely absent in up to 20% of cases.<sup>19</sup> Long-term consequences of RMSF can include partial paralysis of the lower extremities, gangrene requiring amputation of digits or limbs, hearing loss, blindness, damage to vital organs, and neurologic deficits.<sup>10,18</sup> African American males are at higher risk for serious complications due to a genetic enzyme deficiency.<sup>10</sup>

**Ehrlichiosis (incubation period 7 to 10 days):** Symptoms include flu-like illness, severe headache, malaise, myalgias, gastrointestinal symptoms, cough, conjunctival injection, arthralgia, and confusion.<sup>10,20</sup> A maculopapular rash is present in up to 60% of children and less than 30% of adults. Later-stage symptoms include difficulty breathing or bleeding disorders. Immunosuppressed patients are at highest risk for hospitalization and death.<sup>20</sup>

## Diagnostic Tests

A complete blood cell count or a chemistry panel can be helpful (see **Table 1**) in diagnosing tick-borne infection. During the acute phase of illness, polymerase chain reaction (PCR) tests will confirm anaplasmosis,<sup>18</sup>

**TABLE 1. BRIEF GUIDE TO DIAGNOSING TICK-BORNE DISEASES<sup>5,10,21</sup>**

Disease	Common Findings on Routine Laboratory Tests	Diagnostic Findings	Notes
Transmitted by black-legged ticks ( <i>Ixodes scapularis</i> )			
<b>Lyme disease</b> ( <i>Borrelia burgdorferi</i> )	Elevated ESR, mildly elevated hepatic transaminases (in localized or early disseminated disease); with Lyme disease meningitis, CSF typically has a lymphocytic pleocytosis with slightly elevated protein levels and normal glucose levels	No testing needed if EM is present. Otherwise, do 2-step testing: positive or equivocal EIA test followed by a Western blot test. Patients tested 1 to 2 weeks after onset of illness may be negative due to an absence of detectable antibodies.	Rapid initiation of antibiotics may diminish the immune response. For patients with symptoms lasting >1 month, seroconversion to IgG antibodies is expected. For those patients who do not have an EM rash or with signs and symptoms lasting >1 month, make diagnosis based on laboratory tests in addition to symptomatology.
<b>Babesiosis</b> ( <i>Babesia microti</i> )	Decreased hematocrit, elevated reticulocyte counts, elevated ESR, thrombocytopenia, normal or mildly decreased WBC, decreased serum haptoglobin, elevated serum BUN and creatinine, mildly elevated hepatic transaminases, proteinuria, hemoglobinuria	Identification of <i>Babesia</i> parasites in a peripheral blood smear ( <b>preferred method</b> ), or positive PCR assay ( <b>preferred method</b> ), or serology using IFA may be helpful in patients with a low parasitemia.	Blood smear may be negative in infected patients; additional testing is necessary. Intraerythrocytic parasites may be confused with malarial parasites. Transfusion-associated transmission has been reported. Consider babesiosis in patients with febrile illnesses and/or hemolytic anemia who have received blood components in the preceding 3 months.
<b>Anaplasmosis</b> ( <i>Anaplasma phagocytophilum</i> )	Mild anemia, thrombocytopenia, leukopenia, modest elevations in hepatic transaminases	PCR assay during acute illness ( <b>preferred method</b> ), or 4-fold change in IgG-specific antibody titer by IFA in paired serum samples, or IHC staining of organism, or isolation of organism from a clinical specimen in cell culture	DNA testing is particularly important early in the course of illness while bacteria are still present and serologic testing may be negative due to an absence of detectable antibodies. Clinical signs of anaplasmosis and ehrlichiosis are similar. Consider testing for both species.
Transmitted by American dog ticks ( <i>Dermacentor variabilis</i> )			
<b>Rocky Mountain spotted fever</b> ( <i>Rickettsia rickettsii</i> )	Anemia, thrombocytopenia, mildly elevated hepatic transaminases, hyponatremia, azotemia	Four-fold change in IgG-specific antibody titer by IFA in paired serum samples ( <b>preferred method</b> ); 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 of tissue specimens (not reliable in blood samples)	Tests for IgM antibodies 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.
Transmitted by lone star ticks ( <i>Amblyomma americanum</i> )			
<b>Ehrlichiosis</b> ( <i>Ehrlichia chaffeensis</i> )	Thrombocytopenia, mild to moderate leukopenia, modest elevations in hepatic transaminases	PCR assay during acute illness ( <b>preferred method</b> ), or 4-fold change in IgG-specific antibody titer by IFA in paired serum samples, or IHC staining of organism, or isolation of organism from a clinical specimen in cell culture	DNA testing is particularly important early in the course of illness while bacteria are still present and serologic testing may be negative due to an absence of detectable antibodies. Clinical signs of anaplasmosis and ehrlichiosis are similar, and testing for both species is indicated.

BUN, blood urea nitrogen; CSF, cerebrospinal fluid; EIA, enzyme immunoassay; EM, erythema migrans; ESR, erythrocyte sedimentation rate; IFA, immunofluorescence assay; IgG, immunoglobulin G; IHC, immunohistochemistry; PCR, polymerase chain reaction; WBC, white blood cell.

See *Tick-borne Diseases in the New York City Area: A Physician's Reference Manual* at <http://www.nyc.gov/html/doh/html/ehs/ehstick.shtml> for detailed information.

**TABLE 2. TREATMENT OF TICK-BORNE INFECTIONS<sup>5,10</sup>**

Infection	Adults	Children	Comments
<b>Lyme disease<sup>a</sup></b>	Doxycycline <sup>b</sup> 100 mg BID × 10-21 days, OR Cefuroxime axetil 500 mg BID × 14-21 days, OR Amoxicillin 500 mg TID × 14-21 days	<u>Age &lt;8 years:</u> Amoxicillin 50 mg/kg/day in 3 divided doses × 14-21 days, OR Cefuroxime axetil 30 mg/kg/day in 2 divided doses × 14-21 days <u>Age ≥8 years:</u> Doxycycline 4 mg/kg/day in 2 divided doses × 10-21 days	Consider possible coinfection with <i>B. microti</i> and/or <i>A. phagocytophylum</i> in patients with especially severe or persistent symptoms despite treatment.
<b>Babesiosis<sup>c</sup></b>	Oral atovaquone 750 mg every 12 h × 7-10 days, AND oral azithromycin 500-1000 mg on day 1, and 250 mg orally QD thereafter, OR Clindamycin 300-600 mg every 6 h IV or 600 mg every 8 h orally AND oral quinine 650 mg every 6-8 h × 7-10 days	Atovaquone 20 mg/kg every 12 h AND oral azithromycin 10 mg/kg QD on day 1, 5 mg/kg QD thereafter, OR Clindamycin 7-10 mg/kg every 6-8 h IV or orally AND oral quinine 8 mg/kg every 8 h × 7-10 days	Consider possible coinfection with <i>B. burgdorferi</i> and/or <i>A. phagocytophylum</i> in patients with especially severe or persistent symptoms despite treatment.
<b>Anaplasmosis<sup>d</sup></b>	Doxycycline <sup>b</sup> 100 mg BID orally or IV × 10 days	<u>Age ≥8 years with moderate illness:</u> doxycycline 4 mg/kg/day orally or IV in 2 divided doses × 10 days <u>Age &lt;8 years with severe illness who are not coinfecting with Lyme disease:</u> doxycycline 4 mg/kg per day orally or IV in 2 divided doses × 4-5 days or approx. 3 days after resolution of fever and clinical improvement is noted <u>Age &lt;8 years with severe illness who are coinfecting with Lyme disease:</u> doxycycline 4 mg/kg/day orally or IV in 2 divided doses × 4-5 days. Follow with either amoxicillin 50 mg/kg/day in 3 divided doses OR cefuroxime axetil 30 mg/kg/day in 2 divided doses to complete a 14-day course of antibiotic therapy.	Failure to respond in 3 days suggests infection with a different agent or coinfection with <i>B. microti</i> .
<b>Ehrlichiosis</b>	Doxycycline <sup>b</sup> 100 mg BID orally or IV × 10 days	<u>Age ≥8 years:</u> doxycycline 4 mg/kg/day orally or IV in 2 divided doses × 10 days <u>Age &lt;8 years:</u> doxycycline 4 mg/kg/day orally or IV in 2 divided doses × 4-5 days OR approx. 3 days after resolution of fever and clinical improvement is noted	Failure to respond in 3 days suggests infection with a different agent.
<b>Rocky Mountain spotted fever</b>	Doxycycline <sup>b</sup> 100 mg/day BID orally or IV for at least 3 days after fever subsides and until evidence of clinical improvement (typically 5-7 days)	<u>Weight ≥100 lbs (45.5 kg):</u> doxycycline 100 mg/day BID orally or IV for at least 3 days after fever subsides and until evidence of clinical improvement (typically 5-7 days). Consult a pediatric infectious disease specialist. <u>Weight &lt;100 lbs (45.5 kg):</u> doxycycline 2.2 mg/kg body weight/dose BID orally or IV for at least 3 days after fever subsides and until evidence of clinical improvement (typically 5-7 days). Consult a pediatric infectious disease specialist.	If infection is suspected or petechial rash appears on palm or sole, treat immediately, without laboratory confirmation of diagnosis.

<sup>a</sup>For patients intolerant of amoxicillin, doxycycline, and cefuroxime axetil, the macrolides azithromycin, clarithromycin, or erythromycin may be used and the patient should be closely observed to ensure resolution of clinical manifestations. For treatment of later-stage Lyme disease, see Infectious Diseases Society of America Guidelines at <http://cid.oxfordjournals.org/content/43/9/1089.long>.

<sup>b</sup>Doxycycline is the drug of choice in adults and children for anaplasmosis, ehrlichiosis, RMSF, and in most cases of Lyme disease. Limited courses of doxycycline do not result in tooth staining in children. While tetracyclines are usually contraindicated for use in pregnancy, they may be warranted for life-threatening situations with a high clinical suspicion or documentation of anaplasmosis, ehrlichiosis, or RMSF.

<sup>c</sup>Immunocompromised patients: azithromycin 600-1000 mg/day.

<sup>d</sup>Patients with mild illness for whom doxycycline treatment is contraindicated may be treated with rifampin for 7-10 days at a dosage of 300 mg BID orally for adults and 10 mg/kg BID for children (maximum, 300 mg per dose).

See *Tick-borne Diseases in the New York City Area: A Physician's Reference Manual* at [www.nyc.gov/html/doh/html/ehs/ehstick.shtml](http://www.nyc.gov/html/doh/html/ehs/ehstick.shtml) for detailed information.

(Continued from page 20)

ehrlichiosis,<sup>20</sup> and babesiosis,<sup>5</sup> but not RMSF<sup>10</sup> or Lyme disease.<sup>12</sup> This method is most sensitive in the first week of illness (and for the duration of the infection with babesiosis), and rapidly decreases in sensitivity following the administration of appropriate treatment. Treatment should not be withheld due to a pending or negative result, which does not completely rule out the diagnosis.

A blood smear may reveal morulae in the cytoplasm of infected leukocytes with anaplasmosis and ehrlichiosis, or intraerythrocytic parasites with babesiosis.<sup>21</sup> Paired-serum serologic testing using indirect immunofluorescence assay (IFA) to diagnose anaplasmosis, ehrlichiosis, and RMSF should be performed on a sample taken soon after the onset of illness and a second sample taken 2 to 4 weeks later.<sup>21</sup> Often the initial IgG IFA titer is low, or “negative,” and the second shows at least a 4-fold increase in IgG antibody levels. IgM antibodies usually rise at the same time as IgG and remain elevated for months or longer; they are less specific and may result in a false-positive result.

Serologic testing for Lyme disease should follow a 2-step approach. The first step uses an enzyme immunoassay (EIA), and if negative, no further testing is recommended. If the result is positive or equivocal, a Western blot (Wb) should be done. Results are considered positive only if the EIA and Wb are both positive.<sup>12,21</sup> Most patients become seropositive within 8 to 12 days of onset of illness, and, therefore, may test negative in the first 1 to 2 weeks following infection. For patients who do not have an erythema migrans rash or who have had signs and symptoms for >1 month, diagnosis should be based on laboratory tests in addition to symptomatology. Patients

who have been ill for 1 month or longer (months to years) should test IgG positive by Wb. If such patients are IgG negative, they probably do not have Lyme disease.<sup>12,21</sup> See *Tick-borne Diseases in the New York City Area: A Physician's Reference Manual* for detailed information. Laboratory findings and common tests are given in **Table 1**.

## TREATMENT

Treatment is more likely to be effective if started early in the course of disease. For most tick-borne diseases, diagnostic tests based on the detection of antibodies will frequently appear negative in the first 7 to 10 days of illness, so prompt treatment must be based on clinical suspicion alone. Begin treatment (see **Table 2**) at clinical diagnosis for all tick-borne diseases except babesiosis, which should be confirmed by evidence of active parasitemia.<sup>5</sup> See *Tick-borne Diseases in the New York City Area: A Physician's Reference Manual* for detailed information.

## SUMMARY

Providers should become familiar with the epidemiology, diagnostic challenges, and treatment of the tick-borne diseases their patients are most likely to acquire. Primary care providers should educate patients about simple measures they can take to prevent tick bites and tick-borne diseases, and what to do if they are bitten or have concerning symptoms. Presumptive diagnosis should be based on local patterns of disease, history, symptomatology, and testing according to recommended protocols. Treatment in most cases should begin pending confirmatory laboratory testing. ♦

## RESOURCES

### For Providers

- Centers for Disease Control and Prevention: Diagnosis and management of tickborne rickettsial diseases: Rocky Mountain spotted fever, ehrlichioses, and anaplasmosis: [www.cdc.gov/mmwr/PDF/rr/rr5504.pdf](http://www.cdc.gov/mmwr/PDF/rr/rr5504.pdf)  
Workplace Safety & Health Topics. Tick-borne diseases: [www.cdc.gov/niosh/topics/tick-borne](http://www.cdc.gov/niosh/topics/tick-borne)
- New York City Department of Health and Mental Hygiene: *Tick-borne Diseases in the New York City Area: A Physician's Reference Manual*: <http://www.nyc.gov/html/doh/html/ehs/ehstick.shtml>
- Infectious Diseases Society of America treatment guidelines for Lyme disease, human granulocytic anaplasmosis, and babesiosis: [www.nyc.gov/html/doh/downloads/pdf/zoo/idsa\\_guidelines.pdf](http://www.nyc.gov/html/doh/downloads/pdf/zoo/idsa_guidelines.pdf)
- New York City Department of Health and Mental Hygiene: Compendiums and diagnostic and treatment guidelines. Tick-borne diseases: [www.nyc.gov/html/doh/html/zoo/zoo-compend.shtml](http://www.nyc.gov/html/doh/html/zoo/zoo-compend.shtml)  
DOHMH Advisory #10: Tick-borne disease advisory, June 16, 2011: [www.nyc.gov/html/doh/downloads/pdf/cd/2011/11md10.pdf](http://www.nyc.gov/html/doh/downloads/pdf/cd/2011/11md10.pdf)  
Environmental Health. Ticks and tick bite prevention: [www.nyc.gov/html/doh/html/ehs/ehstick.shtml](http://www.nyc.gov/html/doh/html/ehs/ehstick.shtml)

### For Patients

- American Academy of Pediatrics. Summer safety tips—staying safe outdoors: [www.healthychildren.org/English/news/Pages/Summer-Safety-Tips-Staying-Safe-Outdoors.aspx](http://www.healthychildren.org/English/news/Pages/Summer-Safety-Tips-Staying-Safe-Outdoors.aspx)
- Centers for Disease Control and Prevention. Ticks (all 5 tick-borne diseases): [www.cdc.gov/ticks](http://www.cdc.gov/ticks)
- New York City Department of Health and Mental Hygiene. Environmental Health. Ticks: <http://home2.nyc.gov/html/doh/html/ehs/ehstick.shtml>  
“How to prevent tick bites” brochure (English and Spanish): [www.nyc.gov/html/doh/downloads/pdf/zoo/zoo-preventing-tick-bites.pdf](http://www.nyc.gov/html/doh/downloads/pdf/zoo/zoo-preventing-tick-bites.pdf) or call 311 to order copies
- New York State Department of Health. Health advisory: tick and insect repellents: [www.health.ny.gov/publications/2737](http://www.health.ny.gov/publications/2737)  
Information on ticks and Lyme disease (English and Spanish) and other tick-borne diseases: [www.health.ny.gov/diseases/communicable/lyme](http://www.health.ny.gov/diseases/communicable/lyme)
- University of Rhode Island. Tick Encounter. Information on preventing tick-borne disease, tick removal (video), local tick activity: [www.tickencounter.org](http://www.tickencounter.org)



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