

TICK-BORNE DISEASE

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The following is a synopsis of the most important tick-borne diseases in the U.S, some information on signs and symptoms and a few comments on the geographic distribution of the diseases and infection risk in Louisiana. Also, several tips on avoiding infection with tick-borne diseases are included.

- **Lyme Disease:** This illness is transmitted to human hosts from mice and deer through the bite of *Ixodes scapularis* and *Ixodes pacificus* ticks. *Ixodes scapularis* ticks are found in Louisiana. Within seven to ten days after the tick bite, victims may experience a rash at the bite site. This rash may appear with a central area of clearing and is referred to as erythema migrans. Other associated symptoms are flu-like illness, headache and joint pain. If untreated, generalized neurologic, cardiac, skin and joint problems may occur weeks later. Long-term difficulties with fatigue, joint pain and neurologic deficits have also been reported. (Browne BJ; Edwards B; Rogers RL. Dermatologic emergencies. *Prim Care* 2006; 33(3): 685-95, vi)

From 1992 to 2006, 248,074 cases of Lyme disease were reported from the United States and its territories, making Lyme disease the most commonly reported vector-borne illness in the U.S. Ninety-three percent of the cases were reported from Connecticut, Delaware, Massachusetts, Maryland, Minnesota, New Jersey, New York, Pennsylvania, Rhode Island and Wisconsin. More than 65% of patients report an illness onset in the months of June and July. (Bacon RM, Kugeler KJ, Mead PS. Surveillance for Lyme disease--United States, 1992-2006. *MMWR Surveill Summ* 2008; 57(10): 1-9.)

Approximately five to ten “confirmed cases” of Lyme disease are reported each year from Louisiana. Therefore Louisiana is not considered a high risk area. Several anecdotal reports of cases are received by the Infectious Disease Epidemiology Section, Office of Public Health, Louisiana Department of Health and Hospitals (OPH), however, none fulfill the Centers for Disease Control and Prevention (CDC) requirements for diagnosis. (OPH, Reportable Disease Database, 2007)

- **Human Monocytic Ehrlichiosis:** (HME) is a tick-borne rickettsial disease caused an organism referred to as *Ehrlichia chaffeensis*. Most cases are likely asymptomatic and result in very little to no illness. When illness does occur symptoms range from fever, headache, muscle ache, rash, nausea and/or vomiting to more severe symptoms such as altered mental status, lymph node swelling and clotting abnormalities. The disease may cause several laboratory abnormalities, indicating involvement of several organs. Most cases are reported from Missouri, Kentucky, Tennessee, North Carolina, Arkansas, Georgia, Maryland and Oklahoma. Cases are most frequently reported from April to September, a time of elevated tick activity.

(Schutze GE, Buckingham SC, Marshall GS, Woods CR, Jackson MA, Patterson LE, Jacobs RF. Human monocytic ehrlichiosis in children. *Pediatr Infect Dis J* 2007; 26(6): 475-9.) (Schutze GE. Ehrlichiosis. *Pediatr Infect Dis J* 2006; 25(1): 71-2.) The primary vectors of HME are the Lone Star tick, *Amblyomma americanum* and the American dog tick, *Dermacentor variabilis*.

This disease may be underreported. Serosurveys indicate that many children in areas that harbor these tick species do have antibodies to this organism, indicating exposure. (Schutze GE. Ehrlichiosis. *Pediatr Infect Dis J* 2006; 25(1): 71-2.). Since both tick species are found in Louisiana, one can conclude that there is risk of being infected with this organism, although illness is uncommon. (Anderson JF, Magnarelli LA. Biology of ticks. *Infect Dis Clin N Am* 2008; 22: 195-215.)

- **Human Granulocytic Anaplasmosis:** (HGA) was once referred to as Human granulocytic ehrlichiosis. The causative agent is another rickettsial organism, *Anaplasma phagocytophilum*. The disease is characterized by fever, chills, headache, muscle soreness, joint pain, fatigue, lack of appetite and/or low white blood count and other laboratory abnormalities, as with HME. The presence of a rash is not a consistent finding and the disease is generally milder than HME, although the conditions are, in essence, indistinguishable. HGA is also reported primarily from April to September. The deer tick, *Ixodes scapularis*, also a vector of Lyme disease and babesiosis, is the primary vector. (Schutze GE. Ehrlichiosis. *Pediatr Infect Dis J* 2006; 25(1): 71-2.) (Dandache P, Nadelman RB. Erythema migrans. *Infect Dis Clin North Am* 2008; 22(2): 235-60, vi.) (Botelho-Nevers E, Raoult D. Fever of unknown origin due to rickettsioses. *Infect Dis Clin North Am* 2007; 21(4): 997-1011, ix.) (Young CC, Niedfeldt MW, Gottschlich LM, Peterson CS, Gammons MR. Infectious disease and the extreme sport athlete. *Clin Sports Med* 2007; 26(3): 473-87.)

HGA is reported primarily from the upper Midwest and northeastern United States, therefore risk of infection in Louisiana is minimal. (Young CC, Niedfeldt MW, Gottschlich LM, Peterson CS, Gammons MR. Infectious disease and the extreme sport athlete. *Clin Sports Med* 2007; 26(3): 473-87.)

- **Colorado Tick Fever:** This disease is caused by a virus, Coltivirus (Reovirus). The wood tick, *Dermacentor andersoni*, is identified as the tick responsible for transmission to humans, however several other species of ticks have been found to be infected with the virus and likely play a role in the maintenance of the disease in nature. The wildlife reservoirs include the squirrel, chipmunk, porcupine, deer mouse and bushy tailed wood rat. Two hundred to 400 cases are reported annually, however this number is likely under-reported.

Symptoms of infection include fever and chills, headache, muscle ache, stiff neck, light intolerance, fatigue, weakness and in some cases, a macular, maculopapular or petechial rash (rash in 5%-15% of cases). More severe symptoms such as pharyngitis, nausea/vomiting, abdominal pain, spleen enlargement and diarrhea have been reported; neurologic manifestations are reported even more infrequently. Death from the disease is very rare. Most cases are reported from May to July.

The geographic distribution of the disease corresponds to the range of the wood tick, a topographic distribution in an area including the Rocky Mountains and Black Hills at elevations of 4000 to 10,000 feet. The risk of acquiring this disease in Louisiana is essentially zero.

(Romero JR; Simonsen KA. Powassan encephalitis and Colorado tick fever. *Infect Dis Clin North Am* 2008; 22(3): 545-59.)

- **Powassan:** This disease is caused by a type of virus known as a flavivirus, a member of the same viral family that causes West Nile disease. There are two distinct lineages of Powassan virus that coexist in North America, classical Powassan and “Deer Tick virus”. Most of these infections are symptomatic or result in mild symptoms. More severe neuroinvasive symptoms are encephalitis, meningoencephalitis and less commonly, meningitis; however, less than 40 cases of Powassan neuroinvasive disease have ever been recorded. The prototypical Powassan virus is maintained most frequently in groundhogs with the most common tick vector being *Ixodes cookei*. The “Deer Tick virus” is maintained primarily in the white-footed mouse and is transmitted primarily by *Ixodes scapularis*. There are, however, at least two other *Ixodes* species (*I. marxi* and *I. spinipalpus*), and the *Dermacentor andersoni* tick that are also capable of transmission. In addition, 38 mammalian species have been infected, with the American red squirrel (*Tamiasciurus hudsonicus*) serving as an additional capable reservoir.

Infection is usually seasonal, most commonly in the summer and fall. Evidence of infection with Powassan virus has been found in several areas of North America (Alberta, British Columbia, New Brunswick, Nova Scotia, Ontario, Quebec, California, Connecticut, Maine, Massachusetts, New York, South Dakota, Vermont, West Virginia, Wisconsin and Sonora in Mexico).(Romero JR; Simonsen KA. Powassan encephalitis and Colorado tick fever. *Infect Dis Clin North Am* 2008; 22(3): 545-59). Although the disease has never been identified in Louisiana, the widespread occurrence of infection and apparent existence of several capable reservoirs indicates a possibility that the disease might occur. However, one must remember that this disease remains rarely diagnosed.

- **Babesiosis:** The causative agent, most commonly *Babesia microti* (*B. duncani* – northern California and Washington; *B. divergens* – Missouri, Kentucky and Washington), of this disease is a protozoan from the same phylum as the causative agents of malaria, toxoplasmosis and cryptosporidiosis. *Babesia* species have long been implicated in diseases of domestic animals, but in the past 50 years these organisms have been increasingly identified as causes of human disease.

Three distinct clinical syndromes have been observed in humans: mild to moderate flu-like disease that can persist for several weeks, severe disease in the immunosuppressed or elderly and asymptomatic infection. Severe complications of babesiosis include acute respiratory failure, congestive heart failure, liver and renal failure, splenic infarction and disseminated intravascular coagulation. This organism is transmitted by the same tick vector, *Ixodes scapularis* and the same reservoir hosts as Lyme disease. Although babesiosis is less common and is less commonly found in ticks and rodents than the Lyme disease organism (*Borrelia burgdorferi*), incidence may be increasing.

Areas of greatest risk in the United States are the same as areas of greatest risk for Lyme disease. Cases are rarely reported in areas outside of the Northeast and Midwest, but a slight possibility of infections cannot be totally discounted in Louisiana. Human babesiosis has also been reported from other parts of the world.(Vannier E; Gewurz BE; Krause PJ. Human babesiosis. *Infect Dis Clin North Am* 2008; 22(3): 469-88)

- **Tularemia:** The symptoms of this disease vary widely. Some people do not have any symptoms, but this disease also can be severe, causing septic shock and death. Common symptoms include fever, chills, headache and a general sick feeling (malaise). Many people also develop a single, red ulcerated lump with a central scab and tender, swollen lymph nodes in the area. A small number of patients develop pneumonia. This disease does exist in Louisiana wildlife and has been isolated from ticks in Louisiana. Therefore there is a risk of acquiring tularemia in Louisiana.
- **Rocky Mountain Spotted Fever (RMSF):** Symptoms include fever, headache, a spotted rash on wrists and ankles and a patchy rash on arms and legs. Muscle aches (myalgia), nausea, vomiting and abdominal pain are also common. It is now recognized that this disease is broadly distributed throughout the continental United States, as well as southern Canada, Central America, Mexico and parts of South America. Between 1981 and 1996, this disease was reported from every U.S. state except Hawaii, Vermont, Maine, and Alaska. Therefore there is risk, although small, of being infected with RMSF in Louisiana.

Limiting exposure to ticks is the most effective way to reduce the likelihood of acquiring a tick-borne disease. In persons exposed to tick-infested habitats, prompt careful inspection and removal of crawling or attached ticks is an important method of preventing disease. It may take several hours of attachment before organisms are transmitted from the tick to the host. It is unreasonable to assume that a person can completely eliminate activities that may result in tick exposure. Therefore, prevention measures should be aimed at personal protection:

- Wear light-colored clothing to allow you to see ticks that are crawling on your clothing.
- Tuck your pants legs into your socks so that ticks cannot crawl up the inside of your pants legs.
- Apply repellants to discourage tick attachment. Repellents containing permethrin can be sprayed on boots and clothing, and will last for several days. Repellents containing DEET (n, n-diethyl-m-toluamide) can be applied to the skin, but will last only a few hours before reapplication is necessary. Use DEET with caution on children. Application of large amounts of DEET on children has been associated with adverse reactions.
- Conduct a body check upon return from potentially tick-infested areas by searching your entire body for ticks. Use a hand-held or full-length mirror to view all parts of your body. Remove any tick you find on your body. Parents should check their children for ticks, especially in the hair, when returning from potentially tick-infested areas. Additionally, ticks may be carried into the household on clothing and pets. Both should be examined carefully.
- To remove attached ticks, use the following procedure: 1. Use fine-tipped tweezers or shield your fingers with a tissue, paper towel, or rubber gloves. When possible, persons should avoid removing ticks with bare hands. 2. Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. (If this happens, remove mouthparts with tweezers.)(Schutze GE, 2006).

Disease Agent	Vector/Host	Distribution	Incubation Period	Symptoms	General Laboratory Findings	Lab Tests	Treatment
Lyme Disease <i>Borrelia burgdorferi</i>	<i>Ixodes scapularis</i> (Black-legged tick) – widely distributed in the northeastern and upper Midwestern US. <i>Ixodes pacificus</i> (Western Blacklegged tick) – relatively low infection rates, found along the Pacific coast, particularly northern California.	<p>Lyme disease is most frequently reported from the upper Midwestern and northeastern US. Cases have been reported in northern California, Oregon, and Washington.</p> <p>In 2013, 95% of Lyme disease cases were reported from 14 states: Connecticut, Delaware, Maine, Maryland, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, and Wisconsin.</p>	3-30 days	<p>Localized stage: Erythema migrans (EM) - red “bulls-eye” ring or homogenous expanding rash; this will not be present in all cases. Flu-like symptoms, such as malaise, headache, fever, myalgia, arthralgia, and lymphadenopathy.</p> <p>Disseminated state: multiple secondary rashes, flu-like symptoms, and lymphadenopathy. May be rheumatologic manifestations, such as transient migratory arthritis and effusion in joints, migratory pain in tendons, bursae, muscle, and bones, Baker’s cyst. May also have cardiac manifestations, such as conduction abnormalities, myocarditis, and pericarditis. Neurologic manifestations may occur, including: Bell’s palsy or other cranial neuropathy, meningitis, motor and sensory radiculoneuropathy, mononeuritis multiplex, subtle cognitive difficulties. More rarely, encephalitis, encephalomyelitis, subtle encephalopathy, and pseudotumor cerebri may occur. Additional manifestations that may occur include conjunctivitis, keratitis, uveitis, mild hepatitis, and splenomegaly.</p>	<p>Elevated erythrocyte sedimentation rate, mildly elevated hepatic transaminases, microscopic hematuria or proteinuria.</p> <p>In Lyme meningitis, CSF typically shows lymphocytic pleocytosis, slightly elevated protein, and normal glucose.</p>	<p>Demonstration of diagnostic IgM or IgG antibodies in serum. A two-tiered testing protocol is used- EIA or IFA should be performed first; if positive or equivocal it is followed by a Western blot. May also isolate organism from a clinical specimen. In suspected Lyme meningitis, testing for intrathecal IgM or IgG antibodies may be helpful.</p> <p>Serologic tests are usually not sensitive during the localized stage, but are sensitive during the disseminated stage. In persons with illness lasting longer than a month, only IgG tests should be performed. IgM tests alone cannot diagnose current disease. A single positive serologic test results cannot distinguish between active and past infection. Serologic tests should not be used to measure treatment response.</p>	<p>Treatment for localized Lyme disease in adults should be treated with Doxycycline, Cefuroxime axetil, Amoxicillin for 14-21 days. For children, Amoxicillin, Doxycycline, or Cefuroxime axetil may be used. For patients intolerant of these drugs, azithromycin, clarithromycin, or erythromycin may be used, although they have lower efficacy. Patients treated with macrolides should be closely observed.</p> <p>Patients with disseminated disease will require different and more complex treatment.</p> <p>An infectious disease specialist should be consulted for most current treatment guidelines or for individual patient decisions.</p>
Human Monocytic Ehrlichiosis <i>Ehrlichia chafeensis</i> ,	<i>Amblyomma americanum</i> (Lone Star Tick) is associated with <i>E.</i>	Most frequently reported from southeastern and south-central	1-2 weeks	Fever, headache, chills, malaise, muscle pain, nausea, vomiting, diarrhea, anorexia, confusion, conjunctival injection, and rash (more common-	Anemia (in late illness), leukopenia (absolute), mild to moderate elevations in hepatic transami-	Demonstration of a four-fold change in IgG-specific antibody titer by IFA in paired serum samples, or by	Doxycycline for 10-14 days (provides appropriate therapy for possible co-infection with Lyme disease). Clinical suspicion of this disease is

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<i>Ehrlichia ewingii</i> , <i>Ehrlichia muris-like</i> (EML)	<i>chafeensis</i> and <i>E. ewingii</i> . Since 2009, a new EML was identified as a new <i>Ehrlichia</i> species primarily identified in the Upper Midwest, but the tick responsible is unknown.	US, from eastern seaboard to Texas. 35% of all infections have occurred in Oklahoma, Missouri, and Arkansas.		ly reported among children).	nases. Morulae may be detected in about 20% of patients.	detection of DNA by PCR on whole blood. This method is most sensitive within the first week of illness.	sufficient to begin treatment, as delay in treatment may result in severe illness and/or death. Use of antibiotics other than doxycycline increases risk of patient death. At the recommended dose and duration, there is no evidence of staining of permanent teeth.
Human Granulocytic Anaplasmosis (formerly known as Human Granulocytic Ehrlichiosis) <i>Anaplasma phagocytophilum</i>	<i>Ixodes scapularis</i> (Blacklegged tick), and <i>Ixodes pacificus</i> (Western Blacklegged tick)	Upper Midwest and Northeastern US; corresponds with geographic distribution of Lyme disease.	1-2 weeks	Fever, shaking, chills, severe headache, malaise, myalgia, nausea, vomiting, diarrhea, anorexia, cough, rash seen in rare cases	Mild anemia, thrombocytopenia, leukopenia (characterized by relative and absolute lymphopenia and a left shift), mild to moderate elevations in hepatic transaminases may occur in some patients. Visualization of morulae in the cytoplasm of granulocytes during examination of blood smears is suggestive of a diagnosis, but is insensitive and should not be relied upon to rule out anaplasmosis.	Demonstration of a 4 fold change in IgG-specific antibody titer by IFA test in paired serum samples or detection of DNA by PCR; this method is most sensitive within the first week of illness.	Doxycycline for 10-14 days (provides appropriate therapy for possible co-infection with Lyme disease). Clinical suspicion of this disease is sufficient to begin treatment, as delay in treatment may result in severe illness and/or death. Use of antibiotics other than doxycycline increases risk of patient death. At the recommended dose and duration, there is no evidence of staining of permanent teeth.
Colorado Tick Fever Colorado tick fever virus	<i>Dermacentor andersoni</i> (Rocky Mountain Wood tick) – feeds primarily on large mammals.	Western US and Southwestern Canada at elevations 4,000-10,000 feet. Primarily occurs in Colorado, Utah,	1-14 days	Fever, chills, headache, myalgias, and lethargy. About 50% of patients have a biphasic illness with symptoms remitting after 2-4 days, but then recurring 1-3 days later. May also have conjunctival injection, pharyngeal erythema and lymphadenopathy. About 20%	Leukopenia, moderate thrombocytopenia.	Culture and RT-PCR during first 2 weeks of illness. Serologic assays (IgM- capture EIA, IFA, and plaque-reduction neutralization) on convalescent samples. IgM antibodies do not usually ap-	No specific antiviral treatment is available. Supportive care should be provided as appropriate. Patients with confirmed CTF should defer blood and bone marrow donation for at least 6 months after recovery.

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		Montana, and Wyoming. Rarely transmitted via blood transfusion.		of patients have a maculopapular or petechial rash. In adults, a prolonged convalescence with weakness and fatigue is common. Life-threatening complications and death are rare, and generally occur in children.		pear until after 14-21 days after illness onset.	
Tickborne Relapsing Fever \ <i>Borrelia hermsii</i> and other subpopulations	<i>Ornithoros</i> spp (soft tick). Feed on rodents; humans typically encounter them in rodent-infested cabins.	Found mainly in western states. Most cases occur in summer when people vacation and sleep in rodent-infested cabins. However, it can also occur in winter when fires warming cabins reactivate ticks resting in walls and woodwork.	About 7 days, recurring episodes that last about 3 days and are separated by about a week.	Headache, myalgia, chills, nausea, vomiting, arthralgia.	Normal to increased white blood cell count with a left shift, mildly increased serum bilirubin, mild to moderate thrombocytopenia, elevated erythrocyte sedimentation rate, slightly prolonged prothrombin time and partial thromboplastin time	Observation of <i>Borrelia</i> spirochetes in smears of peripheral blood, bone marrow, or CSF (best detected when patient is febrile). Serologic testing is not standardized.	Tetracycline is preferred for adults. If tetracyclines are contraindicated, erythromycin can be used. For CNS involvement, ceftriaxone can be used. All patients should be observed in the first 4 hours of antibiotic therapy for a Jarisch-Herxheimer reaction. Acute respiratory distress requiring intubation has occurred in several patients undergoing TBRF treatment.
Powassan Virus	3 main enzootic cycles occur: <i>Ixodes cookei</i> and woodchucks, <i>Ixodes marxi</i> and squirrels, and <i>Ixodes scapularis</i> and white-footed mice. <i>Ixodes cookei</i> and <i>Ixodes marxi</i> rarely bite humans. <i>Ixodes</i>	United States, Canada, Russian. In the US, cases have been primarily from Northeastern states and the Great Lakes region. There have been approximately 60 cases in the US in the last 10 years.	1-4 weeks	Fever, headache, vomiting, and generalized weakness. Usually progresses to meningoencephalitis, which may include altered mental status, seizure, aphasia, paresis, movement disorder, or cranial nerve palsy.	CSF findings may include lymphocytic pleocytosis, normal or mildly elevated protein, and normal glucose	Testing available at CDC and state health departments. Measures IgM antibodies in CSF or serum. May cross-react with other flaviviruses. RT-PCR may be able to detect viral RNA in CSF specimens, but sensitivity is unknown.	No specific treatment available- supportive care as needed.

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	<p><i>scapularis</i> often bite humans. There are two types of Powassan virus in the United States. The first type, often called lineage 1 POW virus, appears to be associated with <i>Ixodes cookei</i> or <i>Ixodes marxi</i> ticks. The other type, lineage 2 POW virus is sometimes called Deer tick virus, and is associated with <i>Ixodes scapularis</i> ticks. Both lineages have been linked to human disease.</p>						
<p>Babesiosis <i>Babesia microti</i> and other <i>Babesia</i> species</p>	<p><i>Ixodes scapularis</i> (Black-legged tick) - transmission is also possible via blood transfusion or congenitally.</p>	<p>Northeastern and upper Midwestern US, where <i>Babesia microti</i> is endemic. Sporadic transmission through other <i>Babesia</i> species has been</p>	<p>1-9+ weeks</p>	<p>Fever, chills, sweat, malaise, fatigue, myalgia, arthralgia, headache, anorexia, nausea, dark urine. Less common symptoms, but which may occur, are: abdominal pain, vomiting, cough, sore throat, emotional lability, depression, photophobia, conjunctival injection, mild splenomegaly, mild hepatomegaly, jaundice</p>	<p>Decreased hematocrit due to hemolytic anemia, thrombocytopenia, elevated serum creatinine and blood urea nitrogen values, mildly elevated hepatic transaminase values</p>	<p>Identification of <i>Babesia</i> parasites by light-microscopic examination of peripheral blood smear, or positive identification of <i>Babesia</i> through PCR analysis, or isolation of <i>Babesia</i> parasites from a whole blood specimen by</p>	<p><i>Babesia</i> infection can range from asymptomatic to life threatening. Treatment decisions should take into account the patient's age, clinical status, immunocompetence, splenic function, pregnancy status, and allergies. Patients showing symptoms are treated for 7-10 days with a combination</p>

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		documented in other US regions.				animal inoculation. Supportive laboratory evidence: demonstration of a <i>Babesia</i> antibody titer by IFA for IgG.	of two medications – either atovaquone plus azithromycin, or clindamycin plus quinine (normally used in more severe patients). Most persons without clinical manifestations do not require treatment.
Tularemia <i>Francisella tularensis</i>	<i>Derma-center variabilis</i> (American dog tick), <i>Derma-center variabilis</i> (Wood tick), and <i>Derma-center andersoni</i> (Rocky Mountain wood tick) – feeds primarily on large mammals.	Across the US. It is also possible to contract Tularemia through inhalation and direct inoculation. Concern over direct inhalation makes Tularemia a bioterrorism concern.	Typically 3-5 days, but ranges 1-21 days	Clinical presentation of tularemia will depend on a number of factors, including portal of entry. Typically includes fever, chills, headache, malaise, fatigue, anorexia, myalgia, chest discomfort, cough, sore throat, vomiting, diarrhea, abdominal pain, Glandular symptoms that may occur: ulcer at infection site, localized lymphadenopathy. Oculoglandular symptoms: photophobia, excessive lacrimation, conjunctivitis, preauricular, submandibular and cervical lymphadenopathy. Oropharyngeal symptoms may include: severe throat pain, cervical, parotid, and/or retropharyngeal lymphadenopathy. Pneumonic symptoms may include: non-productive cough, substernal tightness, pleuritic chest pain, hilar adenopathy, infiltrate, or pleural effusion may be present on chest X-ray.	Leukocyte count and sedimentation rate may be normal or elevated, thrombocytopenia, hyponatremia, elevated hepatic transaminases, elevated creatine phosphokinase, myoglobinuria, sterile pyuria	Demonstration of a four-fold change in antibody titer in paired sera, or isolation or organism from a clinical specimen, or detection of organism by IFA test or a single elevated serum antibody titer is supportive of the diagnosis, however, a single antibody titer should be confirmed by either one of the methods above.	For adults, streptomycin, gentamicin, ciprofloxacin, or doxycycline is the recommended treatment. For children, streptomycin, gentamicin, and ciprofloxacin are recommended. Gentamicin or streptomycin is preferred for treatment of severe tularemia. Chloramphenicol may be added to streptomycin to treat meningitis. An infectious disease specialist should be consulted for most current treatment guidelines or for individual patient decisions.
Rocky Mountain Spotted Fever <i>Rickettsia rickettsii</i>	<i>Derma-center variabilis</i> (American dog tick), <i>Derma-center andersoni</i> (Rocky Mountain	RMSF cases have been reported throughout the US, but North Carolina, Oklahoma, Ar-	2-14 days	Fever, chills, severe headache, malaise, myalgia, nausea, vomiting, anorexia, abdominal pain, diarrhea, abdominal tenderness, cough, photophobia, focal neurologic deficits (which may include paralysis	Thrombocytopenia, mildly elevated hepatic transaminase levels, and hyponatremia.	Demonstration of a four-fold change in IgG specific antibody titer by IFA test in paired serum samples, or detection of DNA in a skin biopsy of	Doxycycline for 10-14 days (provides appropriate therapy for possible co-infection with Lyme disease). Clinical suspicion of this disease is sufficient to begin treatment, as delay in treatment

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	wood tick) – feeds primarily on large mammals, <i>Rhipicephalus sanguineus</i> (Brown dog tick) – mainly found in Southwestern US and along Mexican border, primary host is the domestic dog.	kansas, Tennessee, and Missouri, account for over 60% of all cases. Recently, there has been an increase in Arizona.		or transient deafness). A maculopapular rash typically appears 2-5 days after the onset of fever, although about 10% of cases never develop the rash. The rash typically appears on wrists, forearms, and ankles, and then spreads to the trunk and sometimes palms and soles. The rash may not develop until late in the disease process, so do not wait to begin treatment. If the disease progress, a petechial rash may develop, which is considered a sign of progression to severe disease. Red to purple spots are usually not seen until day 6 or later of the disease.		rash by PCR (PCR is generally unreliable for blood samples), or immunohistochemical staining of organism from skin or tissue biopsy.	may result in severe illness and/or death. Use of antibiotics other than doxycycline increases risk of patient death. At the recommended dose and duration, there is no evidence of staining of permanent teeth.
Heartland Virus Heartland virus	<i>Amblyomma americanum</i> (Lone Star Tick) is believed to be the vector for Heartland virus, but more study is still needed	Cases have so far only been reported in Missouri and Tennessee. It is not currently known if it exists in other areas of the country. All cases have fallen ill in May-September	Unknown	Fever, malaise, myalgia, diarrhea, anorexia, and nausea.	Unknown	Unknown	Supportive care