Tick-borne Diseases In Dutchess County, NY

Marcus J. Molinaro, County Executive
Dr. Kari Reiber, Commissioner of Health
Overview

• Geographic distribution of tick-borne disease in the United States
• Tick-borne disease in Dutchess County, NY
  - Established tick-borne diseases and new information
    * Lesser known tick-borne diseases (babesiosis, anaplasmosis and ehrlichiosis)
    * Well known tick-borne diseases
  - Potential threats from emerging tick-borne diseases
    * Powassan disease
    * Recently emerging pathogens in the United States
## Tick-borne Diseases in the United States

### Endemic to Dutchess County, NY
- Lyme disease (*borreliosis*)
- Anaplasmosis
- Ehrlichiosis
- Babesiosis
- Powassan disease
- Rocky Mountain Spotted Fever
- Tularemia
- Q-fever* (uncommon or nonexistent from tick attachments)

### Not Currently Considered Endemic to Dutchess County, NY
- Colorado tick fever
- Southern tick-associated rash illness (STARI)
- Tickborne relapsing fever
- Other Spotted Fever Group *Rickettsia (SFGR)*

*Resource: Emerging and Exotic Diseases of Animals CFSPH*
Tick Paralysis

Rare condition caused by a toxin in the saliva of certain species of gravid ticks.

About (43) species of tick implicated.

(2) Cases occurred in Dutchess County, NY since 1995

Children especially girls under 10 are at greatest risk

**Symptoms:**

2-7 days after attachment

Acute, ascending flaccid paralysis that is confused with other neurologic disorders

The condition can worsen to respiratory failure and death in about (10%) of the cases

Paralysis subsides typically within 24 hours of removing the tick

Tick paralysis occurs when an engorged and gravid (egg-laden) female tick produces a neurotoxin in its salivary glands and transmits it to its host during feeding. Experiments have indicated that the greatest amount of toxin is produced between the fifth and seventh day of attachment (often initiating or increasing the severity of symptoms), although the timing may vary depending on the species of tick.

Resource: [http://www.cdc.gov/mmwr/preview/mmwrhtml/00040975.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/00040975.htm)
<table>
<thead>
<tr>
<th>Tick</th>
<th>Female</th>
<th>Male</th>
<th>Geographic Distribution</th>
<th>Possible Pathogens they carry</th>
</tr>
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<tbody>
<tr>
<td>Black-legged Tick</td>
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<td></td>
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<td>Lyme disease</td>
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<tr>
<td>nickname: Deer Tick</td>
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<td>Anaplasmosis</td>
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<td><em>Ixodes scapularis</em></td>
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<td>Babesiosis</td>
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<td><em>Ehrlichia-muris</em>-like (EML)</td>
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<td><em>Borrelia miyamotoi</em></td>
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<td>Powassan disease (Deer tick virus)</td>
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<td>Tick paralysis</td>
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<td>American Dog Tick</td>
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<td>Rocky Mountain Spotted Fever</td>
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<tr>
<td><em>Dermacentor variabilis</em></td>
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<td>Other Spotted fever group rickettsia</td>
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<td>Tularemia</td>
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<td>Lone Star Tick</td>
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<td><em>Amblyomma americanum</em></td>
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<td>STARI</td>
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<td>Tularemia</td>
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<td>Heartland virus</td>
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<td>Bourbon virus?</td>
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<td>Woodchuck Tick</td>
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<td>Powassan disease</td>
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</tbody>
</table>
Tick-Borne Diseases

Epidemiology and Symptoms
Anaplasmosis & Ehrlichiosisis
<table>
<thead>
<tr>
<th><strong>Human Granulocytic Anaplasmosis</strong></th>
<th><strong>Human Monocytic Ehrlichiosis</strong></th>
</tr>
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<tbody>
<tr>
<td><strong>Causative Agent</strong></td>
<td><em>Anaplasma phagocytophila</em></td>
</tr>
<tr>
<td><strong>Incubation Period</strong></td>
<td>1-30 days (average 7-14 days)</td>
</tr>
<tr>
<td><strong>Classic Symptoms</strong></td>
<td>Fever, Headache</td>
</tr>
<tr>
<td></td>
<td>Constitutional Symptoms</td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
<td>Possible Death</td>
</tr>
<tr>
<td></td>
<td><em>(0.0 % to 3.0 % CFR reported from 2000 to 2010)</em></td>
</tr>
<tr>
<td><strong>Lab Tests</strong></td>
<td>Platelet Count</td>
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<tr>
<td></td>
<td>Granulocyte count</td>
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<tr>
<td></td>
<td>Serology</td>
</tr>
<tr>
<td></td>
<td>Morulae</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>Doxycycline</td>
</tr>
</tbody>
</table>

*Source: Centers for Disease Control and Prevention Anaplasmosis & Ehrlichiosis Statistics and Epidemiology*
Number of U.S. Anaplasmosis Cases Reported to the CDC, 1994-2010

Data presented here are based on the year of illness onset rather than reporting year which may differ from numbers reported in the MMWR Annual Summary of Notifiable Diseases.

Cases of anaplasmosis have generally increased from 350 cases in 2000, when the disease became nationally notifiable, to 1163 cases in 2009.

The number of reported cases increased 52% between 2009 and 2010.

Source: Centers for Disease Control and Prevention Anaplasmosis Statistics and Epidemiology
Annual Reported Incidence (per million population) for Anaplasmosis in the United States for 2010 (NN = Not notifiable)

**Geographic distribution of anaplasmosis incidence in 2010:**

The incidence rate was zero for Arizona, California, Connecticut, Indiana, Kentucky, Louisiana, Massachusetts, Montana, Nebraska, Oregon, Pennsylvania, South Dakota, Utah, Washington, West Virginia and Wyoming.

Incidence ranged between 0.1 to 0.7 cases per million persons for Florida, Georgia, Kansas, Michigan, Mississippi, Ohio, South Carolina, and Texas. Annual incidence ranged from 0.7 to 3.1 cases per million persons in Alabama, Arkansas, Illinois, Maryland, Missouri, North Carolina, Oklahoma, Tennessee, and Virginia.

The highest incidence rates, ranging from 3.1 to 136 cases per million persons were found in Delaware, Maine, Minnesota, New Hampshire, New Jersey, New York, Rhode Island, Vermont and Wisconsin.

*Source: Centers for Disease Control and Prevention Anaplasmosis Statistics and Epidemiology*
Anaplasmosis in NYS and Dutchess County, NY

The rate of new cases of Anaplasmosis is falling as are rates of Ehrlichiosis and Lyme disease.

The total number of new cases of Anaplasmosis in Dutchess County in 2011 was 71.

Data Source: New York State Department of Health Communicable Disease Registry
Number of U.S. Ehrlichia chaffeensis Cases Reported to the CDC, 1994-2010

Data presented here are based on the year of illness onset rather than reporting year which may differ from numbers reported in the MMWR Annual Summary of Notifiable Diseases.

The graph displays the number of human cases of ehrlichiosis cases reported to CDC annually from 1994 through 2010.

Cases of ehrlichiosis have increased steadily from 200 cases in 2000, when the disease became nationally notifiable, to 961 cases in 2008.

Cases decreased significantly in 2010 from 944 reported in 2009 to 740 reported in 2010.

Source: Centers for Disease Control and Prevention Ehrlichiosis Statistics and Epidemiology
Annual reported incidence (per million population) for *E. chaffeensis* in the United States for 2010. (NN= Not notifiable)

The incidence rate was zero for Arizona, Connecticut, Indiana, Massachusetts, Oregon, South Dakota, Utah, Vermont, Washington, and Wyoming.

Incidence ranged between 0.03 to 1 case per million persons for California, Florida, Louisiana, Michigan, Ohio, Pennsylvania, Rhode Island and Texas.

Annual incidence ranged from 1 to 3.3 cases per million persons in Alabama, Georgia, Illinois, Kansas, Maine, Minnesota, Mississippi, Nebraska, New Hampshire, New York, South Carolina and West Virginia.

The highest incidence rates, ranging from 3.3 to 26 cases per million persons were found in Arkansas, Delaware, Kentucky, Maryland, Missouri, New Jersey, North Carolina, Oklahoma, Tennessee, Virginia, and Wisconsin.

*Source: Centers for Disease Control and Prevention Ehrlichiosis Statistics and Epidemiology*
The rate of new cases of Ehrlichiosis is falling as are rates of Anaplasmosis and Lyme disease.

The total number of new cases of Ehrlichiosis in Dutchess County in 2011 was 2.
Babesiosis
Babesiosis

**Causative Agent**

<table>
<thead>
<tr>
<th><strong>Babesia microti &amp; duncani</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incubation period</strong></td>
</tr>
<tr>
<td><strong>Classic Symptoms</strong></td>
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<tr>
<td><strong>Outcome</strong></td>
</tr>
<tr>
<td><strong>Laboratory tests</strong></td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
</tr>
</tbody>
</table>

Source: Centers for Disease Control and Prevention Babesia Resources for Health Care Providers
Babesiosis and the Blood supply

TRANSMISSION

- By the bite of an infected tick
- By getting a blood transfusion from an infected donor of blood products
- By congenital transmission – from an infected mother to her baby (during pregnancy or delivery)

What CDC is doing (in collaboration with State and Local Health Departments:
1. Provide reference diagnostic testing for babesia
2. Provide consultation for health professionals

The future
a. Track transfusion-transmitted infection
b. Monitoring and surveillance to determine spread and to discover new strains
c. Prevention strategies including a potential donor screening test

Source: Centers for Disease Control and Prevention Babesia
Incidence* (per 100,000) of reported cases of babesiosis, by county of residence† — 18 states,§ 2011

N = 1,116; county of residence was unknown for eight of the 1,124 patients.


The figure above shows incidence of reported cases of babesiosis, by county of residence, in 18 states during 2011. The 1,124 cases occurred in residents of 15 of the 18 states in which babesiosis was a reportable disease in 2011.

1,092 cases (97%) were reported by the seven main B. microti-endemic states. County-level incidence rates ranged from 0 to >100 cases per 100,000 persons.

Source: Centers for Disease Control and Prevention MMWR Babesiosis 18 States, 2011 June 13, 2012
Babesiosis in NYS and Dutchess County, NY

The rate of new cases of Babesiosis in Dutchess County is approximately 15 times higher than that of NYS (excl NYC).

The total number of new cases of Babesiosis in Dutchess County in 2010 was 38.

Note: In 2011, the case definition changed to include both confirmed and probable cases. Data for 2011 (17.8 cases per 100,000 in Dutchess County) are not presented in the chart as they should not be directly compared with earlier rates.

Data Source: New York State Department of Health Communicable Disease Registry
Lyme disease
Lyme disease

Lyme disease is the most commonly reported vector-borne illness in the United States – in 2012, it was the 7th most common Nationally Notifiable disease. However this disease does not occur nationwide and is concentrated heavily in the northeast and upper Midwest.

In 2012, 95% of Lyme disease cases were reported from 13 states:

- Connecticut
- Delaware
- Maine
- Maryland
- Massachusetts
- Minnesota
- New Jersey
- New York
- Pennsylvania
- Vermont
- Virginia
- Wisconsin
- New Hampshire

Source: Centers for Disease Control and Prevention Lyme Disease Statistics
Reported Cases of Lyme Disease by Year
United States, 2003-2012

The graph displays the number of reported cases of Lyme disease from 2003 through 2012.

The number of confirmed cases ranged from a low of 19,804 in 2004 to high of 29,959 in 2009.

*National Surveillance case definition revised in 2008 to include probable cases; details at http://www.cdc.gov/osels/ph_surveillance/ndss/casedef/lyme_disease_2008.htm

Source: Centers for Disease Control and Prevention Lyme Disease Statistics
Confirmed Lyme disease cases by age and sex—United States, 2001-2010

Reported cases of Lyme disease are most common among boys aged 5-9

Source: Centers for Disease Control and Prevention Lyme Disease Statistics
Clinical Manifestations of Confirmed Lyme Disease Cases--United States, 2001-2010

This figure represents the breakdown of reported Lyme disease cases from 2001 to 2010 by disease manifestation.

The majority of cases are the EM rash. Other manifestations are less common, some patients have more than one presentation. Confirmed according to CDC criteria.

Case definition:
Confirmed only: 2001-2007
Confirmed and Probable: 2008-2010

Source: Centers for Disease Control and Prevention Lyme Disease Statistics
The Hudson Valley Region has some of the highest Lyme disease rates in NYS.

Dutchess County rates have decreased dramatically since 2008 but still remain high.

Data Source: New York State Department of Health Communicable Disease Registry
While the rate of new cases of Lyme Disease is falling, the numbers remain high, translating to approximately 440 cases in Dutchess County in 2011.

Note: In 2008, the CDC revised the case definition for Lyme disease to include confirmed and probable cases. Pre-2008 data should not be combined with nor compared to 2008 and subsequent years. Additionally, in 2009, Dutchess County became a sentinel surveillance county; annual numbers are estimated by the New York State Department of Health.

Data Source: New York State Department of Health Communicable Disease Registry
Lyme Disease
Signs and Symptoms
Early Localized Stage

Red, expanding rash called erythema migrans (EM)

Fatigue, chills, fever, headache, muscle and joint aches, and swollen lymph nodes

Some people may get these general symptoms in addition to an EM rash, but in others, these general symptoms may be the only evidence of infection.

Some people get a small bump or redness at the site of a tick bite that goes away in 1-2 days, like a mosquito bite. This is not a sign that you have Lyme disease. However, ticks can spread other organisms that may cause a different type of rash. For example, Southern Tick-associated Rash Illness (STARI) causes a rash with a very similar appearance.

Source: Centers for Disease Control and Prevention Lyme Disease Signs and Symptoms
Erythema migrans (EM) or "bull's-eye" rash

Rash occurs in approximately 70-80% of infected persons and begins at the site of a tick bite after a delay of 3-30 days (average is about 7 days).

Rash gradually expands over a period of several days, and can reach up to 12 inches (30 cm) across. Parts of the rash may clear as it enlarges, resulting in a “bull's-eye” appearance.

Rash usually feels warm to the touch but is rarely itchy or painful.

EM lesions may appear on any area of the body.

Source: Centers for Disease Control and Prevention Lyme Disease Signs and Symptoms
Early disseminated stage (days to weeks post-tick bite)

Untreated, the infection may spread from the site of the bite to other parts of the body, producing an array of specific symptoms that may come and go, including:

Additional EM lesions in other areas of the body

Facial or Bell's palsy (loss of muscle tone on one or both sides of the face)

Severe headaches and neck stiffness due to meningitis (inflammation of the spinal cord)

Pain and swelling in the large joints (such as knees)

Shooting pains that may interfere with sleep

Heart palpitations and dizziness due to changes in heartbeat

Many of these symptoms will resolve over a period of weeks to months, even without treatment. However, lack of treatment can result in additional complications.

Source: Centers for Disease Control and Prevention Lyme Disease Signs and Symptoms
Late disseminated stage (months-to-years post-tick bite)

Approximately 60% of patients with untreated infection may begin to have intermittent bouts of arthritis, with severe joint pain and swelling. Large joints are most often affected, particularly the knees\textsuperscript{3}. Arthritis caused by Lyme disease manifests differently than other causes of arthritis and must be distinguished from arthralgias (pain, but not swelling, in joints).

Up to 5% of untreated patients may develop chronic neurological complaints months to years after infection\textsuperscript{4}. These include shooting pains, numbness or tingling in the hands or feet, and problems with short-term memory.

\textit{Source: Centers for Disease Control and Prevention Lyme Disease Signs and Symptoms}
Ophthalmic Symptoms (symptoms that affect the eye)

Symptoms: red, itchy eyes

Red, Itchy eyes
(most common ocular symptom)

Conjunctivitis
(inflammation of the clear membrane of the eye)

Keratitis
(inflammation & infection of the cornea)

Iritis
(infection of the colored part of the eye)

Not a commonly reported symptom of Lyme disease

Source: Centers for Disease Control and Prevention Lyme Disease Signs and Symptoms
Lingering symptoms after treatment (post-treatment Lyme disease syndrome)

Approximately 10-20% of patients with Lyme disease have symptoms that last months to years after treatment with antibiotics\(^5\).

These symptoms can include muscle and joint pains, cognitive defects, sleep disturbance, or fatigue.

This condition is referred to as Post-treatment Lyme disease syndrome (PTLDS).

Source: Centers for Disease Control and Prevention Lyme Disease Signs and Symptoms
What you need to know about Lyme carditis

Lyme carditis occurs when Lyme disease bacteria enter the tissues of the heart. This can interfere with the normal movement of electrical signals from the heart’s upper to lower chambers, a process that coordinates the beating of the heart. The result is something physicians call “heart block,” which can be mild, moderate, or severe. Heart block from Lyme carditis can progress rapidly.

Patients may experience light-headedness, fainting, shortness of breath, heart palpitations, or chest pain. Patients with Lyme carditis usually have other symptoms such as fever and body aches, and they may have more specific symptoms of Lyme disease, such as the erythema migrans rash.

Lyme carditis can be treated with oral or intravenous (IV) antibiotics, depending on how severe it is. Some patients might need a temporary pacemaker.

Typically the patient receives antibiotic treatment for 14-21 days. Most symptoms are gone within 1-6 weeks.

Based on national surveillance data from 2001-2010, Lyme carditis occurs in approximately 1% of Lyme disease cases reported to CDC.

Between 1985 and 2008, medical journals reported four deaths, worldwide, as a result of Lyme carditis. In December 2013, CDC published a report describing three additional cases.
Potential threats from emerging tick-borne diseases

Powassan Disease &
Recently emerging pathogens in the United States
POWASSAN DISEASE
From 2001 through 2012, POWV neuroinvasive disease* cases

*Neuroinvasive disease includes cases reported as encephalitis or meningitis.

1958-1998
27 human cases in Canada and northeastern USA

1999-2001
4 new cases identified in NH and ME, after WNV tests were negative
MMWR 50:761-764 (2001)

From 2001 through 2012
POWV neuroinvasive disease cases have been reported in Maine (2), Michigan (1), Minnesota (19), New York (13), Pennsylvania (1), Virginia (1), and Wisconsin (10).

Source: Centers for Disease Control and Prevention Powassan Virus Statistics and Maps
Reported cases of Neuroinvasive Powassan Disease in NYS and Dutchess County 2001 to 2013

New York State has reported 18 cases of POWV neuroinvasive disease from 2001 to 2013

Dutchess County has confirmed 3 cases during that period

Source: Centers for Disease Control and Prevention Powassan Virus Statistics and Maps and the USGS Powassan Virus Human Maps
Powassan Disease

First isolated from a brain of a fatal case in 1958 in Powassan, Ontario Canada

First US case in 1970, New Jersey

Powassan (POW) virus is an RNA virus that belongs to the genus *Flavivirus*. It is related to West Nile, St. Louis encephalitis, and Tick-borne encephalitis viruses.

Causal agent is the Powassan virus and Deer Tick virus.

Humans become infected with POW virus from the bite of an infected tick. Humans do not develop high enough concentrations of POW virus in their bloodstreams to infect feeding ticks. Humans are therefore considered to be “dead-end” hosts of the virus.

<table>
<thead>
<tr>
<th>Causative Agent</th>
<th>Powassan Virus and Deer Tick Virus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incubation period</td>
<td>Incubation period: 1 week to 1 month</td>
</tr>
<tr>
<td>Classic Symptoms</td>
<td>Many people who become infected with POW virus do not develop any symptoms. POW virus can cause encephalitis (inflammation of the brain) and meningitis (inflammation of the membranes that surround the brain and spinal cord). Symptoms can include fever, headache, vomiting, weakness, confusion, loss of coordination, speech difficulties, and seizures.</td>
</tr>
<tr>
<td>Outcomes: Occurs in about 50% of those who survive</td>
<td>Death (10-14% Fatality Rate) Decreased pharyngeal strength, aspiration, dysphonia (speech disorder), Equilibrium and balance problems, Weakness in lower extremities, Aphasia (inability to understand language), Headache, Fatigue, Wasting, Memory dysfunction Quadriplegia (paralysis of both arms and legs) Hemiplegia (paralysis of one side of the body) Hemiparesis (partial paralysis)</td>
</tr>
<tr>
<td>Laboratory tests</td>
<td>Laboratory diagnosis of arboviral infections is generally accomplished by testing of serum or cerebrospinal fluid (CSF) to detect virus-specific IgM and neutralizing antibodies. In fatal cases, nucleic acid amplification, histopathology with immunohistochemistry and virus culture of autopsy tissues can also be useful. Only a few state laboratories or other specialized laboratories, including those at CDC, are capable of doing this specialized testing.</td>
</tr>
<tr>
<td>Treatment</td>
<td>There is no specific medicine to cure or treat POW virus disease. Treatment for severe illnesses may include hospitalization, respiratory support, and intravenous fluids.</td>
</tr>
</tbody>
</table>

Source: Centers for Disease Control and Prevention Powassan
Borrelia miyamotoi
Borrelia miyomotoi

Recently, three cases of human infection with *B. miyomotoi* were identified in the United States. One patient was an elderly, immunocompromised woman with confusion and an unsteady gait.

The bacteria were seen in samples of the patient’s spinal fluid, and she recovered when treated with antibiotics. The two other patients had fever, chills, and muscle aches, similar to the symptoms of the patients in Russia.

CDC is working to better define the public health importance of this infection and is reviewing options for tracking the disease with our partners in state and local health departments. CDC is also developing and evaluating laboratory diagnostic tests to genetically detect the presence of *B. miyomotoi* in infected individuals and their specific immune responses.

**Causative Agent**

<table>
<thead>
<tr>
<th>Incubation period</th>
<th>Incubation period: 2 to 18 Days for TBRF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classic Symptoms</td>
<td>Human infections with <em>B. miyamotoi</em> were first described in 2011 in a report from Russia. Most of the patients had fever, headache, and muscle aches—symptoms typical of TBRF.</td>
</tr>
<tr>
<td>Symptoms similar to those of Lyme disease, such as the erythema migrans rash (bull’s-eye rash), arthritis, or facial palsy, were uncommon.</td>
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</tbody>
</table>

**Laboratory tests**

Diagnosis currently relies on the use of tests to detect DNA of the organism, called polymerase chain reaction (PCR) tests. These tests are under development and not widely available. North American strains of *B. miyamotoi* have not yet been successfully grown in culture, a common method for identifying bacterial diseases. Blood tests based on detection of antibodies require further validation. Blood tests for Lyme disease are unlikely to be helpful in diagnosis of *B. miyamotoi* infections.

**Treatment**

Physicians have successfully treated patients infected with *B. miyamotoi* with a 2-week course of doxycycline.

Source: Centers for Disease Control and Prevention: *B. miyomotoi*
Heartland Virus, Bourbon Virus and *Ehrlichia muris-like*
**Ehrlichia muris-like**

In 2009, a new species of *Ehrlichia* was detected in four human patients (3 from Wisconsin, 1 from Minnesota) using molecular laboratory testing techniques. This new bacterial species was found to be most closely related to *Ehrlichia muris*. This newly identified species has been called *Ehrlichia muris*-like (EML).

Transmitted by the bite of infected *Ixodes scapularis*

Same etiology and treatment as other *ehrlichia* spp.

Only confirmed by specific PCR due to serologic cross-reactivity

Source: Wisconsin Ticks and Tick-borne Diseases Department of Entomology, University of Wisconsin-Madison: *Ehrlichia* sp. Wisconsin (EML)
Heartland Virus

Heartland virus belongs to a family of viruses called Phleboviruses. Viruses in this family are found all over the world. Some of these viruses can cause people to get sick. Most of the phleboviruses that cause people to become ill are passed through the bite of a mosquito, tick, or sandfly.

As of March 2014, eight cases of Heartland virus disease have been identified among residents of Missouri and Tennessee. It is unknown at this time if the virus may be found in other areas of the United States.

Source: Centers for Disease Control and Prevention: Heartland Virus What I Need to Know
Bourbon Virus

Bourbon virus is a novel RNA virus in the genus *Thogotovirus* (family *Orthomyxoviridae*) that was recently discovered in Bourbon County, Kansas.

**Epidemiology**

The one case of Bourbon virus disease that has been identified was in a previously healthy male over 50 years of age who had onset of symptoms during late spring 2014. The patient had reported exposure to ticks before becoming ill.

**Clinical Signs and Symptoms**

The case patient presented with fever, fatigue, anorexia, nausea, vomiting, and a maculopapular rash. He was also found to have thrombocytopenia and leukopenia. Based on the patient’s clinical signs and symptoms, he was thought to have a tick-borne disease. The patient was given doxycycline but failed to improve clinically. His condition worsened, and he died.

**Treatment and Outcome**

Currently there are no specific medications or therapies for Bourbon virus disease. Supportive therapy is recommended for any patient suspected of having Bourbon virus disease.

**Diagnosis**

There is no routine testing available for Bourbon virus. However, protocols are being developed to allow for investigational diagnostic testing of acute disease. Please contact your state health department if you have a patient with an acute illness that might be compatible with Bourbon virus infection.

*Source: Centers for Disease Control and Prevention: Bourbon Virus: What You Need to Know*
Acknowledgements and Sources

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• Dr. Joseph Forrester
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• Dutchess County Department of Health
Thank You for Your Attention

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