



**Indiana**  
**Department**  
**of**  
**Health**

IDEPD Webinar Series

Tick-borne Rickettsial Disease and  
Lyme Disease Investigations

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OUR MISSION:

To promote, protect, and improve the health and safety of all Hoosiers.

OUR VISION:

Every Hoosier reaches optimal health regardless of where they live, learn, work, or play.



# Objectives

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- Review epidemiology of tick-borne rickettsial diseases and Lyme disease in Indiana
- Overview surveillance case definitions
- Discuss steps of case investigation
- Highlight available resources

# Tick-borne Rickettsial Diseases



# Overview

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- Caused by closely related bacteria transmitted by different tick species
- Often characterized by fever, rash, other symptoms
- Prompt diagnosis and treatment is crucial to prevent severe disease
- Endemic diseases
  - Anaplasmosis (*A. phagocytophilum*)
  - Ehrlichiosis (*E. chaffeensis*, *E. ewingii*, *E. muris eauclairensis*)
  - Spotted fever group rickettsiosis (*R. rickettsii*, *R. parkeri*)

# Transmission



## blacklegged tick

- Anaplasmosis (*A. phagocytophilum*)
- Ehrlichiosis (EME)



## lone star tick

- Ehrlichiosis (*E. chaffeensis*, *E. ewingii*)



## American dog tick

- Rocky Mountain spotted fever (*Rickettsia rickettsii*)



## Gulf Coast tick

- *Rickettsia parkeri* rickettsiosis

# Transmission



## blacklegged tick

- Anaplasmosis (*A. phagocytophilum*)
- Ehrlichiosis (EME)



## lone star tick

- Ehrlichiosis (*E. chaffeensis*, *E. ewingii*)



## American dog tick

- Rocky Mountain spotted fever (*Rickettsia rickettsii*)



## Gulf Coast tick

- *Rickettsia parkeri* rickettsiosis

**Rarely rickettsial diseases have been transmitted through blood transfusion and organ transplant.**

# Anaplasmosis

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- Incubation period 5-14 days
- Signs and symptoms
  - Fever, headache, malaise, myalgia, rash\*
  - Transaminitis, leukopenia, and thrombocytopenia
- Patients may develop severe disease if treatment is delayed.
  - Renal/respiratory failure
  - Peripheral neuropathies
  - Disseminated intravascular coagulation (DIC)-like coagulopathies
  - Rhabdomyolysis
  - Hemorrhage

# *Ehrlichia chaffeensis* ehrlichiosis

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- Incubation period 5-14 days
- Early illness (days 1–5)
  - Fever, headache, malaise, myalgia, GI symptoms, rash\*
  - Transaminitis, leukopenia, and thrombocytopenia
- Patients may develop severe illness if treatment is delayed.
  - CNS involvement, TSS-like or septic shock-like syndromes, renal/hepatic failure, coagulopathy, pancytopenia
- Infections due to *E. ewingii* and *E. muris eauclairensis* are typically less severe.





# *E. ewingii* and *E. muris eauclairensis* ehrlichiosis

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- Incubation period and symptoms are similar to those of *E. chaffeensis*
- Infections are typically less severe
- GI symptoms are less common in patients with *E. ewingii*
- Rash is infrequent in cases of *E. muris eauclairensis*.

# Rocky Mountain Spotted Fever (RMSF)

- Incubation period is 3–12 days
- Early illness (days 1–5)
  - Acute febrile illness
  - Macular rash spreading from extremities to trunk
  - Periorbital and peripheral edema
- Late illness (day 5 or later)
  - Altered mental status, coma, cerebral edema
  - Respiratory compromise
  - Petechial rash
  - Skin and soft tissue necrosis
  - Multisystem organ failure

Days from illness onset	Signs and symptoms	Laboratory indicators	Images
Days 1-2	<ul style="list-style-type: none"> <li>• Abrupt onset of high fever</li> <li>• Headache, myalgia, and malaise</li> </ul>	Laboratory results (white blood cells [WBC], platelets, sodium) generally within normal limits	
Days 2-4	<ul style="list-style-type: none"> <li>• Faint macular rash begins on wrists and ankles and spreads centrally</li> <li>• Abdominal pain, nausea/vomiting</li> <li>• Cough</li> <li>• Calf tenderness</li> <li>• Periorbital and peripheral edema (more common in children)</li> </ul>	<ul style="list-style-type: none"> <li>• Mildly elevated transaminases and mild thrombocytopenia</li> <li>• WBC usually within normal limits</li> </ul>	 <p>Photo credit: G. Alvarez Hernandez</p>
<b>Doxycycline is most effective at preventing severe illness and death if administered within the first 5 days of symptoms</b>			
Days 5-7	<p><i>Progression in symptoms from days 2-4:</i></p> <ul style="list-style-type: none"> <li>• Fever typically <math>\geq 104^{\circ}\text{F}</math></li> <li>• Worsening respiratory status</li> <li>• Worsening abdominal pain (may mimic acute appendicitis or cholecystitis)</li> <li>• Rash becomes petechial and more widespread, typically involves palms and soles</li> </ul>	<ul style="list-style-type: none"> <li>• Worsening thrombocytopenia</li> <li>• Elevated hepatic transaminases, mild to moderate</li> <li>• Hyponatremia</li> </ul>	
Days 7-9	<p><i>Further progression from days 5-7:</i></p> <ul style="list-style-type: none"> <li>• Rash becomes diffuse and coalesces (forming purpura)</li> <li>• Necrosis of the digits leading to peripheral gangrene</li> <li>• Septic shock</li> <li>• Myocarditis and cardiac arrhythmias</li> <li>• Renal failure</li> <li>• Pulmonary edema or Acute Respiratory Distress Syndrome (ARDS)</li> <li>• Cerebral edema, meningoencephalitis, altered mental status, coma, seizures</li> </ul>	<ul style="list-style-type: none"> <li>• Severe thrombocytopenia</li> <li>• Elevated creatinine, creatinine kinase and lactic acid</li> <li>• WBC mildly to moderately elevated</li> </ul>	

# *R. Parkeri* Rickettsiosis

Incubation period: 3–12 days

- Less severe than RMSF
- Signs and Symptoms
  - Eschar at the site of tick bite
  - Febrile illness
  - Rash
    - maculopapular or vesicular eruptions
    - trunk and extremities
  - Mild transaminitis, leukopenia or thrombocytopenia



# Risk Factors for Severe Disease

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- Delayed antibiotic treatment or delayed medical care
- People < 10 years of age or > 65 years of age
- Immune compromising conditions (e.g., persons with advanced HIV, persons receiving chemotherapy, or persons receiving other immune-suppressing medications)
- G6PD deficiency (RMSF)

# Importance of Early Treatment

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**Early treatment with the antibiotic, doxycycline, can prevent poor outcomes. If rickettsial disease is suspected, treatment should be initiated immediately.**

**Doxycycline**  
**saves lives!**

**A good reason to smile:**  
Doxycycline is the **#1 recommended treatment** for suspected rickettsial infections in patients of all ages.

New research shows **NO** evidence of tooth staining when used in short courses.

 [Click to learn more.](#)

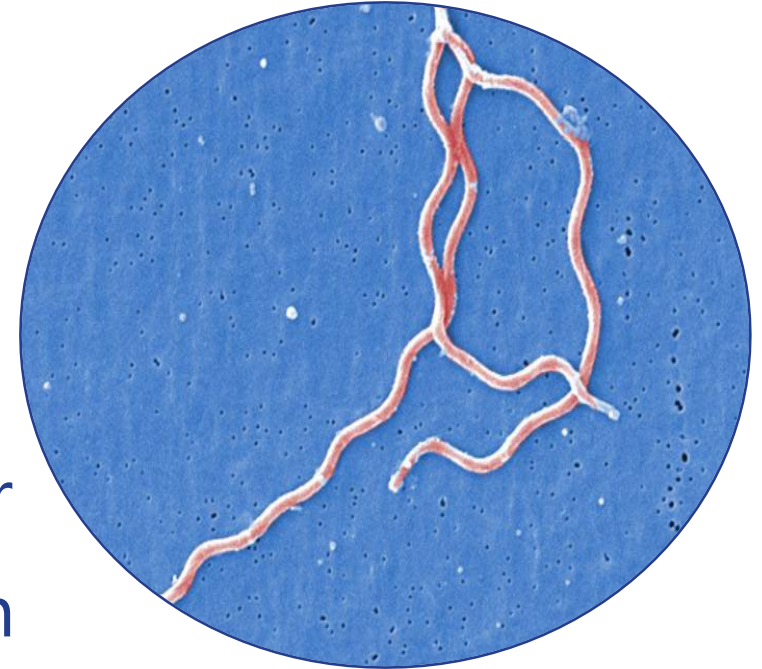
# Lyme Disease



# Overview

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- Lyme disease is a bacterial infection
  - *Borrelia burgdorferi*
  - *Borrelia mayonii*
- Early illness is non-specific
- Late illness can be complex
- Co-infections with other diseases can occur
- Most infections are adequately treated with doxycycline\*



\*Certain clinical manifestations may require alternate treatment regimens (<https://www.cdc.gov/lyme/hcp/clinical-care/index.html>) depending on severity.

# Transmission

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- Lyme disease is transmitted by the bite of a tick infected with *Borrelia* spp.
  - Blacklegged tick (*Ixodes scapularis*)
- Transmission occurs:
  - After an infected tick has been attached for at least 24 hours
  - Most transmission occurs after 36 hours of attachment



# Early Symptoms (3 to 30 Days)

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## Flu-Like Illness

- Fever
- Chills
- Headache
- Malaise
- Myalgia
- Arthralgia

## Lymphadenopathy

## Erythema migrans (EM) rash



# Later Symptoms (weeks to months)

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## Dermatologic

Multiple EM rashes, distant from site of tick bite

## Rheumatologic

Arthritis with severe joint pain and swelling in one or more joints (typically the knee)



## Neurologic

Cranial neuritis (e.g., Bell's palsy), Lymphocytic meningitis, Radiculoneuropathy, Encephalomyelitis



## Cardiac

Lyme carditis (e.g., 2<sup>nd</sup>/3<sup>rd</sup> grade AV block)

# Points to Remember-Testing

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- Once elevated, antibody titers will remain so for months to years; a “test of cure” is not recommended.
- Cross-reactivity may occur in patients with other conditions (e.g., relapsing fever, syphilis, rheumatoid arthritis, and Epstein-Barr virus infection).
- Patients who receive antibiotic treatment early in disease may be less likely to seroconvert.
- Development of antibodies does not prevent re-infection.

# Surveillance Case Definitions and Investigation Process



# Surveillance Case Definitions

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- Developed by Council of State and Territorial Epidemiologists (CSTE) and approved by CDC.
- A set of uniform criteria used to define a disease for public health surveillance.
  - Allows for consistent comparison of case counts across reporting jurisdictions
  - Cases classified as “confirmed”, “probable”, or “suspect”
- Not intended to be used by healthcare providers for making a clinical diagnosis or determining how to meet an individual patient’s health needs
- Routinely updated

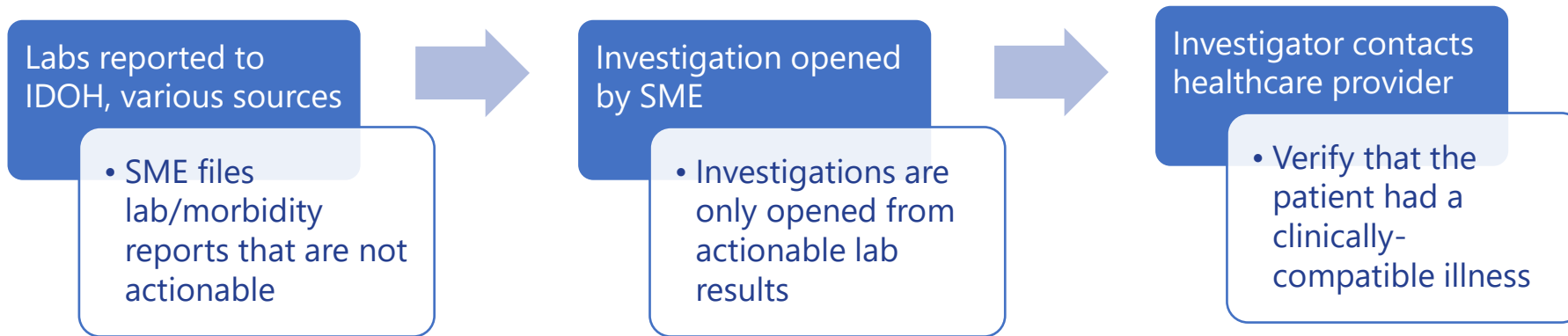
# Case Definition Links

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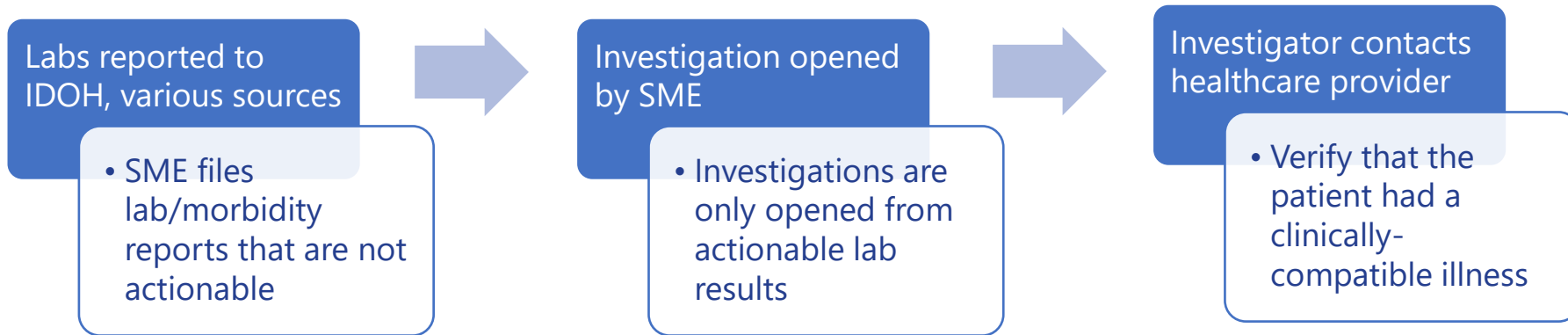
- [Anaplasmosis](#)- Updated 2024
- [Ehrlichiosis](#)- Updated 2024
- [Spotted Fever Rickettsiosis](#)- Updated 2020
- [Lyme disease](#)- Updated 2022


# Case Investigation Process

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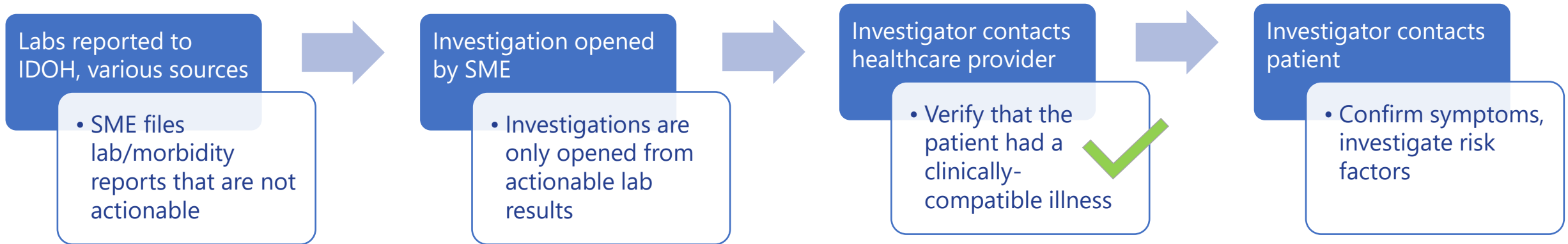


# Case Investigation Process



- Reasons to stop here: 
- No symptoms
  - Tested due to tick bite only
  - "Test of cure" \*
  - Alternate etiology can fully explain symptoms

# Case Investigation Process



## Risk factors:

- Tick bite/time in tick habitat
- Travel to endemic area
- Biologic

# Case Investigation Resources



# Rickettsial Disease Investigation Guide

## Tickborne Rickettsial Diseases: Anaplasmosis, Ehrlichiosis, and Spotted Fever Rickettsiosis Case Investigation Guide



### Infectious Agent

Tickborne rickettsial diseases in humans often share similar clinical features yet have different patterns of distribution and causes within a population. These diseases include Rocky Mountain spotted fever (RMSF) caused by *Rickettsia rickettsii*; other spotted fever group (SFG) rickettsiosis, caused by *Rickettsia parkeri*; Ehrlichiosis caused by *Ehrlichia chaffeensis*, *Ehrlichia ewingii*, and *Ehrlichia muris euclairensis*; and Anaplasmosis caused by *Anaplasma phagocytophilum*.

### Signs and Symptoms

Many tickborne diseases will present, at first, with nonspecific symptoms that may include:

- Fever
- Chills
- Malaise (not feeling well)
- Headache
- Muscle and joint pain
- Lymphadenopathy (enlarged lymph nodes)

Some may also present with other systemic (body systems) symptoms, such as:

- Neurological
- Cardiovascular
- Gastrointestinal symptoms

For detailed information on signs and symptoms, refer to the following webpages:

- [Anaplasmosis](#)
- [Ehrlichiosis](#)
- [Spotted Fever Rickettsiosis](#)

### Transmission

#### Transmission route

The bacteria that cause these diseases are transmitted primarily through the bites of infected ticks. Rarely, *Ehrlichia* species and *Anaplasma* have been spread through blood transfusions and organ transplants.

- *E. chaffeensis* and *E. ewingii* are carried by the lone star tick (*Amblyomma americanum*)
- *E. muris euclairensis* is carried by the blacklegged tick (*Ixodes scapularis*). While the blacklegged tick is widely distributed throughout the state, human ehrlichiosis infections from *E. muris euclairensis* have only been found in Wisconsin and Minnesota.
- *Rickettsia rickettsii* is carried by the American dog tick (*Dermacentor variabilis*).

- *Rickettsia parkeri* is carried by the Gulf Coast tick (*Amblyomma maculatum*).

### Incubation Period

- Anaplasmosis: 5-14 days
- Ehrlichiosis: 5-14 days
- Spotted fever rickettsiosis: 3-12 days

### Infectious Period

Once infected, humans are considered dead-end hosts and are not capable of transmitting the infection to others.

### Seasonality and Other Risk Factors

Cases are typically reported in spring and summer months when ticks are most active.

Risk factors for severe illness include:

- Delayed antibiotic treatment
- Age: younger than 5 years old or older than 65 years old
- Weakened immune system: such as those receiving some cancer treatments, individuals with advanced HIV infection, people who have received organ transplants, or people taking certain medications.

### Case Definitions

The Centers for Disease Control and Prevention and the Council of State and Territorial Epidemiologists set the standard clinical and laboratory case definitions:

- Anaplasmosis: <https://ndc.services.cdc.gov/case-definitions/anaplasmosis-2024/>
- Ehrlichiosis: <https://ndc.services.cdc.gov/case-definitions/ehrlichiosis-2024/>
- Spotted Fever Rickettsiosis: <https://ndc.services.cdc.gov/case-definitions/spotted-fever-rickettsiosis-2020/>

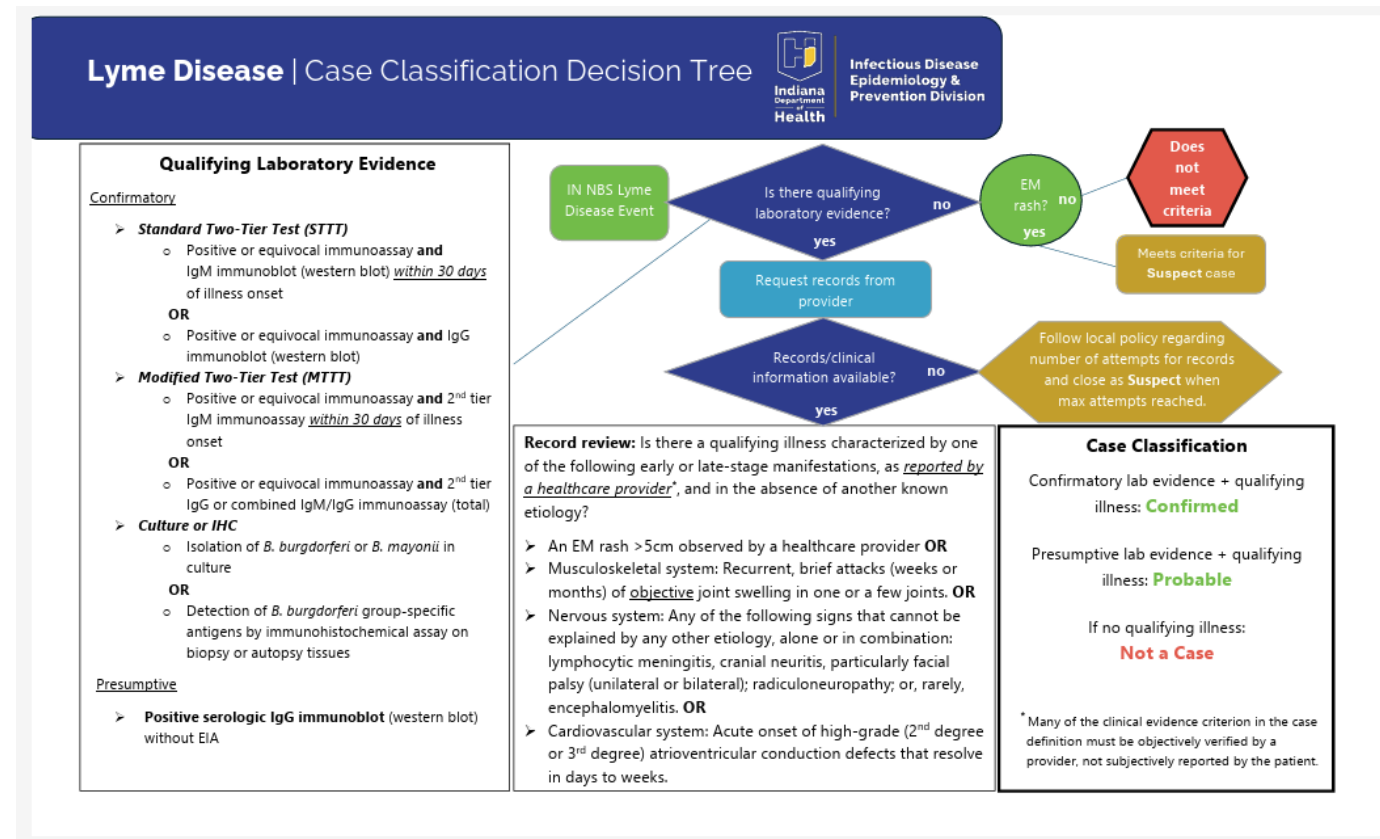
### Lab Testing

- Testing should be considered for any person with a compatible illness and known risk factors, such as history of a tick bite
- The optimal diagnostic test depends on the timing relative to symptom onset and the type of specimen(s) available for testing
  - Anaplasmosis and Ehrlichiosis can be identified by tests including serology (by IFA), polymerase chain reaction (PCR), immunohistochemistry (IHC), culture, and blood-smear microscopy.
  - Spotted fever rickettsiosis can be identified by tests including serology (by IFA), immunohistochemistry (IHC), and polymerase chain reaction (PCR)



# Lyme Disease Surveillance Guide

- General surveillance notes
- Guidance on interpreting clinical criteria
- Test interpretation
- Case classification decision tree
- Lab interpretation cheat sheet



# Quick Facts Sheets

Infectious Disease  
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## Anaplasmosis

January 2025

**What is anaplasmosis?**  
In Indiana, the blacklegged tick (*Ixodes scapularis*) transmits anaplasmosis. Anaplasmosis is a tick-borne disease caused by the bacterium *Anaplasma phagocytophilum*. The bacterium was previously known by other names, including *Ehrlichia equi* and *Ehrlichia phagocytophilum*, and the disease was previously known as human granulocytic ehrlichiosis (HGE).

**What are the symptoms of anaplasmosis?**  
Signs and symptoms of anaplasmosis typically begin within 1-2 weeks after the bite of an infected tick. People in the early stages of illness can experience mild to moderate flu-like symptoms, such as:

- Fever and chills
- Muscle aches
- Severe headache
- Nausea, vomiting, diarrhea, or loss of appetite

Rarely, if treatment is delayed or if there are other medical conditions present, severe illness can occur. Signs and symptoms of severe illness can include respiratory failure, bleeding problems, organ failure, and death. People over the age of 50 and those with weakened immune systems are more likely to develop serious illness.

**How is anaplasmosis diagnosed and treated?**  
Diagnosis of anaplasmosis is based upon the presence of signs and symptoms, a history of possible exposure to ticks, and appropriate laboratory testing. Early recognition of symptoms is important. Doxycycline is the treatment of choice for adults and children of all ages with suspected anaplasmosis. Treatment is most effective at preventing severe complications and death if started early in the course of illness and should never be delayed while waiting for laboratory results. If you think you have anaplasmosis, contact your health care provider right away.

**How to prevent anaplasmosis?**  
Blacklegged ticks are most encountered in wooded environments. In Indiana, nymphal ticks are most active during spring and summer and adults are most active during the fall and early spring. However, adult ticks may be active any time winter temperatures are above freezing. Wearing an EPA-registered insect repellent, reducing the amount of exposed skin, and checking your body for ticks daily are important steps in preventing tick bites. The best way to prevent anaplasmosis is to avoid tick bites. Visit the [Indiana Department of Health \(IDOH\) tick prevention page](#) for more information.

**What should be done after a tick bite?**  
People who have removed an attached tick sometimes question if it should be tested for tick-borne diseases. Some laboratories offer this testing, but IDOH does not recommend it. If the tick tests positive, it does not necessarily indicate the individual is infected; if the tick tests negative, it may provide a false security as the individual could've been unknowingly bitten by a different infected tick. In instances where you notice an attached tick, follow the steps below for proper removal.

1. Use clean, fine-tipped tweezers for tick removal. In instances where tweezers are not available shield your fingers with a paper towel, tissue, or gloves.
2. Grasp the tick as close to the skin's surface as possible.
3. Pull upward with steady even pressure. Don't twist or jerk the tick; this can cause the mouth-parts to break off and remain in the skin. If this happens, remove the mouth-parts with tweezers. If you cannot remove the mouth easily with tweezers, leave alone and let the skin heal.
4. After removing the tick, thoroughly clean the bite area and your hands with rubbing alcohol or soap and water.

**More Information**  
For more information on anaplasmosis, visit the IDOH anaplasmosis webpage.

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## Ehrlichiosis

January 2025

**What is ehrlichiosis?**  
In Indiana, the lone star tick (*Amblyomma americanum*) is the primary tick species that transmits ehrlichiosis. Ehrlichiosis is the general name used to describe diseases caused by the bacteria *Ehrlichia chaffeensis*, *E. ewingii*, or *E. muris euclairensis* in the United States. The majority of reported cases are due to infection by *E. chaffeensis*.

**What are the symptoms of ehrlichiosis?**  
Symptoms of ehrlichiosis usually appear within 1-2 weeks after the bite of an infected tick. People in the early stages of illness can experience flu-like symptoms, such as:

- Fever and chills
- Severe headache
- Muscle aches
- Confusion
- Nausea, vomiting, diarrhea, or loss of appetite
- Rash (more common in children)

Untreated ehrlichiosis can rapidly progress to a serious and life-threatening illness. Older people and those with weakened immune systems due to HIV infection, splenectomy or immunosuppressive therapies (e.g. corticosteroids, chemotherapy, long term immunosuppressive therapy following organ transplant) are more likely to develop serious illness.

**How is ehrlichiosis diagnosed and treated?**  
Diagnosis of ehrlichiosis is based upon the presence of signs and symptoms, a history of possible exposure to ticks, and appropriate laboratory testing. Early recognition of symptoms is important. A commonly prescribed antibiotic, doxycycline, is the treatment of choice for adults and children of all ages with suspected ehrlichiosis. Treatment is most effective at preventing severe complications and death if it is started early in the course of illness and should never be delayed while waiting for laboratory results. If you think you have ehrlichiosis, contact your healthcare provider right away.

**How to prevent ehrlichiosis?**  
Lone star ticks are most often encountered in brushy areas, are aggressive feeders, and will typically pursue their hosts. These ticks are most active in the spring and summer months. Wearing an EPA-registered insect repellent, reducing the amount of exposed skin, and checking your body for ticks daily are important steps in preventing tick bites. The best way to prevent ehrlichiosis is to avoid tick bites. Visit the [IDOH tick prevention page](#) for more information.

**What should be done after a tick bite?**  
People who have removed an attached tick sometimes question if it should be tested for tick-borne diseases. Some laboratories offer this testing, but IDOH does not recommend it. If the tick tests positive, it does not necessarily indicate the individual is infected; if the tick tests negative, it may provide a false security as the individual could've been unknowingly bitten by a different infected tick. In instances where you notice an attached tick, follow the steps below for proper removal.

1. Use clean, fine-tipped tweezers for tick removal. In instances where tweezers are not available shield your fingers with a paper towel, tissue, or gloves.
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4. After removing the tick, thoroughly clean the bite area and your hands with rubbing alcohol or soap and water.

**More Information**  
For more information on ehrlichiosis, visit the IDOH ehrlichiosis webpage.

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## Lyme Disease

January 2025

**What is Lyme disease?**  
Lyme disease is the most commonly reported tick-borne disease in Indiana and in the United States. In Indiana, the blacklegged tick (*Ixodes scapularis*) transmits the *Borrelia* species bacteria that causes Lyme disease. There are measures you can take to prevent Lyme disease. However, if you do become infected, most infections are treatable with a short course of commonly prescribed antibiotics.

**What are the symptoms of Lyme disease?**  
Signs and symptoms of Lyme disease include

- An expanding skin rash, called erythema migrans (EM rash)
- Flu-like symptoms (fever, chills, headache, fatigue, swollen lymph nodes)
- Severe joint pain and swelling
- Neurologic symptoms (numbness, pain, facial palsy)
- Heart problems (irregular heart rhythm)

An EM rash, when present, appears 3-20 days at the site of the tick bite. The rash can appear on any area of the body and may have a central clearing as it expands, resulting in a "bull's-eye" appearance. The rash may be warm, but it is rarely itchy or painful. Not all rashes that occur following a tick bite are due to Lyme disease.

**How is Lyme disease diagnosed and treated?**  
Diagnosis of Lyme disease is based upon the presence of signs and symptoms, a history of possible exposure to ticks, and appropriate laboratory testing. Early recognition of symptoms is important and people treated in the early stages of Lyme disease usually recover after a short course of antibiotics.

Some people may continue to have non-specific symptoms such as fatigue, pain, and joint and muscle aches that persist for months after treatment. This is called post-treatment Lyme disease syndrome, or PTLDS.

**How is Lyme Disease prevented?**  
The key to preventing Lyme disease is avoiding tick bites. However, these ticks can be very small and difficult to see. Adult ticks are approximately the size of a sesame seed and nymphal ticks are as small as a poppy seed.

Wearing an EPA-registered insect repellent, reducing the amount of exposed skin, and checking your body for ticks are important steps in preventing Lyme disease and other tick-borne illness. It's important to know where you might find ticks and when ticks are active. Blacklegged ticks are most encountered in wooded environments. In Indiana, nymphal ticks are most active during spring and summer and adults are most active during the fall and early spring. However, adult ticks may be active any time temperatures are above freezing.

In general, CDC does not recommend taking antibiotics after tick bites to prevent tickborne diseases. However, in certain circumstances, a single dose of doxycycline after a tick bite may lower your risk of Lyme disease. Consider talking to your healthcare provider if you live in an area where Lyme disease is common.

Blacklegged tick (*Ixodes scapularis*)  
Adult female

Adult male

Nymph

Larva

Anaplasmosis- [https://www.in.gov/health/idepd/files/vectorborne-zoonotic/Anaplasmosis-Fact-Sheet\\_FINAL.pdf](https://www.in.gov/health/idepd/files/vectorborne-zoonotic/Anaplasmosis-Fact-Sheet_FINAL.pdf)

Ehrlichiosis- [https://www.in.gov/health/idepd/files/vectorborne-zoonotic/Ehrlichiosis-Fact-Sheet\\_FINAL.pdf](https://www.in.gov/health/idepd/files/vectorborne-zoonotic/Ehrlichiosis-Fact-Sheet_FINAL.pdf)

Lyme disease- [https://www.in.gov/health/idepd/files/vectorborne-zoonotic/Lyme-disease-Fact-Sheet\\_FINAL.pdf](https://www.in.gov/health/idepd/files/vectorborne-zoonotic/Lyme-disease-Fact-Sheet_FINAL.pdf)

# Questions?

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