Kansas Department of Health and Environment
Division of Health

Lyme Disease Investigation Guideline

Contents

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Revision History

Date	Replaced	Comments
09/2011	04/2009	Minor formatting of investigation guideline. BEPHI replaced BSE throughout. Updated to 2011 CDC case definition.
02/2012	-	Removed references to KS-EDSS
01/2016	09/2011	Updated Laboratory Analysis Section and Epidemiology More details added to Investigators Responsibilities and Data Management. Reformatted Standard Case Investigation section to assist with EpiTrax system data entry. Added information on PTLDS and when to close a case. Updated Notification, Investigator Responsibilities, and Data Management sections with disease surveillance indicator targets.
05/2018	01/2016	Updated case definition and updated Notification Section with requirements of new reporting regulations.
03/2022	05/2018	Updated case definition to new 2022 CDC definition and laboratory analysis based on “modified two-tier tests” methodology. Disease Overview: comments added on *B. mayonii.* Updated weblinks and references. Checked accessibility.

CASE DEFINITION (CDC 2022)

Clinical Description for Public Health Surveillance:

An illness characterized by one of the following early or late-stage manifestations, as reported by a healthcare provider, and in the absence of another known etiology:

- Erythema migrans (EM) rash.

  For purposes of surveillance, EM is defined as a skin lesion (observed by a healthcare provider) that typically begins as a red macule or papule and expands over a period of days to weeks to form a large round lesion, often with partial central clearing. A single primary lesion must reach a size of ≥5 cm in diameter.

  Note: Secondary lesions also may occur.

- Musculoskeletal system.

  Recurrent, brief attacks (weeks or months) of objective joint swelling in one or a few joints.

  Note: Objective joint swelling may sometimes be followed by chronic arthritis in one or a few joints.

- Nervous system.

  Any of the following signs that cannot be explained by any other etiology, alone or in combination:

  - lymphocytic meningitis;
  - cranial neuritis, particularly facial palsy (unilateral or bilateral);
  - radiculoneuropathy; or,
  - rarely, encephalomyelitis.

- Cardiovascular system.

  Acute onset of high-grade (2nd-degree or 3rd-degree) atrioventricular conduction defects that resolve in days to weeks.

  Note: Atrioventricular conduction defects may sometimes be associated with myocarditis.

Note: This CSTE case definition is intended solely for public health surveillance purposes and does not recommend diagnostic criteria for clinical partners to utilize in diagnosing patients with potential Lyme Disease.

Laboratory Criteria for Case Classification:

Note: The categorical labels used here to stratify laboratory evidence are intended to support the standardization of case classifications for public health surveillance. The categorical labels should not be used to interpret the utility or validity of any laboratory test methodology.

Confirmatory laboratory evidence:

1. Isolation of *B. burgdorferi* sensu stricto or *B. mayonii* in culture, **OR**
2. Detection of *B. burgdorferi* sensu stricto or *B. mayonii* in a clinical specimen by a *B. burgdorferi* group-specific nucleic acid amplification test (NAAT) assay, **OR**
3. Detection of *B. burgdorferi* group-specific antigens by immunohistochemical assay on biopsy or autopsy tissues, **OR**
4. Positive serologic tests[1] in a two-tier or equivalent format, including:
    a. Standard two-tier test (STTT): a positive or equivocal first-tier screening assay, often an enzyme immunoassay [EIA] or immunofluorescence assay [IFA] for immunoglobulin M (IgM), immunoglobulin G (IgG), or a combination of immunoglobulins, followed by a concordant positive IgM[2] or IgG[3] immunoblot interpreted according to established criteria, **OR**
    b. Modified two-tier test (MTTT): positive or equivocal first-tier screen, followed by a different, sequential positive or equivocal EIA in lieu of an immunoblot as a second-tier test[4].

Presumptive laboratory evidence:

1. Positive IgG immunoblot[5], interpreted according to established criteria[3], without positive or equivocal first-tier screening assay.

[1] Currently, there are no serologic tests available for *B. mayonii* infection, but cross-reactivity with *B. burgdorferi* testing may occur.

[2] IgM Western Blot (WB) is considered positive when at least two of the following three bands are present: 24 kDa (OspC)*, 39 kDa (BmpA), and 41 kDa (Fla). Low incidence states should disregard IgM results for specimens collected >30 days after symptom onset. *Depending upon the assay, OspC could be indicated by a band of 21, 22, 23, 24 or 25 kDA.

[3] IgG WB is considered positive when at least five of the following 10 bands are present: 18 kDa, 24 kDa (OspC)*, 28 kDa, 30 kDa, 39 kDa (BmpA), 41 kDa (Fla), 45 kDa, 58 kDa (not GroEL), 66 kDa, and 93 kDa. *Depending upon the assay, OspC could be indicated by a band of 21, 22, 23, 24 or 25 kDA.

[4] The MTTT algorithm should be performed using assays specifically cleared by the US Food and Drug Administration (FDA) for this purpose. (Mead et al, 2019)

[5] While a single IgG WB is adequate for surveillance purposes, a two-tier test is still recommended for clinical diagnosis.

Criteria to Distinguish a New Case from an Existing Case

A new case is one that has not been reported within the same calendar year (January through December).

Case Classification Based on State or Territorial Incidence[1]:

Low-incidence[2] Jurisdictions	**High-incidence[3] Jurisdictions**
Suspect • A case that meets confirmatory or presumptive laboratory criteria, but no clinical information is available, OR • A case of *erythema migrans* rash with no laboratory evidence of infection.	**Suspect** • A case that meets presumptive laboratory evidence
Probable • A clinically compatible case[4] that meets presumptive laboratory criteria.	**Probable** • A case that meets confirmatory laboratory evidence.
Confirmed • A clinically compatible[4] that meets confirmatory laboratory criteria.	**Confirmed** • N/A

[1] For determining incidence for case classification and reporting purposes, calculations should be made at the state or territory level. Case classification for reporting should not be differentially applied at the subdivision level.

[2] **High-incidence jurisdictions** are those that have had an average Lyme disease incidence of ≥10 confirmed cases/100,000 population for a period of three consecutive years. At the time of CSTE position statement 21-ID-05 (spring 2021), those jurisdictions were: Connecticut, Delaware, Maine, Maryland, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia, Wisconsin, and the District of Columbia (Lyme Disease Data Tables: Historical Data | CDC)

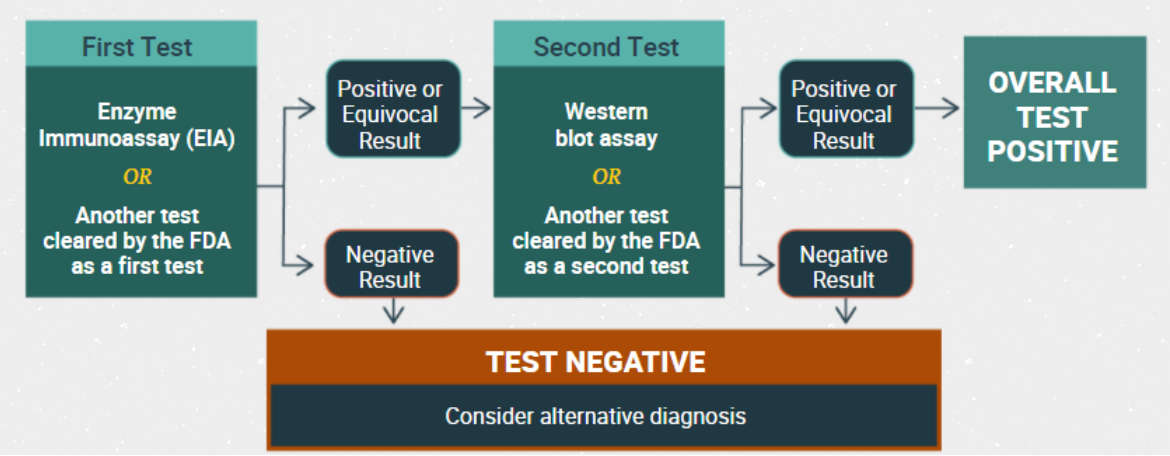
[3] **Low-incidence jurisdictions** are those that have not had an average Lyme disease incidence of ≥10 confirmed cases/100,000 population for a period of three consecutive years. Once ≥10 confirmed cases/100,000 population have been observed in a low-incidence jurisdiction for a period of three consecutive years, they become a high-incidence jurisdiction for the purposes of surveillance and should permanently switch reporting criteria.

[4] A clinically compatible case is defined as a case that meets the clinical criteria defined above.

Note: This CSTE case definition is intended solely for public health surveillance purposes and does not recommend diagnostic criteria for clinical partners to utilize in diagnosing patients with potential Lyme Disease.

LABORATORY ANALYSIS

- Prior consultation required from the KDHE Epidemiology Program at 1-877-427-7317 for testing to be performed through CDC.
- Commercial laboratory tests are available and helpful if used correctly.
- CDC currently recommends a two-step testing process for Lyme disease that can be done using the same blood sample. If the first step is negative, no further testing is recommended. If the first step is positive or equivocal (considered "indeterminate"), the second step is performed. The overall result is positive only when the first test is positive (or equivocal) and the second test is positive (or for some tests equivocal).



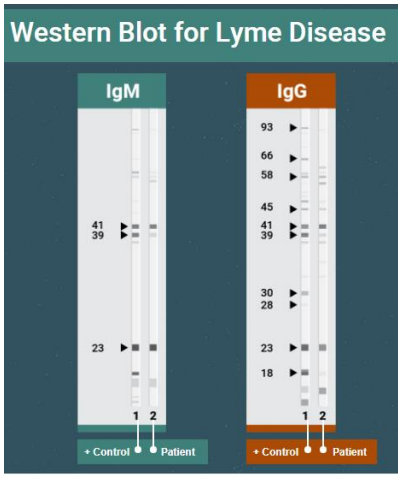
Source: CDC NCEZID Web-based training (WB4330)

- Serologic tests are insensitive during the first few weeks of infection.
- With illness duration >1 month, only IgG or combined IgG/IgM testing should be performed (not IgM alone). A positive IgM test alone in a patient with illness duration >1 month is not reliable for diagnosing current disease.
- Due to antibody persistence, single positive serologic test results cannot distinguish between active and past infection.
- Serologic tests cannot be used to measure treatment response.
- Infection with other diseases, including some tickborne diseases, or some viral, bacterial, or autoimmune diseases, can result in false positive test results.

CDC recommends:

- IgM immunoblot be considered positive if two of the following three bands are present: 24 kDa (OspC) *, 39 kDa (BmpA), and 41 kDa (Fla).
- IgG im
- munoblot be considered positive if five of the following 10 bands are present: 18 kDa, 21 kDa (OspC) *, 28 kDa, 30 kDa, 39 kDa (BmpA), 41 kDa (Fla), 45 kDa, 58 kDa (not GroEL), 66 kDa, and 93 kDa.

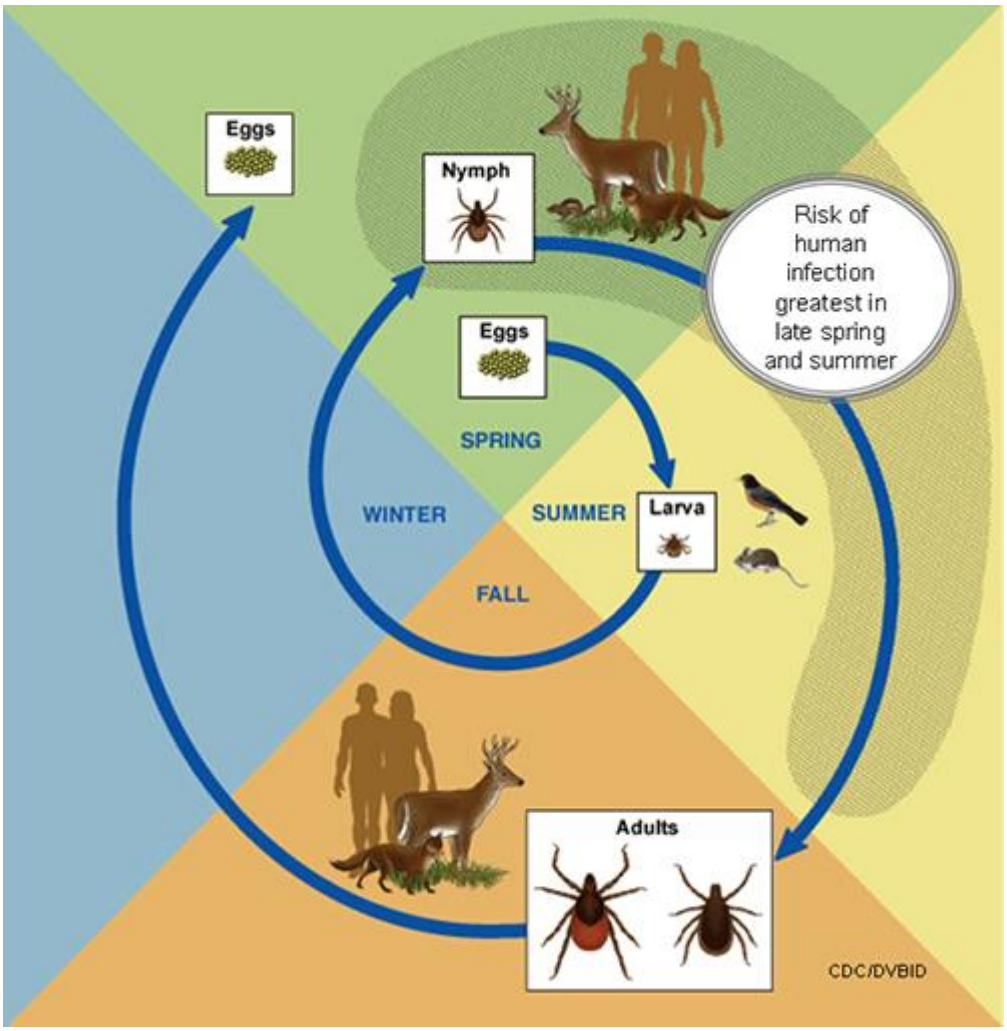
* The molecular mass of OspC is dependent on the strain of *B. burgdorferi* being tested. The 24 kDa and 21 kDa proteins referred to are the same.



EPIDEMIOLOGY

The incidence of Lyme disease is associated with the density of infected tick vectors. While most cases in the United States have been reported in the Northeast, western states, and upper Midwest, nearly all states have reported cases. The incidence varies among states and counties and by season. Most cases occur between April and October with a peak in June and July, when the risk of contact with ticks is greatest.

The lifecycle of blacklegged ticks (*Ixodes scapularis* and *Ixodes pacificus*):



DISEASE OVERVIEW

A. Agent:

In North America, Lyme disease is caused most commonly by the spirochete *Borrelia burgdorferi,* but sometimes by *B. mayonii* in the upper Midwest.

B. Clinical Description:

While the chronology of signs and symptoms may vary significantly, there are three general stages in the clinical manifestation of Lyme disease: early localized, early disseminated, and late.

- *Early Localized*: Symptoms tend to be nonspecific and may include: fever, muscle aches, headache, mild neck stiffness, and joint pain. Erythema migrans (EM) occurs at the site of the tick bite in approximately 70-80% of cases. Typically, EM rashes are circular and grow to a diameter of 5-15 cm, although the shape can be triangular, oval, or irregular. EM frequently clears in the center, resulting in the classic "bull's-eye" presentation.
  - Illness caused *B. mayonii* is like that caused by *B. burgdorferi*; but, unlike *B. burgdorferi, B. mayonii* can cause nausea and vomiting; large, widespread rashes; and a higher concentration of bacteria in the blood.
- *Early Disseminated*: In untreated persons, multiple EM rashes may appear within 3-5 weeks after the tick bite. These secondary lesions, indicative that the infection has spread into the blood, resemble the primary lesion but tend to be smaller. Common signs include: mild eye infections and paralysis of facial muscles (Bell's palsy). Additional symptoms may include: headache, fatigue, and muscle and joint pain. Disruptions of heart rhythm occur in <10% of cases.
- *Late*: Late disease is marked by recurrent arthritis in the knees and shoulders; other joints may also be involved. Neurological signs may include: impairment of mood, sleep disorders, memory difficulties, paralysis of facial muscles, pain or tingling sensations in the extremities and less commonly, meningitis and encephalitis. Late-stage symptoms can persist for several years and tend to resolve spontaneously.

C. Reservoirs:

- Certain ixodid ticks that can transmit transstadially (remain infected from one life stage cycle to the next).
- Wild rodents (i.e., including mice, pack rats squirrels, shrews, and other small vertebrates) help maintain an enzootic transmission cycle.
- Deer serve as important mammalian maintenance host for vector tick species.

D. Mode(s) of Transmission:

Tick-borne; in experimental animals, transmission by *I. scapularis* and *I. pacificus* does not occur until the tick has been attached for 24 hours or more.

E. Incubation Period:

For EM, 3 to 32 days after tick exposure (mean 7 to 10 days); early stages may be inapparent and the patient may present only with late manifestations.

F. Period of Communicability:

Not communicable person-to-person.

G. Susceptibility and Resistance:

All persons are susceptible. Reinfection has occurred after treatment.

H. Treatment:

Usually, amoxicillin, doxycycline, or cefuroxime. Ceftriaxone may be used in Lyme neurological and arthritis disease. Refer to: Treatment | Lyme Disease | CDC. Consider possible co-infections with other agents such as *B. microti* or *A. phagocytophilum* depending on exposure location.

A single dose of doxycycline can lower the risk for Lyme disease when certain conditions are met: Guidance for Clinicians: Recommendations for Patients after a Tick Bite (cdc.gov)

NOTIFICATION TO PUBLIC HEALTH AUTHORITIES

Suspected cases of Lyme disease shall be reported within 24 hours, except if the reporting period ends on a weekend or state-approved holiday, the report shall be made by 5:00 p.m. on the next business day after the 24-hour period:

1. Health care providers and hospitals: report to local public health.
2. Local public health jurisdiction: report to KDHE-BEPHI (see below).
3. Laboratories: report to KDHE-BEPHI (see below).

Kansas Department of Health and Environment (KDHE)
Bureau of Epidemiology and Public Health Informatics (BEPHI)
Phone: 1-877-427-7317
Fax: 1-877-427-7318.

Further responsibilities of state and local health departments to the CDC:

As a nationally notifiable condition, confirmed, probable, and suspect Lyme cases require ROUTINE report to the Center of Disease Control and Prevention (CDC).

1. ROUTINE reporting requires KDHE-BEPHI to file an electronic report for within the next reporting cycle.
2. **Local public health jurisdiction** will report information requested as soon as possible, ensuring that the electronic form is completed within 14 days of receiving a notification of a Lyme report.

INVESTIGATOR RESPONSIBILITIES

1) Report all cases to the KDHE-BEPHI.
   - Initiate the case investigation within 3 days of notification of a report.
   - Complete the investigation within 14 days of the notification.
2) Contact medical provider to collect additional information and confirm diagnosis using current case definition.
   - Collect all information requested in Step 1 of case investigation.
   - Ensure that case/proxy is aware of the diagnosis.
3) Conduct a case investigation to determine the individual's at-risk activities and potential geographical location of exposure.
4) Record data, collected during the investigation, in the KS EpiTrax system under the data's associated [tab] in the case morbidity report (CMR).
5) As appropriate, use the disease fact sheet to notify the case, contacts and other individuals or groups.

STANDARD CASE INVESTIGATION AND CONTROL METHODS

Case Investigation

1) Contact the medical provider who ordered testing of the case and obtain the following information; including medical records for hospitalized patients.
   - Did the physician diagnosis Lyme disease? [Investigation – Symptoms]
     - If the physician, specifically states it is not a case of Lyme disease – the investigator should document this and close the case.
   - Was erythema migrans (EM) diagnosed by a physician? [Investigation – Symptoms]

  - EM is a skin lesion that begins as a red macule/papule and expands over a period of days or weeks to form a large round lesion (often with partial central clearing). The size must reach at least 5 cm.
  - If there was EM diagnosed, invest time and effort to identify the most likely location of exposure (Step 2). [Investigation – Exposure]
- Obtain information on any laboratory tests performed.
  - Results of EIA/IFA testing, IgM and IgG or Total (1st tier or 2nd tier).
  - Results of Western Blot, IgM and IgG (2nd tier only after 1st tier)
  - Results of culture, if done.
- Record onset date of first symptoms associated to this episode [Clinical]
  - Non-confirmatory symptoms, including arthralgias, bundle branch block, cognitive impairment, encephalopathy, fatigue, fever/sweat/chills, headaches, myalgias, myocarditis, neck pain, rash other than EM, palpitations, paresthesias, peripheral neuropathy, visual/auditory impairment. [Investigation – Symptoms]
  - Confirmatory symptoms: Arthritis (characterized by brief attacks of joint swelling), Bell's Palsy or other cranial neuritis, radiculoneuropathy, lymphocytic meningitis, encephalomyelitis, 2nd/3rd degree atrioventricular block. [Investigation – Complications]
- Collect patient's demographics (address, birth date, gender, race/ethnicity, primary language, and phone number(s)). [Demographic]
- Record treatment: type of antibiotic and number of days prescribed.
- Record hospitalizations: location and duration of stay. [Clinical]
- Record outcomes: survived or date of death. [Clinical]
- Record pregnancy status for women. [Clinical]

2) Establish if illness is compatible to Lyme based on labs and symptoms.
   - A case of EM diagnosed by a medical provider who does not specifically state it is not a case of Lyme should always be investigated.
   - If any of the following situations are present without EM the investigation can be closed as 'Not a Case':
     - Medical provider states it is not a case of Lyme disease.
     - A positive IgM sample was collected >30 days from the onset of illness and the IgG result is negative.
     - A positive IgM by immunoblot that did not first tier testing performed that was 'equivocal' or 'positive' for IgM or total antibody.
     - An immunoblot where the number of positive bands are less than two for IgM or less than five for IgG.
3) If a continued investigation is needed and the patient charts do not provide information on the following risk factors or travel, interview the case to determine risk factors and transmission. [Investigation – Exposure]
   - Thirty days prior to patient's illness onset, was there any exposure to wooded or brushy areas or exposure to animals that may have been in a wooded/brushy area.
   - Where were the wooded or brushy areas located that were associated to direct or indirect exposure during the 30 days prior to illness onset.
     - Travel to other Kansas counties? (If yes, City/County and dates)
     - Was there travel outside of Kansas?
       - Travel in the U.S.? (If yes, City/State and dates)

    - Travel internationally? (If yes, City/Country and dates)
- Record patient's occupation [Epidemiologic]

4) Examining the epidemiological information, record where the infection was most likely imported from. (Indigenous or out-of-county, state, or U.S.) [Epidemiologic]; also record the county, state, and country that was the most likely exposure [Investigation – Exposure].

Contact Investigation

Not usually required, these diseases cannot be transmitted from person-to-person, but an individual living in the same household, travel companions, co-workers, and anyone else who might be exposed to infected ticks is potentially at risk.

Isolation, Work and Daycare Restrictions

None.

Case Management

Not required, but some patients may report "Chronic Lyme disease". Please read the talking points below on "Chronic Lyme" or Post-treatment Lyme disease.

1) It is not uncommon for patients treated for Lyme disease with a recommended 2 to 4-week course of antibiotics to have lingering symptoms of fatigue, pain, or joint and muscle aches at the time they finish treatment.
2) In a small percentage of cases, these symptoms can last for more than 6 months. Although sometimes called "chronic Lyme disease," this condition is properly known as "Post-treatment Lyme Disease Syndrome" (PTLDS).
3) The cause of PTLDS is not known, but additional antibiotic treatment may not be the best course of action.
    - Studies have not shown that patients who received prolonged courses of antibiotics do better in the long run than patients treated with placebo.
    - Long-term antibiotic treatment for Lyme disease has been associated with serious complications.
    - Patients with PTLDS almost always get better with time; but it can take months to feel completely well.

For a patient who feels they are suffering from PTLDS, instruct them:

1) Check with your doctor to make sure that Lyme disease is not the only thing affecting your health.
2) Become well-informed. A lot of inaccurate information is available, especially on the internet. Learn how to sort through this maze.
3) Track your symptoms. It can be helpful to keep a diary of your symptoms, sleep patterns, diet, and exercise to see the influence on your well-being.
4) Maintain a healthy diet and get plenty of rest.
5) Share your feelings. If your family and friends can't provide the support you need, talk with a counselor who can help you find ways of managing your life during this difficult time.

Additional resources are at: Post-Treatment Lyme Disease Syndrome | CDC

Contact Management

1) Preventive treatment is generally not recommended after a recognized tick bite. However, in areas that are highly endemic for Lyme disease, a single dose of doxycycline may be offered to adult patient who are not pregnant and to children older than 8 years of age when ALL of the following circumstances are met:
   - Doxycycline is not contraindicated.
   - The attached tick can be identified as an adult or nymphal *I. scapularis*.
   - Estimated time of attachment is ≥36 hours based on the degree of tick engorgement or likely time of exposure.
   - Prophylaxis can be started within 72 hours of tick removal.
   - The tick bite occurred in a state where Lyme disease incidence is high or in an area where >20% of ticks are infected with *Borrelia burgdorferi*.
2) Instruct those exposed to a tick to monitor themselves for symptoms. Treatment is necessary only if symptoms develop.
3) Those who exhibit any signs or symptoms compatible with tick-borne illness should be referred to their medical provider for evaluation.

Environmental Measures

Veterinary tick control in domestic animals:

1) Domestic animals may become infected with Lyme disease bacteria and some (dogs, for instance) may develop arthritis.
2) Domestic animals can carry infected ticks into areas where people live.
3) Veterinary tick control products may help to reduce tick presence on pets.

Community-based integrated tick management strategies:

1) May reduce the incidence of tick-borne infections, but limiting exposure to ticks is the most effective method of prevention
2) Strategies to reduce vector tick densities through area-wide application of an acaricide (i.e., chemicals that kill ticks and mites) and control of tick habitats (e.g., leaf litter and brush) have been effective in small-scale trials.
3) New methods under development include applying acaricide to rodents and deer by using baited tubes, boxes and deer feeding stations in areas where these pathogens are endemic.
4) Biological control with fungi, parasitic nematodes, and parasitic wasps may play important roles in integrated tick control efforts.

Additional measures that can assist with determining risk include:

- Entomologic surveys: Inventory and mapping of tick populations sometimes with limited testing for Borrelia burgdorferi. This can occur as part of special studies and through monitoring at deer.
- Reports of increased Lyme morbidity in animals in the area.
- Tick identification: Contact your local K-state extension office or the Insect Diagnostician with the K-State Department of Entomology.

Education

As opportunities allow, the following general messages should be distributed:

1) In tick-infested areas, the highest risk of bites is from March-July.
2) The use of protective clothing, including light-colored garments, long pants tucked into socks, long-sleeved shirts, hats, as well as tick repellents, may reduce risk.
3) Outdoor activities in tick-infested areas present opportunities for exposure.
4) Keep yards clear of excessive leaves, brush, and tall grasses. Walk in the center of trails to avoid contact with tall grasses and brush.
5) When camping, sleep in screened tents.
6) Hunters should be aware of tick infestations on mammals, especially deer, and check for tick attachments after handling carcasses.
7) Keep pets free of ticks.
8) Transmission requires a long attachment. Check for ticks at regular intervals while outdoors and after spending time outdoors in tick infested areas.
9) Remove attached ticks intact, do not leave embedded head parts. Use gentle, direct traction with tweezers or hemostat. Other methods, such as application of a hot match or petroleum products to the tick, are less reliable. Do not crush ticks as this may result in direct inoculation of spirochetes.

Additional public education materials are available at:

- Lyme Disease Toolkit | CDC
- Tickborne Disease Index on Tick Website | CDC

Medical Providers will find the following resources helpful:

- Healthcare Providers | Lyme Disease | CDC
- Webinar May 20, 2021 - Lyme Disease Updates and New Educational Tools for Clinicians (cdc.gov)

MANAGING SPECIAL SITUATIONS

Outbreak Investigation

- There are no formal outbreak definitions; however, the investigator may consider the possibility of an outbreak when there is an unusual clustering of cases in time and/or space.
- Notify KDHE immediately, 1-877-427-7317.
- Active case finding will be an important part of any investigation.

DATA MANAGEMENT AND REPORTING TO THE KDHE

A. Accept the case assigned to the LHD and record the date the LHD investigation was started on the [Administrative] tab.

B. Organize and collect data, using appropriate data collection tools including:
- The Lyme Disease Form can be used to collect information.
- Alternatively, investigators can collect and enter all required information directly into EpiTrax [Investigation], [Clinical], [Demographics], [Epidemiological] tabs.
- During outbreak investigations, refer to guidance from a KDHE epidemiologist for appropriate collection tools.

C. Report data collected during the investigation via EpiTrax**.**
- Verify that all data requested on the Lyme Disease Form has been recorded on an appropriate EpiTrax [tab], or that actions are completed for a case lost to follow-up as outlined below.
- Some data that cannot be reported on an EpiTrax [tab] may need to be recorded in [Notes] or scanned and attached to the record.
- Paper report forms do not need to be sent to KDHE after the information is recorded and/or attached in EpiTrax. The forms should be handled as directed by local administrative practices.

D. If a case is lost to follow-up, after the appropriate attempts to contact the case have been made:
- Indicate 'lost to follow-up' on the [Investigation] tab with the number of attempts to contact the case recorded.
- Record at least the information that was collected from the initial reporter.
- Record a reason for 'lost to follow-up' in [Notes].

E. Once the investigation is completed, the LHD investigator will record the date the investigation was completed on the [Administrative] tab and click the "Complete" button. This will trigger an alert to the LHD Administrator so they can review the case before sending to the state.
- The LHD Administrator will then "Approve" or "Reject" the CMR.
- Once a case is "Approved" by the LHD Administrator, BEPHI staff will review and close the case after ensuring it is complete and that the case is assigned to the correct event, based on the reported symptoms reported.

  (Review the EpiTrax User Guide, Case Routing for further guidance.)

ADDITIONAL INFORMATION / REFERENCES

A. Treatment / Differential Diagnosis: 2021. "Lyme Disease (Lyme Borreliosis, *Borrelia burgdorferi* sensu lato Infection)", Red Book: 2021–2024 Report of the Committee on Infectious Diseases, Committee on Infectious Diseases, American Academy of Pediatrics, David W. Kimberlin, MD, FAAP, Elizabeth D. Barnett, MD, FAAP, Ruth Lynfield, MD, FAAP, Mark H. Sawyer, MD, FAAP

B. Case Definitions: CDC Division of Public Health Surveillance and Informatics, Available at https://ndc.services.cdc.gov/

C. CDC References on Established Criteria for Interpreting Testing:

- Centers for Disease Control and Prevention. Recommendations for test performance and interpretation from the Second National Conference on Serologic Diagnosis of Lyme Disease. MMWR Morb Mortal Wkly Rep 1995; 44:590–1. Accessed at www.cdc.gov/mmwr/preview/mmwrhtml/00038469.htm
- Updated CDC Recommendation for Serologic Diagnosis of Lyme Disease. MMWR Morb Mortal Wkly Rep 2019;68:703. Accessed at https://www.cdc.gov/mmwr/volumes/68/wr/mm6832a4.htm

D. Tickborne Diseases of the United States: A Reference Manual for Health Care Providers: https://www.cdc.gov/ticks/tickbornediseases/index.html

E. Additional Information (CDC): https://www.cdc.gov/lyme/index.html