Common ticks encountered in Michigan

Only the blacklegged tick transmits the Lyme disease pathogen

American dog tick
Blacklegged tick (deer tick)
Lone star tick (rare)

Lyme disease: background information

- Lyme disease is the most common vector-borne disease in the United States (Mead 2015)
- Vector: Ticks
  - Main vector in northeastern and north central U.S.: *Ixodes scapularis* (AKA blacklegged and deer tick)
- Pathogen: *Borrelia burgdorferi*
  - Bacterium
  - Spirochete
Ticks will embed their mouthparts in the skin, and may be difficult to detect due to their small size. Prompt removal of ticks is preventative for Lyme disease as studies have shown it takes >36 hours for efficient *B. burgdorferi* transmission to occur.

People come into contact with ticks while working or recreating in wooded areas or areas with shade and vegetation, which is the preferred habitat for Blacklegged ticks.

Lyme bacteria

Lyme disease is maintained in nature through infection between Blacklegged ticks and small mammals.

Ecology of Lyme disease

Nymphal stage: the epidemiologically most important stage for humans!

70% of infected persons have Erythema migrans (EM) rash

- Begins at the site of a tick bite after a delay of 3 to 30 days
- Expands gradually
- “Bull’s-eye” appearance
Other symptoms 3 to 30 days after tick bite include:

- Fever
- Chills
- Headache
- Fatigue
- Muscle and joint aches
- Swollen lymph nodes
- Full recovery usually with early recognition & treatment with antibiotics

Emergence and Expansion of Lyme Disease in Michigan
Michigan passive public health surveillance

Lyme disease cases by year, Michigan 2002–2016

Reported Lyme disease cases in Michigan: 2015

EPI Curve

2016 Atypical Case Investigation

- **July 12, 2016** – MDHHS contacted by Washtenaw County public health regarding suspected Lyme carditis case with potential local exposure
  - Interview with patient and family: no history of travel, but walked dog frequently on family property. Pt reported embedded ticks in neck and scalp in early May, he thought they were “dog ticks”

- **July 20, 2016** – MDHHS receives convalescent specimens for confirmatory Lyme antibody testing

- **July 27, 2016** – Lyme positive antibody results confirmed by MDHHS Bureau of Laboratories
Important Considerations

- Blacklegged ticks and Lyme disease were not previously thought to be established in Washtenaw Co.
- Previous field surveillance has not detected populations
- Few tick submissions from the public
- Case report provided strong evidence of local exposure to ticks with resulting Lyme illness
- MDHSS EZID Section staff, Michigan State University faculty & students, and local public health proposed ecologic case follow-up to determine if Washtenaw County is an area of Lyme emergence

Field investigation (Aug. 28-Sept. 2, 2016)

Objectives:
To assess Lyme disease risk at case patient’s residence, natural areas in Washtenaw County, and a control site by:
   a) Investigating the relative abundance of *I. scapularis*
   b) Determining the infection prevalence of *B. burgdorferi* in ticks and small mammal tissue biopsies
Methods

Tick dragging

Small mammal trapping

Laboratory procedure
A. Tick identification
B. DNA extraction
C. PCR for pathogen DNA

Results – trapping effort and success

Table 1. Trapping effort and capture success for small mammals in southeastern Michigan (Waterloo SRA, Pinckney SRA, and the patient’s residence), and at the Mid-Michigan Control Site. At each site, transects were trapped for 2 consecutive nights between August 28 - September 2, 2016.

<table>
<thead>
<tr>
<th>Site</th>
<th>Mammals captured</th>
<th>Adjusted trap nights</th>
<th>Capture success (%)</th>
<th>Mark recapture population estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterloo SRA</td>
<td>30</td>
<td>286</td>
<td>10.5</td>
<td>27.5</td>
</tr>
<tr>
<td>Pinckney SRA</td>
<td>18</td>
<td>146</td>
<td>12.3</td>
<td>22</td>
</tr>
<tr>
<td>Patient residence</td>
<td>3*</td>
<td>73</td>
<td>2.7</td>
<td>**</td>
</tr>
<tr>
<td>Total for Southeast</td>
<td>50</td>
<td>565</td>
<td>9.9</td>
<td>31.5</td>
</tr>
<tr>
<td>Mid-Michigan Control</td>
<td>48</td>
<td>260</td>
<td>15.9</td>
<td>105</td>
</tr>
</tbody>
</table>

* Found dead on property; **Insufficient data to analyze. Control site w/much higher small mammal populations.

Results – on host ticks

Figure 2. Percentage of small mammals infested with *Ixodes scapularis* larvae at four sites in mid and southeastern Michigan, August 28 – September 2, 2016.
Results – dragging success

<table>
<thead>
<tr>
<th>Site</th>
<th># Ticks (L / N)</th>
<th>Distance dragged (m²)</th>
<th>Overall dragging success (L / N)</th>
<th>Ticks/1000 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterloo SRA</td>
<td>112 / 0</td>
<td>1470</td>
<td>0.070 / 0</td>
<td>78 / 0</td>
</tr>
<tr>
<td>Pinckney SRA</td>
<td>0 / 0</td>
<td>1200</td>
<td>0 / 0</td>
<td>0 / 0</td>
</tr>
<tr>
<td>Patient residence</td>
<td>0 / 0</td>
<td>240</td>
<td>0 / 0</td>
<td>0 / 0</td>
</tr>
<tr>
<td>Mid Michigan Control</td>
<td>134 / 3</td>
<td>1910</td>
<td>0.065 / 0.002</td>
<td>65 / 2</td>
</tr>
</tbody>
</table>

Results – B. burgdorferi prevalence

Discussion

- Ecologic case follow-up studies help document the expanding distribution of *I. scapularis*, and provided valuable information regarding Lyme disease risk.
- Waterloo and Pinckney SRA’s are now considered to have established populations of *I. scapularis*.
- Waterloo and Pinckney SRA’s span Livingston, Washtenaw, and Jackson Counties, so additional field studies may document further population spread in those counties.
- *B. burgdorferi* has been documented in Washtenaw Co. wildlife.
- It is likely that Lyme disease risk will continue to expand into suitable habitats.
Fall 2016 Field Surveillance Results

- Dates: Range from Oct. 11-Nov. 16, 2017
- Total meters dragged: 48,005 m²
- 400 ticks collected
  - 1 blacklegged nymph
  - 399 blacklegged adults
- Ticks collected in 6/12 counties
- Preliminary pathogen testing: Infection detected in Washtenaw and Iosco Counties
Fall 2016 Field Surveillance Conclusions

- Michigan's Lyme disease risk map has been updated to reflect the new information.
- Continued outreach to the public and healthcare providers regarding Lyme disease risk in the region.
- Additional field surveillance efforts in Spring/Summer 2017.

More resources available online:

- www.michigan.gov/lymeinfo
- www.michigan.gov/lyme
- www.cdc.gov/lyme
Why is the Lyme disease definition changing?

• As with other nationally notifiable conditions, CDC works with states and territories on an ongoing basis to discuss ways to simplify and improve surveillance for Lyme disease.

• This new case definition is the result of several years of collaboration to create more standardized criteria to determine likelihood of exposure to Lyme disease.

Key changes to the definition

1. Testing of cerebrospinal fluid (CSF) is no longer required for the reporting of encephalomyelitis.

2. Criteria to distinguish a new case from an existing case have been added.
   – Case not previously reported to public health authorities
3. Exposure

- In the PAST: Exposure has been defined as residence in or travel to a wooded, brushy, or grassy area in an “endemic” county, which proved to be an unstandardized classification.

- NOW (2017): Likelihood of exposure will be assessed based on residence in or travel to a wooded, brushy, or grassy area in a state that consistently reports a high incidence of Lyme disease (>10 per 100,000 population).
  - Confirmation of cases with only an erythema migrans rash and without exposure in a high incidence state requires laboratory evidence of infection.

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High vs. Low Incidence States

- The U.S. is now divided into high- or low-incidence Lyme disease states

- **High-incidence**: at least 10 confirmed cases/100,000 for the previous three reporting years

- **Low-incidence**: less than 10 confirmed cases/100,000 for the previous three reporting years

- Michigan is considered a LOW-incidence state

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What are the high-incidence states?

- Connecticut (CT)
- Delaware (DE)
- Maine (ME)
- Maryland (MD)
- Massachusetts (MA)
- Minnesota (MN)
- New Hampshire (NH)
- New Jersey (NJ)
- New York (NY)
- Pennsylvania (PA)
- Rhode Island (RI)
- Vermont (VT)
- Virginia (VA)
- Wisconsin (WI)
Exposure change

- Now, you need to ask if the patient has traveled to a high-incidence state within 30 days before the onset of signs/symptoms
- If he/she did NOT travel to a high-incidence state, we will no longer classify a patient with an EM who lacks laboratory evidence, as a confirmed case

Key changes to the definition

   - Final totals of reported Lyme disease cases will continue to be reported in the annual final tables in CDC’s MMWR each fall, on CDC’s Lyme disease statistics webpage, and in the annual Summary of Notifiable Infectious Diseases and Conditions, published in CDC’s MMWR each year.

Case Classifications in MDSS

You can now close a case as either:

1) Suspect
2) Probable
3) Confirmed
Suspect Cases

• A case of EM where there is no known exposure* and no laboratory evidence of infection
  – *Exposure is defined as having been (less than or equal to 30 days before onset of EM) in wooded, brushy, or grassy areas (i.e., potential tick habitats) of Lyme disease vectors in a HIGH INCIDENCE STATE.

Probable Cases

• Any other case of physician-diagnosed Lyme disease that has laboratory evidence of infection
  – Laboratory evidence plus non-confirmatory ss/sx

Confirmed Cases

• A case of EM with exposure in a high incidence state OR
• A case of EM with laboratory evidence of infection and a known exposure in a low incidence state OR
• Any case with at least one late manifestation that has laboratory evidence of infection
Review of lab results

To meet CDC criteria:
• 2-tier positive IgM Western Immunoblot (WB or IB) test collected within 30 days of onset
• 2-tier positive IgG WB/IB
• 1-tier positive IgG WB/IB
• Positive B. burgdorferi culture
• CSF antibody positive for B. burgdorferi by EIA or IFA (CSF titer must be higher than serum titer)

Does NOT meet CDC criteria:
• Positive ELISA/EIA/IFA only
• IgM WB/IB only
• IgM WB/IB collected >30 days after onset

Please enter information about all laboratory testing performed into MDSS!

Updated flow chart...

The updated flow chart can be found here.
No, does not meet lab criteria

2
Speak to healthcare provider (HCP) to determine if patient had a diagnosed erythema migrans (EM)

Yes, EM diagnosed

No, EM not diagnosed

3
Did patient have exposure to a wooded, brushy, or grassy area <30 days before onset in a HIGH-incidence state?

Exposure in HIGH-incidence state

No exposure in HIGH-incidence state

Confirmed

Suspected

The updated flow chart can be found [here](#).

Updated flow chart...

Receive a positive lab result

1
 Verify that the patient had all labs necessary to meet CDC criteria

Yes, meets criteria

No, does not meet criteria

• 2-tier + IgM Western Immunoblot (WB or IB) test collected within 30 days of onset OR
• 2-tier + IgG WB/IB test OR
• 1-tier + IgG WB/IB test OR
• B. burgdorferi culture OR
• CSF antibody + for B. Burgdorferi by EIA or IFA (CSF titer must be higher than serum titer)

• Positive ELISA/EIA/IFA only OR
• IgM WB/IB only OR
• IgM WB/IB collected >30 days after onset

The updated flow chart can be found [here](#).

Yes, meets lab criteria

2
Speak to healthcare provider (HCP) to determine if patient had a diagnosed EM

Did not diagnose and/or no exposure

Diagnosed with exposure

Confirmed

The updated flow chart can be found [here](#).
Any Questions?

Let’s go over a couple of examples...

Example 1

• 32 yo male dx with LD on August 10, 2017
• Pt lives in Oakland county
• Ss/sx: EM dx (by PCP!!!), myalgia, fever, and fatigue
• Onset of ss/sx: August 1, 2017
• Additional info.: No hx of tick bite, but went camping in WI on July 20, 2017
• No laboratory tests run, dx was made by PCP based on clinical presentation

Classification?
Confmed

- Lab results do not meet CDC criteria
- EM dx by health care provider
- Exposure to wooded/brushy area <30 days before onset in a HIGH-incidence state

A case of EM with exposure in a high-incidence state

Example 2

- 45 yo female dx with LD on June 30, 2017
- Lives in Van Buren county, no travel hx
- Additional info.: remembers pulling off an engorged tick after spending multiple days cleaning up brush in yard
- Ss/sx: EM dx (by PCP!!!), myalgia, headache, chills, fatigue
- Onset of ss/sx: June 15, 2017
- Laboratory tests: WB was run-Positive IgM only (collected June 30)

Classification?

Suspected

- Lab results do not meet CDC criteria (need 2-tier testing)
- EM was dx by health care provider
- No exposure in a HIGH-incidence state

A case of EM where there is no known exposure and no laboratory evidence of infection
Example 3

- 12 yo male dx with LD on September 5, 2017
- Lives in Leelanau county, no out-of-state travel hx
- Additional info.: Recently went to North Manitou Island for weekend camping trip with boy scout troop and all of the boys were pulling ticks off of one another while hiking
- Ss/sx: fatigue, neck pain, headache, fever
- Onset of ss/sx: August 20, 2017
- Laboratory tests: Positive EIA, positive WB/IB IgM, negative WB/IB IgG (collected Sept. 5, 2017)

Classification?

Probable

- No EM dx by health care provider
- No late manifestations of LD
- Other symptoms not specific to LD were present
- Lab results meet CDC criteria

Any other case of physician-diagnosed Lyme disease that has laboratory evidence of infection

Tick ID and Testing!

- Expert tick identification and testing is available from the MDHHS.
- Place the tick in a small vial containing a damp piece of tissue or piece of grass and submit it using the MDHHS test requisition, following guidelines for tick identification and testing found at: www.michigan.gov/lyme.
- This service is free to the public for ticks removed from residents in Michigan.
QUESTIONS?