Tickborne Illness in Wisconsin - Lyme Disease, 2010

Diep (Zip) Hoang Johnson
Wisconsin Division of Public Health
608-267-9000
07/09/10
Tickborne Surveillance in WI

- Lyme disease
- Anaplasmosis/Ehrlichiosis
- Babesiosis
- Spotted Fever Rickettsiosis (SPF), including Rocky mountain spotted fever (RMSF)
- Powassan
# Reported Confirmed and Probable Cases, 2009

<table>
<thead>
<tr>
<th>Disease</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyme disease</td>
<td>2584</td>
</tr>
<tr>
<td>Anaplasmosis/Ehrlichiosis</td>
<td>340</td>
</tr>
<tr>
<td>Babesiosis</td>
<td>17</td>
</tr>
<tr>
<td>RMSF*</td>
<td>5</td>
</tr>
</tbody>
</table>

*Most of the reported cases were exposed out of state*

Revised 4/27/10
• Ticks are not insects
• They are arthropods closely related to mites and spiders
• In US, there are 80 species (850 species worldwide)
• 12 species are of public health or veterinary concerns
• In Wisconsin and the mid-west, the blacklegged tick, *Ixodes scapularis* are known as the “deer” or “bear” tick is a major concern for Lyme disease
Ixodes scapularis

In Wisconsin *Ixodes* ticks can transmit

- Lyme disease
- Babesiosis
- Anaplasmosis
- Ehrlichiosis- *E. muris* -like (EML)
- Powassan virus infection
Ixodes – 2-year Life Cycle

Based on EM case onsets, nymphs account for most transmission.

Risk of infection is greatest in spring and summer.

Adult females and nymphs can acquire an infectious agent and transmit disease to the host when they take a blood meal.
“Wood” Ticks

Dermacentor variabilis

- Commonly known as “wood” ticks, American dog ticks
- Most common ticks found in eastern and central United States
- They do not transmit Lyme disease, anaplasmosis, or babesiosis
- 2009, 88 Dermacentor ticks collected in northwestern WI were negative for multiple agents

Dermacentor andersoni

- Commonly known as the Rocky Mountain wood ticks
- Rock Mountain spotted fever (RMSF), new name spotted fever rickettsiosis (SFR)
- Tularemia (found in western North America)
- Colorado tick fever
Lyme Disease

Disease Characteristics
Laboratory testing, results, and interpretations
Surveillance Case Definition
Epidemiology and Statistics
Reporting
Lyme Disease

- Spirochete bacterium - *Borrelia burgdorferi*
- Reportable disease since 1980
- Endemic in Wisconsin
- Seasonal transmission
- Transmitted by a bite of an infected *Ixodes scapularis* tick
- Reservoir for the bacteria - birds and small mammals
- Host of the ticks - small and large mammals (deer and humans)
History

• Cases reported in Europe as early as 1909
• First fully described in Lyme, Connecticut in 1975 after a childhood cluster of illnesses
• However, the first reported case in USA was seen in Wisconsin in 1969
Tick Embedded in Skin

Ticks must be attached for 24-48 hours to transmit bacteria
Early Localized Stage-Erythema Migrans (EM)

The EM rash expands in size (> 5cm) occurs within 30 days of tick bite

- EM begins at the site of the tick bites
- Headache
- Low grade fever
- Myalgias
Early Disseminated Stage

Occurs from days to weeks
- Fever and chills
- Headaches
- Malaise or fatigue
- Myalgias (muscle and joint pain)
- Cranial neuritis (Bell’s palsy)
- Multiple EM lesions
- Generalized lymphadenopathy (lymph nodes)
- Stiff neck/Meningitis
- Radiculoneuropathy (nerves and roots)
- Arthritis (asymmetrical, larger joints)
- Atrioventricular block (atrium of the heart)
- Myopericarditis (inflammation of muscular walls and the fibroserous sacs of the heart)
Early Disseminated Symptoms

- Large Joint Swelling
- Cranial Neuritis
Late Persistent Stage

Occurs from months to years

- Arthritis
- Encephalomyelitis (inflammation involving both brain and spinal cord)
- Nervous system
- Cardiovascular system
- Fatigue
Recurrent Episodes of Lyme Disease

Study of EM patients*

- No lasting immunity, can get infected more than once
- Uncertain if having one episode provides short-lived immunity
- Repeated episodes of Lyme disease may reflect relapse of a persistent infection or reinfection
- Most recurrent episodes are due to reinfection
- Reinfection may be due to at least 17 different subtypes of *B. burgdorferi* strains in the US
- More difficult to differentiate between reinfection and relapse if no EM is present

*Reference 6,7,8
Lyme Disease Reinfection

- EM rash at a different site from the original episode of infection; recent tick bite within 30 days from the site of lesion
- EM rash usually has a raised or indented red point within the center of the rash at the site where the tick was removed from the skin
- Usually seasonal during spring or summer in places where nymphs are abundant
- Symptoms appear to be less severe with each episode of reinfection
- Reinfection may occur (≥ 1 year after initial episode)
- May be due to treatment in the early stage of Lyme disease before a strong antibody response was produced
- Reinfection is very rare in patients who were treated in late stage of Lyme disease

*Reference 6,7,8
Lyme Disease Relapse

• Relapses can occur if patient with Lyme disease is left untreated or treatment failure

• Patient with EM rash that are treated usually does not have relapses

• Rash can reappear anytime usually within a year of the first EM (untreated) episode

• EM rash is at the same site as the original episode of infection; no history of recent tick bite within 30 days from the site of lesion

• EM rash does not have a raised or indented red point within the center of the rash at the site where the tick was removed from the skin

*Reference 6,7,8
Lyme Disease - Treatment

- CDC uses the guidelines by the Infectious Diseases Society of America (IDSA)
- Antibiotics - very effective if treated early (amoxicillin, doxycycline,..)
- Usually oral but may be given intravenously in more severe cases
- Recurrent symptoms may require a second course of antibiotic
- Long-term intravenous courses (months to years) have not been shown to be beneficial but may cause more complications (gallstones, catheter associated bloodstream infections,...)
- Post-lyme disease syndrome in patients who have non-specific symptoms after treatment but have no evidence of active infection with *B. burgdorferi* is not very well understood
Is there a vaccine against Lyme disease?

- No current available vaccine for humans
- Vaccine was available in 1998 (LYMERrix), discontinued in 2002 (need for frequent boosters, expensive, not approved for children, decrease in demand)
- On-going research
Lyme Disease- Antibody Response

Both IgM and IgG can persist for years (10-20 years)

- **Specific IgM response to *B. burgdorferi***
  - Produce earlier than IgG
  - Peaks within the first several weeks
  - IgM is less specific than IgG
  - Generally highest among patients with early disseminated infection

- **Specific IgG response**
  - Produce a few weeks after IgM
  - Peaks months to years
  - Generally highest in later stages of infection
  - Most active infections should have a positive IgG test result in one month
Lyme Disease- Testing Methods

- FDA approved over 70 different commercial tests for Lyme disease
- Appropriate testing should be validated for accuracy by either FDA approved or published in peer-reviewed scientific literature
- Most common serologic assays to detect antibodies include:
  - Enzyme immunoassay (EIA) tests
  - Immunofluorescent assays (IFA)
  - Western Blot test
- Culture- detects growth of organism to confirm active infection
- PCR- molecular method of detecting DNA of organism (synovial fluid)
Limitation of Testing

• Serology testing*
  – Tests variability predictive among different manufactures (positive predictive value, sensitivity, specificity, and accuracy)
  – False negatives may occur in the first few weeks after infection when the antibody response is low (certain tests may not have high sensitive)
  – false positive and cross-reacting antibodies to other tickborne, autoimmune, viral, bacteria, musculoskeletal, and neurological diseases
  – Reproducibility is not reliable between inter- and intra-laboratories
  – Serology testing does not distinguish between active or past infection
  – Serology tests are not required for patients with early localized EM lesions
  – Serology tests are most helpful for patients who have early disseminated stage

*Reference 1,3,4,5
Limitation of Testing (continue)

- **PCR**
  - Good results when use on synovial fluid and skin biopsy
  - Low sensitivity when use on blood, CSF, or urine
  - Cannot be used on treated patient
  - Potential for false positive due to contamination

- **Culture**
  - Best to confirm active infection
  - High sensitive in skin biopsy of EM patients
  - Low sensitivity in patients with extracutaneous manifestation
  - Time consuming, expensive, and labor-intensive
  - Low sensitivity in blood, serum (CSF unknown)
  - Cannot be used on treated patient

*Reference 1,3,4,5*
Surveillance

Purpose for surveillance:

• Define demographic, geographic, and seasonal distribution of Lyme disease
• Monitor disease trends in a more consistent and unified manner
• Identify areas where Lyme disease may be emerging and current areas in Wisconsin where there may be increased risk of ticks infected with Lyme disease
• Evaluate where to target prevention and control measures and to determine if the current process is effective
Reporting in WI

- All positive laboratory results should be reported
- Tests that are EIA equivocal and WB positive should be reported
- Reporting can be done through Electronic Reporting (ELR) into Wisconsin Electronic Disease Surveillance System (WEDSS)
- All patient with EM rash (with or without lab results) should be reported
- WEDSS and ELR case study will be conducted in the afternoon workshop
Lyme Disease-National Case Definition Overview

• In 2008, a new Lyme disease (LD) case definition was adopted (CD-08) by Council of State and Territorial Epidemiologists (CSTE)

• This replaced the 1996 CSTE case definition (CD-96)

• WI employed the new CSTE case definition for all LD reports received since 2008
Case Definition

Criteria for meeting case definition*:

• A case must meet **BOTH** the clinical presentation for Lyme disease and the laboratory criteria for evidence of infection by CDC

• Case definition or confirmatory signs and symptoms
  – Erythema migrans (EM), arthritis with joint swelling, Bells palsy or other cranial neuritis, lymphocytic meningitis, Radiculoneuropathy, and 2\textsuperscript{nd} or 3\textsuperscript{rd} degree atrioventricular block

• Other signs and symptoms that are non-confirmatory
  – More common symptoms that may be present in other illness such as other rash, fever, sweats, chills fatigue, arthalgias, and myalgias

*Reference 2
Case Definition

Terminology

• Exposure
  – History of having been in a wooded, brushy, or grassy area (less than or equal to 30 days before onset of symptoms)
  – In a Lyme disease endemic county

• Endemic
  – A county with at least 2 confirmed cases
  – Or a county where established populations of ticks have been shown to be infected with *Borrelia burgdorferi*
  – Wisconsin is an endemic state
Lyme Disease – 2008 Wisconsin Case Definition

1. **Confirmed case**
   - EM rash in a Wisconsin resident (WI is an endemic state, any WI resident is considered “exposed”), or
   - At least one confirmatory late manifestation and laboratory evidence of infection that meets CDC criteria

2. **Probable case**
   - Any other physician diagnosed Lyme disease with only non-confirmatory signs/symptoms and laboratory evidence of infection

3. **Suspect case**
   - Any positive test with no clinical information or patient demographics (no case report form)
   - Any case reports with incomplete follow-up
Established Laboratory Criteria

• The most important change: the two-step serology testing is now required instead of recommended as in the past

• 1st tier testing- EIA or IFA test (sensitive but less specific)
  – Screening test can include total antibody, IgM, or IgG
  – EIA result is reported as an index number
  – IFA result is reported as a titer
  – All positive results should have the second test Western Blot (WB) performed

• 2nd tier testing- WB test (specific but less sensitive)
  – Results are reported out as bands
  – IgM (2 out of 3 bands): 41, 39, 21-25 kDa
  – IgG (5 out of 10 bands): 18, 21-15, 28, 30, 39, 41, 45, 58, 66, and 93 kDa
High Risk Areas

Upper Midwest & Northeast

CDC

High
Moderate
Low
Minimal or None
Reported Lyme Disease Cases by Year of Illness Onset, Wisconsin, 2000-2010

* Previous to 2008 only confirmed cases were reported. Beginning 2008, the total number of cases includes confirmed and probable cases. **Number of cases for 2010 is from January to June 15, 2010.
Lyme Disease Average Annual Incidence
Wisconsin, 2005-2007

This map is based on the county of residence of confirmed cases. Some infections may have been acquired during travel to other areas.

Revised 02/16/2010
Lyme Disease Incidence
Wisconsin, 2009

Revised 04/27/2010
Data Source: Wisconsin Division of Public Health
Zip Johnson of the Wisconsin Division of Health checks a hunter-registered deer for deer ticks
Wisconsin State Survey of Deer Ticks 1981

Map showing the presence of deer ticks in Wisconsin counties in 1981, with different colors indicating the number of ticks found: green for no ticks, yellow for 1 or more ticks, and white for not surveyed. The Wisconsin River is indicated on the map.
Ixodes Ticks Surveillance in 2009

- State-wide infection rate in nymphs ticks ranges from 20% - 24% (Average = 22%).
- Infection rate in adults ticks is usually twice that of the nymphs ticks.
- Wisconsin ticks infectivity rate is similar to other Lyme disease endemic states.
Don’t get “Tick-ed”

• Avoid areas that could have ticks (wooded areas)
• Wear protective clothing, long pants and sleeves
• Tuck pants into socks or boots to prevent ticks from crawling under clothing
• Tuck shirts into pants
• Use repellants per label instructions (adults-20-30% DEET, children-10%)
• Permethrin spray for clothing
• Check for ticks after being outdoors
• Environmental- landscape to create tick safe areas
Reality = Personal Protection
Lyme Disease Websites

DPH website:
http://dhfs.wisconsin.gov/communicable/LymeDisease/index.htm

CDC website:
http://www.cdc.gov/ncidod/dvbid/lyme/index.htm

IDSA website:
http://www.idsociety.org/default.aspx
References

3. CDC. Recommendation for test performance and interpretation from the second national conference on serologic diagnosis of Lyme disease. MMWR 1995;44:590-591
5. CDC. Notice to readers: caution regarding testing of Lyme disease. MMWR 2005;54:125-126
Additional Questions

Feel free to contact me at DPH:

Diep Hoang Johnson, Epidemiologist
Phone: (608) 267-9000
E-mail: diep.hoangjohnson@wi.gov