Tickborne Diseases in Wisconsin
Fight the Bite

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Wisconsin Department of Health Services
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Protecting and promoting the health and safety of the people of Wisconsin.
Overview

• Tickborne infections associated with *I. scapularis* in Wisconsin.

• Tick vectors, reservoirs, and hosts.

• Tickborne diseases data and statistics.

• Diagnosis and treatment.

• Control and prevention.
Ticks

- Ticks are found in woods, bushes, high grass, and leaf litter.
- Active outdoors in warm weather and need moisture to survive.
- They can detect heat and carbon dioxide from nearby host.
- Attach to host when there is physical contact.
- In US, there are 80 species (850 species worldwide).
- 12 species are of public health or veterinary concerns, only one is of concern in Wisconsin.
- *Ixodes* species commonly known as the “blacklegged” or “deer” tick, an important vector for most of the tickborne diseases in Wisconsin.
American Dog Ticks

*Dermacentor variabilis*

- Commonly known as “wood” ticks.
- Most common ticks found in eastern and central United States.
- In Wisconsin, they do not transmit Lyme disease, anaplasmosis, ehrlichiosis, and Powassan virus.
- Transmit spotted fever group in North and South America, but most of the reported cases from Wisconsin residents were associated with travel to another endemic state.
**Ixodes scapularis** (Blacklegged or Deer Tick)

Smaller than a American dog/wood tick, adult female and nymph can transmit infection through a bite for a blood meal.

Dermacentor variabilis (American dog or wood tick)
Life Cycle of Blacklegged Tick

During the 2-year life cycle, total 3 blood meals.

Nymphs feed on variety of hosts. Based on EM case onsets, nymphs account for most human transmission.

Larva activity peak in August when they feed on primarily white-footed mice (small mammals and birds), first chance for picking up the bacteria.

Adult ticks becomes active in October and can remain active in the winter if temperatures are above freezing. In the spring of the second year, they will deposit eggs.
Stages of blood engorgement in female adult *Ixodes* ticks depicted by the durations of attachment (borrowed from IDSA, Dr. Richard Falco-Fordham University).
Distribution of *I. scapularis*

- Found along the east coast of United States.
- Small mammals, primarily white-footed mice (*Peromyscus leucopus*) are the most important reservoir hosts.
- Adult ticks feed on large mammals, primarily the white-tailed deer; therefore, deer can play an important role in the tick-life cycle.
- However, deer blood can inactivate *Borrelia* bacteria and are dead-end host.
Zip Johnson of the Wisconsin Division of Public Health checked a hunter-registered deer for ticks.
UW-Madison, Entomology-Blacklegged Tick Surveys

1981

1994

2008-2009

Dark color of the pie = % deer infested with *Ixodes* ticks.
The Ticks Are Marching On…

Surveillance by the UW-Madison, Department of Entomology in 2010-2012.

• *Ixodes* species ecology is established in urban parks in Madison (Arboretum, Sandburg, and Pheasant Branch Conservancy).
• Milwaukee County, Bayside Doctor’s Park.
• Kettle Moraine in southern Waukesha County.
• Spring Green in Sauk County.
• Average state infectivity rate for *Borrelia* in nymphs is 22% (20-24%); other tickborne diseases infectivity rate are unknown.
Wisconsin Tick Surveillance, 2011-2012

Ticks collected from different agencies in Wisconsin.

UW-Madison, Dept. Entomology and Wisconsin Division of Public Health.
*I. scapularis* found on small mammals, 2011-2012

***I. scapularis*** found on animals from counties.

No submissions from participating counties.
Tickborne Diseases in Wisconsin
Tickborne Diseases in Wisconsin

• Anaplasmosis - caused by the bacteria *Anaplasma phagocytophilum*.

• Babesiosis - typically *Babesia microti* parasite.

• Ehrlichiosis - bacteria *Ehrlichia chaffeensis* and *E. muris*-like.

• Lyme disease - bacteria *Borrelia burgdorferi*.

• Powassan virus - tickborne virus in the arbovirus group.

Courtesy of CDC
## Surveillance in WI, 2002-2012

<table>
<thead>
<tr>
<th>Tickborne Infections</th>
<th>Total Cases (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2012</td>
</tr>
<tr>
<td></td>
<td>n= 2,552</td>
</tr>
<tr>
<td><strong>Total (confirmed and probable)</strong></td>
<td></td>
</tr>
<tr>
<td>• Powassan</td>
<td>2 (0.78)</td>
</tr>
<tr>
<td>• Lyme disease</td>
<td>1,906 (75)**</td>
</tr>
<tr>
<td>• Anaplasmosis/Ehrlichiosis</td>
<td>586 (23)</td>
</tr>
<tr>
<td>• Babesiosis</td>
<td>44 (1.7)</td>
</tr>
<tr>
<td>• Spotted fever group rickettsiosis (SFGR)*</td>
<td>14 (0.55)</td>
</tr>
</tbody>
</table>

*Mostly acquired during travel to another endemic state.  
**Change in reporting requirement in June 2012
Diagnosis of Tickborne Diseases

• Tickborne diseases can be diagnosed using clinical presentation and laboratory testing.

• Laboratory tests for tickborne diseases include:
  – Serologic assays (blood, cerebral spinal fluid) to detect antibodies including ELISA, IFA, plaque reduction neutralization test (PRNT).
  – Culture to detect the growth of organism to confirm active infection.
  – PCR molecular method of detecting the presence of DNA of organism.
  – Blood smear.

• Refer to the tickborne diseases chart for specific signs and symptoms.
  http://www.dhs.wisconsin.gov/communicable/Tickborne/PDFfiles/Tickborne%20chart_04%202013%202012_final.pdf
Anaplasmosis and Ehrlichiosis Clinical Manifestation and Diagnosis

- Fever, headache, fatigue, muscle aches, and shaking chills.
- Symptoms usually appear 5-10 days after a tick bite.
- Less common symptoms: nausea, vomiting, diarrhea, cough, joint pain, confusion, and occasional rash.
- Abnormal laboratory findings: anemia, leukopenia, thrombocytopenia, and elevated liver enzymes.
- If suspected, treatment with antibiotics should be initiated as soon as possible and not delayed because of pending test results.
- Most common test is IgM/IgG antibody blood test but PCR is the test of choice.
Reported Cases of Anaplasmosis and Ehrlichiosis, Wisconsin, 1999-2010

Reported Cases of Anaplasmosis/Ehrlichiosis in Wisconsin 1999-2010

*Total number of cases include confirmed and probable. Revised 2/6/2013

Annual Incidence per 100,000
Total Number Represents Confirmed and Probable Cases
- <1
- 1.0 - 6.9
- 7.0 - 19.9
- 20.0 - 39.9
- ≥40.0

WI incidence = 9.7 cases/100,000

Revised 08/02/2010
Data Source: Wisconsin Division of Public Health
Total Confirmed and Probable Cases of Anaplasmosis and Ehrlichiosis, Wisconsin, 2008-2012

Reported Total Cases of Anaplasmosis in Wisconsin 2008-2012

Year of Illness Onset

Cases

2008 2009 2010 2011 2012

206 281 499 697 517

Reported Total Cases of Ehrlichia chaffeensis in Wisconsin 2008-2012

Year of Illness Onset

Cases

2008 2009 2010 2011 2012

17 34 20 7 18

Reported Total Cases of Ehrlichia muris-like in Wisconsin 2009-2012

Year of Illness Onset

Cases

2009 2010 2011 2012

3 5 10 4
Total Cases Anaplasmosis of and Ehrlichiosis Reported by County of Residence, Wisconsin, 2012

Reported Total Cases of *Anaplasma phagocytophilum* in Wisconsin, 2012 (N=517)

Reported Total Cases of *Ehrlichia chaffeensis* in Wisconsin, 2012 (N=16)

Reported Total Cases of *Ehrlichia muris*-like in Wisconsin, 2012 (N=4)
Novel *Ehrlichia* Species, *E. muris*-like (EML)

- In 2009, EML was first identified in a cluster of four case-patients from Wisconsin (3) and Minnesota (1). This atypical *Ehrlichia* had never before been identified in North America.

- From 2009-2013, a total of 30 confirmed EML cases have been identified in Wisconsin and one case-patient was cultured positive. Minnesota health department reported 32 EML cases.

- Species is closest to *E. muris* associated with the white-footed mouse (*Peromyscus leucopus*) in Japan.

- The test of choice is PCR, no commercial serology tests are yet available.

- 38 *I. scapularis* ticks and two white-footed mice were PCR positive for EML, no other tick vectors have been identified.
Investigation of *E. muris*-like Cluster 2009-2012

- Obtained all acute and convalescent samples of all reported *Ehrlichia* cases for testing at CDC.
- Obtained and reviewed medical records.
- Standardized investigation questionnaire to interview patients regarding potential exposures.

- All EML patients had exposure to ticks at home and/or in another county in WI.
- Many reported seeing deer and wild animals in their backyard.
• It is uncertain how widely spread the *E. muris*-like infections because of the limited testing available.
• Division of Public Health continues to work with laboratories to bring the multiplex PCR testing on board.
Ehrlichia muris-like Prevalence in Ticks Collected from Small Mammals, 2011-2012

Ehrlichia muris-like real-time PCR positive
Ixodes scapularis 2011-2012

Total: 19/330
5.8%

Western- 8/108 (7.4%)
North-central- 7/141 (4.9%)
Northeastern- 4/67 (5.9%)
Powassan Virus (POWV) Infection

- Rare tickborne arbovirus infection.
- Initially isolated in 1958, in Northern Ontario.
- First case in United States - New Jersey in 1970.
- Cases have been reported in northeast regions of United States including Maine, Michigan, Minnesota, New York, Vermont, and Wisconsin.
- Reservoir- small mammals.
- Vector- *Ixodes scapularis*.
Powassan Virus Clinical Diagnosis

- The infection is acquired by a bite of an infected blacklegged tick for short duration (10-15 minutes).
- Incubation period is usually $\geq 1$ week (range from 8-34 days).
- Acute onset of fever, muscle weakness, confusion, headache, nausea, vomiting, and stiff neck.
- Severe signs and symptoms - respiratory distress, tremors, seizures, gait unbalance, confusion, paralysis, and coma.
- Neuroinvasive disease - most of the cases reported encephalitis and meningitis leading to long-term neurologic sequelae.
- There are no commercial testing available, only ELISA and plaque reduction neutralization test (PRNT) are performed at the Centers for Disease Control and Prevention (CDC).
Powassan Virus cases in Wisconsin, 2003-2012 (n=13)

This map is based on the county of residence of cases and not by county of exposure.

Revised 03/31/14
Treatment for Tickborne Diseases

• There is no specific treatment for Powassan virus infections, supportive care is all that is available.

• In all other tickborne diseases (Lyme, anaplasmosis, and ehrlichiosis), antibiotics can be very effective if treated early in the infection (oral or intravenously in severe Lyme cases).

• No vaccines are available at this time.
Proper Tick Removal

- Tweezers or a tissue.
- Grasp the tick as close to skin’s surface as possible.
- Slowly pull the tick straight out, not at an angle.
- Clean the bite area on the skin with rubbing alcohol or soap and water.
- Take note of the tick bite area, look for rash that is spreading over time and increasing in size.
- See a physician if a rash or tickborne illness-like symptoms develop after tick removal.

Courtesy of CDC
Tick Prevention and Control

Integrated tick management:

• Avoidance of tick habitats.
• Personal protection.
• Vector management.
• Reduction of tick habitats.
• Anti-tick vaccines for reservoir hosts.
• Vaccines for human.
Avoidance of tick habitats.
• When in wooded areas, walk on cleared pathways and trails to reduce the chance of coming in contact with ticks.

Personal protection.
• Wear protective clothing, long pants and sleeves.
• Tuck shirts into pants and pants into socks or boots to prevent ticks from crawling under clothing and attaching to skin.
• Use repellents per label instructions (20% DEET and other products).
• Permethrin spray for clothing.
• Check for ticks for people and pets after being outdoors.
• Take showers to wash off crawling ticks.
• Use repellent products or acaricides on pets.
Environmental Tick Control

- Landscape to create tick safe areas.
- Remove leaf litters.
- Trim bushes and shrubs.
- Spray acaricides - EPA registered companies.
- Apply natural products with biocidal activities. New nootkatone product extracted from yellow cedar, grapefruit and orange peel or botanical products such as oil of rosemary.

Tick Control

• Restrict movement of infested hosts into an area to reduce immigration of ticks.

• Reduce the population of rodents habitats near homes by reduce stack wood and food sources.

• Use fences, deer repellents, and plants that will discourage large mammals including deer.

• Eliminate ticks on host by using nesting material, boxes with pesticides, or bait stations with acaracide (ivermectin).

• Wildlife vaccination delivered to hosts as oral bait.
Resources

• http://www.dhs.wisconsin.gov/communicable/Tickborne/Index.htm
• http://www.cdc.gov/lyme/resources/TickborneDiseases.pdf
• http://labs.russell.wisc.edu/wisconsin-ticks/
• http://cfpub.epa.gov/oppret/ref/insect/
• http://npic.orst.edu/
Additional Questions

Feel free to contact:

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