Lyme Disease: Knowledge, Beliefs, and Practices of Physicians in a Low Endemic Area
Dr. Bonnie Henry, British Columbia Centre for Disease Control
A Webber Training Teleclass

Outline
• Intro and history
• Lab testing
• Ecological niche model
• Surveillance review
• Physician awareness survey
  – Part I
  – Part II
• Field study
• Prevention messages

Background
Lyme disease found in B.C.

Controversy
Intense conflict between mainstream medical/scientific community and Lyme Disease support/advocacy groups over “chronic Lyme disease”

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The Vector

**The Vector in BC**
- *Ixodes pacificus*
- More rarely found:
  - *Ixodes angustus*
  - *Ixodes auritulus*
- Infectivity level low
- *Dermacentor* not a competent vector

Surveillance Case Definitions

**Confirmed Case**
Erythema migrans or at least one late manifestation with laboratory confirmation of infection:
- isolation of *Borrelia burgdorferi* from an appropriate clinical specimen
- OR
- Two step testing using a screening EIA and confirmatory Western blot

Surveillance Case Definitions

1. For purposes of surveillance, erythema migrans is defined as a skin lesion 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 central clearing. A single primary lesion must reach greater than or equal to 5 cm in size. Secondary lesions also may occur. Annular erythematous lesions occurring within several hours of a tick bite represent hypersensitivity reactions and do not qualify as erythema migrans. For most patients, the expanding erythema migrans lesion is accompanied by other acute symptoms, particularly fatigue, fever, headache, mildly stiff neck, arthralgia, or myalgia. These symptoms are typically intermittent. The diagnosis of erythema migrans must be made by a physician. Laboratory confirmation is recommended for persons with no known exposure.

2. Late manifestations include any of the following when an alternative explanation is not found:
   - Musculoskeletal system: Recurrent, brief attacks (weeks or months) of objective joint swelling in one or a few joints, sometimes followed by chronic arthritis in one or a few joints. Manifestations are not limited to synovial involvement. Arthritis, including mono- or oligoarthritis, may be the only late manifestation. Chronic progressive arthritis not preceded by brief attacks and chronic symmetrical polyarthritis are not diagnostic criteria. Additionally, arthralgia, myalgia, or fibromyalgia syndromes alone are not criteria for musculoskeletal involvement.
   - Nervous system: Any of the following, alone or in combination: lymphocytic meningitis; cranial neuritis, particularly facial palsy (may be bilateral); radiculoneuropathy; or (rarely) encephalomyelitis.
   - Encephalomyelitis must be confirmed by demonstration of antibody production against *B. burgdorferi* in the CSF, evidenced by a higher titre of antibody in CSF than in serum. Headache, fatigue, paresthesia, or mildly stiff neck alone are not criteria for neurologic involvement.
   - Cardiovascular system: Acute onset of high-grade (2nd-degree or 3rd-degree) atrioventricular conduction defects that resolve in days to weeks and are sometimes associated with myocarditis.
   - Palpitations, bradycardia, bundle branch block, or myocarditis alone are not criteria for cardiovascular involvement.

Isolation and/or Detection of *Borrelia burgdorferi* from Tick and Mice Populations in B.C. (1993 – 1996)

<table>
<thead>
<tr>
<th>Year</th>
<th>Tick</th>
<th>Culture Positive</th>
<th>Total</th>
<th>Mouse</th>
<th>Culture Positive</th>
<th>Total</th>
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Isolation and/or Detection of *Borrelia burgdorferi* from Tick and Mice Populations in B.C. (1997 – 2007)

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<thead>
<tr>
<th>Year</th>
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<td>2006</td>
<td>1</td>
<td>396</td>
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<td>35</td>
<td>802</td>
<td>5</td>
<td>807</td>
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Ticks Received for ID and *B. burgdorferi* Culture from BC Physicians, Veterinarians and Residents (2000-2007).

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Mice Sera Tested</th>
<th>IFA Positive</th>
<th>WB Positive</th>
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<td>33</td>
<td>5</td>
<td>0</td>
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<td>34</td>
<td>4</td>
<td>1</td>
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<td>2005</td>
<td>34</td>
<td>8</td>
<td>3</td>
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<td>2005</td>
<td>17</td>
<td>2</td>
<td>1</td>
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<td>2007</td>
<td>46</td>
<td>15</td>
<td>1</td>
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<tr>
<td>3.66%</td>
<td>154</td>
<td>34</td>
<td>8</td>
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Risk Areas

Risk Areas

Positive
*Borrelia burgdorferi*
Samples from Ticks and Rodents, 1993-1999

Landscape Epidemiology

- Explores the relationship between the ecology and epidemiology of infectious diseases to identify geographical areas where disease transmission occurs
  - Ecological Niche Modeling

- Ecological niche: the total range of environmental conditions that are suitable for a species existence and maintenance of populations

Geographic Distribution of *Ixodes pacificus* in British Columbia, 1993-2006

Geographic Distribution of *Ixodes angustus* in British Columbia, 1993-2006

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Lyme Surveillance Review
- Reviewed all data from iPHIS, laboratory and enhanced surveillance databases
- From Jan 1, 1997 to Dec 31, 2008
- Compared annual rates with Washington and with high endemic states
- Capture-recapture methodology

Results
- 81 confirmed cases
- 44.1% male and 55.9% female
- Average age 48.7 and median age 52.5 years
- Range 4-88 years
- 42% were infected outside of BC
  - Primarily Europe and Eastern USA
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Capture-Recapture results
• Yielded an estimate of 120 (95%CI: 95 – 193) as the true number of LD cases in BC from 1997-2008
• Rates ranging from 0.33/100,000 to a maximum of 1.91/100,000
• High endemic states of the US rates: 29.2/100,000 population

Comparison to high and low endemic areas

<table>
<thead>
<tr>
<th>Year</th>
<th>British Columbia</th>
<th>Washington State</th>
<th>California</th>
<th>Connecticut</th>
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<tbody>
<tr>
<td>1997</td>
<td>3</td>
<td>10</td>
<td>-</td>
<td>0.4</td>
</tr>
<tr>
<td>1998</td>
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<td>0.3</td>
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<td>0.3</td>
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<td>2008</td>
<td>9</td>
<td>23</td>
<td>74</td>
<td>0.2</td>
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Avg. Rate: 0.19
Avg. Rate: 0.19
Avg. Rate: 0.26
Avg. Rate: 84.43

Discussion
• Annual incidence rates low and stable over last 12 years
• Lyme is underreported in BC
  – Underreporting is common for rare diseases
  – Is this because cases are being missed or because they are not being reported?

Physicians Awareness Survey 2008
• Sent out to all family physicians and pediatricians, internal medicine specialists with a practice address in BC
• 81% of respondents were Family Physicians
• In practice for an average 21 years and saw average 122 patients/week
• Geographically representative of MDs in BC

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Results

- 148 respondents recalled diagnosing 221 cases of LD in 2007 (range 0-5)
- Only 13 cases were reported to public health in 2007
- Overall knowledge score: 73% (8.7/12) for FD and 75% (9.0/12) specialists

LD Knowledge

<table>
<thead>
<tr>
<th>Family Physicians</th>
<th>Specialists</th>
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</thead>
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<tr>
<td>EM rash is diagnosed in &lt; 60% of patients</td>
<td>True</td>
</tr>
<tr>
<td>False</td>
<td>22.8%</td>
</tr>
<tr>
<td>Don't know</td>
<td>7.3%</td>
</tr>
<tr>
<td>The physical exam finding of EM rash is enough to diagnose Lyme disease</td>
<td>True</td>
</tr>
<tr>
<td>False</td>
<td>44.2%</td>
</tr>
<tr>
<td>Don't know</td>
<td>26.6%</td>
</tr>
<tr>
<td>What is the infectious agent that causes Lyme disease?</td>
<td>T. pallidum</td>
</tr>
<tr>
<td>B. burdorferi</td>
<td>8.9%</td>
</tr>
<tr>
<td>Unknown</td>
<td>24.9%</td>
</tr>
<tr>
<td>When is the incubation period from tick bite to EM rash?</td>
<td>1-3 days</td>
</tr>
<tr>
<td>4-30 days</td>
<td>46.8%</td>
</tr>
<tr>
<td>&gt;30 days</td>
<td>35.9%</td>
</tr>
</tbody>
</table>

Clinical Case 1

- 35 y.o. male presents with a rash
- History of hiking in the woods in South Vancouver Island
- Doesn't recall a tick bite
- No laboratory testing

What would you do:
1. Treat with an antibiotic for Lyme Disease at this time
2. Reassure and educate the patient, with no further follow up
3. No treatment or testing now, but see patient back for follow up
4. Send patient for a test for LD
5. Refer patient to a specialist

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Case Scenario 1

- A patient with erythema migrans and no laboratory testing performed to date

Case 1: answer

- Correct answer: 1
- Physician diagnosed Erythema Migrans is sufficient to establish a diagnosis of Lyme Disease (given potential exposure history and area of exposure);
- Serologic confirmation is not necessary and could lead to delays in diagnosis and treatment due to false-negative EIA in early LD

Case Scenario #2

- A patient with a known tick bite, no symptoms, no laboratory testing performed to date, and a normal exam

Case Scenario #3

- A patient with recurrent, asymmetric arthritis that began 3 months ago, no history of EM, and multiple negative Western blot tests for Lyme disease

LD Survey I

- Over 90% recognized there was a risk of LD in BC
- Level of risk highly correlated with geographic risk (statistically significant)
- 31% FD and 12% specialists had treated someone for LD due to patient concern despite believing they did not have LD
- 30% didn’t know LD is reportable to PH

LD Survey I

- What does ‘diagnosed’ mean?
- Are people being diagnosed by more than one doctor?
- Why are people not reporting?
- Led to Lyme II study

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Lyme Survey II

- Sample of 1500 physicians sent survey
- 424 responded (29.9%)
- Years in practice: mean 17.4 years (range 1-60)
- 28.3% (120/424) indicated they had treated at least 1 patient for Lyme
- Average number treated 3.02 (range 1-30)

Lyme Survey II

- Number of Patients Physicians have Treated for Lyme

Lyme Survey II

- Physician Reporting of Lyme by Degree of Suspicion of Disease (4 categories)

Lyme Survey II

- Reasons Given for not Reporting a Probable or Definite Case of Lyme

Need for Field Study

- Field tick surveillance is necessary to assess the risk of contracting Lyme disease in different regions of BC
- No field surveillance carried out since 2007 (research)
- Some studies in eastern Canada show the Lyme disease carrying tick population increasing (climate change)

Goal of Study

- Update current status of tick surveillance data
- Share data with provincial health authorities
- Field data driven public health policies and programs for prevention of Lyme disease in BC
- Update GIS map of ticks and Lyme disease positive areas
- Determine if tick population is expanding (climate change)
- Metagenomic analyses for novel pathogens in ticks

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Field Work
11 sites

- Location = risk area
- Time = suitable temperature

- May to September 2013 weekly
  (break for 3 weeks in August due to Temp)
- Around 3 to 4 days per trip
- Work hours range from 8 to 12 hours
- Need 2 days to autoclave, clean, and replenish supplies

Finished field work in early September 2013
Full time lab work since then
Currently finished the ID and PCR parts of the study

Results

Mice (n=238)
- ID individually
- Tick collection
- Dissection (x6)
- Extraction (x2)
- Real-time PCR (x2)
- IFA (+ > WB)

Results

Ticks (n=467)
All from mice, none from flagging
- ID individually
- Pooled by stages
- Extraction
- Real-time PCR

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Results

Ticks

<table>
<thead>
<tr>
<th>Species</th>
<th>Larvae</th>
<th>Nymph</th>
<th>Adult Female</th>
<th>Adult Male</th>
<th>Total</th>
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<tr>
<td>Ixodes pacificus</td>
<td>258</td>
<td>136</td>
<td>9</td>
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<td>403</td>
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<tr>
<td>Dermacentor andersoni</td>
<td>25</td>
<td>16</td>
<td>1</td>
<td>0</td>
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<td>12</td>
<td>6</td>
<td>3</td>
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<td>1</td>
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N=467

PCR Results

3 / 186
0 / 476

Summary

- The mouse / tick population is similar to our previous studies (need further analysis)
- Three *Ixodes pacificus* ticks were PCR positive
- The three tick positive sites are repeat positives from previous BC study

Summary

- Mouse serology testing is ongoing.
- Metagenomics study has yet to be done.
- The field study will be performed in 2014 at the same locations.

Public Health Action

- There is a clear but low risk of Lyme Disease in BC
- Laboratory results need to be taken in context of risk
- Monitoring of trends and geographic distribution helps with risk assessment
- No specific public health intervention
- Risk assessment allows tailored messages for prevention: no tick bite=no Lyme disease

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Prevention is key

- To prevent tick bites the following measures are strongly recommended:
  - Walk on cleared trails;
  - Wear a hat, long sleeves and pants and light coloured clothing;
  - Tuck pant legs into socks or boots;
  - Use an insect repellent containing DEET on clothing and exposed skin.

Prevention through the lifecycle

Knowledge Translation
- Pamphlets for parents at parks etc
- Mailings and articles for physicians
- Messages in media
- BUT

Tick talk
- Partnered with UBC
  http://www.bccdc.ca/ds-cond/a-z/LymeDisease/ticktalk/default.htm
  http://www.youtube.com/watch?v=ACu5mIiVAus

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- Sophie Li
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Thank you

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