The Federal Tick-borne Disease Working Group and CDC's current activities on IPM for Lyme disease prevention and control

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Division of Vector-Borne Diseases
Federal TBD IPM Working Group

Mission Statement
To communicate and collaborate on IPM-related activities and efforts that ultimately will reduce the risk of exposure in humans to infected ticks and the pathogens they transmit.

Specific Activities
• Collect, share, organize, and integrate information on best practices, including communications tools and resources, related to IPM of ticks and TBDs
• Identify and prioritize research gaps and needs
• Share agency-specific strategic plans relating to the control of infected ticks and the pathogens they may transmit
• Develop white papers and consensus documents that can be shared across U.S. federal agencies for the purpose of promoting and coordinating IPM programs and activities

Drafted: 12 August 2011
Federal TBD IPM Working Group

Participating agencies
(In alphabetical order)

• Centers for Disease Control and Prevention*
• Department of Defense
• Environmental Protection Agency*
• National Institutes for Health
• National Park Service
• National Science Foundation
• US Geological Survey
• US Department of Agriculture*

*Co-leaders
Federal TBD IPM Working Group

Meeting Frequency and Agenda

• Quarterly meetings – next meeting is November 19th

• Agenda
  – Roll call and introductions
  – Agency Spotlight Presentation
  – Activity and work stream updates
  – Agency updates and upcoming events
  – Review of action items and timelines
Federal TBD IPM Working Group

Key accomplishments
• Coordination of 2013 TBD IPM conference, Arlington, VA, March 5-6, 2013
• White paper – July 22, 2013

Current activities
• Updates, coordination
• 2016 meeting planning
CDC's current activities on IPM for Lyme disease prevention and control
Tick-borne Diseases in the U.S.

- Anaplasmosis*
- Babesiosis*
- Lyme disease (*Borrelia burgdorferi)*
- *Borrelia miyamotoi* infection
- Other novel *Borrelia* spp
- Bourbon virus
- Colorado Tick Fever
- Ehrlichiosis (including *E. muris*-like agent)*
- Heartland virus infection
- Southern Tick-Associated Rash Illness
- Spotted Fever Group Rickettsia*
- Tick-borne relapsing fever
- Powassan virus infection*
- Tularemia*

Note: Green text denotes recently identified pathogens

*reportable to CDC
<table>
<thead>
<tr>
<th>Disease/agent</th>
<th>Reported cases*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyme disease</td>
<td>33,461</td>
</tr>
<tr>
<td>Spotted Fever Rickettsiosis</td>
<td>3,647</td>
</tr>
<tr>
<td><em>Anaplasma phagocytophilum</em></td>
<td>2,800</td>
</tr>
<tr>
<td>Babesia</td>
<td>1,759</td>
</tr>
<tr>
<td><em>Ehrlichia chaffeensis</em></td>
<td>1,475</td>
</tr>
<tr>
<td><em>Anaplasma or Ehrlichia – undetermined/other</em></td>
<td>213</td>
</tr>
<tr>
<td>Tularemia</td>
<td>180</td>
</tr>
<tr>
<td>Powassan virus</td>
<td>8</td>
</tr>
</tbody>
</table>

*total reported cases – confirmed and probable
Distribution of Key Tickborne Diseases, 2013

Each dot represents one case reported according to county of residence and not necessarily where the disease was acquired. In 2013, no cases were reported from Hawaii. In Alaska, there were 14 travel-related cases of Lyme disease and one case of tularemia. Babesia was reportable in only 28 states.
## Top 10 Notifiable Diseases in the United States, 2014

<table>
<thead>
<tr>
<th>Disease</th>
<th>Case numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Chlamydia</td>
<td>1,441,798</td>
</tr>
<tr>
<td>2. Gonorrhea</td>
<td>350,062</td>
</tr>
<tr>
<td>3. Salmonellosis</td>
<td>51,455</td>
</tr>
<tr>
<td>4. HIV/AIDS (new diagnoses)</td>
<td>35,606</td>
</tr>
<tr>
<td>5. Lyme disease</td>
<td>33,461*</td>
</tr>
<tr>
<td>6. Pertussis</td>
<td>32,971</td>
</tr>
<tr>
<td>7. Shigellosis</td>
<td>20,745</td>
</tr>
<tr>
<td>8. Syphilis</td>
<td>19,999</td>
</tr>
<tr>
<td>10. Varicella</td>
<td>10,172</td>
</tr>
</tbody>
</table>

*Total number of cases estimated at close to 300,000 per year
Emerging Issues and Concerns

- Expanding disease burden and distribution
- Novel and emerging pathogens and conditions
Reported Cases of Lyme Disease by Year, United States, 1997-2014

Cases

Probable cases*
Confirmed cases


*National Surveillance case definition revised in 2008 to include probable cases; details at http://www.cdc.gov/ncphi/disss/nndss/casedef/lyme_disease_2008.htm
Lyme Disease U.S. Case Distribution – 18 year Trend

Reported TBD Cases by Year, United States, 2001-2013
Novel and Emerging Tick-borne Pathogens in Humans

- *Borrelia miyamotoi* across the northern U.S.
- Powassan virus in the NE and upper MW
- Heartland virus in Missouri, Tennessee and Oklahoma
- Bourbon virus (*Thogotovirus*) in Kansas
- Novel Lyme *Borrelia* sp. in upper MW
Heartland Virus

- Two Missouri patients suspected of having ehrlichiosis positive for a novel phlebovirus related to SFTS virus
- Common features at presentation: Fever, fatigue, headache, nausea, myalgia, arthralgia, thrombocytopenia, and leukopenia.
- Seven additional cases reported, in Missouri, Oklahoma, Tennessee*
  - Five hospitalized, two died
- *Amblyomma americanum* suspected tick vector**
- Serological evidence indicates widespread exposure in wildlife

* MMWR 2014;63:270-1; Clin Infect Dis (on line)
Bourbon Virus

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Research

Novel Thogotovirus Associated with Febrile Illness and Death, United States, 2014

Olga I. Kosoy, Amy J. Lambert, Dana J. Hawkinson, Daniel M. Pastula, Cynthia S. Goldsmith, D. Charles Hunt, and J. Erin Staples

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Suggested citation for this article

Abstract

A previously healthy man from eastern Kansas, USA, sought medical care in late spring because of a history of tick bite, fever, and fatigue. The patient had thrombocytopenia and leukopenia and was given doxycycline for a presumed tickborne illness. His condition did not improve. Multiorgan failure developed, and he died 11 days after illness onset from cardiopulmonary arrest. Molecular and serologic testing results for known tickborne pathogens were negative. However, testing of a specimen for antibodies against Heartland virus by using plaque reduction neutralization indicated the presence of another virus. Next-generation sequencing and phylogenetic analysis identified the virus as a novel member of the genus Thogotovirus.
CDC Tick-borne Disease Acute Febrile Illness Study

- Begun in 2014
- Conducted in collaboration with the state health departments of Minnesota and Tennessee, together with Mayo Clinic and the Vanderbilt University Medical Center
- Goal is to evaluate samples from 30,000 patients over 4 years
- Will utilize standard diagnostics, targeted PCR/sequencing, and next generation sequencing
- Studies to date have already identified a novel Lyme *Borrelia* sp.
Challenges and Opportunities
Lyme Disease in the U.S. – Current State of Affairs

• The case numbers are higher than they have ever been
• The geographic case distribution is more extensive than ever in the past
• There is significant polarization among key stakeholders
• There is currently no ‘magic bullet’ that is effective for disease prevention and control
Other Concerns

• Fewer scientists (entomologists and microbiologists) specializing in TBDs
• Less research being conducted on TBDs
• Less general interest and awareness in the academic community
• Tick control is largely seen as a responsibility of individual homeowners with limited public support or participation
Priorities for Prevention and Control
Lyme Disease Strategic Priorities

Goal: To reduce the incidence of Lyme disease human cases in the U.S. using evidence-based prevention tools and approaches (Re-establish Healthy People Goal)

Strategy:
- Strengthen national surveillance and understanding disease risk and burden
- Identify, develop and evaluate prevention and control practices
- Improve early and accurate diagnosis and treatment
- Identify, characterize, and prevent illness caused by new Borrelia species
- Collaborate with key partners to promote the use of effective prevention tools and strategies
### Lyme disease control toolbox

<table>
<thead>
<tr>
<th><strong>Personal Protection Measures</strong></th>
<th><strong>Treatment/Vaccination in Humans</strong></th>
<th><strong>Landscape/Vegetation Management</strong></th>
<th><strong>Killing of Host-Seeking Ticks</strong></th>
<th><strong>Rodent-Targeted Approaches</strong></th>
<th><strong>Deer-Targeted Approaches</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoidance of tick habitat</td>
<td>Antibiotic prophylaxis after tick bite</td>
<td>Xeroscaping/Hardscaping</td>
<td>Synthetic chemical acaricide</td>
<td>Topical acaricide bait box</td>
<td>Topical acaricide feeding station</td>
</tr>
<tr>
<td>Physically protective clothing</td>
<td>Human vaccine</td>
<td>Keep grass short, remove weeds</td>
<td>Natural product-based acaricide</td>
<td>Oral vaccine</td>
<td>Deer reduction</td>
</tr>
<tr>
<td>Regular tick checks &amp; Prompt removal</td>
<td></td>
<td>Remove leaf litter and brush</td>
<td>Fungal acaricide</td>
<td>Oral antibiotic bait</td>
<td>Deer fencing</td>
</tr>
<tr>
<td>Synthetic chemical repellent</td>
<td></td>
<td>Remove rodent harborage</td>
<td></td>
<td>Oral tick growth regulator</td>
<td>Oral tick growth regulator</td>
</tr>
<tr>
<td>Natural product-based repellent</td>
<td></td>
<td>Avoid plants that attract deer</td>
<td></td>
<td></td>
<td>Anti-tick vaccine for deer</td>
</tr>
<tr>
<td>Permethrin-treated clothing</td>
<td></td>
<td>Move play structures to low risk areas</td>
<td></td>
<td></td>
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<tr>
<td>Natural product-based acaricidal soap/lotion</td>
<td></td>
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</tbody>
</table>

**Note:** Yellow text denotes intervention that is not currently available but under development.
Ongoing Intervention Projects

• Nootkatone formulation and evaluation work
• Acaricide, bait box and other residential trials
• Reservoir-targeted vaccine work
• IPM cooperative agreements
  – URI
  – CAES
• CDC Project 2020 studies in preparation
  – Permethrin study
  – ITM study
• National TBD IPM meeting in planning for May 2016
CDC Lyme Disease Prevention Activities – Lessons Learned…

• There are many tools available for killing ticks
• Killing ticks in your own yard doesn’t necessarily equate to reducing risk of illness
• Tick control responsibility should be shared between homeowners and local communities
• The best solutions (in the absence of a vaccine) will probably be IPM* methods, evaluated across a variety of local settings

*Integrated Pest Management
Conclusions

• Tick-borne diseases in humans are increasing in numbers and distribution in the U.S.
• There are numerous research questions still to be answered
• Safe and effective prevention tools are badly needed
• Prevention and control requires validated tools and methods (diagnosis, treatment, and interventions), and effective collaboration
• Responsibility for tick control should be shared between homeowners and their local communities
Thank you for your time and interest!

Acknowledgments: Numerous staff of CDC’s Division of Vector-Borne Diseases

The findings and conclusions in this report have not been formally disseminated by the Centers for Disease Control and Prevention and should not be construed to represent any agency determination or policy.