Overview

- Ticks and tick identification
- Tick-borne diseases in the United States
  - Lyme disease
  - Rocky Mountain Spotted Fever
  - Ehrlichiosis
  - Babesiosis
  - Tularemia
  - Tick-borne relapsing fever
- Prevention and control of tick-borne diseases
Ticks

• Not insects
• Four life stages
  – Egg
  – Larva (6 legs)
  – Nymph (8 legs)
  – Adult (8 legs)
• Life cycle—may use several hosts
• ≈ 80 species in US, 12 of public health/veterinary importance

Ixodes scapularis

• Blacklegged tick, deer tick
• Transmits Lyme disease, babesiosis, ehrlichiosis
• Found in eastern and north central United States
• Feed on wide variety of mammals and birds

Dermacentor variabilis and D. andersoni

• Dog tick, wood tick
• Vector of Rocky mountain spotted fever, tularemia
• Widely distributed, common
• Adults feed on dogs, other medium to large mammals; larvae/nymphs feed on small rodents

Ticks, Tick-borne Diseases, and Their Control
**Amblyomma americanum**

- Lone star tick
- Vector of human monocytic ehrlichiosis, STARI
- Widely distributed in southeastern US, Atlantic Coast
- Wide host range

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**Soft Ticks**

- Take brief (<30 minute) blood meals at night
- Vector of tick-borne relapsing fever
- Widely distributed
- Wide host range
- Live in burrow, caves, nests, cabins

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*Ticks, Tick-borne Diseases, and Their Control*
### Other ticks of public health importance

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Notes</th>
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<tbody>
<tr>
<td><em>Ixodes pacificus</em></td>
<td>Western blacklegged tick</td>
<td>Lyme disease in western US</td>
</tr>
<tr>
<td><em>Ixodes cookei</em></td>
<td>Woodchuck tick</td>
<td>Powassan virus vector</td>
</tr>
<tr>
<td><em>Rhipicephalus sanguineus</em></td>
<td>Brown dog tick</td>
<td>Tick infestations of homes</td>
</tr>
<tr>
<td><em>Dermacentor albipictus</em></td>
<td>Winter tick</td>
<td>Large animals; hunters</td>
</tr>
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### Tick-borne Diseases in the United States

#### Lyme Disease
- Most common vector-borne disease in US
- First described in 1976
- Caused by spirochete, *Borrelia burgdorferi*
- Transmitted by *Ixodes scapularis* and *I. pacificus*
- Approximately 20,000 cases reported each year in United States
- Northeast, upper mid-Western United States
- Primary reservoir is small mammals
- Presence of deer enhance tick populations

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*Ticks, Tick-borne Diseases, and Their Control*
2-Year Cycle of Lyme Disease

Symptoms of Lyme Disease

Reported cases of Lyme disease by month of illness onset - United States, 2004
Ticks, Tick-borne Diseases, and Their Control
Southern Tick-associated Rash Illness (STARI)
- Causes rash similar to that of Lyme disease
- Transmitted by *Amblyomma americanum*
- Southeastern and south-central United States

Rocky Mountain Spotted Fever (RMSF)
- Caused by *Rickettsia rickettsii*
- Transmitted most commonly by *Dermacentor variabilis* and *D. andersoni*
- 250-1200 cases/year in United States

Incidence of RMSF in the United States
**RMSF: Signs and Symptoms**

- 5-10 day incubation period
- Early:
  - Fever, nausea, vomiting, muscle pain, lack of appetite, severe headache
- Later:
  - rash, abdominal pain, joint pain, diarrhea
- 3-5% mortality

**Ehrlichiosis (Anaplasmosis)**

- Three clinically similar pathogens:
  - *Ehrlichia chaffeensis* (Human Monocytic Ehrlichiosis)
    - transmitted by *Amblyomma americanum*
    - southeastern and south central United States
  - *E. ewingii*
    - rare, immunosuppressed patients
    - few cases in central United States
  - *E. phagocytophila* (Human Granulocytic Ehrlichiosis)
    - transmitted by *Ixodes scapularis* and *I. pacificus*
    - northeast, upper mid-Western United States
- Approximately 1200 cases per year in United States
**Ehrlichiosis (Anaplasmosis)**

Areas human ehrlichiosis may occur based on approximate distribution of vector tick species - CDC

**Seasonal Distribution of ehrlichiosis in the United States**

Number of reported cases by year

**Babesiosis**

- Caused by *Babesia microti*
- Transmitted by *Ixodes scapularis*
- Reservoir in white-footed mice
- Northeastern and mid-Western US
- Rare, few cases each year
- Clinically more severe in immunocompromised and elderly

*Ticks, Tick-borne Diseases, and Their Control*
Tularemia
• Caused by bacterium, *Francisella tularensis*
• Transmitted by:
  – Tick (*Dermacentor variabilis, D. andersoni, Amblyomma americanum*) or deerfly bite
  – handling infected sick or dead animals
  – eating or drinking contaminated food or water
  – inhaling airborne bacteria
• 200 cases per year in United States
• Most cases in south-central and western United States
• Symptoms dependent on the route of infection

Tick-borne Relapsing Fever (TBRF)
• Caused by *Borrelia* spp.
• Transmitted by soft ticks (*Ornithodoros* spp.)
• Approximately 25 reported cases/year in United States
• Characteristic relapsing episodes of fever

TBRF Epidemiology
• TBRF reported from 14 states in western US
• Most cases occur in rustic cabins or homes at >8000 feet elevation
• Most common in summer
Tick Paralysis

- Caused by toxin produced by *Dermacentor* ticks
- Progressive, ascending paralysis
- Reversed upon removal of tick
- May result in death if tick is not removed
- More frequent in young girls

Treatment of Tick-borne diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Antibiotic</th>
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<tr>
<td>Lyme disease</td>
<td>Tetracyclines, penicillins</td>
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<tr>
<td>STARI</td>
<td>Doxycycline</td>
</tr>
<tr>
<td>Rocky Mountain Spotted Fever</td>
<td>Clindamycin + quinine</td>
</tr>
<tr>
<td>Babesiosis</td>
<td>sulfate /azithromycin + atovaquone</td>
</tr>
<tr>
<td>Ehrlichiosis</td>
<td>Doxycycline</td>
</tr>
<tr>
<td>Tularemia</td>
<td>several</td>
</tr>
<tr>
<td>Tick-borne Relapsing Fever</td>
<td>Tetracyclines, erythromycin</td>
</tr>
</tbody>
</table>

Prevention and Control of Tick-borne Diseases
Prevention and Control: Individual Level

- Prevent tick bites: Use repellent, tick checks, and other simple measures to prevent tick bites
- Control ticks around your home and in your community
- Ask your doctor if taking antibiotics after a tick bite is right for you
- Learn the early signs of tick-borne illness

Prevent Tick Bites

- Prompt tick removal reduces risk
  - Conduct tick checks after outdoor activities
  - Remove attached ticks early; use tweezers
- Avoid tick infested areas
- Wear light colored clothing to see ticks
- Tuck pants into sock or boots to keep ticks on exterior of clothes

Ticks, Tick-borne Diseases, and Their Control
Personal Repellent Use

- DEET (N, N-diethyl-3-methylbenzamide)
  - Use for exposed skin and clothing
  - Higher concentrations, longer duration of protection
    - 10% effective
    - 25-35% optimal
    - >50% no more efficacious or longer lasting
  - No greater than 20-30% for children
- Permethrin
  - Can be used to treat clothing only
- Botanical products
  - Less effective against ticks

Tick Testing and Tick Bite Prophylaxis

- Neither generally recommended following tick bites
  - Ticks attached <36 hours very low risk
- Tick bite prophylaxis: Single dose doxycycline (200 mg) within 72 hours of tick bite
- Always monitor site of tick bite and health closely following a tick bite

Proper Tick Removal

- Use fine-tipped tweezers to grasp tick close to skin
- Pull tick’s body away from skin (avoid crushing head)
- Clean skin with soap and water
- Properly dispose of tick

DON’T: use petroleum jelly, a hot match, nail polish, or other products to remove a tick.
Vaccination

- Vaccine for Lyme disease removed from market in 2002
- Vaccines not available for other tick-borne diseases

Prevention and Control: Tick Reduction and Environment

- Apply acaricide to tick habitat areas
- Reduce tick habitat vegetation
- Acaricide treatments for mice and deer
- Reduce deer density by hunting or capture and removal
- Construct fences to exclude deer from properties
- Educational efforts to promote personal use of repellents and regular tick checks

Acaricides

- Single application at start of tick season
  - Treat mid-May to early June
  - Fall application may be needed for adult ticks
- Treat tick habitat only
- Many products registered for use against ticks on residential landscapes
- Soft tick control:
  - Fumigation of buildings with pyrethrin and permethrin
  - May need more than one application
Alternatives to Acaricides

- Biological Control—Fungi
  - Some approved for use against ticks
  - Problems with mass production, spore quality, conditions for use
- Natural Forest Products
  - Extracts from trees highly effective acaricides
  - Use as repellents?

血脂anisopliae on tick
Photo by Kirby Stafford

Landscaping Controls

- Create a tick-free zone
  - Blacklegged ticks found primarily in densely wooded and brushy areas
  - In lawns, 82% of ticks within 3 years of the perimeter
Landscaping Controls

Management strategies include:
- Brush removal and burning
- Leaf litter removal (ticks 49-77%)
- Wood chips barriers (ticks 35-77%)
- Use landscaping controls in combination with other acaricides and other management strategies

Management of Tick Hosts: Deer

- Deer exclusion
- Deer repellents
- Deer resistant plantings
  - List of plants at www.caes.state.ct.us
- Deer reduction and management
  - Complete or near eradication necessary

Management of Tick Hosts: Small mammals and birds

- Rodent-proof buildings
- Identify and remove rodent nesting materials
- Move firewood away from homes
- Birdhouses and feeders
  - away from house
  - clean up spilled feed
  - Set up in late fall and winter
- Seal foundations
Treatment of Tick Hosts

- Rodent bait boxes
  - Treats mice and chipmunks with fipronil
- Damminix
  - Permethrin-treated cotton balls
  - Target larvae on mice
- 4-Poster Tickicide
  - Permethrin passively applied to deer via corn baited deer feeding stations

Mason's Island 1999-2001
Additional information

Division of Vector-Borne Infectious Diseases
National Center for Zoonotic, Vector-Borne, and
Enteric Diseases
Centers for Disease Control and Prevention
P.O. Box 2087
Fort Collins, Colorado, 80522

Telephone: (970) 221-6400
Fax: (970) 221-6476
Email: dvbid@cdc.gov

Useful Resources

- http://www.cdc.gov/ncidod/diseases/submenus/sub_lyme.htm
  - Tick Management Handbook
  - IDSA Guidelines for Lyme Disease treatment

Ticks, Tick-borne Diseases, and Their Control
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• Images: http://phil.cdc.gov/phil/home.asp