Vector borne diseases: An overview

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Important facts:

- This section stands between you and lunch
- Each vector borne disease (VBD) can itself be a 4 hour lecture
- Impossible to cover vector borne diseases in 10 mins
Objectives

- By the end of these 10 mins, participants to understand:
  - Complexity and diversity of vector borne diseases
  - Arthropod vectors of specific agents
  - The changing epidemiology of vector borne disease
  - Personal measures to prevent vector borne diseases
  - Vulnerability of special populations to impact of VBD

Not objectives

- Will not:
  - Discuss signs/symptoms of specific VBD
  - Diagnostic testing of specific VBD
  - Management of VBD
  - Cause death by powerpoint
  - Keep you from lunch
Vector borne diseases (VBD)

According to the World health organization:

- Vector-borne diseases account for more than 17% of all infectious diseases, causing more than 1 million deaths annually.
- More than 2.5 billion people in over 100 countries are at risk of contracting dengue alone.
- Malaria causes more than 400 000 deaths every year globally, most of them children under 5 years of age.
- Other diseases such as Chagas disease, leishmaniasis and schistosomiasis affect hundreds of millions of people worldwide.
- Many of these diseases are preventable through informed protective measures.

Different ways to Categorize VBD:

- Vector type
  - Mosquito borne
  - Tick borne
  - Flea/louse borne
- Infectious agent (disease causing organism)
  - Virus → Virus type eg flavivirus, alpavirus
  - Parasite → Malaria, onchocerciasis, lymphatic filariasis
  - Bacterium → Lyme, relapsing fever, anaplasma agents
- Pathologic effect/ target organs
  - Encephalitis
  - Relapsing fever
  - Spotted fever
- Other
What vector borne diseases and weddings have in common

All you ever need to remember about VBDs is summarized in the old wedding rhyme:

Something old
Something new
Something borrowed
Something blue
And a sixpence in her shoe
### Something old: Historically present in US, and either persist in US or remain a threat

<table>
<thead>
<tr>
<th>Disease</th>
<th>Infectious Agent</th>
<th>Agent type</th>
<th>Primary vector</th>
<th>Effective treatment/vaccine</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rocky Mountain Spotted fever</td>
<td><em>Rickettsia rickettsii</em></td>
<td>Bacterium</td>
<td>Dermacentor ticks</td>
<td>Treatment- Y Vaccine- N</td>
<td>Ongoing threat</td>
</tr>
<tr>
<td>Yellow fever</td>
<td>Yellow fever flavivirus</td>
<td>Virus</td>
<td>Aedes mosquitoes</td>
<td>Treatment- N Vaccine- Y</td>
<td>Ongoing threat- Importation/Bioterrorism</td>
</tr>
<tr>
<td>Plague</td>
<td><em>Yersinia pestis</em></td>
<td>Bacterium</td>
<td>Fleas (rat fleas)- Also inhalation</td>
<td>Treatment- Y Vaccine- N</td>
<td>Ongoing threat Bioterrorism + Enzootic in US NW and SW</td>
</tr>
<tr>
<td>Tularemia</td>
<td><em>Franciscella tularensis</em></td>
<td>Bacterium</td>
<td>Dermacentor ticks, Lone star ticks, Deer fly- Also inhalation</td>
<td>Treatment- Y Vaccine- N</td>
<td>Ongoing threat- Enzootic/Endemic in US + Bioterrorism threat</td>
</tr>
</tbody>
</table>
Something new: These diseases were first identified in the US (and recently too).

<table>
<thead>
<tr>
<th>Disease</th>
<th>Infectious Agent</th>
<th>Agent type</th>
<th>Primary vector</th>
<th>Effective treatment/vaccine</th>
<th>First described</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyme disease</td>
<td><em>Borrelia burgdorferi</em> spp</td>
<td>Bacterium</td>
<td>Blacklegged tick</td>
<td>Treatment- Y Vaccine- Long story</td>
<td>Lyme CT, 1975</td>
</tr>
<tr>
<td>Lyme disease</td>
<td><em>Borrelia mayonii</em></td>
<td>Bacterium</td>
<td>Blacklegged tick</td>
<td>Treatment-Y Vaccine- N</td>
<td>WI &amp; MN (2014)</td>
</tr>
<tr>
<td>Bourbon virus disease</td>
<td>Bourbon virus</td>
<td>Virus (Thogotoviridae)</td>
<td>Tick- species TBD</td>
<td>Treatment- N Vaccine- N</td>
<td>Kansas 2014</td>
</tr>
<tr>
<td>Heartland virus disease</td>
<td>Heartland virus</td>
<td>Virus (bunyaviridae)</td>
<td>Lone star tick</td>
<td>Treatment- N Vaccine- N</td>
<td>Missouri 2009</td>
</tr>
<tr>
<td>STARI- Southern Tick associated Rash illness</td>
<td>Unknown – ?? Allergic reaction to tick antigens</td>
<td>Unknown</td>
<td>Lone star tick</td>
<td>N</td>
<td>~1997</td>
</tr>
</tbody>
</table>
### Something borrowed: Recently arrived in US. Now makes it’s home here (or is trying to)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Infectious Agent</th>
<th>Agent type</th>
<th>Primary vector</th>
<th>Effective treatment/vaccine</th>
<th>Year in US</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Nile virus disease</td>
<td>West Nile virus</td>
<td>Virus (flaviviruse)</td>
<td>Culex &amp; other Mosquitos</td>
<td>Treatment- N Vaccine- N</td>
<td>1999</td>
</tr>
<tr>
<td>Chikungunya virus</td>
<td>Chikungunya virus</td>
<td>Virus (alphavirus)</td>
<td>Aedes Mosquitos</td>
<td>Treatment- N Vaccine- N</td>
<td>~ 2006</td>
</tr>
<tr>
<td>Zika virus disease</td>
<td>Zika virus</td>
<td>Virus (flaviviruse)</td>
<td>Aedes mosquitoes</td>
<td>Treatment- N Vaccine- N</td>
<td>2014/15</td>
</tr>
</tbody>
</table>
Something blue  Something “Ew!!!”

<table>
<thead>
<tr>
<th>Diseases</th>
<th>2013 Reported Cases</th>
<th>Median (range) 2004–2013&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tick-Borne</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lyme disease</td>
<td>36,307</td>
<td>30,495 (19,804–38,468)</td>
</tr>
<tr>
<td>Spotted Fever Rickettsia</td>
<td>3,359</td>
<td>2,255 (1,713–4,470)</td>
</tr>
<tr>
<td>Anaplasmosis/Ehrlichiosis</td>
<td>4,551</td>
<td>2,187 (875–4,551)</td>
</tr>
<tr>
<td>Babesiosis&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1,792</td>
<td>1,128 (940–1,792)</td>
</tr>
<tr>
<td>Tularemia</td>
<td>203</td>
<td>136 (93–203)</td>
</tr>
<tr>
<td>Powassan</td>
<td>15</td>
<td>7 (1–16)</td>
</tr>
<tr>
<td><strong>Mosquito-Borne</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Nile virus</td>
<td>2,469</td>
<td>1,913 (712–5,673)</td>
</tr>
<tr>
<td>Malaria&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1,594</td>
<td>1,484 (1,255–1,773)</td>
</tr>
<tr>
<td>Dengue&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>843</td>
<td>624 (254–843)</td>
</tr>
<tr>
<td>California serogroup viruses</td>
<td>112</td>
<td>78 (55–137)</td>
</tr>
<tr>
<td>Eastern equine encephalitis</td>
<td>8</td>
<td>7 (4–21)</td>
</tr>
<tr>
<td>St. Louis encephalitis</td>
<td>1</td>
<td>10 (1–13)</td>
</tr>
<tr>
<td><strong>Flea-Borne</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plague</td>
<td>4</td>
<td>4 (2–17)</td>
</tr>
</tbody>
</table>

**Numbers are increasing for many of these + most cases unreported**

Source: https://health2016.globalchange.gov/vectorborne-diseases
And a sixpence (not a dollar) in her shoe: VBDs disproportionately impact certain groups...
... But first: Detour for “an ounce of prevention”

prevent tick borne dx: BLAST

- B- Bathe within 2 hr
- L- Look for ticks on body & light colored clothing
- A- Apply repellant
- S- Spray yard
- T- Treat pets, treat clothing

prevent mosquito dx- PACTS

- P- Protective clothing
- A- Apply repellant
- C- Clean up your yard
- T- Follow travel recs:
  - prophylactic meds, (malaria)
  - vaccine (YF)
  - postpone travel (zika)
- S- Screens
  - Doors and windows
  - Or Air-conditioning + sealed doors

** Notice that all require time commitment and many require significant $$$ commitment**
And a sixpence (not a dollar) in her shoe:
How Climate, social determinants and VBDs interact to impact the most vulnerable

Source: https://health2016.globalchange.gov/vectorborne-diseases
Determinants of Vulnerability

EXPOSURE
Exposure is contact between a person and one or more biological, psychosocial, chemical, or physical stressors, including stressors affected by climate change.

SENSITIVITY
Sensitivity is the degree to which people or communities are affected, either adversely or beneficially, by climate variability or change.

ADAPTIVE CAPACITY
Adaptive capacity is the ability of communities, institutions, or people to adjust to potential hazards, to take advantage of opportunities, or to respond to consequences.

VULNERABILITY of Human Health to Climate Change

HEALTH IMPACTS
Injury, acute and chronic illness (including mental health and stress-related illness), developmental issues, and death

https://health2016.globalchange.gov/populations-concern
Thank You