The Bugs That Bug You

Plymouth County Extension

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Introduction
Introduction
Blood-feeding

Blood-feeding is very old

Ticks: 400 million years
Tick and Mosquito Diseases

Why do mosquitoes and ticks **suck**?

Blood is nutritious!

Maybe evolved from plant-feeding?
Mosquito Feeding

- Cannulate blood vessels
- Quick feeders
- Only females feed on blood
- Egg production
Tick Feeding

- Create feeding lesions
- Long-term feeders
• All life stages feed
More discoveries past 40 years?

Discovery of Tickborne Pathogens as Causes of Human Disease in the United States, 1900–Present

Note: This timeline shows when tickborne pathogens were recognized as causes of human disease. In some cases, organisms were identified in ticks before they were associated with human disease. In other cases, the disease was recognized before the etiological agent was found to be tickborne.
Lyme Disease

Reported Cases of Lyme Disease -- United States, 2001-2015

CDC.gov
Massachusetts EEE Risk Categories

Current EEE Risk Level
- Remote
- Low
- Moderate
- High
- Critical

Current Risk Levels – as of September 23, 2019

Massachusetts Department of Public Health
Are Things Getting Worse?

more than triple, since 2004, in the US
Why?

BECAUSE

SCIENCE
How Did They Become the Bad Guys?

It wasn’t always this way

Looking back through history...

Hunter-gatherers: Fewer pathogens?
How Did We Get to This Point?

Onset of agrarian/agricultural (~40k years ago) (Edman, 1988):

- Destruction of wild hosts
- Destruction of wild habitat
- Community living
- Domesticated animals (14k years ago)

- Vectors adapted to new food
- ...Diseases!

Edman, 1988; Anderson and May 1979, 1991
And, for the Disease?

Animal diseases

- Lyme, babesiosis = mice and small rodents
- EEE, WNV = birds (robins, cardinals)
What’s Causing this?

Changing land-use patterns

- Changing ecology
- Close contact with animals
- Expansion of hosts

Falco and Fish, 1988; Eisen and Eisen, 2018
What’s Causing this?

• Degraded habitats
What’s Causing this?

Increased temperatures:

- Reproduction cycles (7-14 days vs months)
- Faster extrinsic incubation period (EIP)
- Warm-weather species moving north

<table>
<thead>
<tr>
<th>Culex pipiens</th>
<th>20 ºC (68ºF)</th>
<th>30 ºC (86ºF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Nile</td>
<td>15 days</td>
<td>5 days</td>
</tr>
<tr>
<td>EIP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Culex tarsalis*

14 days at 70º F
10 days at 80º F
Where Do We Go From Here?

Different Strategies

Pathogen-vector
• Control animal populations
• Aerial sprays

Human-pathogen
• Vaccines

Vector-human
• Repellents
• Sprays (yard/aerial)
• Sterile insect technique
Staying Safe
There are tools that already exist that we can rely on!
Basically, soil organisms require high humidity (82%+) 6.3% of the total population is active at a time

Stafford, 1994; Daniels, 2000; Rodgers et al 2007; Berger et al 2014; Kim et al, 2017
Basically, aquatic organisms
Clean Up

- Rake leaves 75-77% reduction in nymphs

Shulze, 1995; Linske et al. 2019
Yard Sprays

- Can reduce ticks
- Can be long lasting
- Use a pyrethroid
- Timing
- Repeat yearly
- Hire someone
- DIY

DIY

- EPA-registered
- Made for use on lawns and gardens
- Lists that it will control deer ticks (or ticks, in general)
- Listed as “ready to use” or “ready to spray”
- FOLLOW THE LABEL

Yard Management

Most fly 2 km or less

Mullen and Durden, 2019
Mosquito Management

Weekly, remove/replace water
Source Reduction

Keep water moving
Variable and TEMPORARY

Local mosquito control project.... FREE by trained professionals

Stoops et al. 2019
Protection for Outside?

What about going into tick habitat?

Step 1: Cover up!
Delay Bites

- Netting
Delay Bites

• Tucking your pants into your socks

• Sometimes you find ticks... down there
Time of Day Matters

Day-bitérs
• EEE: 34/428 pools
• WNV: 1/87 pools

Night and twilight biters
• EEE: 394/428 pools
• WNV: 86/87 pools

Ae. vexans  Cq. perturbans  Cx. pipiens

Executive Office of Health and Human Services
DEET, not DDT

- 60 years of use
- ~700 million people annually
- >8 billion human applications in 1998

- 4 deaths associated with DEET
- Never confirmed

- 1 million die people/year from mosquitoes
- 300,000 US cases of Lyme/year
- Falling coconuts kill 150 people/year

Schreck et al, 1995; Fradin and Day, 2002; Perkins, 2006; Chen-Hussey, 2014; Kuehn, 2013
But, you have options...

- Picaridin or Icaridin
- IR3535

Jury still out?
- Oil of Lemon Eucalyptus or PMD (p-menthane-3,8-diol)
- Bio UD or 2-undecanone

Gardulf et al, 2004; Bissinger et al, 2008; Bissinger et al, 2009; Bissinger and Roe, 2010; Carroll et al 2010; Bissinger et al, 2011
PERMETHRIN

- Garden centers, big box stores, Amazon
- Or through InsectShield.com

Schreck et al, 1978; Shreck et al 1982; Soto et al 1995; Miller et al 2011; Connally et al 2018; Prose et al 2018; Mitchell et al 2020
• **Only** clothing and shoes

• Apply in advance and wait for it to dry

• Lasts for 6 washings or 1 month

• Keep cats away until it’s dry
Repellents

25(b) exempt (“all natural”)?

- No evidence of safety or efficacy
- May be no better than water

Eisen and Dolan, 2016
Myths

“Tick tubes”
• Not reliable

Citronella candles
• Not acceptable levels of repellency

Mosquito bracelets
• Metafluthrin... worked
• Others... zero protection

Daniels et al. 1991, Stafford 1991, Stafford 1992; Lucas et al. 2007; Müller et al., 2008; Revay et al. 2013; Rodriguez et al., 2017
Treatments for Cats and Dogs

- Diseases specific to pets
- **Proper** treatment to protect
Tick Checks

- 90% did not remove a nymph in ≤ 1 day
- >81% did not remember being bit

Yet et al, 1995; Nigrovic et al, 2019
How Do You Remove a Tick?

Don’t over complicate things!

1. Use tweezers
2. Firmly grasp it
3. Pull straight up
Bitten?

• Symptoms: Generalized, non-descript for many cases

• Gather evidence... see a medical professional

*experiences a minor stomach pain*

*Google symptoms*

Web MD: You already died.

Me:
Evidence

Bitten?

Ok... when?

What species?

What was in it?

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Result Date</th>
<th>Result</th>
</tr>
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<tbody>
<tr>
<td><em>Borrelia general species</em></td>
<td>11/30/2017 @ 3:22 PM EDT</td>
<td>POSITIVE</td>
</tr>
<tr>
<td>(Lyme or relapsing fever- generic)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Borrelia burgdorferi sensu lato</em></td>
<td>11/30/2017 @ 3:23 PM EDT</td>
<td>POSITIVE</td>
</tr>
<tr>
<td>(Lyme borreliosis- specific)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Borrelia miyamotoi</em></td>
<td>11/30/2017 @ 3:22 PM EDT</td>
<td>NEGATIVE</td>
</tr>
<tr>
<td>(Hard tick relapsing fever)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Borrelia mayonii</em></td>
<td>11/30/2017 @ 3:22 PM EDT</td>
<td>NEGATIVE</td>
</tr>
<tr>
<td>(Lyme borreliosis)</td>
<td></td>
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<tr>
<td><em>Babesia microi</em></td>
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<td>POSITIVE</td>
</tr>
<tr>
<td>(Babesiosis: often found in humans)</td>
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Photograph the Bite

Rashes?
Photograph them!
Show a doctor!
Bottom Line

With the right knowledge and awareness...

Vector-borne diseases are preventable.
Questions?