The Backyard Integrated Tick Management Study

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Peridomestic risk for exposure to *I. scapularis* ticks

Approx. 90% of backyard ticks are found in the wooded edge and ecotone where lawns meet woods.
Fragmented forest landscapes = increased edge density
Peridomestic prevention strategies

- Personal protection
- Landscape/yard-based interventions

Yard-based interventions

- **Goal:** reduce entomologic risk

- **Chemical Strategies:**
  - Targeted application of acaricide
  - Rodent-targeted interventions
Single, springtime application of acaricide

- Field studies: Reduction of questing nymphal *I. scapularis* 68-100% after a single application of synthetic pyrethroid (multiple studies)

- Best control using high-pressure sprayers
Single, springtime application of acaricide

- The degree to which humans were protected by reduction **not determined**

- Small sample sizes, highly controlled, ideal conditions
Tick Box™ Tick Control System

- Fipronil-treated wick (0.7% active ingredient)
- Passive application to mouse and chipmunk reservoir hosts
- Studies
  - Lab evaluation: prevented tick bites for 4-6 weeks after single application to mice in lab (Dolan et al. 2004)
  - Field evaluation (Schulze et al. 2017; Dolan et al. 2004)
    - 62-97% reduction of host seeking *I. scapularis* nymphs,
    - 60% reduction in *B. burgdorferi* infection prevalence in ticks
  - Treated properties were contiguous
  - Human disease/tick encounter outcomes not measured

Understanding entomologic risk alone may not predict human disease outcomes

• Recommended interventions are based upon results of highly-controlled field and lab studies
  • Does high efficacy → effectiveness of a treatment?

• The true relationship between entomologic risk and human exposure in the peridomestic environment is not fully understood

• Population-based studies that measure human outcomes are needed
TickNET: Lyme and other tickborne diseases prevention study 2011-2012

- Randomized, blinded, placebo-controlled trial
- Assessed efficacy of single springtime application of pesticide to residential yards
Tick abundance at acaricide vs. placebo groups

63% fewer nymphs at treatment properties

Hinckley et al. *J Infect Dis* 2016
Human disease and tick encounters not similarly reduced

<table>
<thead>
<tr>
<th>Outcome, Year(s), Site</th>
<th>Acaricide</th>
<th>Placebo</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ticks crawling</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>185/762 (24.3)</td>
<td>209/769 (27.2)</td>
<td>.19</td>
</tr>
<tr>
<td>2012</td>
<td>139/541 (25.7)</td>
<td>150/518 (29.0)</td>
<td>.23</td>
</tr>
<tr>
<td>Overall</td>
<td>324/1303 (24.9)</td>
<td>359/1287 (27.9)</td>
<td>.08</td>
</tr>
<tr>
<td>CT</td>
<td>133/474 (28.1)</td>
<td>157/491 (32.0)</td>
<td></td>
</tr>
<tr>
<td>MD</td>
<td>68/319 (21.3)</td>
<td>60/289 (20.8)</td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>123/510 (24.1)</td>
<td>142/507 (28.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Ticks attached</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>127/762 (16.7)</td>
<td>145/769 (18.9)</td>
<td>.26</td>
</tr>
<tr>
<td>2012</td>
<td>86/541 (15.9)</td>
<td>84/518 (16.2)</td>
<td>.89</td>
</tr>
<tr>
<td>Overall</td>
<td>213/1303 (16.3)</td>
<td>229/1287 (17.8)</td>
<td>.33</td>
</tr>
<tr>
<td>CT</td>
<td>78/474 (16.5)</td>
<td>103/491 (21.0)</td>
<td></td>
</tr>
<tr>
<td>MD</td>
<td>35/319 (11.0)</td>
<td>30/289 (10.4)</td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>100/510 (19.6)</td>
<td>96/507 (18.9)</td>
<td></td>
</tr>
<tr>
<td><strong>Self-reported illness</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>27/739 (3.7)</td>
<td>25/755 (3.3)</td>
<td>.72</td>
</tr>
<tr>
<td>2012</td>
<td>14/534 (2.6)</td>
<td>14/513 (2.7)</td>
<td>.91</td>
</tr>
<tr>
<td>Overall</td>
<td>41/1273 (3.2)</td>
<td>39/1268 (3.0)</td>
<td>.78</td>
</tr>
</tbody>
</table>

**Verified illness**

| 2011                   | 13/739 (1.8)  | 14/755 (1.9)   | .89     |
| 2012                   | 6/534 (1.1)    | 6/513 (1.2)    | .94     |
| Overall                | 19/1273 (1.5)  | 20/1268 (1.6)  | .90     |

Data are no. (%) of households with specified characteristics.
Effectiveness of Residential Acaricides to Prevent Lyme and Other Tick-borne Diseases in Humans

Despite reduction in ticks at intervention sites, human disease incidence and human-tick encounters were not reduced.

Possible explanations:

- Exposures outside of own backyard
- Non-linear relation between tick abundance and human exposure
  - “tick prone” people?
  - “tick reduction” threshold?

Conclusions/recommendations

- Use interventions that include reducing tick infection rates
- Understand human behavior in the peridomestic environment
Preventing tickborne disease requires:

- Reduce entomologic risk
  - Tick abundance
  - Tick infection rates

- Understand human behavior
  - Prevention practices
  - Outdoor exposures

Prevent tickborne disease
Integrated Tick Management (ITM)

- Application of more than one approach to tick control
- May target different tick life stages and/or different hosts
- Can reduce the amount of chemicals applied to environment and reliance on a single mode of action
  - Minimizes potential for resistance
- Limited number of studies applying ITM for reducing tickborne disease
STUDY GOALS

1. Evaluate two tick management tick tactics at single vs. contiguously treated backyards

2. Understand how people use outdoor environments
## BITM Study Design

### ITM Approach:

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Active Ingredient</th>
<th>Targets:</th>
<th>Time of Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tick Box™ Tick Control System bait boxes</td>
<td>Fipronil</td>
<td>Larval ticks parasitizing mice and chipmunks</td>
<td>July</td>
</tr>
<tr>
<td>Targeted application of acaricide spray</td>
<td>Beta-cyfluthrin</td>
<td>Questing nymphs</td>
<td>May</td>
</tr>
</tbody>
</table>
BITM Study Design

• Placebo-controlled prospective study

• Properties/households in western CT and southern RI

• **Outcome measures:**
  - **Entomologic:** tick abundance and infection rates
  - **Human:** self reported tick encounters and human disease; daily activity log of outdoor activity
Recruitment

- GIS-assisted targeted mailings
- Door hanging cards
- Neighbor letters
- Informational website
  - Study purpose/design
  - FAQs
  - Screening survey
Study Inclusion criteria

- Responsible for yard-maintenance decisions
- No tick treatments used for past two years
- No deer-exclusion fencing present
- Residence located in study catchment area
- Parcel size = 0.5 – 3 acres
- Property adjacent to forested/brushy edge habitat
- Primary spring/summer residence
Replacing sensitive information
Treatment application targets two life stages
BITM Study Design

- **Two year** treatment
- **Households are blinded** to treatment group
- **Monthly electronic surveys** administered to measure tick encounters and disease diagnosis
- **Daily activity survey** administered for one week in June
- **Neighbor surveys** sent to properties adjacent to enrolled properties.
Ticks detected on humans/pets submitted to **URI** TickSpotters for confirmatory ID

TickSpotters Submit Form

Review our 3 step guide with tips to improve your TickSpotters photo submission: **Photo Tips**

**SPOT A TICK - SUBMIT A PIC!**
Life stages are Top to Bottom: Adult Female, Adult Male, Nymph, Larva

TickSpotters BITM

Please let us know if you've found a tick! And remember, TAKE A PICTURE and we will reply. Your submissions help TickEncounter track tick activity and build risk warning tools like our Current Tick Activity In

Your Area application.
BITM Daily Activity Survey

Time spent in outdoor locations:
In backyard:
- Forest edge
- Lawn adjacent to edge
- Lawn far from edge
- Gardens

- Non-backyard locations
BITM STUDY – Current Status

Certain information removed due to sensitive information

Ticks sampled twice at all enrolled properties (pre-treatment) in late May-July 2017 (~2000 ticks tested by CDC DVBD)

Monthly surveys conducted May – Aug 2017

Daily activity survey conducted in June 2017

Bait boxes installed in late July 2017 weighed 4 weeks post-installment

TickSpotters use ongoing
BITM STUDY – Upcoming, 2018

- First acaricide spray treatment May 2018
- Second bait box installment July 2018
- Continue surveys, TickSpotters, residential tick sampling
For more information

www.backyardtickstudy.org
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