Testing environmental interventions to prevent Lyme and other tick-borne diseases in our communities

Principal Investigators: Richard S. Ostfeld and Felicia Keesing

Cary Institute of Ecosystem Studies • Bard College • Centers for Disease Control & Prevention • New York State Department of Health • Dutchess County Department of Behavioral & Community Health

www.tickproject.org
THREE TICK-BORNE DISEASES

Lyme disease
Anaplasmosis
Babesiosis

Multiply by 10
LYME DISEASE 2001

1 dot placed randomly within county of residence for each reported case.
LYME DISEASE 2013

1 dot placed randomly within county of residence for each confirmed case

THE TICK PROJECT
LYME DISEASE IN THE 21ST CENTURY

- Rapidly increasing in incidence and range
- No vaccines available
- Diagnosis and treatment problematic
- Estimated cost: $712M to $1.3B/year
- Effective tick management poorly developed
  - Small scale, poor replication, poor control
Effectiveness of Residential Acaricides to Prevent Lyme and Other Tick-borne Diseases in Humans

Alison F. Hinckley,1 James I. Meek,2 Julie A. E. Ray,2a Sara A. Niesobecki,2 Neeta P. Connally,3 Katherine A. Feldman,4 Erin H. Jones,4a P. Bryon Backenson,5 Jennifer L. White,5 Gary Lukacik,5 Ashley B. Kay,1a Wilson P. Miranda,5 and Paul S. Mead1

1Division of Vector-Borne Diseases, Centers for Disease Control and Prevention, Fort Collins, Colorado; 2Connecticut Emerging Infections Program, Yale School of Public Health, New Haven, and Western Connecticut State University, Danbury; 3Maryland Department of Health and Mental Hygiene, Baltimore; and 4New York State Department of Health, Albany

2-year, 3-state, 2727-household, double-blind, randomized, placebo-controlled study.

One annual springtime Bifenthrin spray.

Effects on ticks and cases of TBDs
63% reduction in questing nymphal blacklegged ticks

But......
<table>
<thead>
<tr>
<th>Outcome, Year(s), Site</th>
<th>Acaricide</th>
<th>Placebo</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ticks crawling</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>Ticks attached</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>Self-reported illness</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>
<tr>
<td>Verified illness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>13/739 (1.8)</td>
<td>14/755 (1.9)</td>
<td>.89</td>
</tr>
<tr>
<td>2012</td>
<td>6/534 (1.1)</td>
<td>6/513 (1.2)</td>
<td>.94</td>
</tr>
<tr>
<td>Overall</td>
<td>19/1273 (1.5)</td>
<td>20/1268 (1.6)</td>
<td>.90</td>
</tr>
</tbody>
</table>

Data are no. (%) of households with specified characteristics.
Why?

- 63% reduction in tick abundance is too modest?
- Treating individual yards too restricted?
GOAL

Develop and test a safe, effective, and affordable means of preventing tick-borne disease at the scale of whole neighborhoods
TWO INTERVENTIONS

*Metarhizium anisopliae*
TWO INTERVENTIONS

Metarhizium anisopliae
TWO INTERVENTIONS

_Metarhizium anisopliae_
TWO INTERVENTIONS

*Metarhizium anisopliae*
TWO INTERVENTIONS

TCS Bait boxes
Mice and chipmunks are the main source of tick infection.
TWO INTERVENTIONS
TCS Bait boxes

Fig. 3. (A) Infestation rates of *P. leucopus* on Nauyauq Pt. compared with untreated areas. Pretreatment collections were performed in April and May, posttreatment in June to September. Fipronil-treated bait boxes were in place by 15 May all 3 yr. (B) Infestation rates of mice including New Areas. (C) Infestation rates during 2001. 15 May–July, properties received Prototype 2 bait boxes; modified Protecta Jr. boxes were used August and September.
TWO INTERVENTIONS

Met52 kills ticks in the environment

TCS Bait boxes kill ticks on “reservoir hosts” responsible for feeding and infecting many ticks
STUDY DESIGN

Location
STUDY DESIGN

Neighborhoods
STUDY DESIGN

Interventions, imposed on neighborhoods (~100 homes)

<table>
<thead>
<tr>
<th></th>
<th>Bait boxes</th>
<th>Inactive bait boxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fungus</td>
<td>6 replicates</td>
<td>6 replicates</td>
</tr>
<tr>
<td>Inactive fungus</td>
<td>6 replicates</td>
<td><strong>6 replicates</strong></td>
</tr>
</tbody>
</table>

Scientific gold standard: randomized, placebo-controlled, double-blind
STUDY DESIGN

Measurements

- Per capita cases of tick-borne disease
- Numbers of encounters with ticks
- Tick abundance and infection prevalence

- Covariates (wildlife diversity, deer abundance, percent of properties participating)
- Non-target effects
STUDY DESIGN

Expectations

➢ Two interventions will be more powerful than one
➢ Longer duration (spray twice, boxes all season) more effective
➢ TCS bait boxes will reduce infection prevalence as well as abundance of ticks
➢ Treatment of neighborhoods more effective than single yards
STUDY DESIGN

Logistics

- Five year project, 2016 through 2021
- Collaboration between the Cary Institute of Ecosystem Studies, Bard College, CDC, NYSDOH, DCDOBCH
- Funding from the Steven & Alexandra Cohen Foundation
- Additional funding from several smaller donations
STUDY DESIGN

Current status

- 24 neighborhoods have been selected
- At present, ~1000 households have agreed to participate, others being contacted
- In pre-intervention year (2016) sampled mammals at 229, and ticks at 192 properties
- Interventions started April 2017, to continue through 2020
- Conduct “biweekly surveys” of all participants
FOR MORE INFORMATION

www.tickproject.org