Goals, Study Design Considerations and Implementation: Establishing and moving toward the goals (Lyme disease)

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Integrated Tick Management Symposium
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Ultimate goals

- Reduce human bites by vector ticks
- Reduce the burden of Lyme disease and other tick-borne diseases
Chain of events for a Lyme disease case to occur

Host-seeking infected tick → Bite by infected tick → Tick feeding long enough to transmit spirochetes → Lyme disease case

If you remove a tick quickly (within 24 hr) you can greatly reduce your chances of getting Lyme disease.

Risk measures to predict Lyme disease cases:

- Density of host-seeking infected ticks
- No. known bites by infected vector ticks
- No. known bites by infected vector ticks (>48 hr)
- Lyme disease incidence

Human behavior / Personal protection → Tick detection and removal → Transmission efficiency
# Personal protective measures and environmentally-based tick/pathogen control methods

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[Graph: Lyme disease cases, 1995-2014]

- **Available now**: Black text
- **Not yet available**: Red text
Development and evaluation of tick-borne disease prevention interventions

**INTERVENTION EVALUATIONS**

- **Concept**
  - Initial laboratory trials
    - Can it work?

- **Small-scale controlled intervention trials**
  - Can it work?

- **Large-scale controlled intervention trials**
  - Can it work?
  - Pragmatic intervention trials
    - Will it work?

- **Programmatic evaluation**
  - Does it work?

**Recommendations & education**

1. **Controlled intervention trial**
   - Optimal execution of the intervention

2. **Pragmatic intervention trial**
   - Real-world execution of the intervention

3. **Programmatic evaluation**
   - Impact on knowledge, attitudes, behaviors, and disease burden
Example 1: Spray-on repellent (personal protective measure)


Large-scale controlled intervention trials: Still lacking


Programmatic evaluation:
- Lyme disease cases have increased despite long-standing recommendations for repellent use to prevent tick bites
- Hook et al. (2015) found that ~25% of respondents routinely use repellent in Lyme disease endemic regions
Example 2: Synthetic pyrethroid to kill host-seeking ticks

Laboratory trials with *I. scapularis*: Maupin and Piesman 1994; previous trials in the 1980s with several other tick species

Small-scale controlled intervention trials with *I. scapularis* abundance outcome: Solberg et al. 1992; Curran et al. 1993; Schulze et al. 2001b, 2005; Rand et al. 2010; Stafford and Allan 2010; Elias et al. 2013; >85% control of host-seeking *I. scapularis* nymphs up to 7 wk regardless of application method, spray pressure, or woodland versus residential setting

Large-scale controlled intervention trials / Pragmatic intervention trials with tick- and disease-based outcomes: Hinckley et al. 2016; 45-69% reduction of *I. scapularis* nymphs in residential ecotones (from barrier spraying) did not reduce either tick bites or Lyme disease cases

Programmatic evaluation: Hook et al. (2015) found that <10% of respondents currently use yard-based pesticides in Lyme disease endemic regions
Example 3:
Integrated tick / pathogen management

**Laboratory trials:** Based on combinations of single methods already proven in lab trials (if applicable)

**Small-scale controlled intervention trials with *I. scapularis* abundance outcome:**
- Schulze et al. (2007, 2008); integrated use of barrier spraying with pyrethroid (Yr 1 only) and topical acaricides for rodents (Yrs 1-2 only) and deer (Yrs 1-3); **abundance of host-seeking nymphs reduced by 86% in the year after the intervention was put in place and by 86–94% in the two following years**
- Additional studies are nearing completion (Mather, Stafford); final results still pending

**Large-scale controlled intervention trials / Pragmatic intervention trials with tick- and disease-based outcomes:** Still lacking but one study about to start (Ostfeld/Keesing; tentatively fungal acaricide to kill host-seeking ticks combined with rodent-targeted acaricide)

**Programmatic evaluation:** Not yet applicable
### Integrated tick/pathogen management: ITM component options

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**Selection of ITM combinations to move forward in pipeline:**
- Acceptability
- Cost
- Single household vs Neighborhood/Community
- Potential for reducing Lyme disease (hard data, simulation modeling)
Moving forward

- Prioritization of single and integrated prevention/control approaches to move through the development/evaluation pipeline
  - Weak evidence bases for most approaches, single or ITM, even in small scale intervention trials
  - Only very limited numbers of ITM approaches can realistically be evaluated in large scale intervention trials with Lyme disease outcomes
  - Investment in programmatic implementation will be driven by evidence for disease reduction

- Maintaining expertise to conduct intervention evaluation studies
- Design of intervention evaluation studies – Alison Hinckley
- Study outcome measures – Howie Ginsberg
- Responsible implementation parties / end user engagement – Tom Mather
- Finding the funds (order of magnitude increase needed) – Ben Beard
With thanks to the “pipeline group”
Ben Beard, Marc Dolan, Rebecca Eisen, Ken Gage, Alison Hinckley,
Sarah Hook, Kiersten Kugeler, Paul Mead, Christina Nelson, Anna Perea,
and others........

For more information, contact CDC
1-800-CDC-INFO (232-4636)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.