ITCH- Is Tick Control Helping?

Yankee Conference on Environmental Health

Northampton MA
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University of Massachusetts Amherst
BE REVOLUTIONARY™

NEWVEC
NEW ENGLAND CENTER OF EXCELLENCE IN VECTOR-BORNE DISEASES

Vectors, parasites and populations

- Andrew Lover, PI

- Estee Cramer (PhD cand.)
- Johanna Ravenhurst (PhD cand.)
- Mahfuj Alam (2nd year PhD student)
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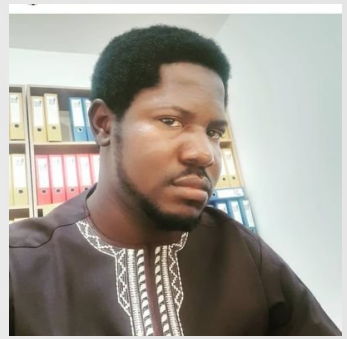

School of
Public Health and Health Sciences

Dept of Biostatistics and Epidemiology

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Our broad aim: operational research

Any research producing practically-usable knowledge which can be used to improve *any* aspect of program implementation (e.g., effectiveness, efficiency, coverage, access, scale-up, sustainability).

- It addresses specific problems within specific programs, and not general issues.
- It addresses those problems that are "*interventionable.*"
- May use existing data, or can require new data collection.
- The science of *better.*

Atlantic convoys, WWII.

The goals of operations research

Sturdy and robust

Serviceable

Fancy

What can operation research do?

Maximize limited resources: what dragging/trapping sites, schedules, modalities are "best" for for different types of public health surveillance? (Maximizing diversity? Finding positive pools? Tracking IR? Measuring impacts for nuisance biters?).

Vexing questions: when there's apparently sufficient coverage of "good" interventions, yet transmission persists.

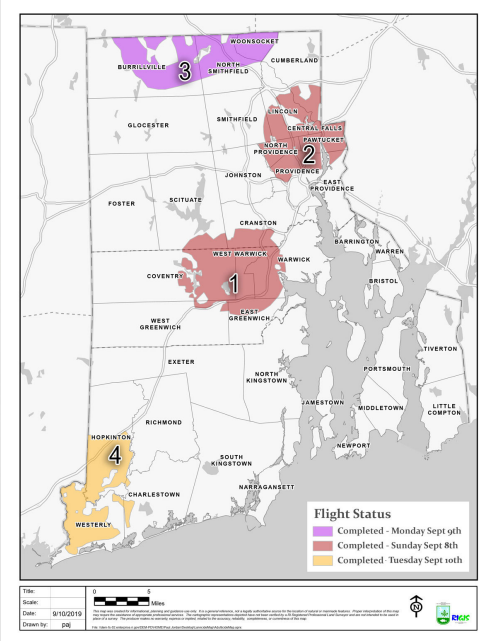
How do we get here?

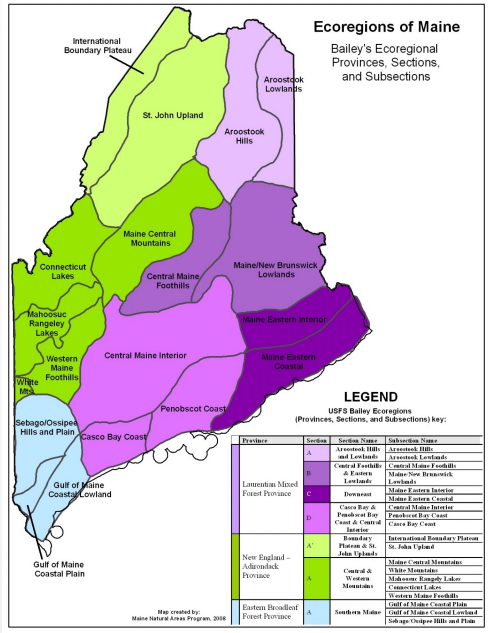
ITCH Internet-based Survey

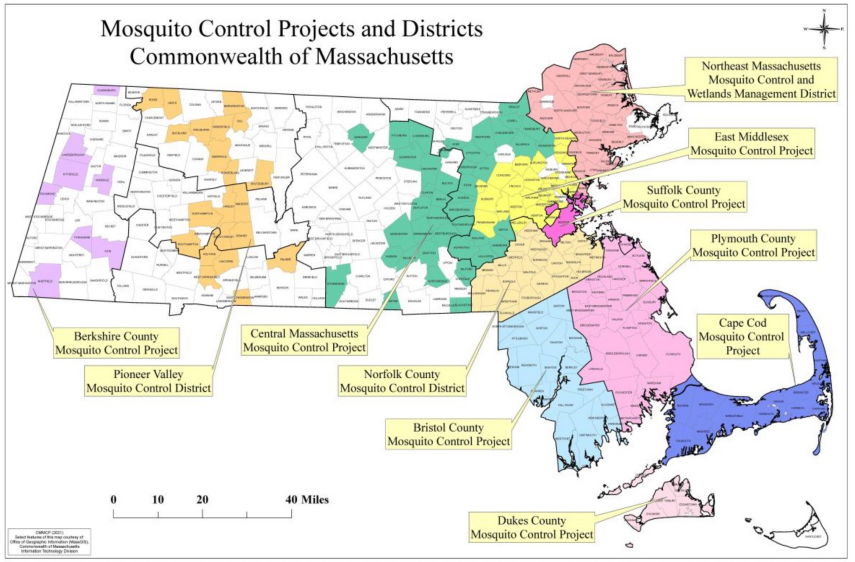
Rationale for ITCH

Current data on uptake, and evidence-base for residential tick control is limited across the Northeast.

Moreover, what differences are there across regional gradients?







Burden of TBD in the US

- Estimated to be 8-10x underreporting for Lyme.

Table 6: Reported Tick-borne Disease Cases and All Vector-Borne Diseases Cases, 2004-2018

Tick-borne Diseases	Year															
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Lyme Disease	19,804	23,305	19,931	27,444	35,198	38,468	30,158	33,097	30,831	36,307	33,461	38,069	36,429	42,743	33,666	**478,911**
Anaplasmosis / Ehrlichiosis	875	1,404	1,455	1,999	2,107	2,267	2,615	3,586	3,725	4,551	4,488	5,137	5,750	7,718	6,123	**53,800**
Spotted Fever Rickettsiosis	1,713	1,936	2,288	2,221	2,563	1,185	1,985	2,802	4,470	3,359	3,757	4,198	4,269	6,248	5,544	**49,168**
Babesiosis	N	N	N	N	N	N	N	1,128	937	1,796	1,760	2,100	1,910	2,368	2,160	**14,159**
Tularemia	134	154	95	137	123	93	124	166	149	203	180	314	230	239	229	**2,570**
Powassan virus	1	1	1	7	2	6	8	16	7	15	8	7	22	33	21	**155**
Subtotal Tick-borne Diseases	22,527	26,800	23,770	31,808	39,993	42,649	34,890	40,795	40,119	46,231	43,654	49,825	48,610	59,349	47,743	**598,763**
Total All Reported Vector-Borne Diseases*	**27,385**	**33,874**	**30,484**	**41,401**	**43,803**	**47,655**	**49,395**	**45,175**	**54,110**	**61,142**	**56,374**	**55,644**	**96,071**	**66,862**	**51,482**	**760,828**

*Notifiable vector-borne diseases; anaplasmosis/ehrlichiosis infections, babesiosis, California serogroup virus diseases, chikungunya virus disease, dengue virus infections, eastern equine encephalitis virus disease, Lyme disease, malaria, plague, Powassan virus disease, spotted fever rickettsiosis, St. Louis encephalitis virus disease, tularemia, western equine encephalitis virus disease, yellow fever, zika virus infection and disease

Tick-borne Disease Working Group 2020 Report to Congress, https://www.hhs.gov/sites/default/files/tbdwg-2020-report_to-ongress-final.pdf

Overview

- ITCH1 internet-based survey
- ITCH2 field sampling
- Questions

Presented on behalf of all the collaborating labs.

UMass: Steve Rich, Andrew Lover, Gaung Xu
UNH: Jeff Garnas
U Maine: Allie Garnder
Northern VT University: Bill Landesman
URI: Nelle Couret, Tom Mather





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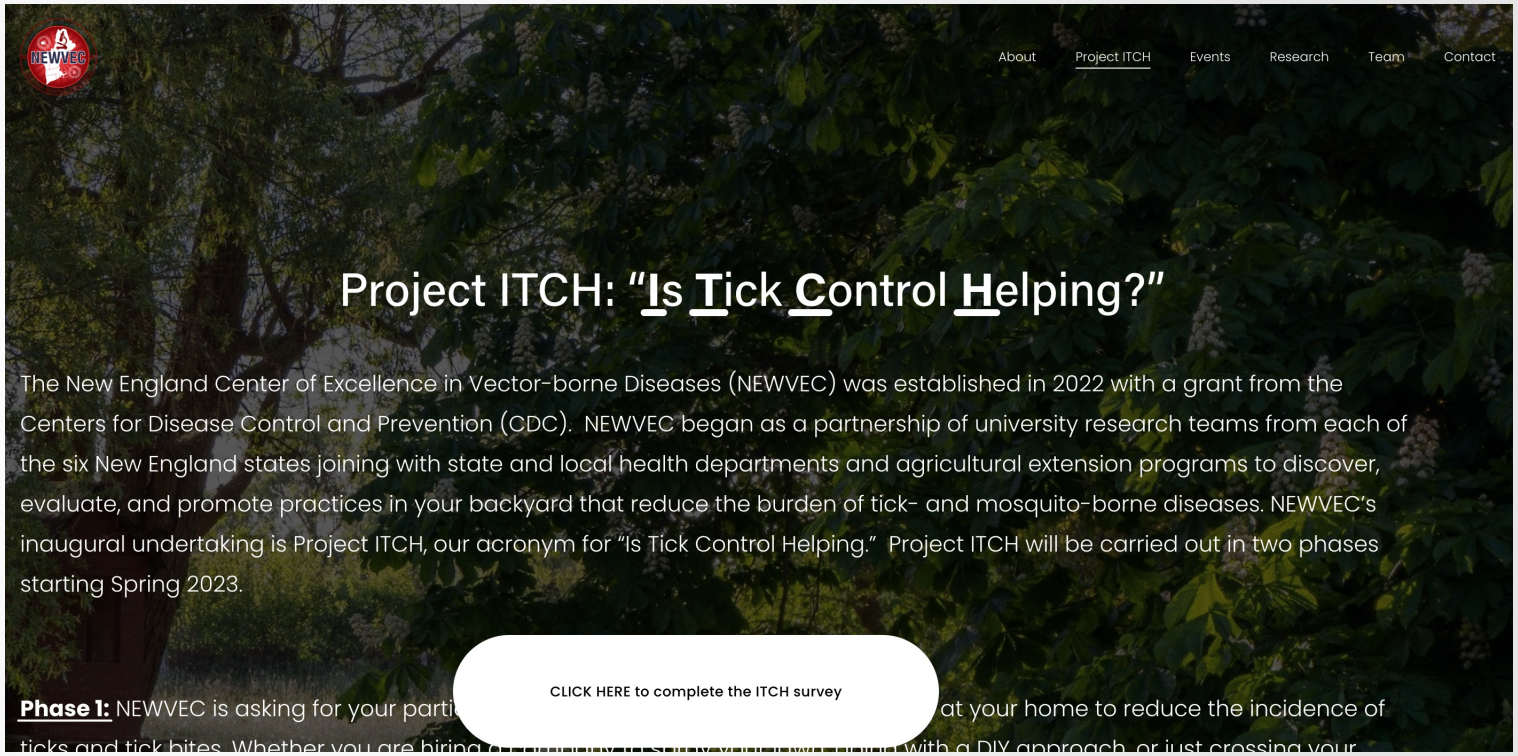
ITCH Phase I (May-Sept 2023)

10-15 min survey, including

- Household demographics
- Motivations for doing/ not doing prevention activities
- General KAP
- Current vector control practices
- Recent confirmed VBD in household
- Willingness to spend for control



UMass IRB Approval #3639

https://www.newvec.org/itch

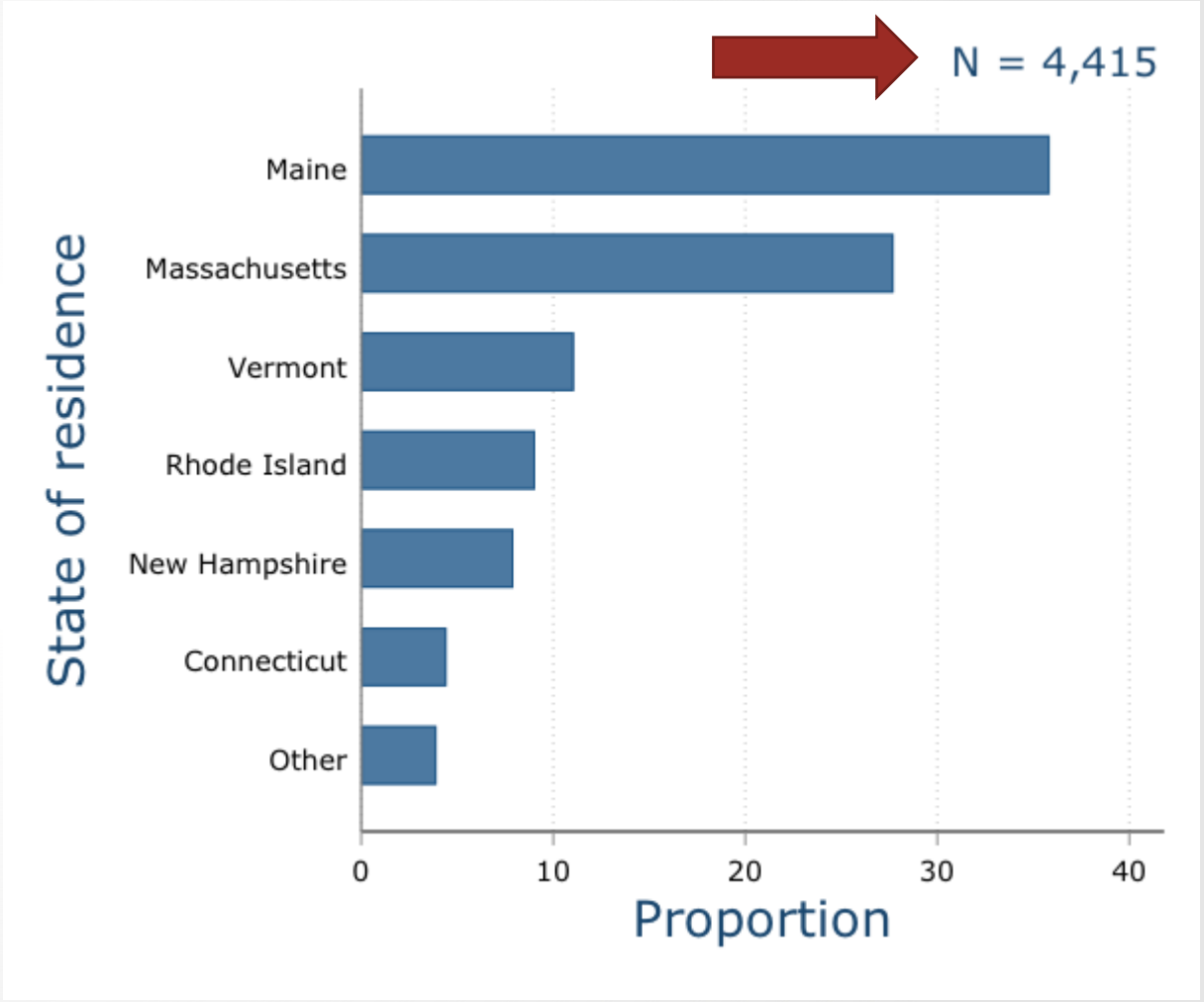
Phase I uptake

How? Emails to local organizations

- Tick Encounter; Tick Report; ag station listservs; gardeners groups, etc.
- Complemented by mass media "blitz" in ME and VT.

- Monitoring demographics to look for any "blind spots."
-

  Also ask all respondents if they're interested in having their yard surveyed (Phase II).

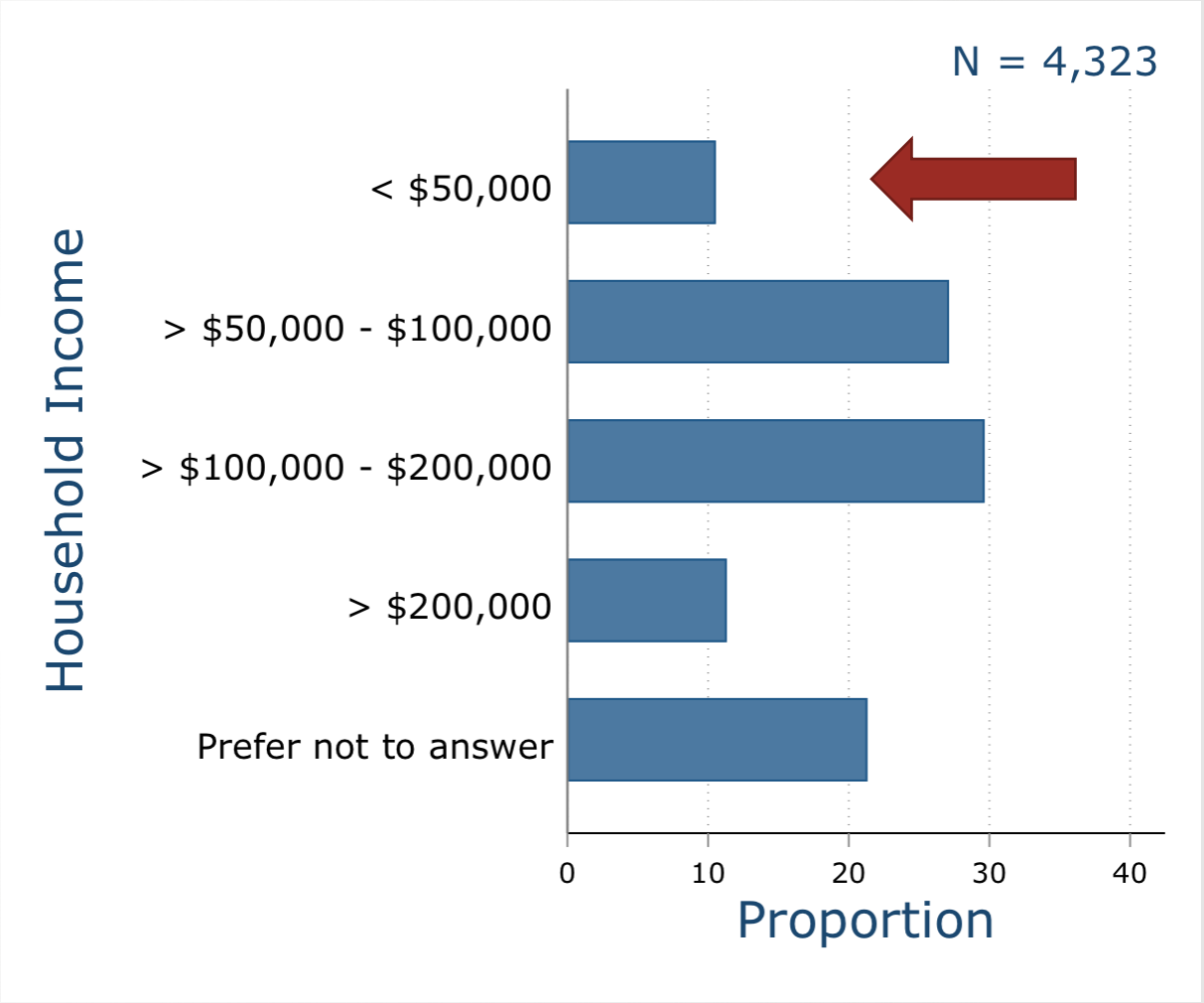


Demographics of responses

Household income

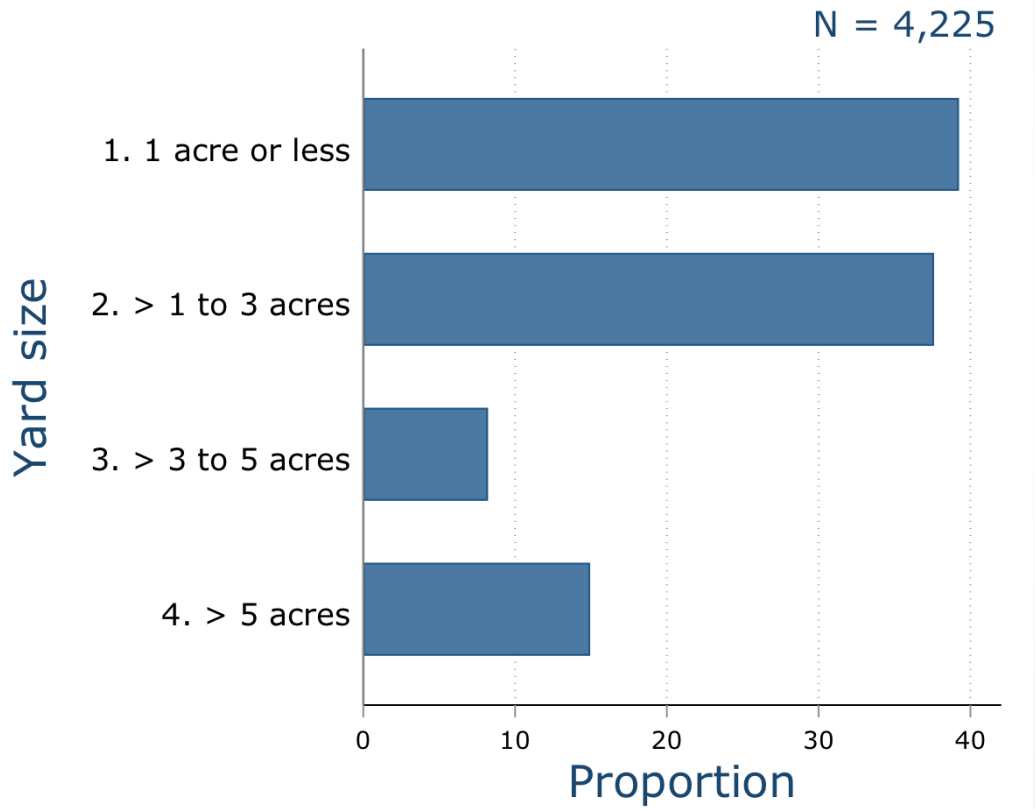
- Comparable coverage to census data

  (American Community Survey, www.census.gov/programs-surveys/acs)



https://censusreporter.org/profiles/03000US1-new-england-division/

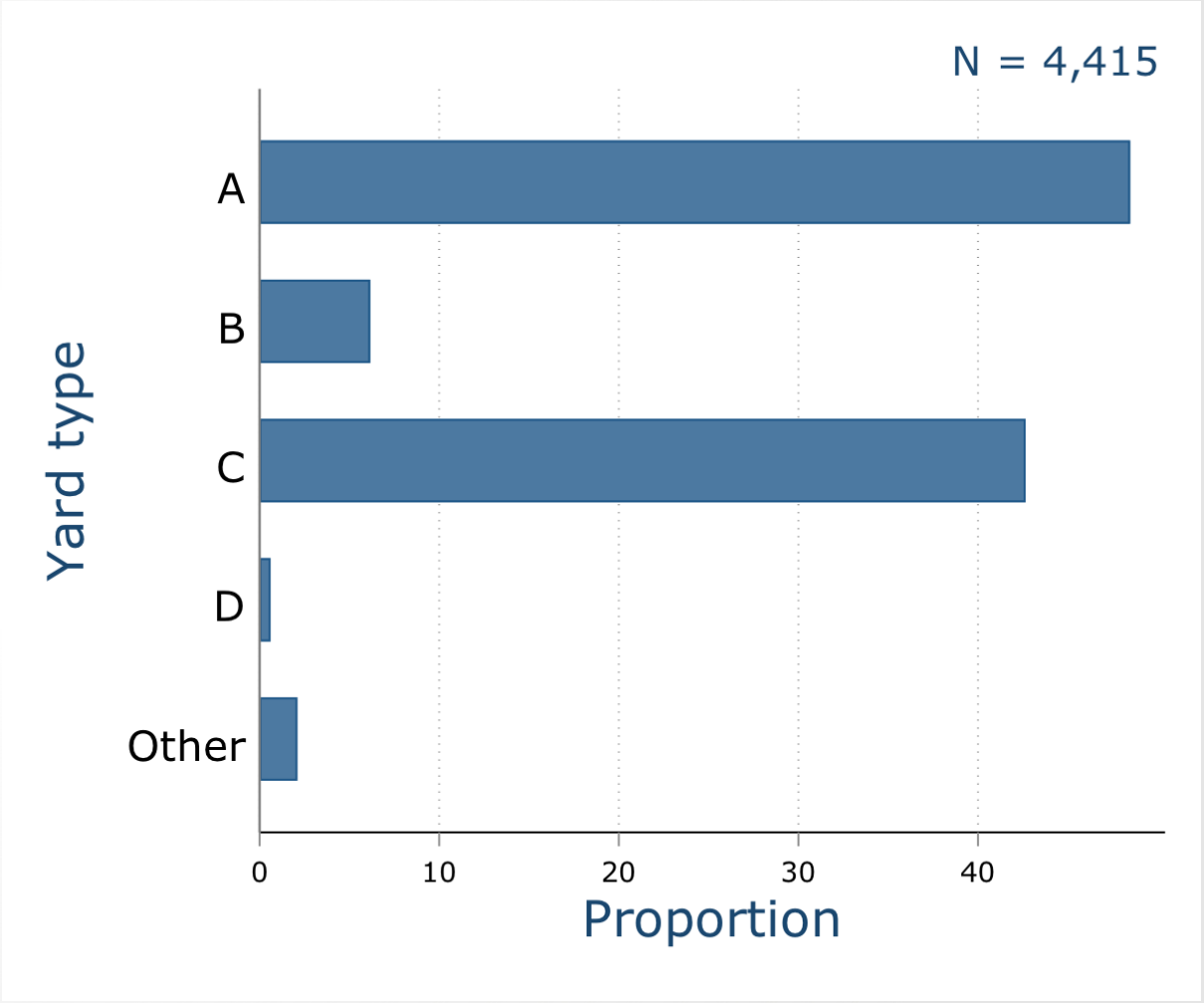
Yard sizes across the region



Size	MA	RI	CT	VT	ME	NH	Total
1 acre or less	626	223	87	114	487	101	1,638
> 1 to 3 acres	417	134	83	178	647	154	1,613
> 3 to 5 acres	74	17	11	65	143	37	347
> 5 acres	102	23	14	130	301	57	627
	1,219	397	195	487	1,578	349	**4,225**

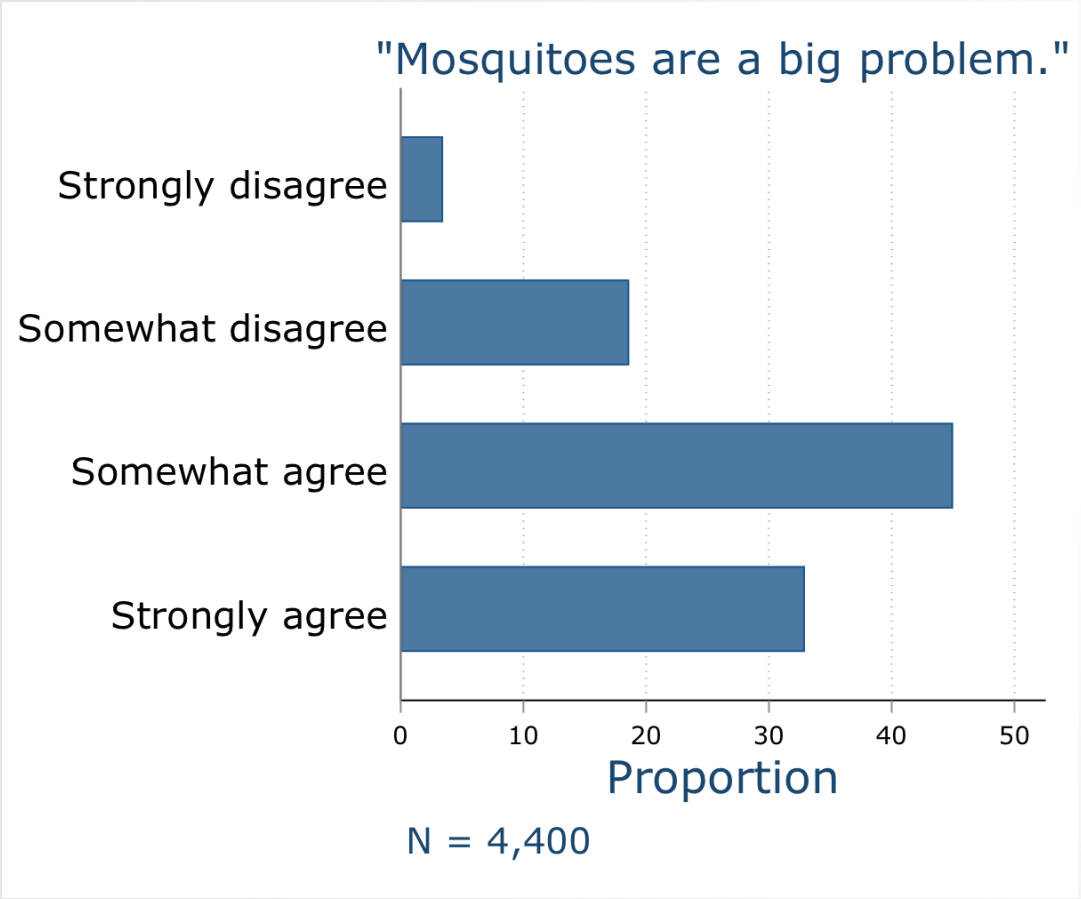
$\chi 2$ test for difference, $p < 0.0001$

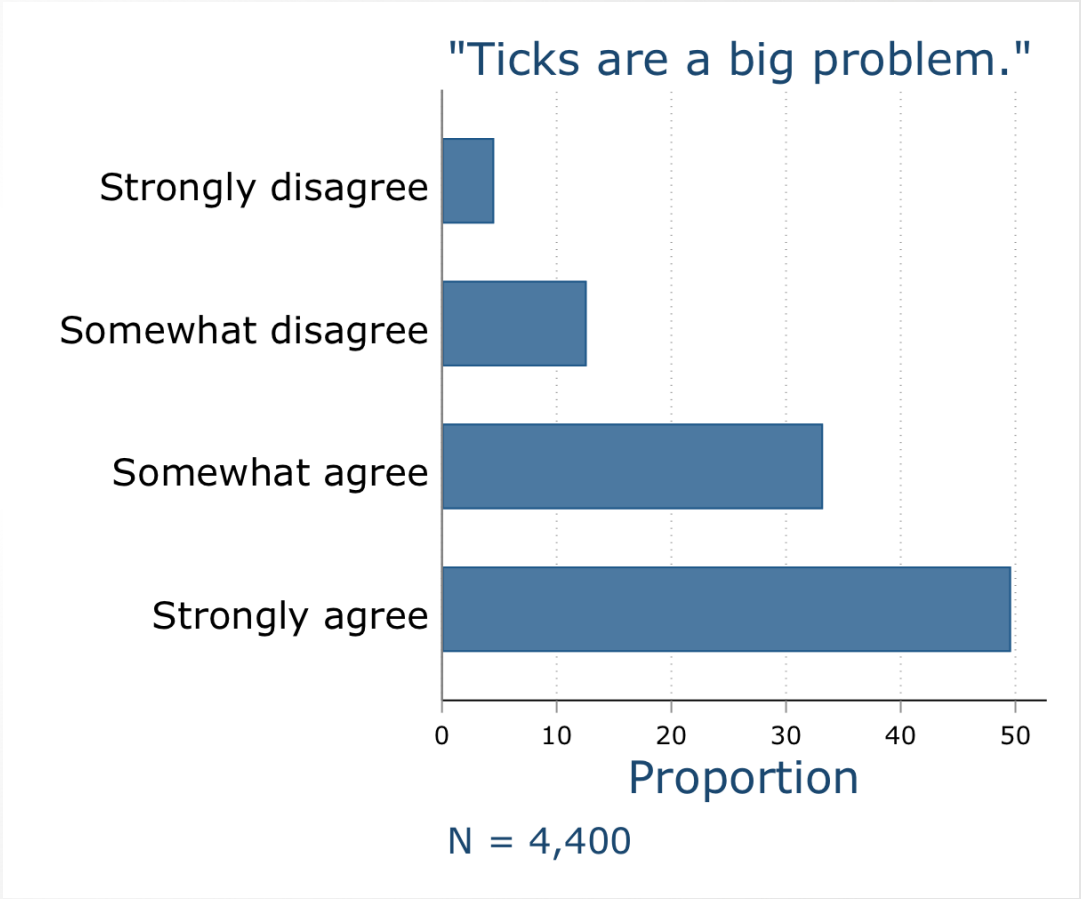
Household/yard type



Broad housing classes to capture variation in peridomestic settings

Levels of concern via Likert scale

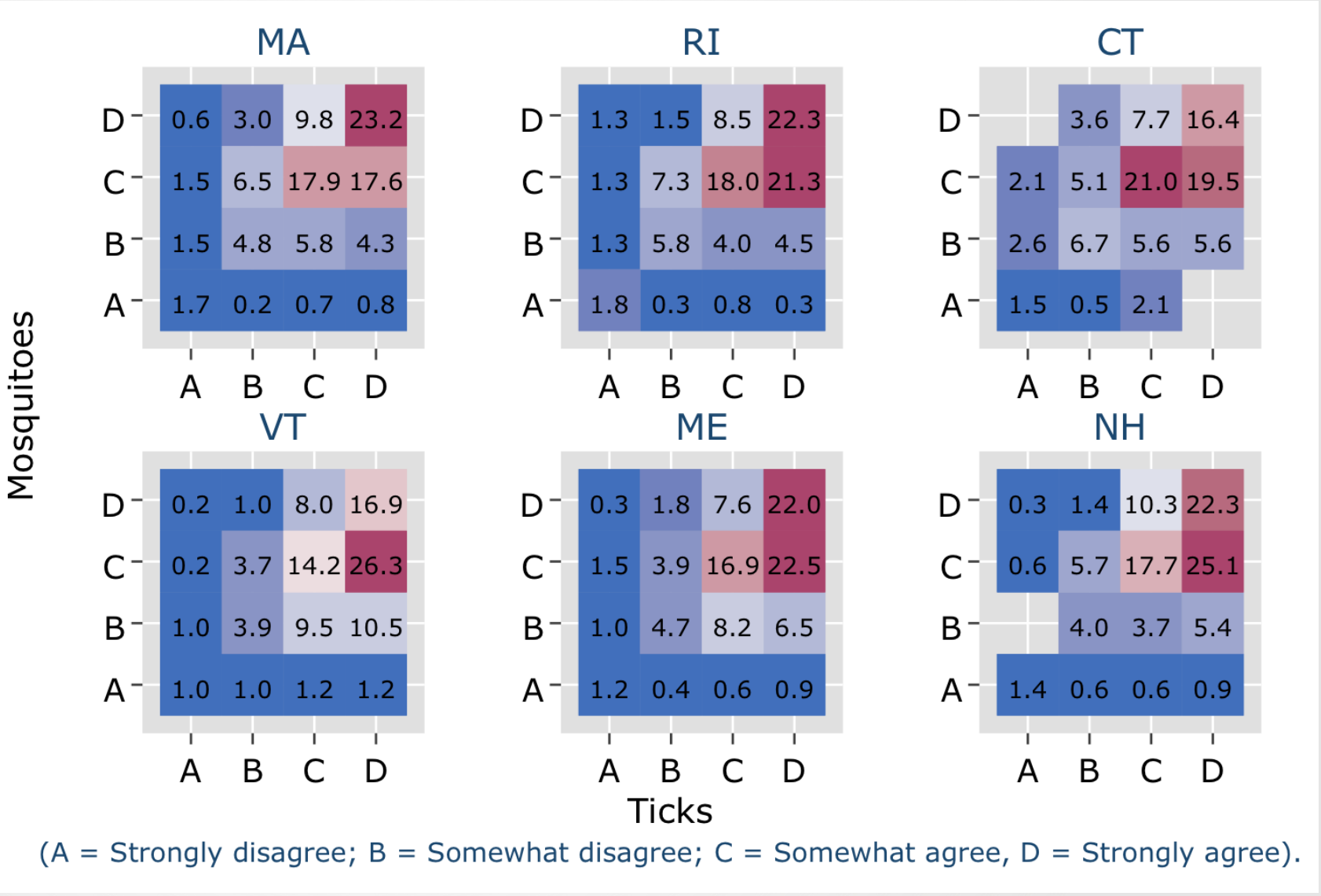




Joint concern

Regional variation in the combined concern for each vector "type."

Do programs need differential targeting?



(A = Strongly disagree; B = Somewhat disagree; C = Somewhat agree, D = Strongly agree).

Prevalence of household-level vector control interventions

Activity	Prevalence
Rodent bait boxes	10.5 %
Tick tubes	12.9 %
Vegetation management	37.7 %
Landscaping (wood chips, etc.)	18.1 %
Removal of standing water	63.3 %
Deer fencing	8.2 %
Citronella candles, torches etc.	30.2 %
Pesticides (any)	20.5 %
Commercial pesticide application	14.4 %
Any intervention (N = 4,242)	**86.6 %**

Multivariable models for any household-level vector control

Outcome- any vector control method (N = 4,139).

Analysis with robust errors, and adjusted for HH income; Stata 17.

Factor		Odds ratio	95% CI	p-value
State	MA (ref)	1.0	-	-
	CT	1.02	(0.59, 1.77)	0.947
	RI	0.87	(0.59, 1.28)	0.480
	VT	**0.57**	**(0.41, 0.79)**	**0.001**
	ME	**0.48**	**(0.37, 0.61)**	**< 0.001**
	NH	0.82	(0.55, 1.22)	0.332
Yard Size	Up to acre (ref)	1.0	-	-
	> 1 to 3 acres	**1.32**	**(1.05, 1.65)**	**0.016**
	> 3 to 5 acres	1.38	(0.93, 2.04)	0.114
	> 5 acres	**0.66**	**(0.50, 0.98)**	**0.003**
Yard Type	A	**1.65**	**(1.14, 2.39)**	**0.007**
	B (ref)	1.0	-	-
	C	**1.56**	**(1.08, 2.23)**	**0.015**
	D	0.76	(0.24, 2.40)	0.645
	Other	1.46	(0.72, 2.96)	0.299

ITCH Field Sampling

Phase II- field sampling, Spring-Summer 2023

RI only (Tom Mather's lab)

Comparison of *Ix. scapularis* density at treated and untreated yards.

Treated yards included a range of options: vegetation management; wood chipping; professional bifenthrin application.

ME, NH, VT, and MA (Gardner, Garnas, Landesman, Lover, Rich labs)

Measuring density/pathogen prevalence.

Flagging with unified protocol across a diverse set of domestic properties.

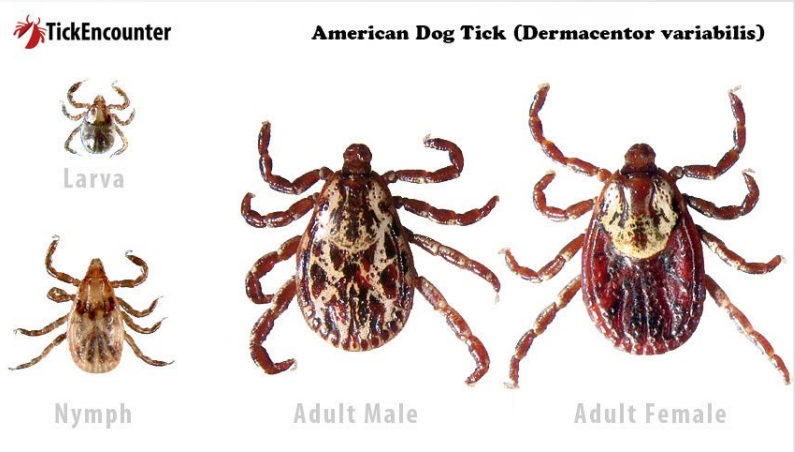
Why? Limited baseline data available on density at domestic sites; data to be used for subsequent seasons.

Preliminary flagging results

2,831 hard ticks from field sampling

- 2,148 *Ixodes scapularis*
- 496 *Dermacentor variabilis*
- 187 Other spp.

Borrelia prevalence consistent with prior surveys; some regional variations.

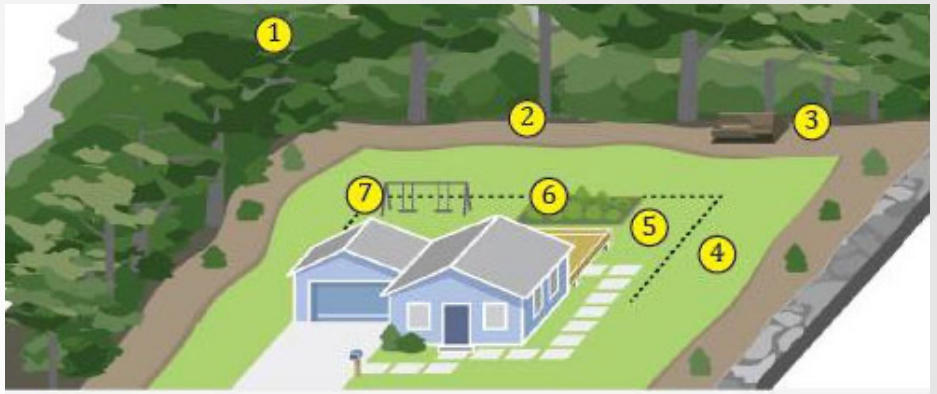


Proposed future outcomes

Can we *quantify* the impact of current residential interventions for tick control?

Are there important differences across ecozones?

How can these results inform updated best practices?



1	**Tick zone**	Avoid areas with forest and brush where deer, rodents, and ticks are common.
2	**Wood chip barrier**	Use a 3 ft. barrier of wood chips or rock to separate the "tick zone" and rock walls from the lawn.
3	**Wood pile**	Keep wood piles on the wood chip barrier, away from the home.
4	**Tick migration zone**	Maintain a 9 ft. barrier of lawn between the wood chips and areas such as patios, gardens, and play sets.
5	**Tick safe zone**	Enjoy daily living activities such as gardening and outdoor play inside this perimeter.
6	**Gardens**	Plant deer resistant crops. If desired, an 8-ft. fence can keep deer out of the yard.
7	**Play sets**	Keep play sets in the "tick safe zone" in sunny areas where ticks have difficulty surviving.

Based on a diagram by K. Stafford, Connecticut Agricultural Experiment Station

What questions do you have?

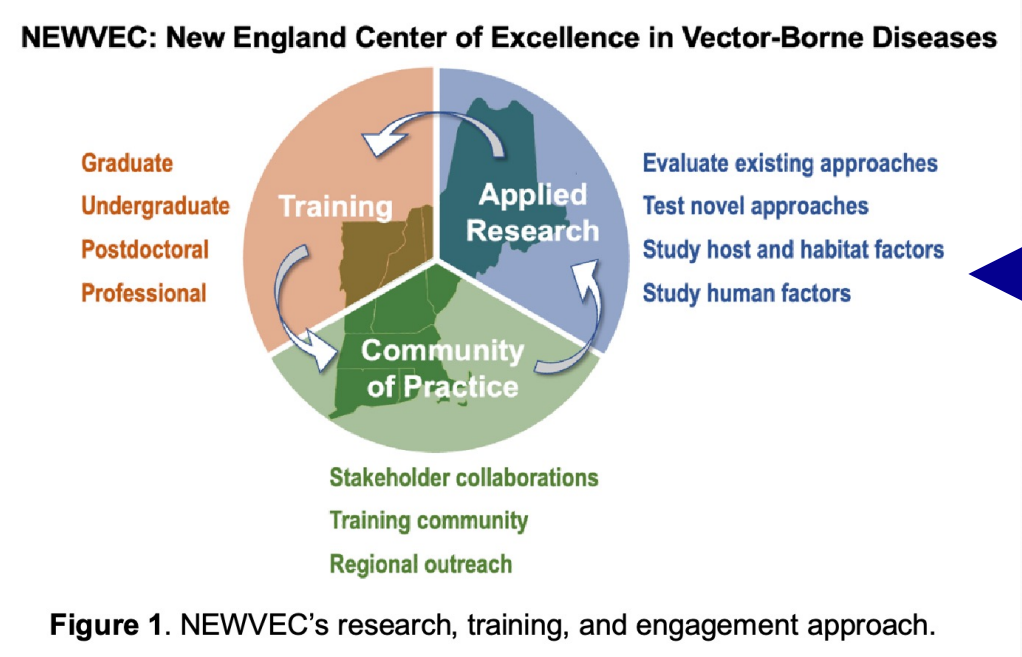
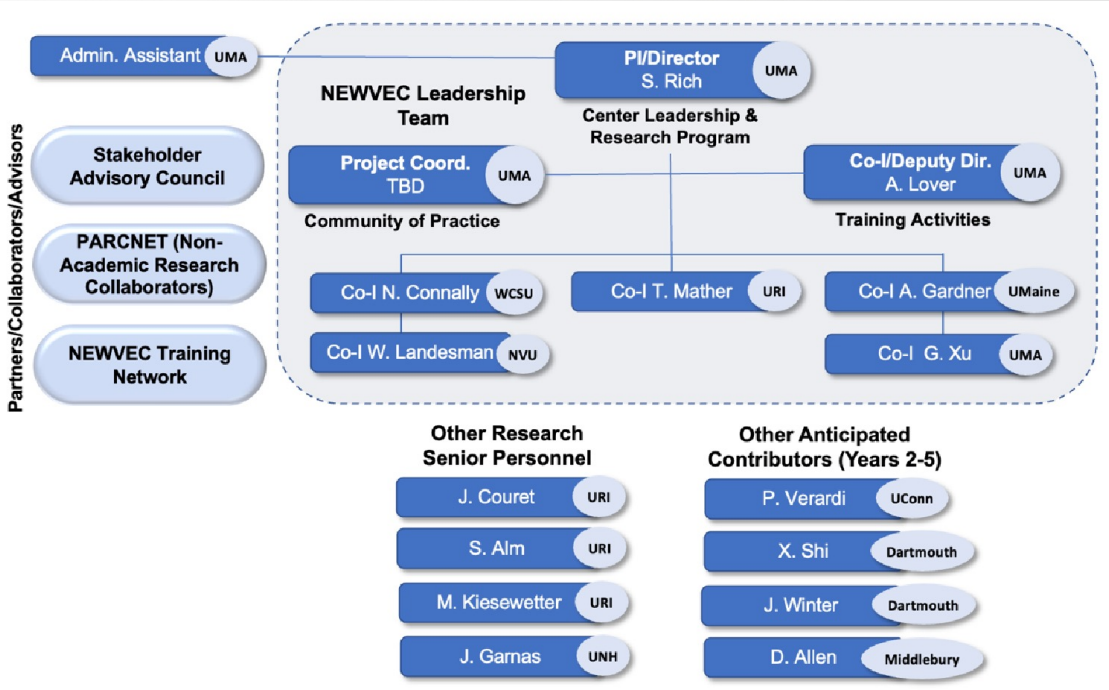


Figure 1. NEWVEC's research, training, and engagement approach.



Funding for this work provided to UMass via
Cooperative agreement #0000003031 (US Centers for Disease Control and Prevention).

email: alover@umass.edu; **lab website**: loverlab.io; **NEWVEC**: https://www.newvec.org/

University of Massachusetts Amherst

What can NEWVEC do to support local/regional programs?

- **Technical assistance including:**
  statistical consulting; data analysis; sample size/power and design of experiments; GIS/geospatial analysis; hotspot detection.
- **Why**? analytics to help optimize the cycle **of implementation-analysis-refinement**.

1. **Help utilize existing data:** what trapping sites, schedules, modalities are "best" for your program's immediate goals?

2. **Support design and analysis of pilot OR studies**

3. **Where possible, provide student trainees for "extra" data collection to support larger OR efforts**

4. **Work together to implement "large scale" OR where warranted**

My lab's research

Understanding, targeting, and improving interventions to highest-risk populations and locations.

- **Why?** Program impacts are often compromised if target groups/locations are poorly understood and/or interventions poorly aligned (moreover, poor use of limited resources) vs. "broad brush" programs.
- **Therefore,** diverse study tools are needed to design effective and evidence-based interventions for practical public health programming.

Randomized trials

"Real world" public health programs

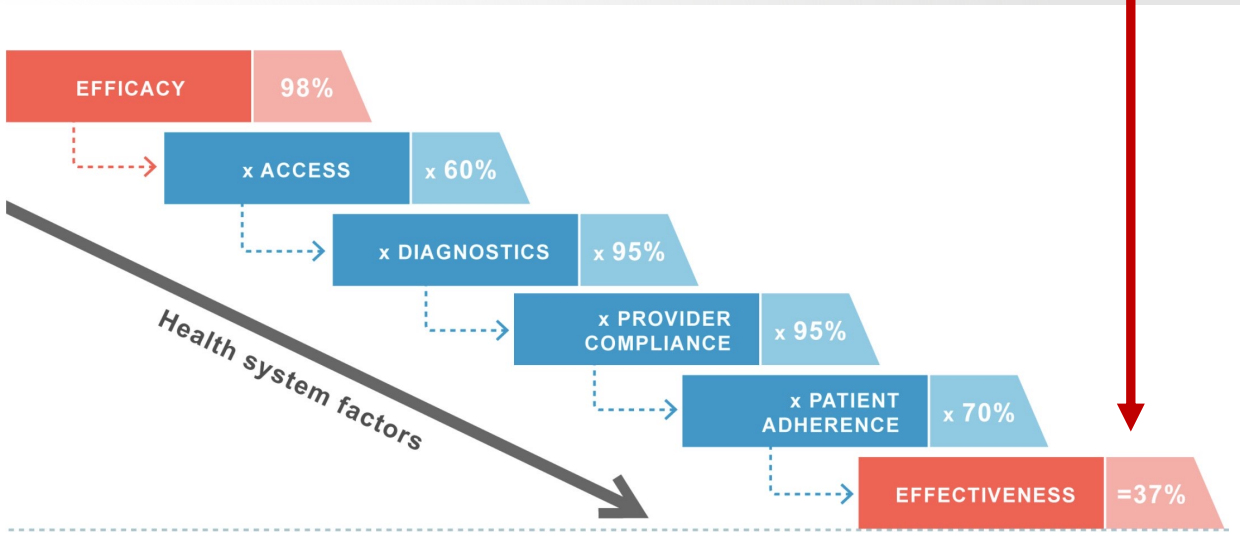


Fig 2. Effectiveness decay. Loss of effectiveness of interventions within the health system is depicted here by steps. The pattern of effectiveness decay (how much is lost and at what step) varies and depends on the specifics of a given health system [12]. The percentages of decay/loss are hypothetical.

https://doi.org/10.1371/journal.pmed.1002454.g002

PLoS Medicine, *14*(11), e1002454, 2017.