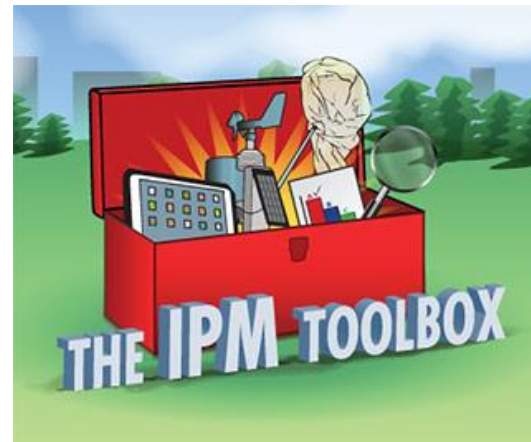




Tick IPM Series Part 2: Tick-borne Disease: Integrated Risk Management

June 24, 2020



Webinar Details

- Welcome
- A recording of this webinar will be available within a week at
 - <http://www.neipmc.org/go/ipmtoolbox>

We Welcome Your Questions

- Please submit a question **at any time** using the Q&A feature to your right at any time
- If you'd like to ask a question anonymously, please indicate that at the beginning of your query.

Webinar Presenter



Stephen M. Rich,
Professor of Microbiology
Director of the Laboratory of Medical Zoology
University of Massachusetts, Amherst

Some Questions for You

Outline

- Overview
- Public Health Exposure
- Tick Reports
- Passive Surveillance Database
- Future Webinars



A photograph of a person walking away on a dirt path through a dense forest. Sunlight filters through the trees, creating a dappled light effect on the ground. The person is wearing a red dress. The text 'QUEST' is overlaid in the upper left, and a list of tick behaviors is overlaid in the center-right.

QUEST

**Ticks don't:
Jump,
Fly, or
Drop from trees**

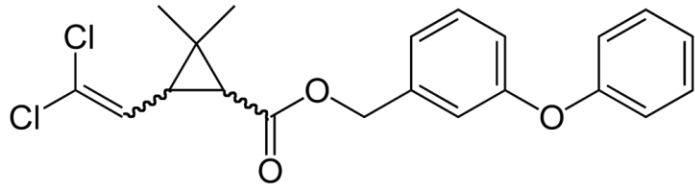
Personal Protection

- Proper clothing
 - Light colored
 - Tuck pant leg into socks
- CHECK for ticks

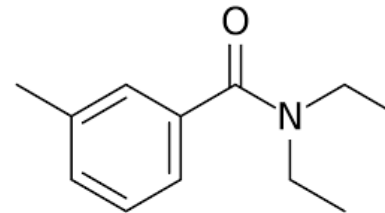


Personal Protection (chemical)

- **TREAT CLOTHING**
 - Permethrin (acaricide)



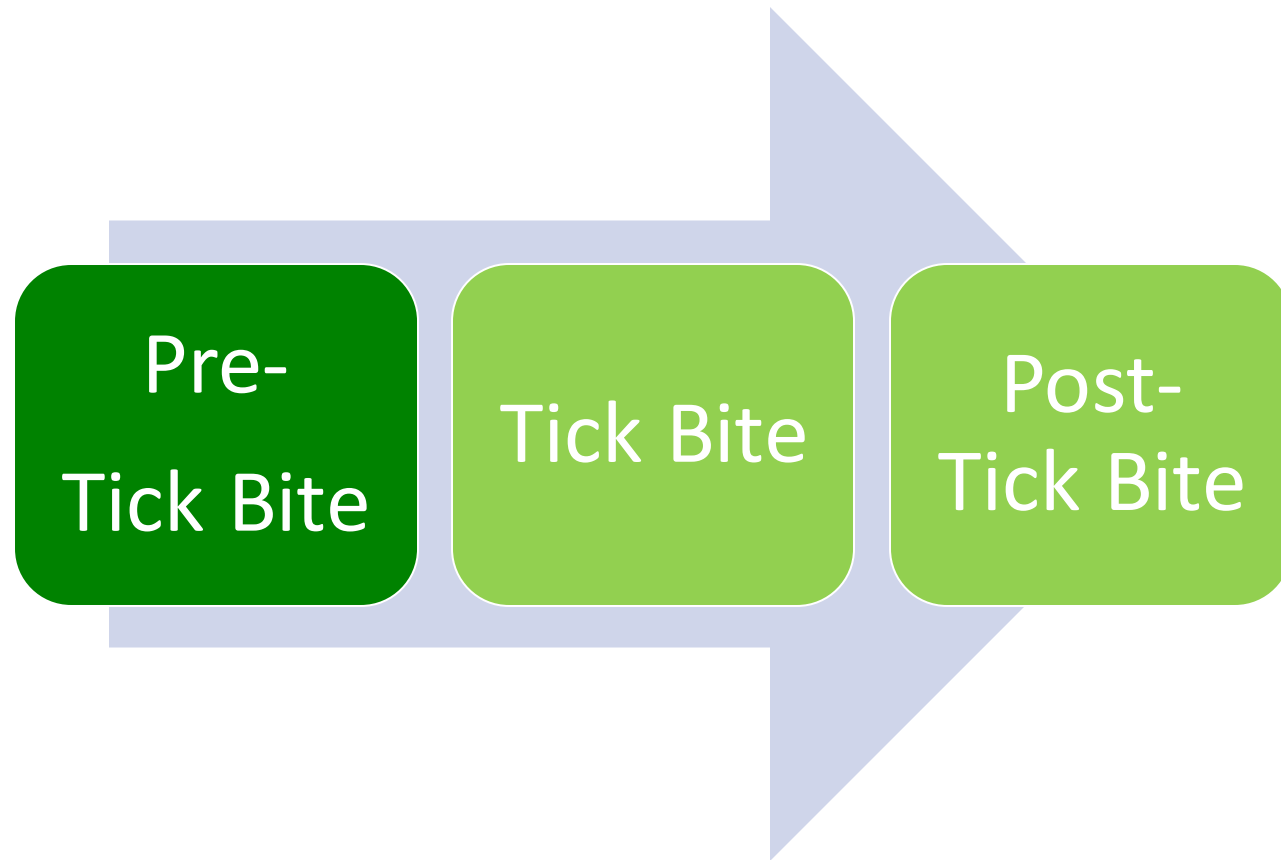
- **TREAT SKIN**
 - DEET (repellent)



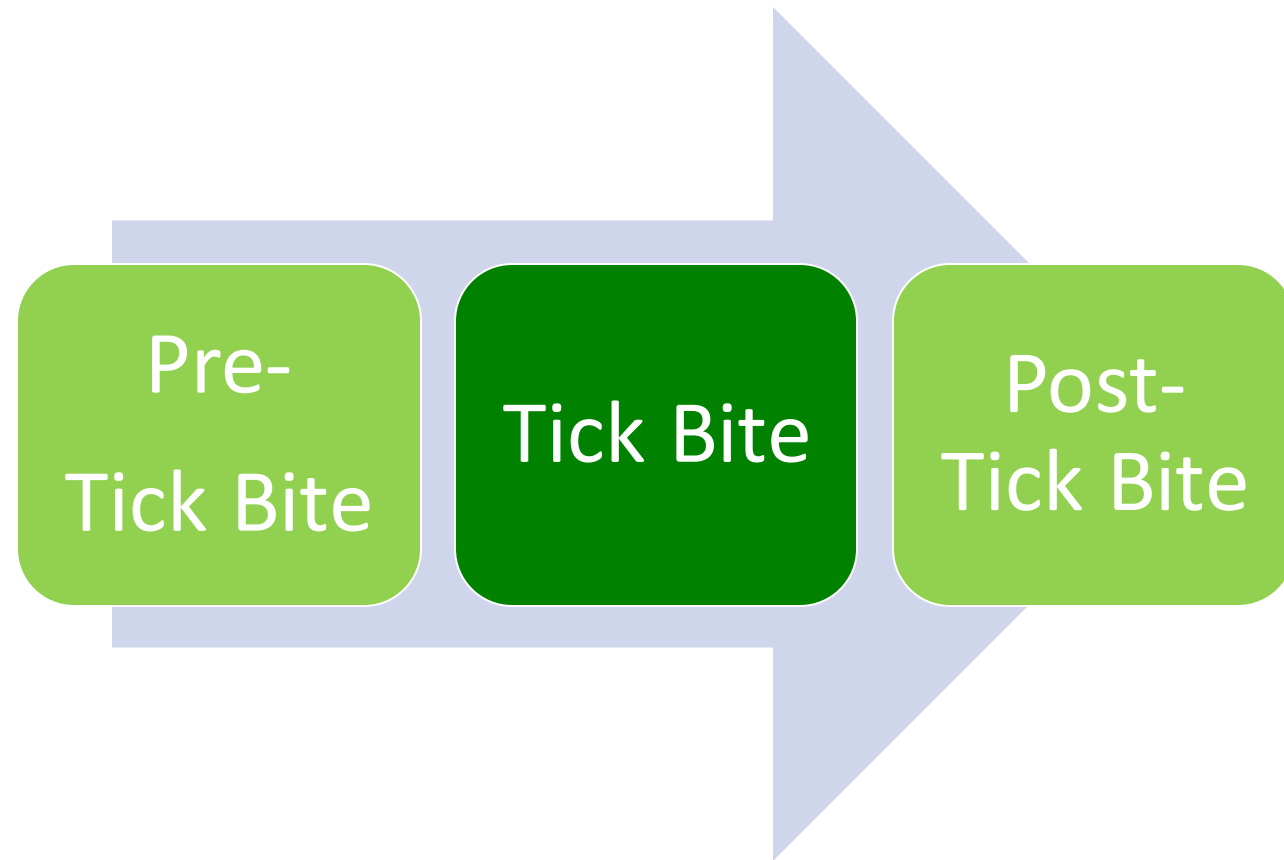
Source Reduction

- Kill questing ticks
 - Perimeter Spray
- Kill ticks on hosts
 - 4-posters
 - Bait boxes
 - Vaccines (@ ticks)
- Reduce infection
 - Wildlife vaccine (@pathogens)
 - Transgenics

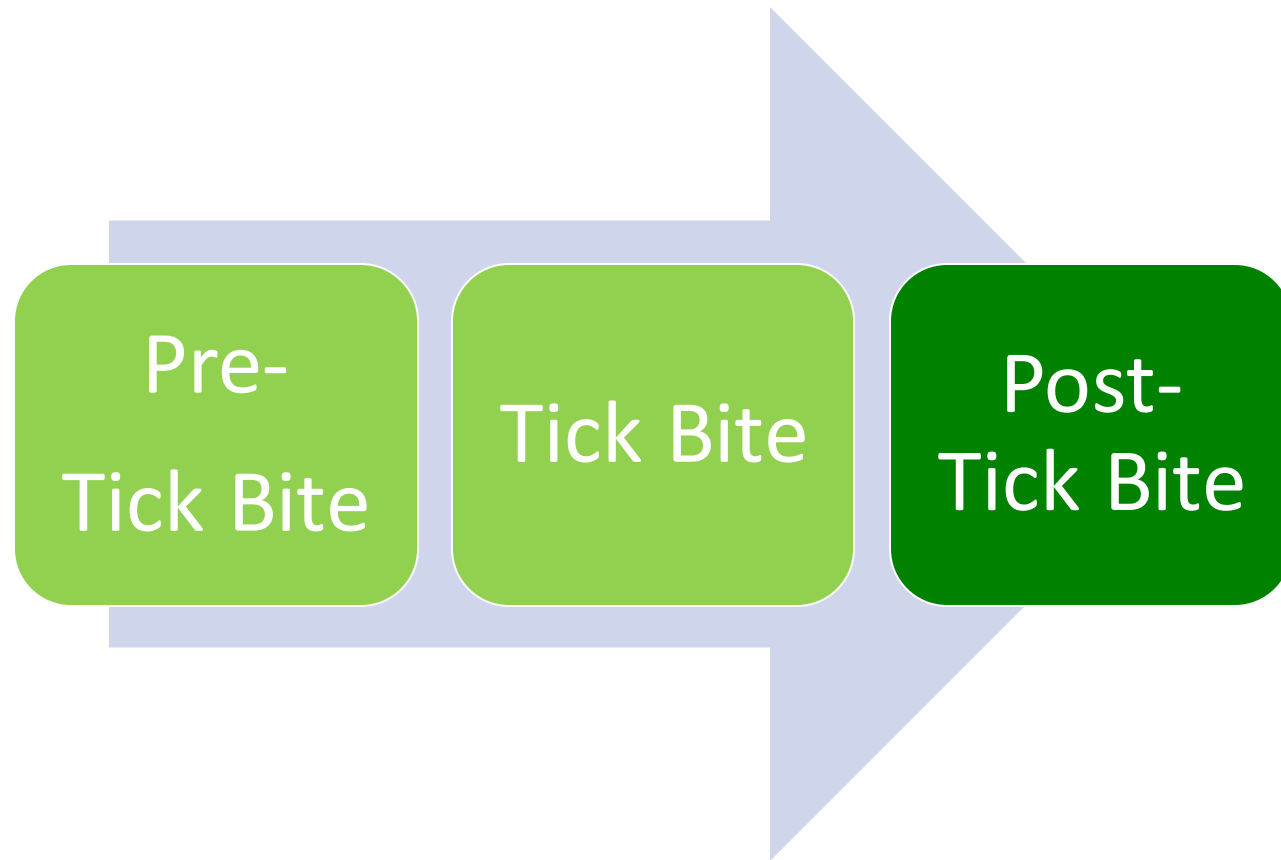
The Story Line of TBD



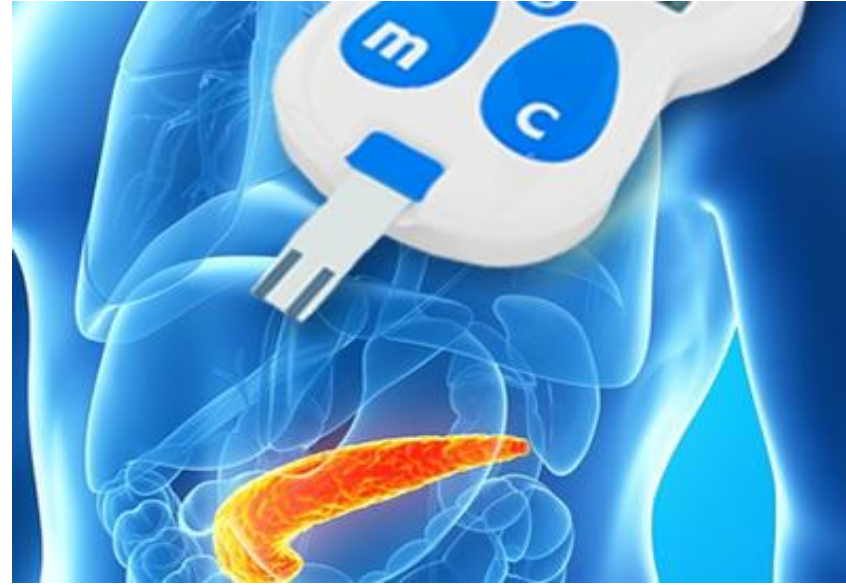
The Story Line of TBD



The Story Line of TBD



THREATS TO PUBLIC HEALTH



THREATS TO PUBLIC HEALTH

HAZARD

A **HAZARD** is something that has the potential to harm you



RISK

RISK is the likelihood of a hazard causing harm



EXPOSURE

HAZARD



RISK



EXPOSURE

- **Tick species**
 - Different species, different hazards

EXPOSURE

Human Biting Ticks

Deer tick
(*Ixodes scapularis*)



Lyme borreliosis
Babesiosis
Anaplasmosis
Borrelia miyamotoi
Powassan virus (Deer tick virus)

Dog tick
(*Dermacentor variabilis*)



Tularemia
Rocky Mountain Spotted Fever

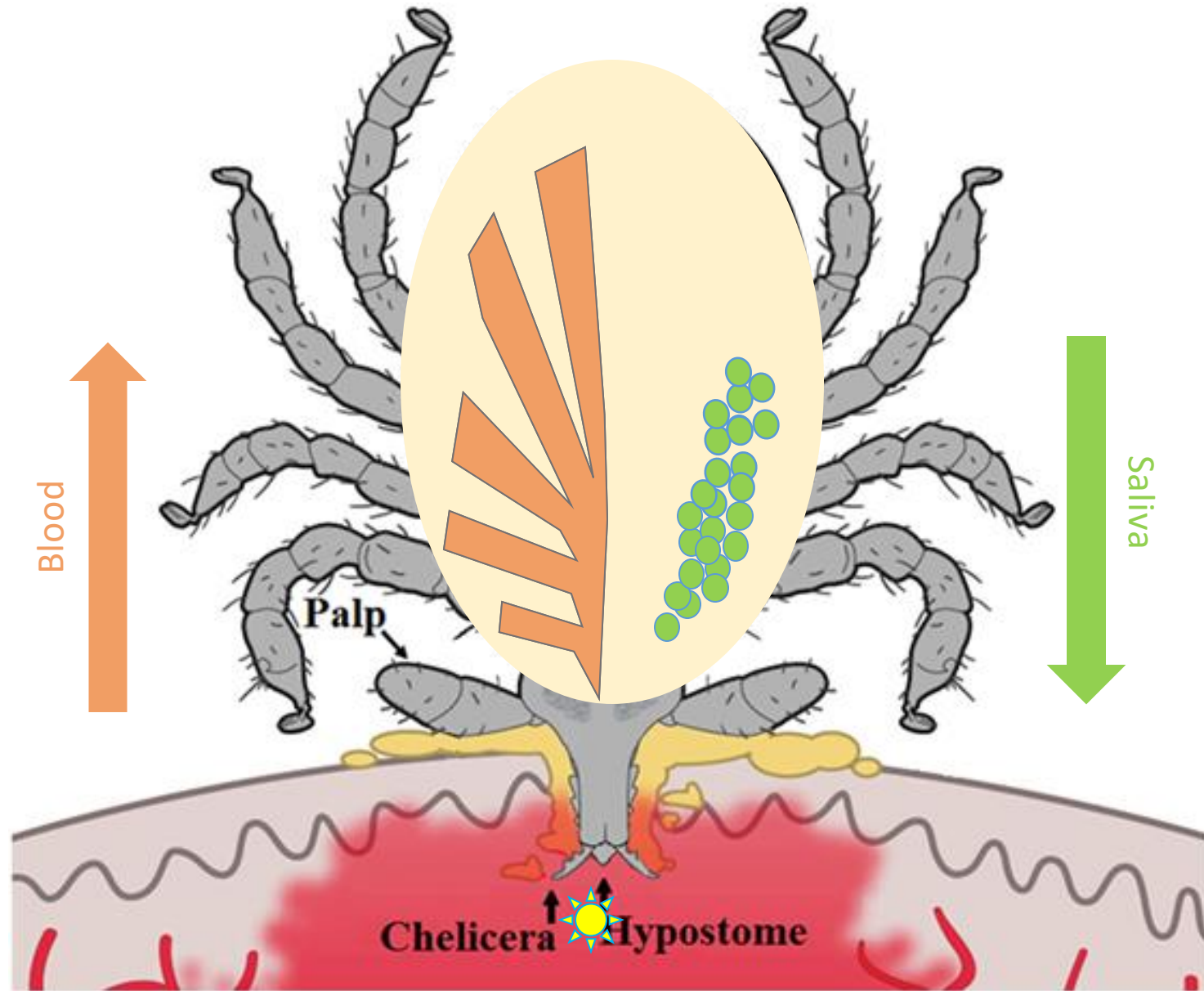
Lone Star tick
(*Amblyomma americanum*)

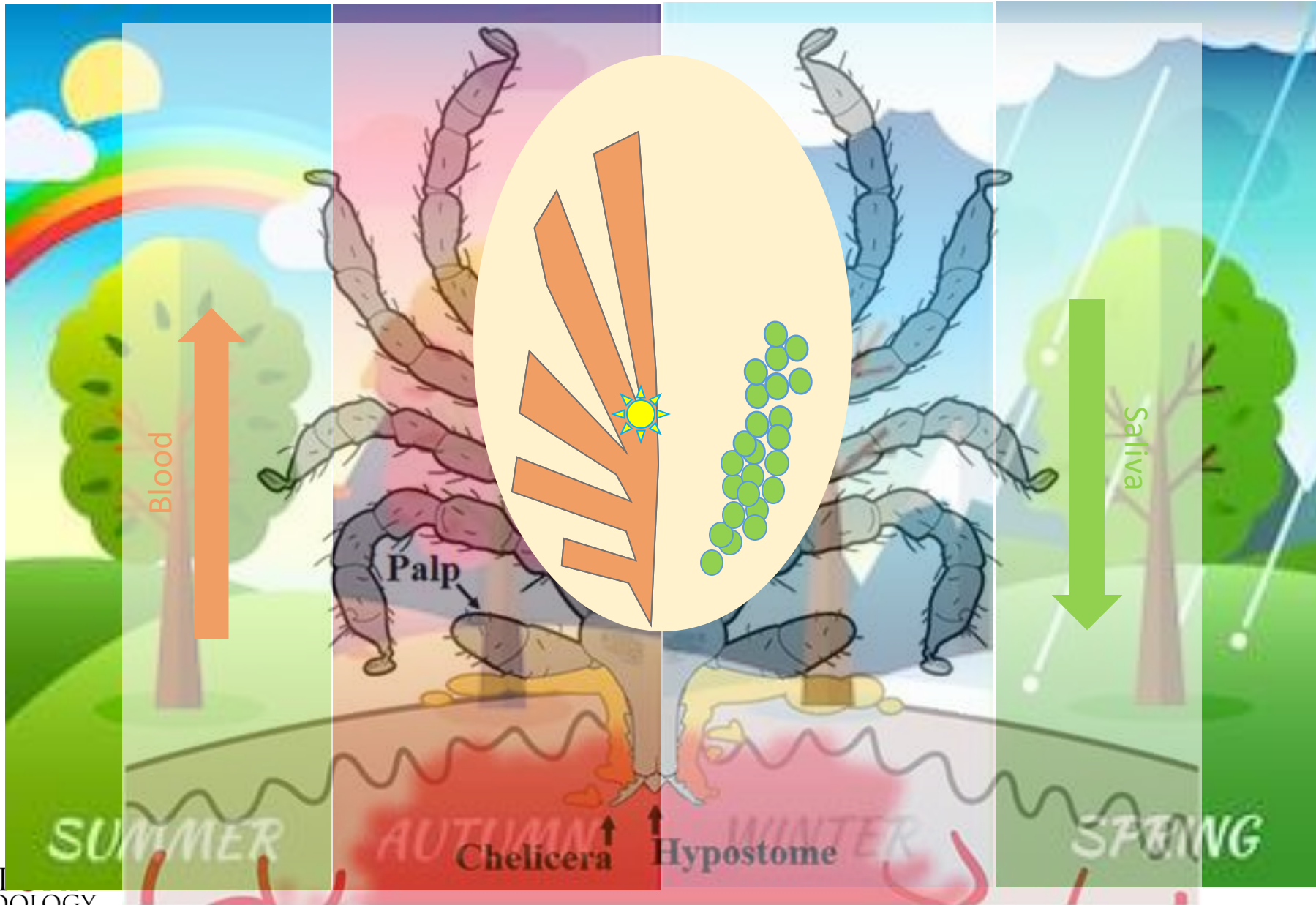


Ehrlichiosis
Southern Tick-associated
rash illness (STARI)
Alpha-galactose (Red meat
Allergy)

EXPOSURE

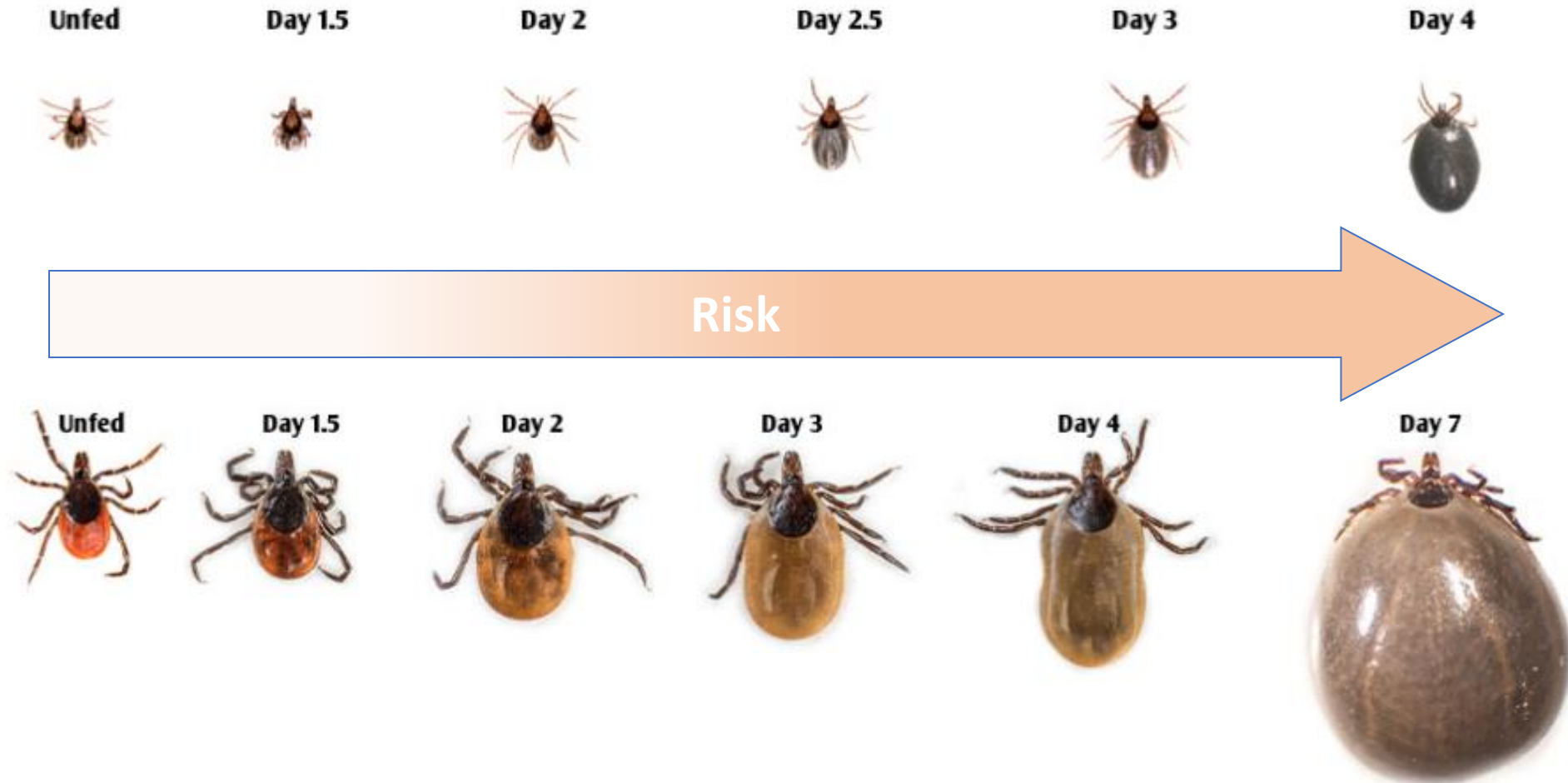
- **Tick species**
 - Different species, different hazards
- **Duration of feeding**
 - Pathogen transmission takes time



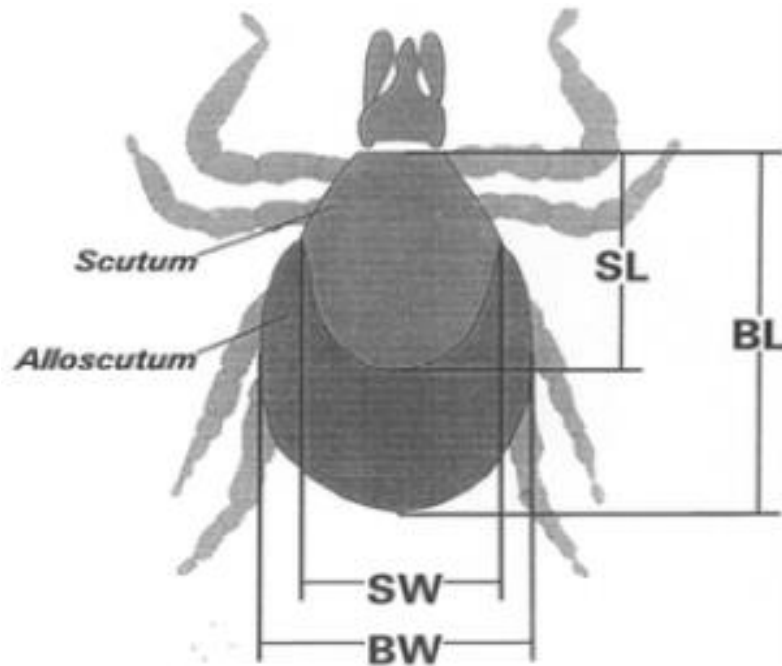


Risk increases with feeding

(time of attachment)



In-processing



- Match online order to mailed tick (six digit order#)
- Identify tick species and photograph dorsal/ventral
- Determine feeding status
 - FLAT
 - PARTIALLY FED
 - ENGORGED

EXPOSURE

- **Tick species**
 - Different species, different hazards
- **Duration of feeding**
 - Pathogen transmission takes time
- **Infection status**
 - Not all ticks are infected

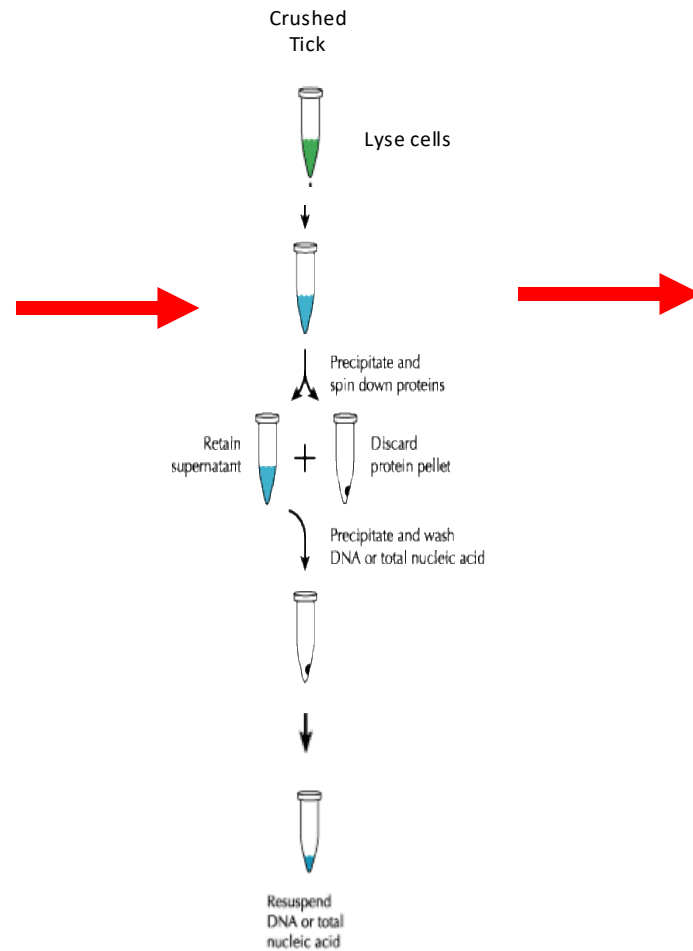
Test for Pathogens

Break up tissue

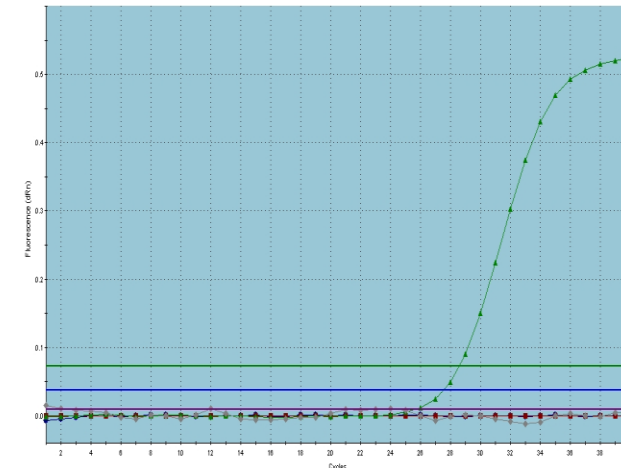
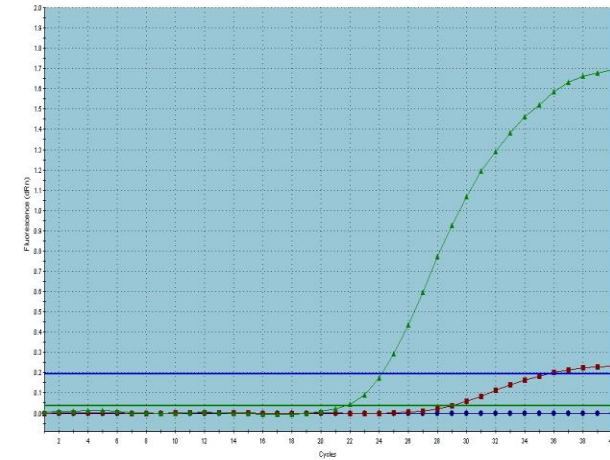


96-wells

Total nucleic acid extraction



Determination of bacterial presence using qPCR



Questions



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TICK REPORTS

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TickReport
A piece of data is peace of mind

About

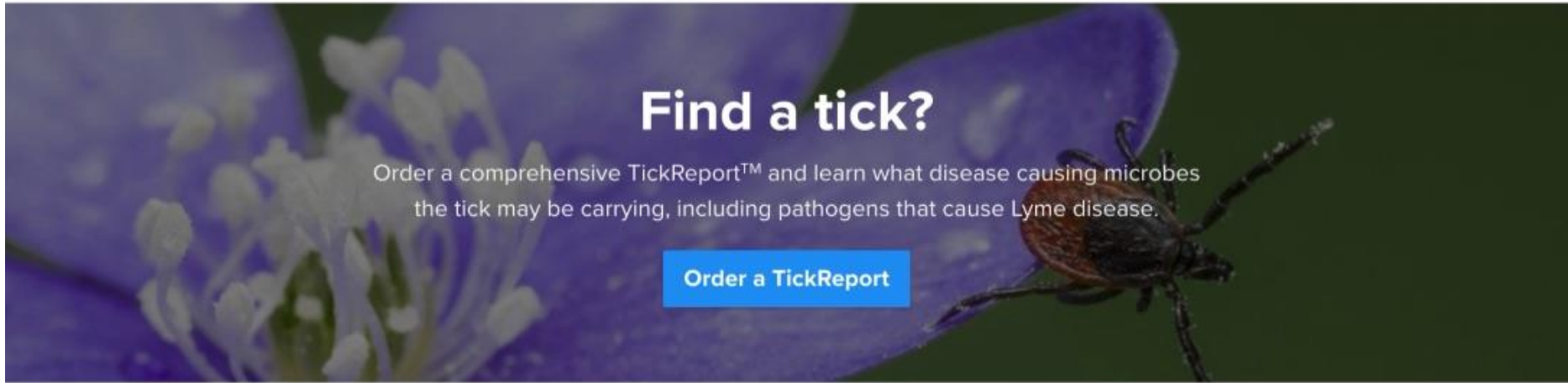
Pricing

Contact

FAQ

Statistics

[Order Now](#)



TICKREPORT

1. Place Your Order

Standard identification and testing for common to your species of tick, including pathogens that cause Lyme disease, costs \$50 per tick. We also offer expanded packages that test a wider array of pathogens.

[View detailed pricing](#)

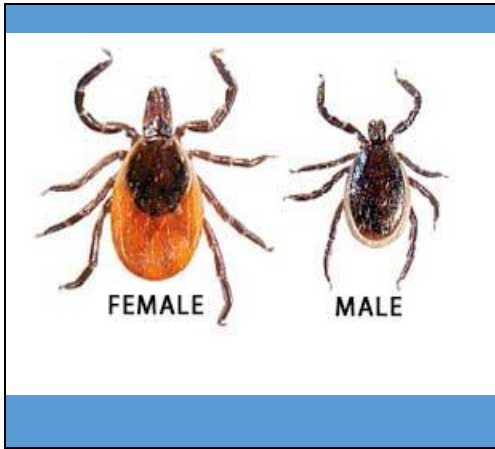
lab. We'll identify it and determine the correct tests to apply. You may also hand deliver your tick to the laboratory.

We suggest using UPS or FedEx for fastest service.

Results in 72 hours

Results are securely delivered via email within 3 business days after your tick arrives at our lab.





Deer (Blacklegged) tick tests

Borrelia burgdorferi (Lyme)*
Borrelia miyamotoi (relapsing fever)*
Borrelia mayonii
Anaplasma phagocytophilum
Babesia microti
Ehrlichia-muris-like

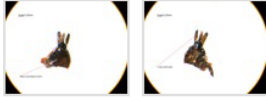


Non-Deer (non-Blacklegged) tick tests

Borrelia burgdorferi (Lyme)*
Borrelia lonestari (STARI)*
Rickettsia rickettsii (Rocky Mountain Spotted Fever)
Rickettsia parkeri
Rickettsia philipii
Ehrlichia chafeensis (Ehrlichiosis)
Francisella tularensis (Tularemia)
Borrelia burgdorferi (Lyme)

Tick Identification

Species: *Ixodes scapularis* (Black-legged or Deer tick)
 Sex: female
 Stage: adult
 Feeding State: unknown



Internal Quality Control Testss

Test	Result	Cost
Tick DNA Quality	PASSED	included
Tick RNA Quality	--	--

Test Results

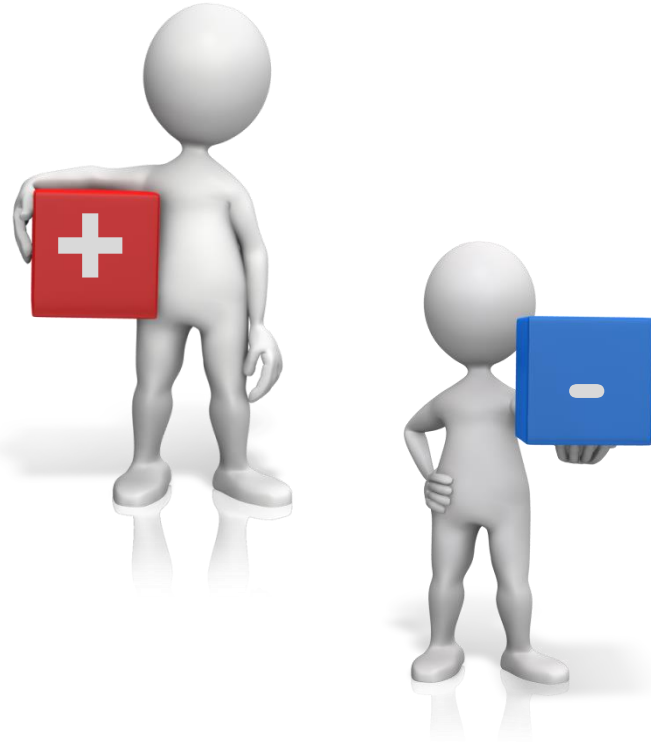
Pathogen	Result Date	Result	Cost
<i>Borrelia general species</i> (Lyme or relapsing fever- generic)	--	POSITIVE	included
<i>Borrelia burgdorferi sensu lato</i> (Lyme borreliosis- specific)	--	POSITIVE	included
<i>Borrelia miyamotoi</i> (Hard tick relapsing fever)	--	NEGATIVE	included
<i>Babesia microti</i> (Babesiosis often found in humans)	--	NEGATIVE	included
<i>Anaplasma phagocytophilum</i> (Human Granulocytic Anaplasmosis; HGA)	--	NEGATIVE	included
TickReport Fee:			\$50.00
Total:			\$50.00

Customer & Patient Information

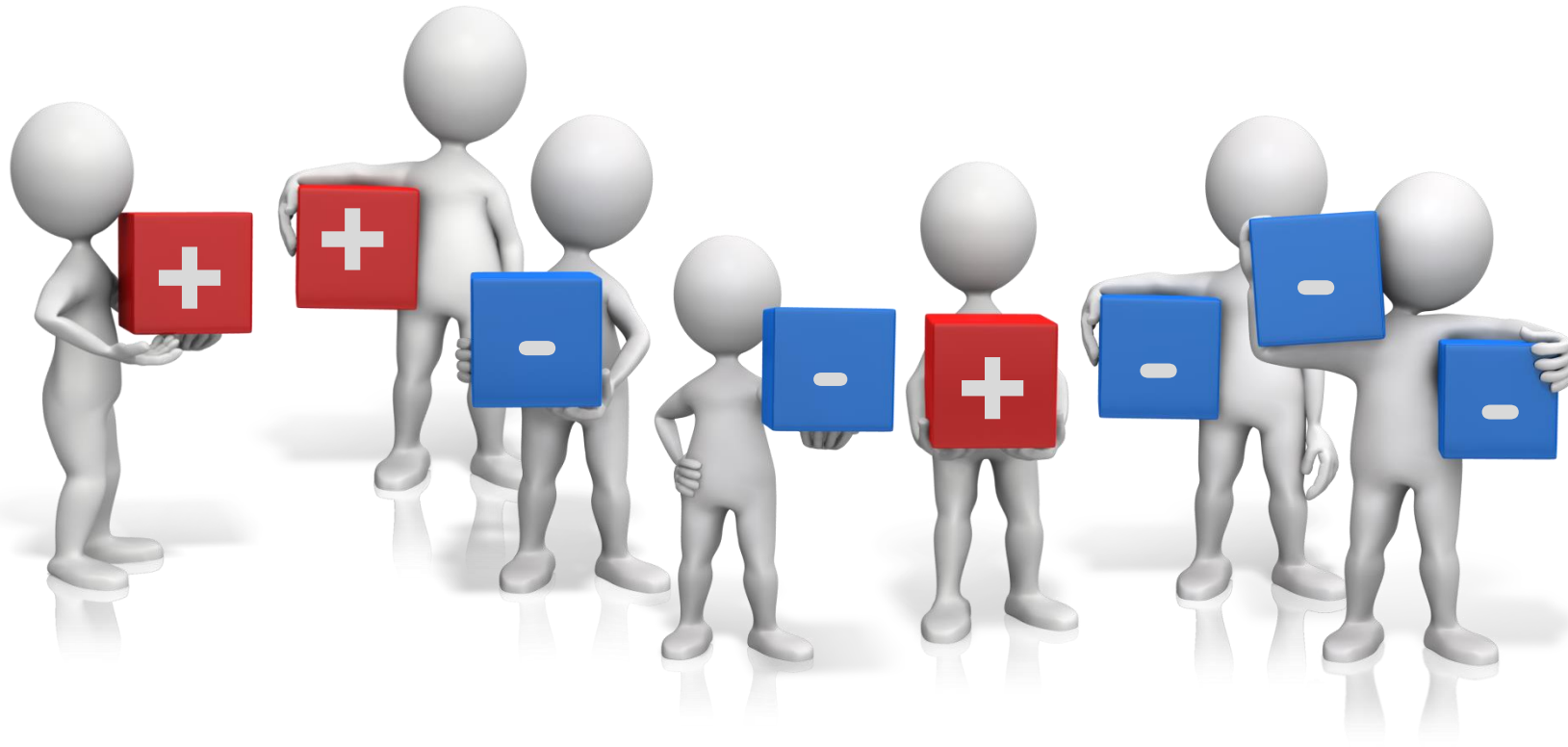
Customer Contact:
 Stephen Rich
 965 E. Pleasant St.
 Amherst, MA 01002
 Phone: 4135590193
 Email: smrich@umass.edu

Patient Information:
 Host Source:
 City: Amherst
 State: MA
 Zip: 01002
 Attached: Yes
 Site of Attachment: Back
 Rash Present: Yes
 Rash Size: 1"

Date tick was removed: 03/19/2016
 Customer Notes: n/a



PUBLIC Health benefits of exposure assessments



Passive Surveillance



Surveillance (Hazard/Risk/Exposure)

	Hazard	Risk	Exposure
Threat	Field Sampling Ticks	Human Case Reports	Surveillance of Human-biting ticks
Tick encounter rate	Indirect	-	Direct
Infection rates among ticks	Direct	Indirect	Direct
Duration of tick exposure	-	-	Direct

Questions



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PASSIVE SURVEILLANCE DATABASE

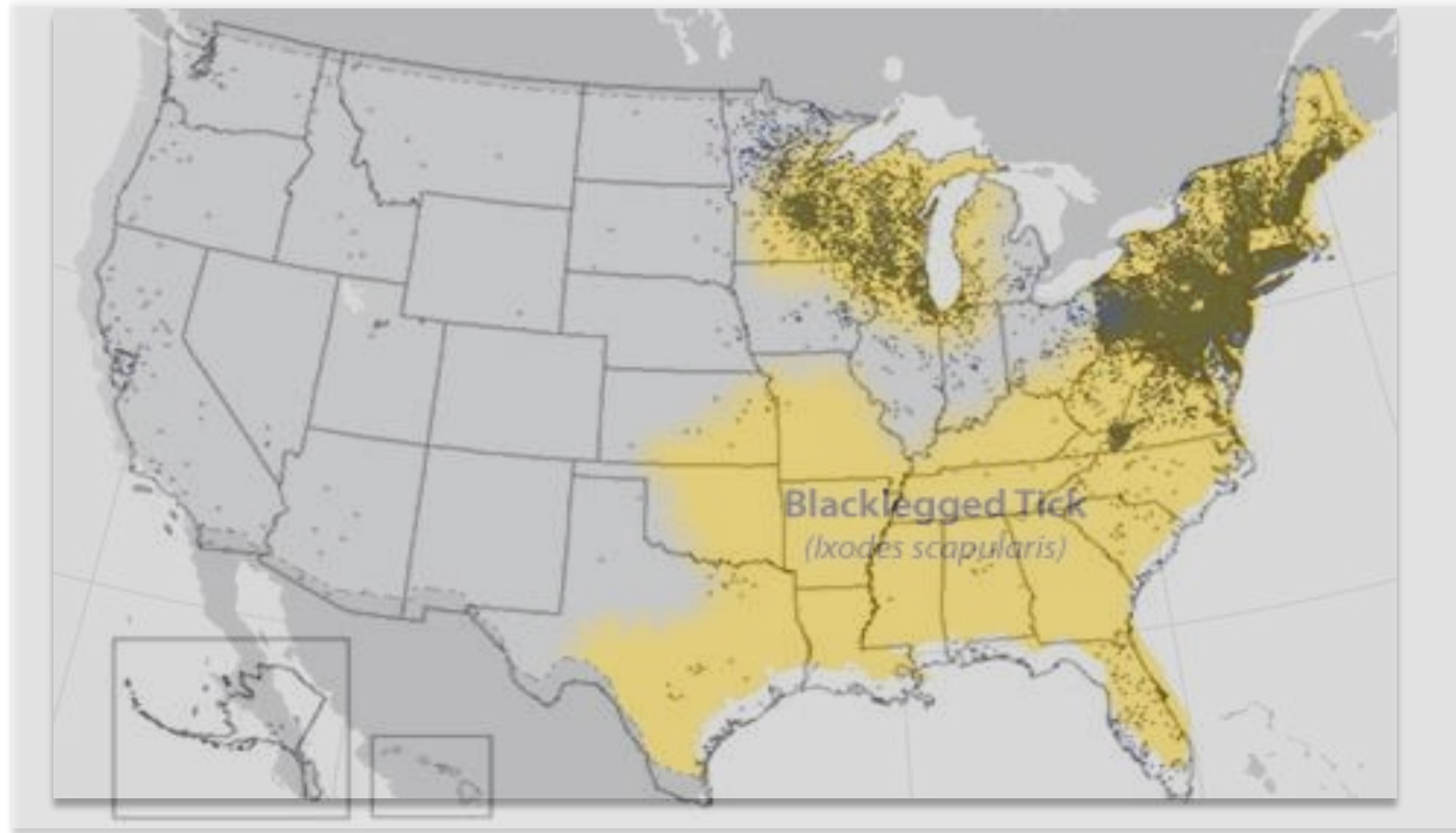
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National Institute
of Food and
Agriculture

Blacklegged Tick Hazards and Lyme Disease Risk



TickReport Data fields

CLIENT/SUBSCRIBER	TICK	BITE
id	species	attached_to_skin
tid	stage	attached_site
email	sex	attached_minutes
name	feeding	rash(size)
address	host	tick_removed_date
city	host_gender	remark
state	host_age	dna_extraction_method
zipcode	location_city	
country	location_state	
phone	location_zipcode	
fax	location_country	
ckient_memo	referred_by	
followup_okay	tick_dna_quality (species)	

TickReport Archive (2006-present)

- LMZ has tested >70,000 human-biting ticks since 2006
 - Ticks sent from all 50 US states (and beyond)
 - Approx 40% annually from MA
 - Approx. 12% from Cape Cod (2014-present)

State	%
MA*	40.89%
NY	11.73%
ME	5.81%
NH	5.78%
VA	3.72%
CA	3.72%
PA	3.61%
NJ	3.56%
VT	3.14%
MD	2.21%
RI	2.20%
CT	2.09%
NC	1.02%
IL	1.01%
WI	.99%
OH	.80%
Other	8.52%

Human-biting ticks submitted to TickReport

(2006-2020)

species	count	CT	MA	ME	NH	NJ	NY	VT
Deer or Blacklegged tick	41,149	1003	21105	2885	2741	1139	5464	2242
American dog tick	8,385	230	3111	490	915	425	703	132
Lone star tick	6,485	65	376	29	18	572	1163	23
Western blacklegged tick	1,630	0	16	1	2	1	3	0
Pacific Coast tick	301	0	3	1	0	0	3	0
Rocky Mountain wood tick	224	2	2	0	0	1	5	0
Woodchuck tick	157	6	47	25	12	3	22	20
Castor bean tick	97	0	21	2	5	5	12	1
Brown dog tick	73	0	5	0	0	1	5	0
<i>Ixodes spinipalpis</i>	62	0	0	0	0	0	0	0
Gulf Coast tick	58	0	1	0	0	0	0	0
<i>Ixodes angustus</i>	53	0	0	0	0	0	1	0
<i>Ixodes dentatus</i>	49	3	25	0	0	1	3	1
Squirrel tick	25	2	6	2	4	1	5	1
Cayenne tick	19	0	6	0	0	1	2	2
Asian long-horned tick	16	3	1	0	0	6	5	0
Mouse tick	11	0	1	3	0	0	1	3
Winter or Moose tick	8	0	3	0	0	0	0	0

Passive Surveillance provides novel Public Health insights

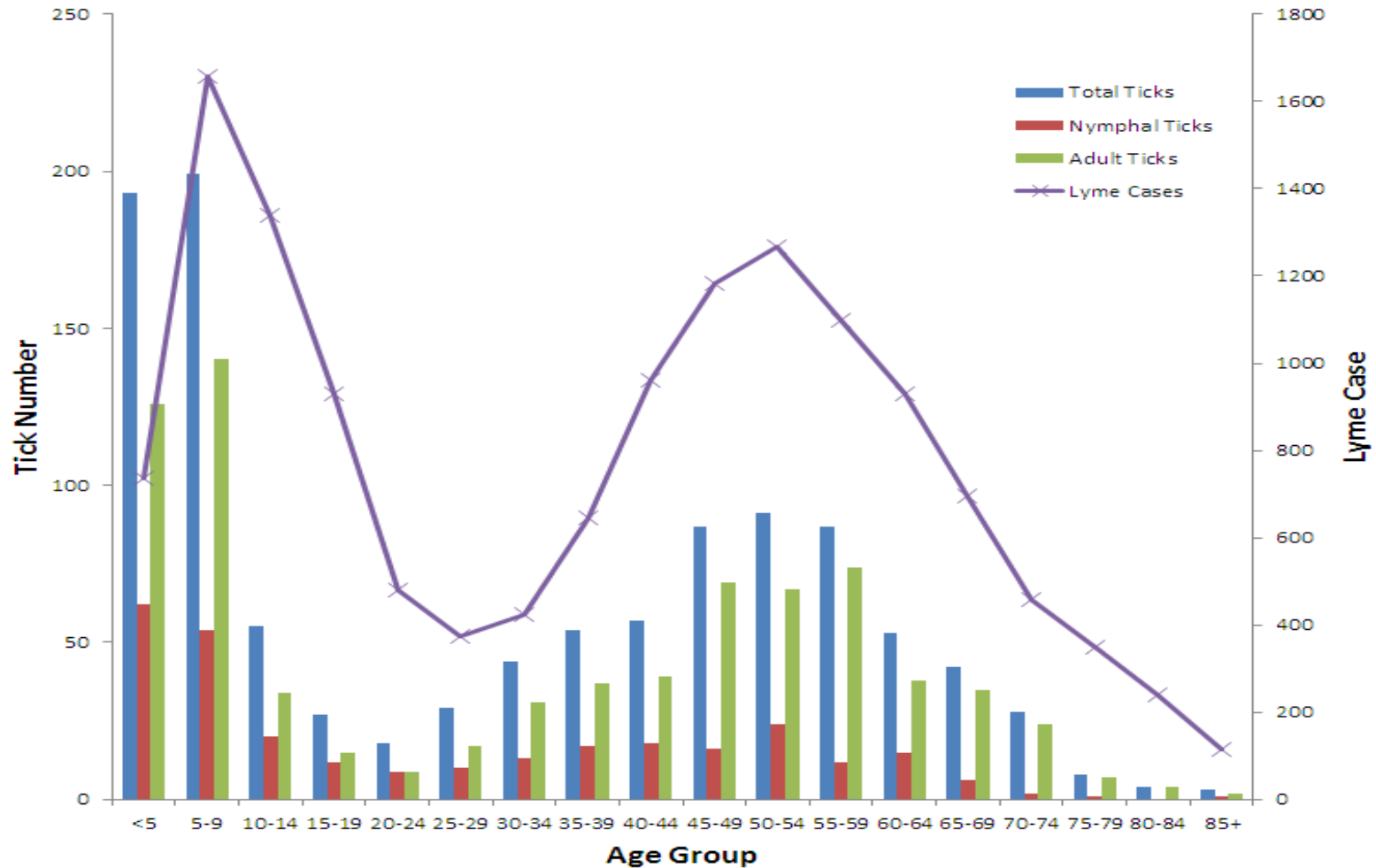
- **Assessing Threats**
 - Who is getting bit by ticks?
 - When are they getting bit?
 - Where are these bites occurring?
 - What disease causing pathogens are involved?



Who is getting bit?

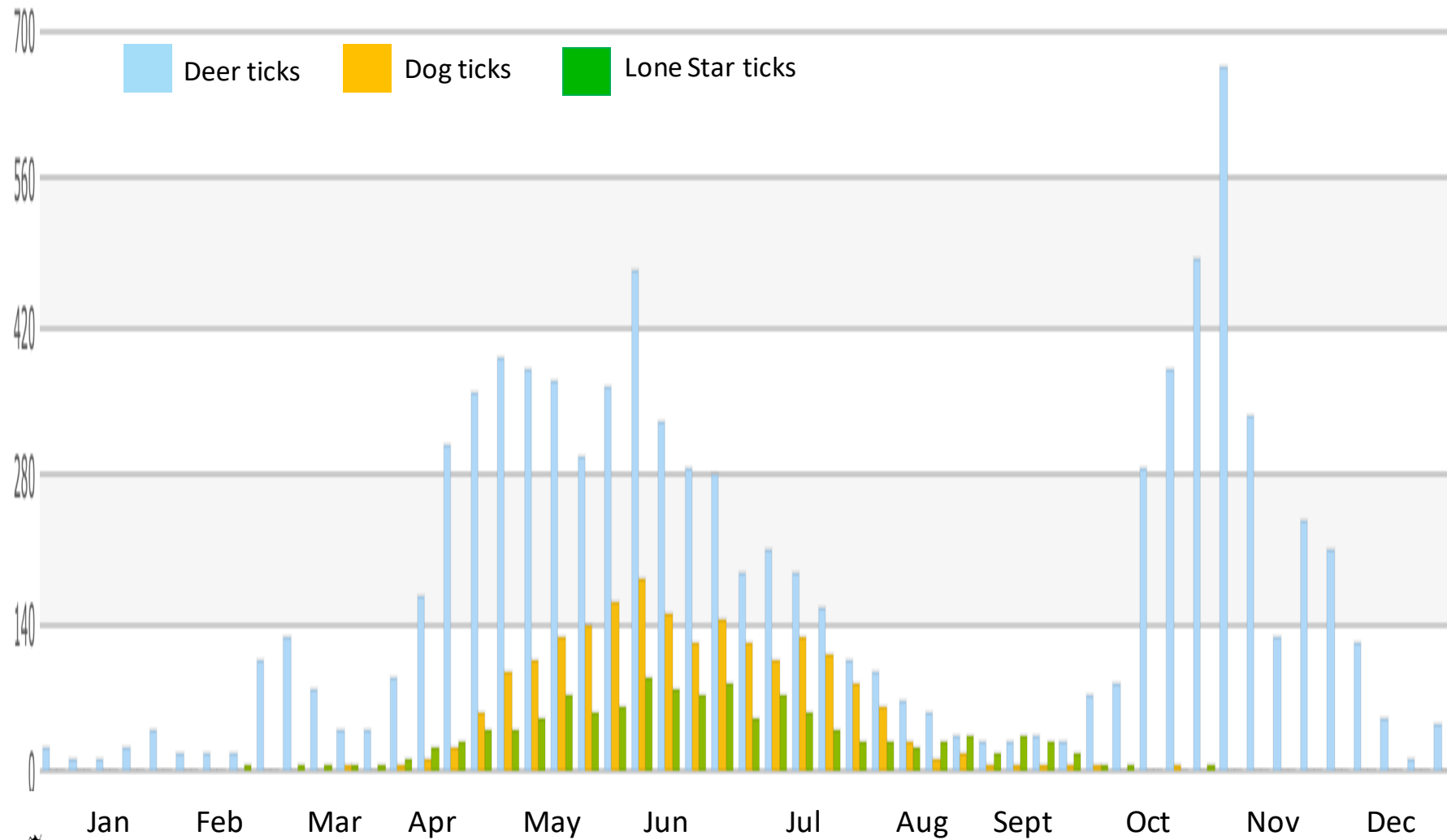


Age distribution of tick attacks

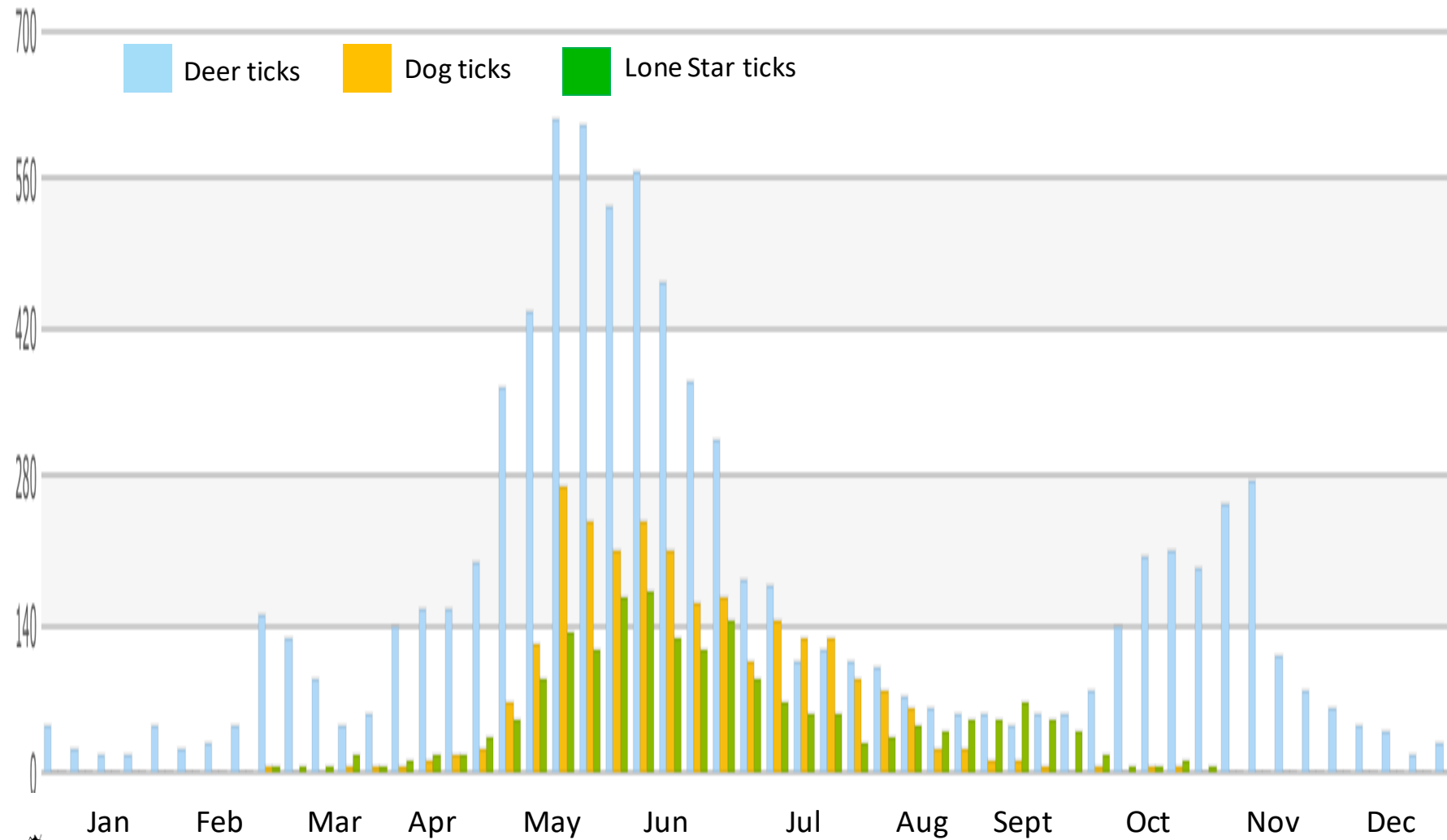


When are people/pets getting bit?

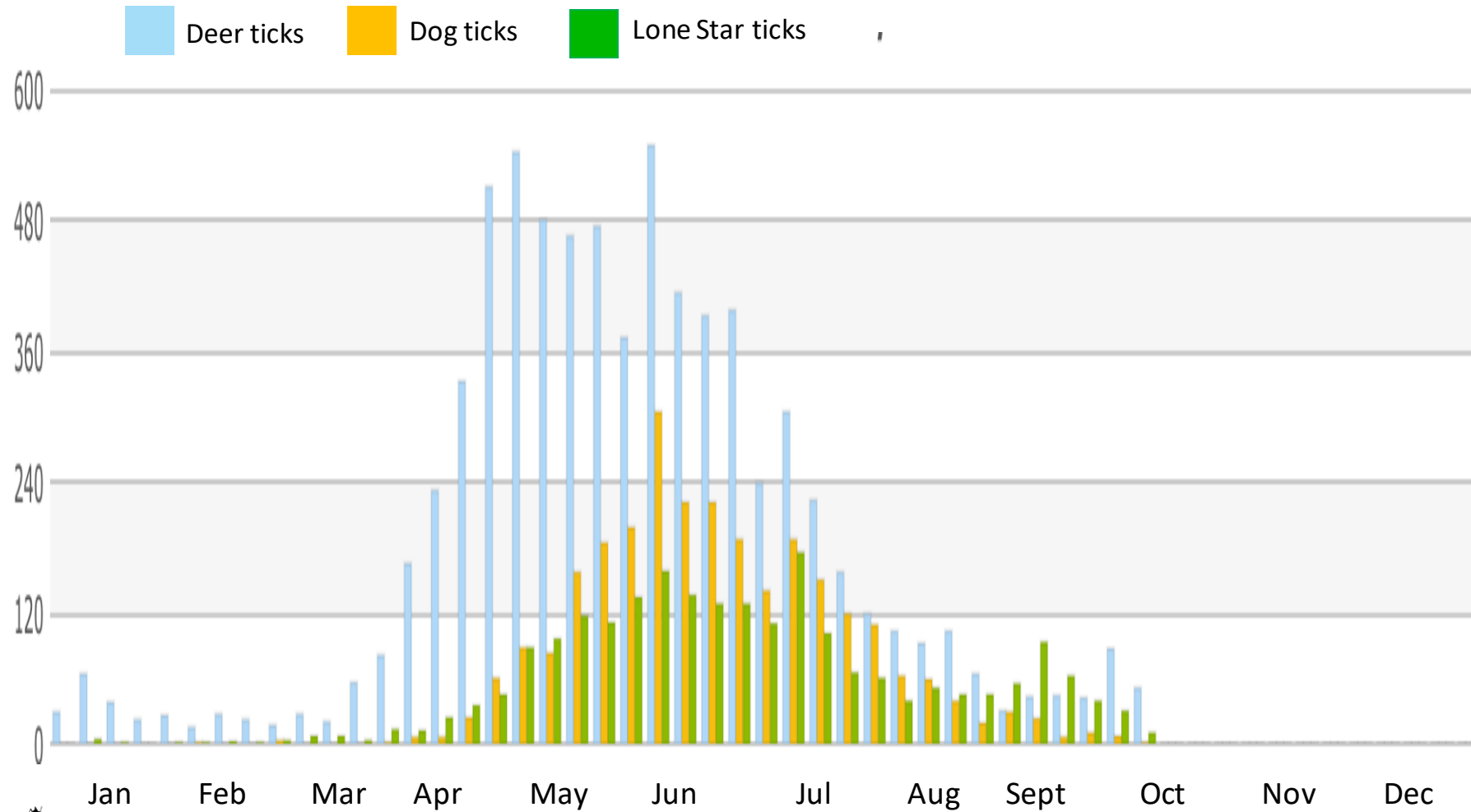
Seasonal Tick Activity (MA, 2017)



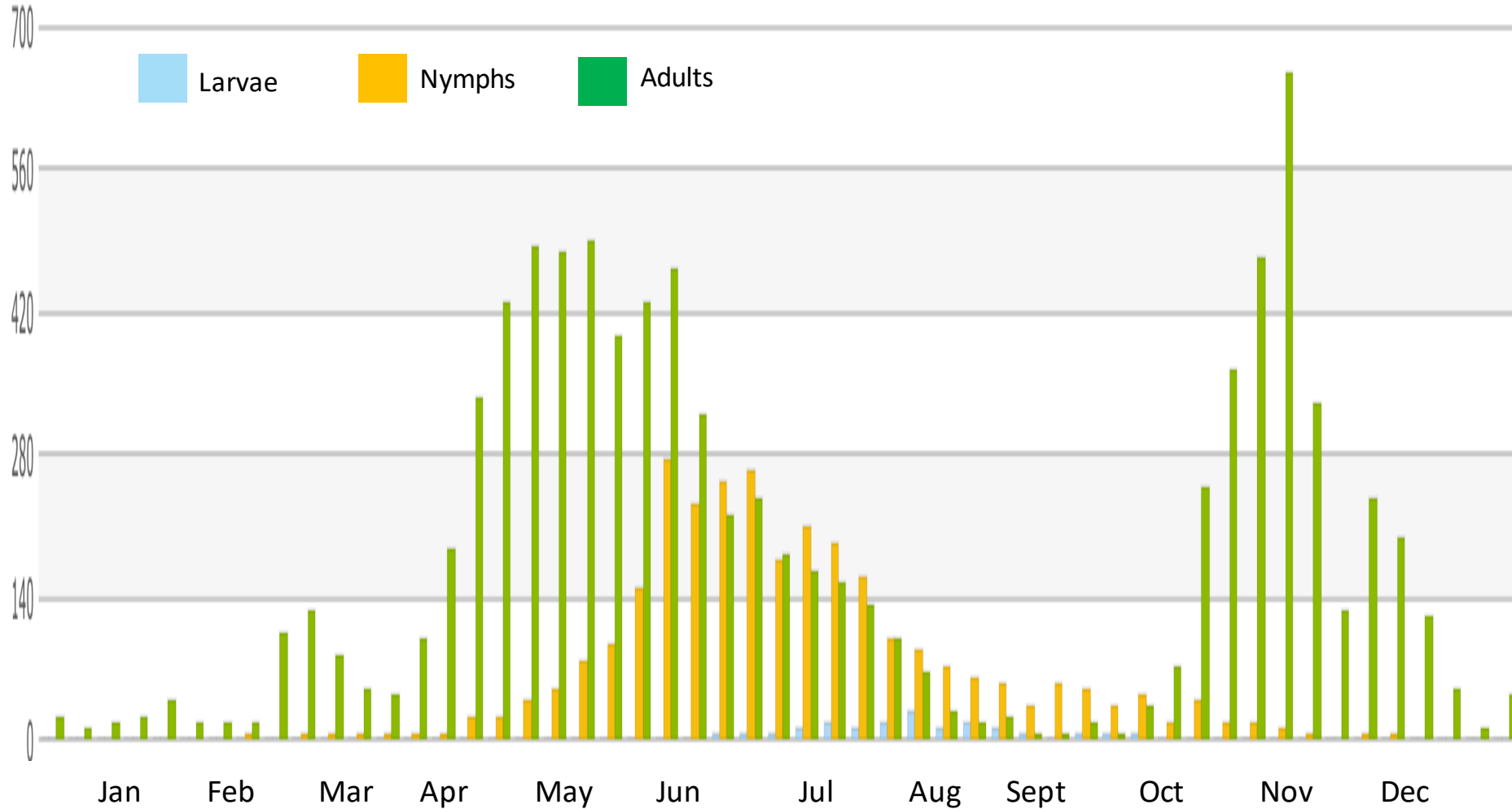
Seasonal Tick Activity (MA, 2018)

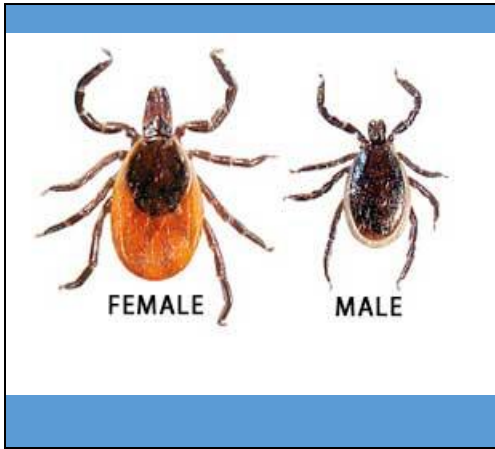


Seasonal Tick Activity (MA, 2019)



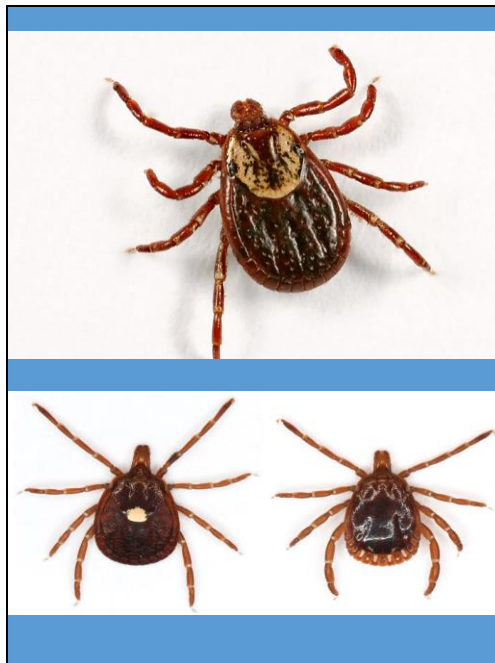
Deer Tick Activity (MA, 2017)





Deer (Blacklegged) tick tests

- Borrelia burgdorferi* (Lyme)*
- Borrelia miyamotoi* (relapsing fever)*
- Borrelia mayonii*
- Anaplasma phagocytophilum*
- Babesia microti*
- Ehrlichia-muris-like*

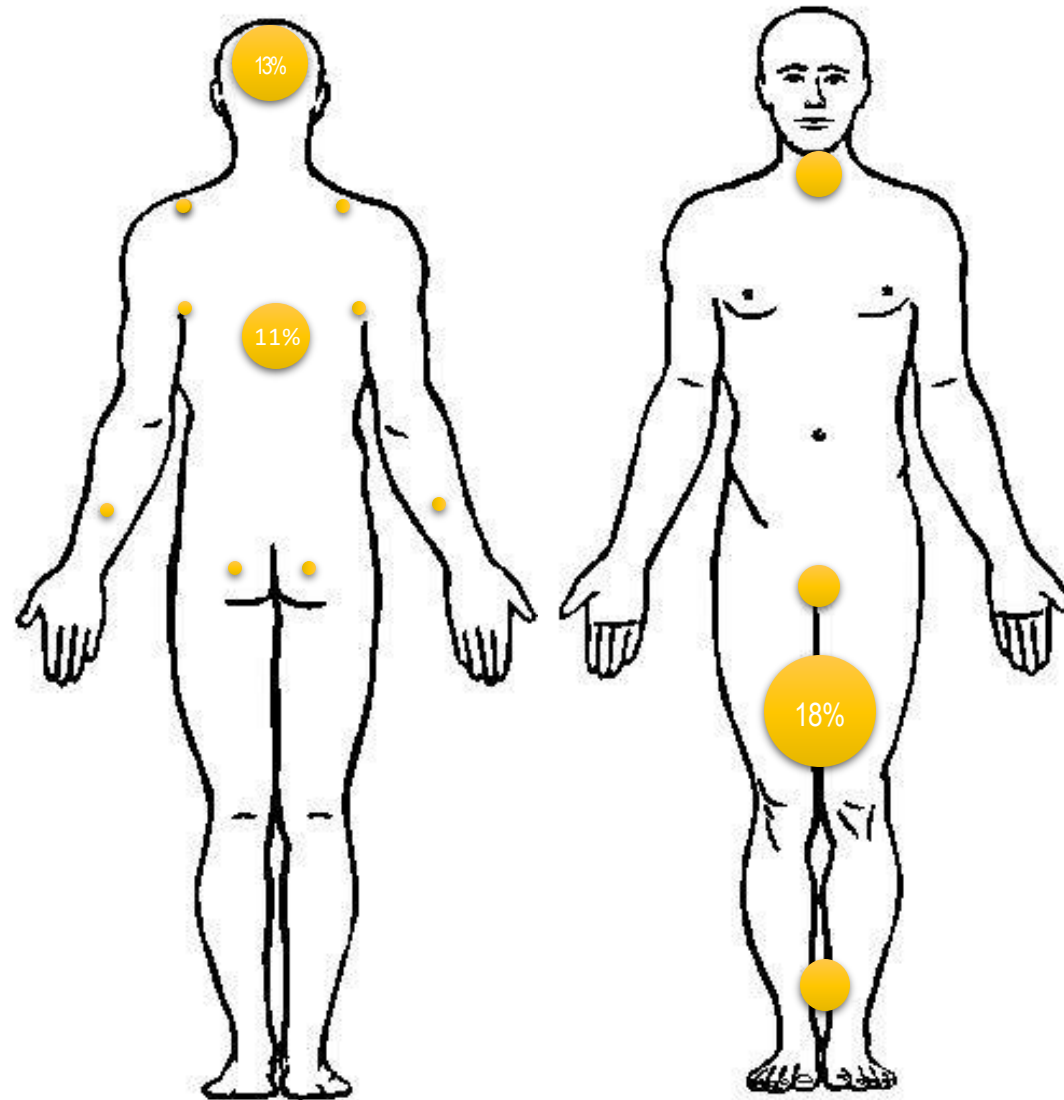


Non-Deer (non-Blacklegged) tick tests

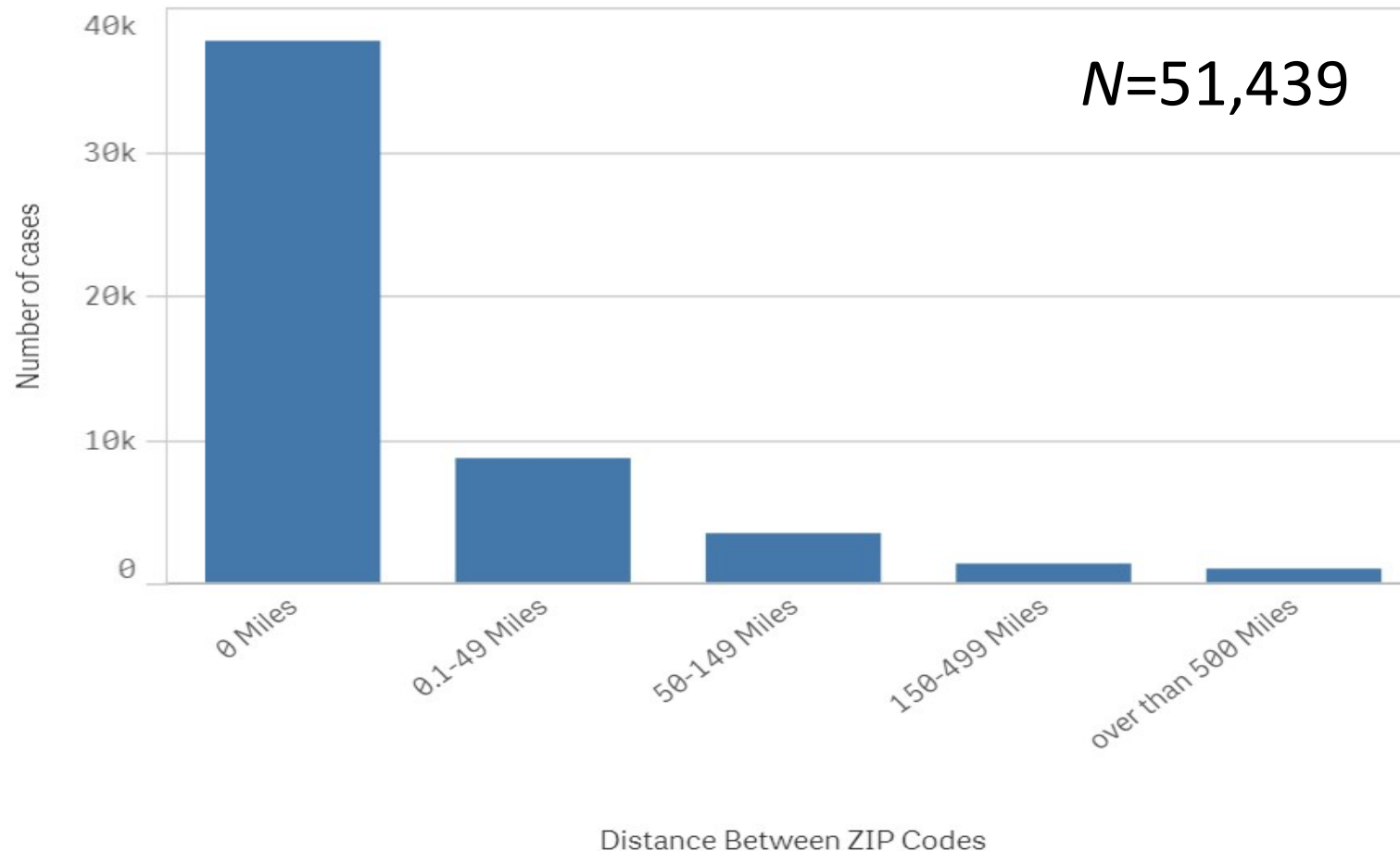
- Borrelia burgdorferi* (Lyme)*
- Borrelia lonestari* (STARI)*
- Rickettsia rickettsii* (Rocky Mountain Spotted Fever)
- Rickettsia parkeri*
- Rickettsia philipii*
- Ehrlichia chafeensis* (Ehrlichiosis)
- Francisella tularensis* (Tularemia)
- Borrelia burgdorferi* (Lyme)

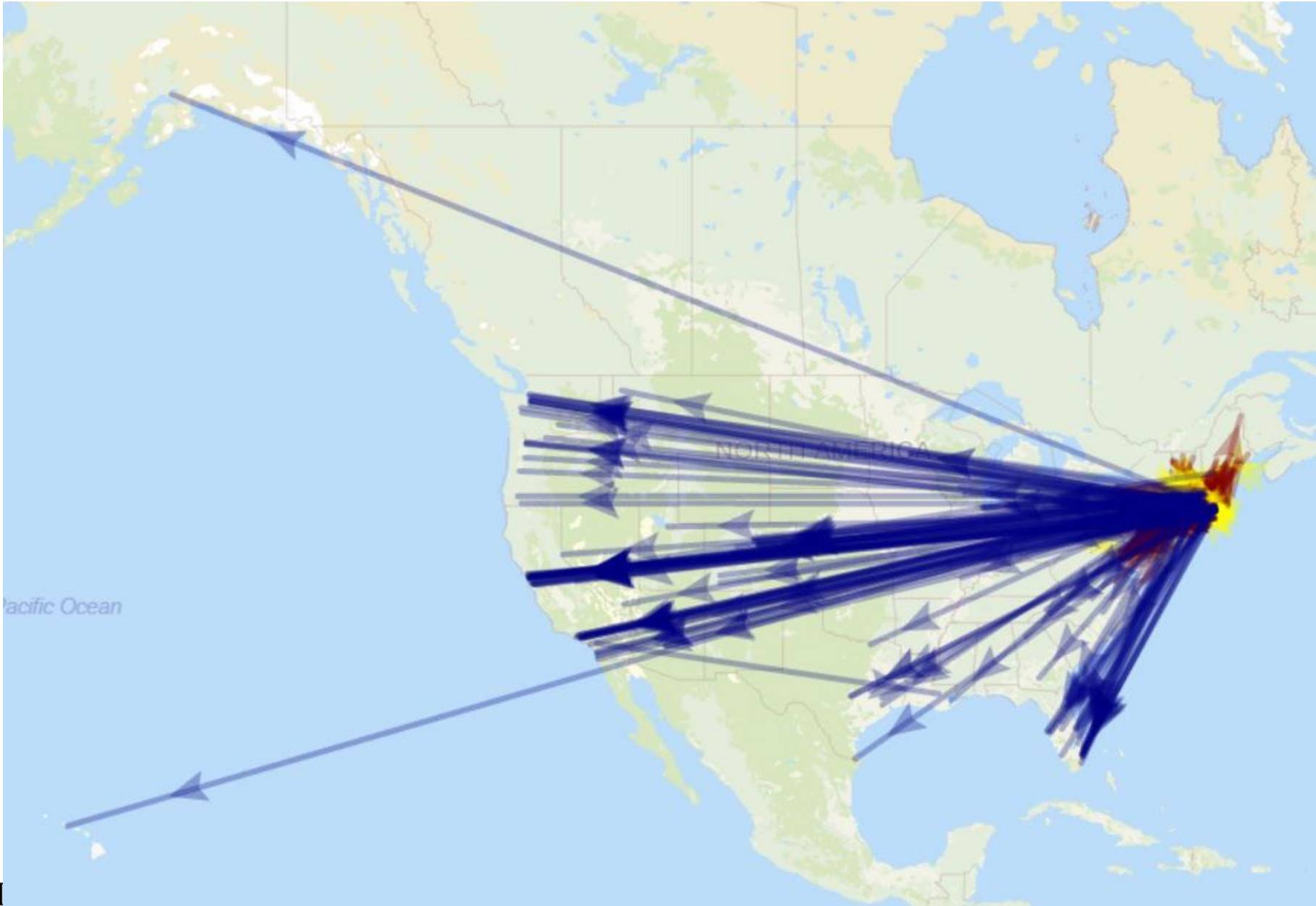
Where are these bites being reported?

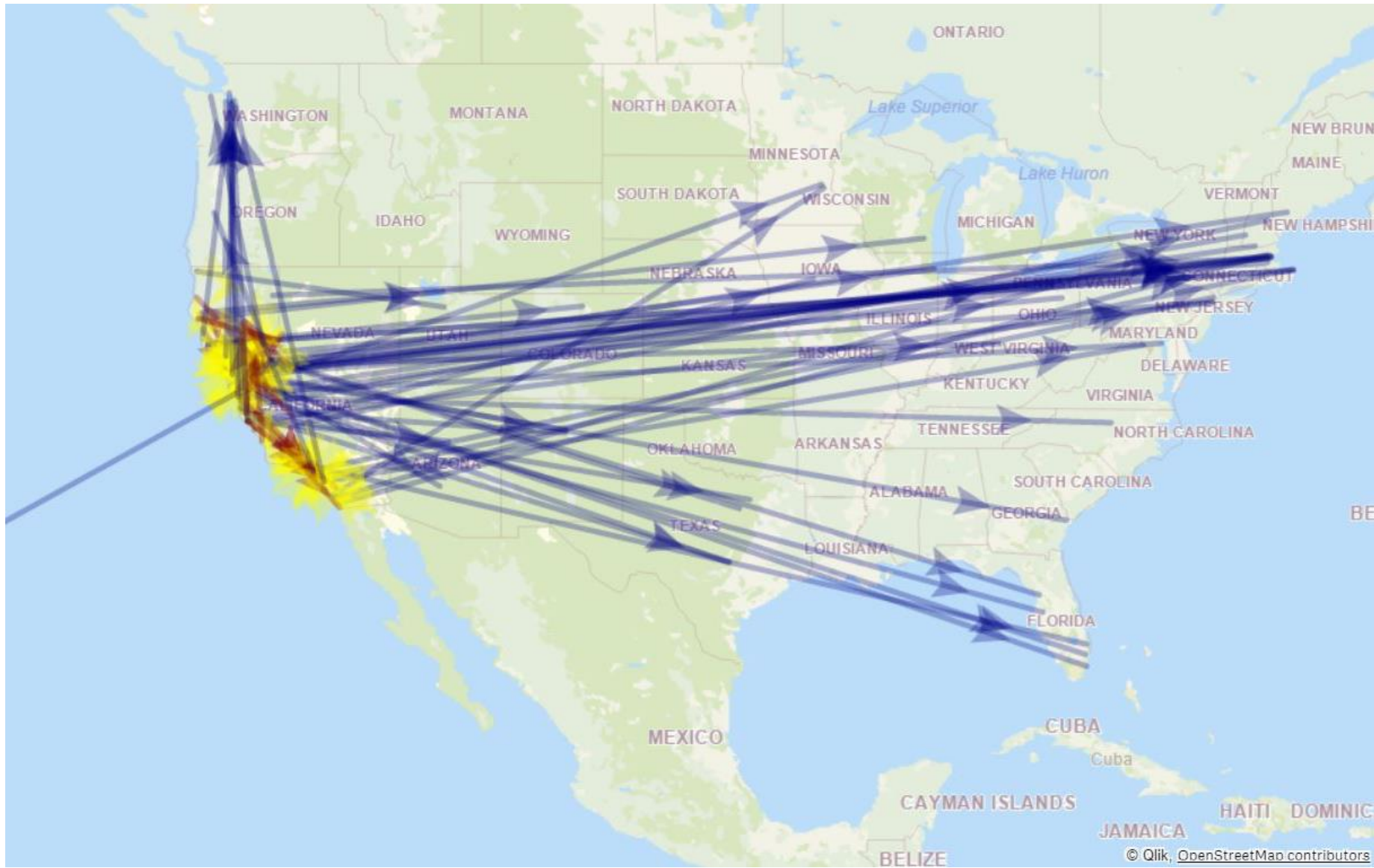
Tick Bite Distribution



Distance between geo-location of tick bite and home address





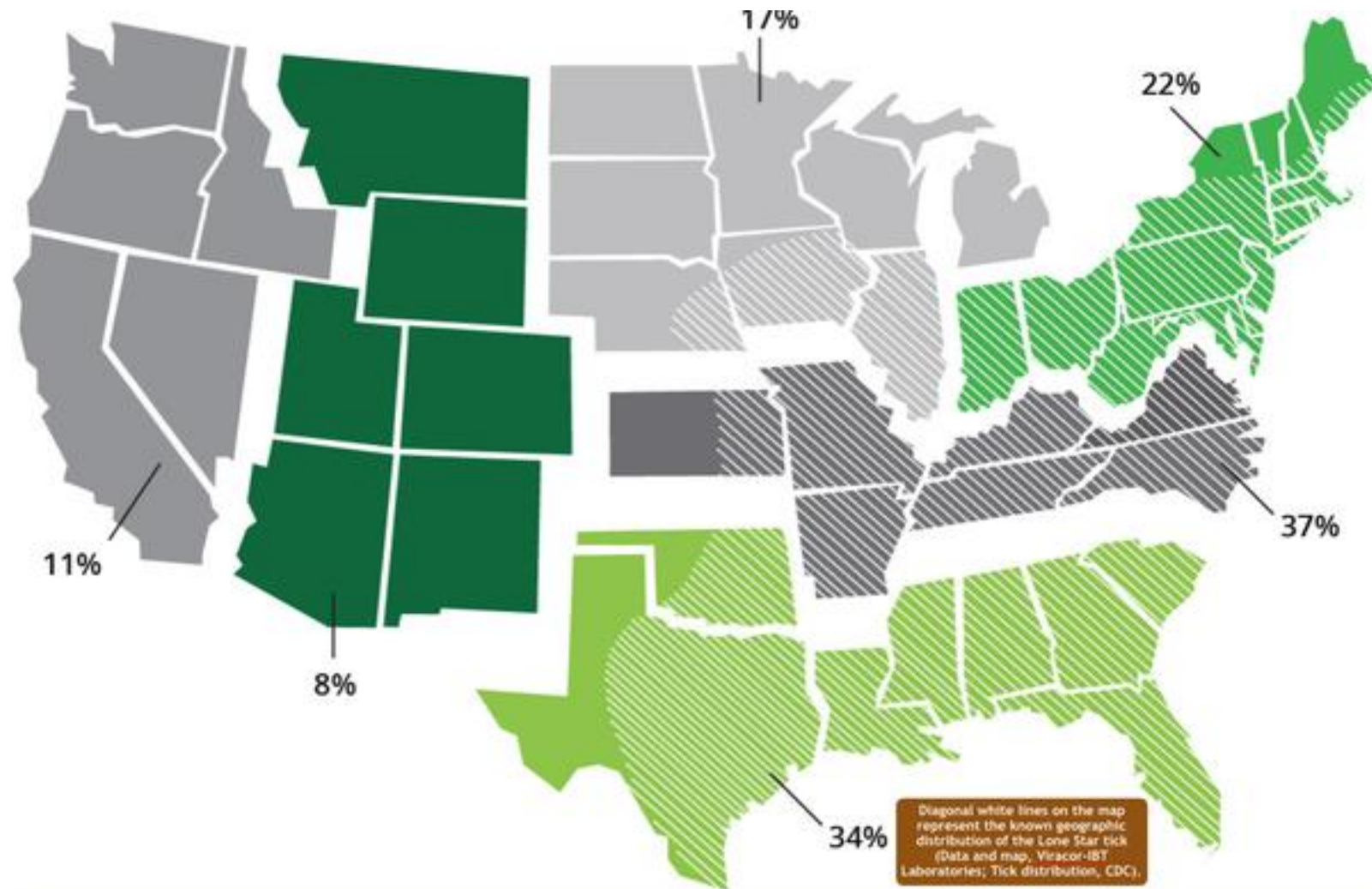


TickReport submissions from West Coast

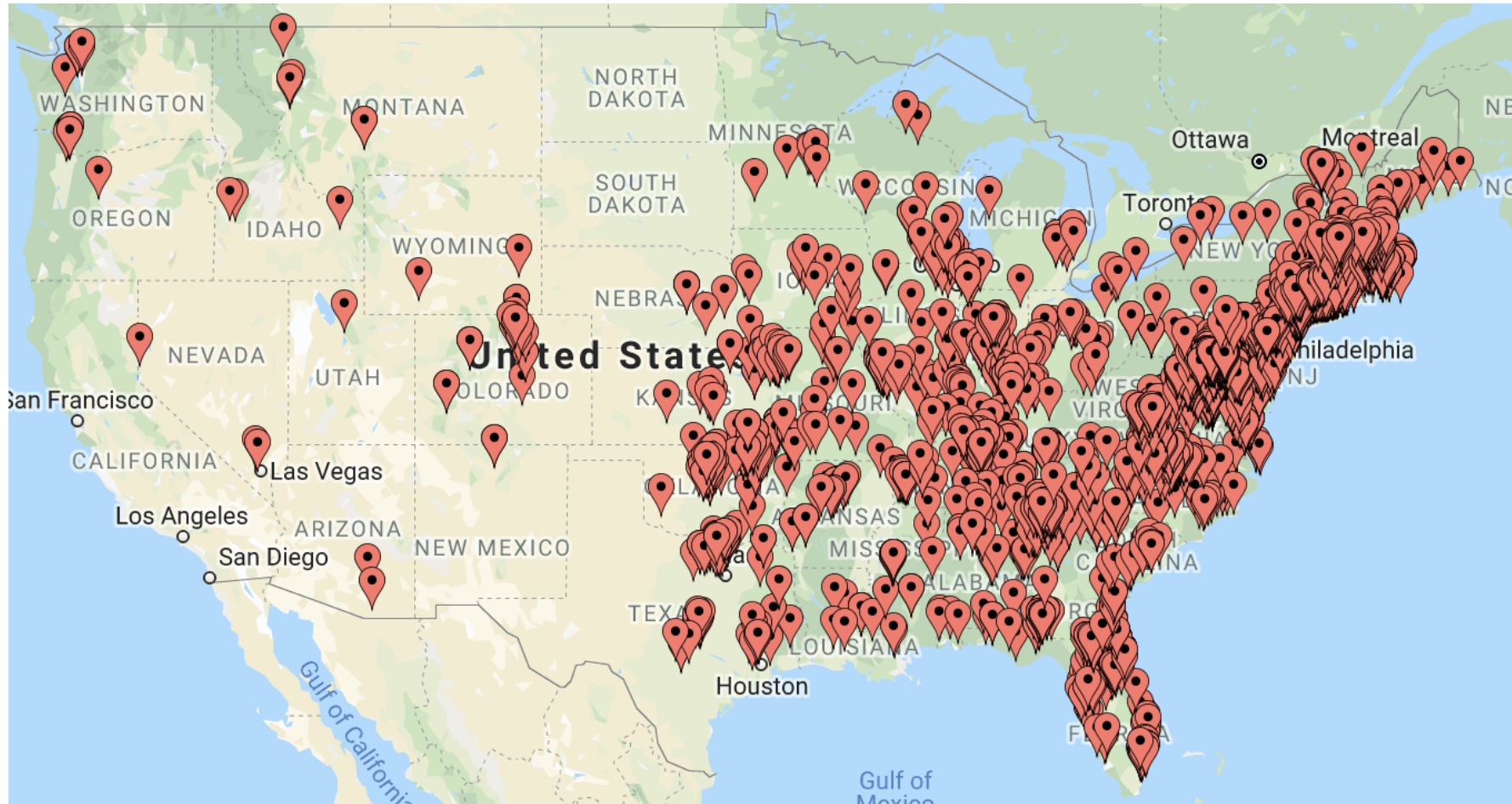
		<i>B.burg</i>	<i>B.miya</i>	<i>Ba. microti</i>	<i>A.phag</i>
Endemic	<i>I. pacificus</i> (n=381)	1.3%	1.0%	0.0%	0.5%
	<i>I. spinipalpis</i> (n=28)	14.3%	0.0%	0.0%	10.7%
	TOTAL	2.2%	1.0%	0.0%	1.2%
Non-endemic	<i>I. cookei</i> (n=1)	0.0%	0.0%	0.0%	0.0%
	<i>I. holocyclus</i> (n=1)	0.0%	0.0%	0.0%	0.0%
	<i>I. ricinus</i> (n=6)	0.0%	0.0%	0.0%	16.7%
	<i>I. scapularis</i> (n=111)	27.0%	2.7%	3.6%	7.2%
	TOTAL	25.2%	2.5%	3.4%	7.6%

Xu, Pearson, Dykstra., Andrews, & Rich (2019) Human-biting Ixodes ticks and pathogen prevalence from California, Oregon and Washington. Vectorborne Zool. Dis. In print.

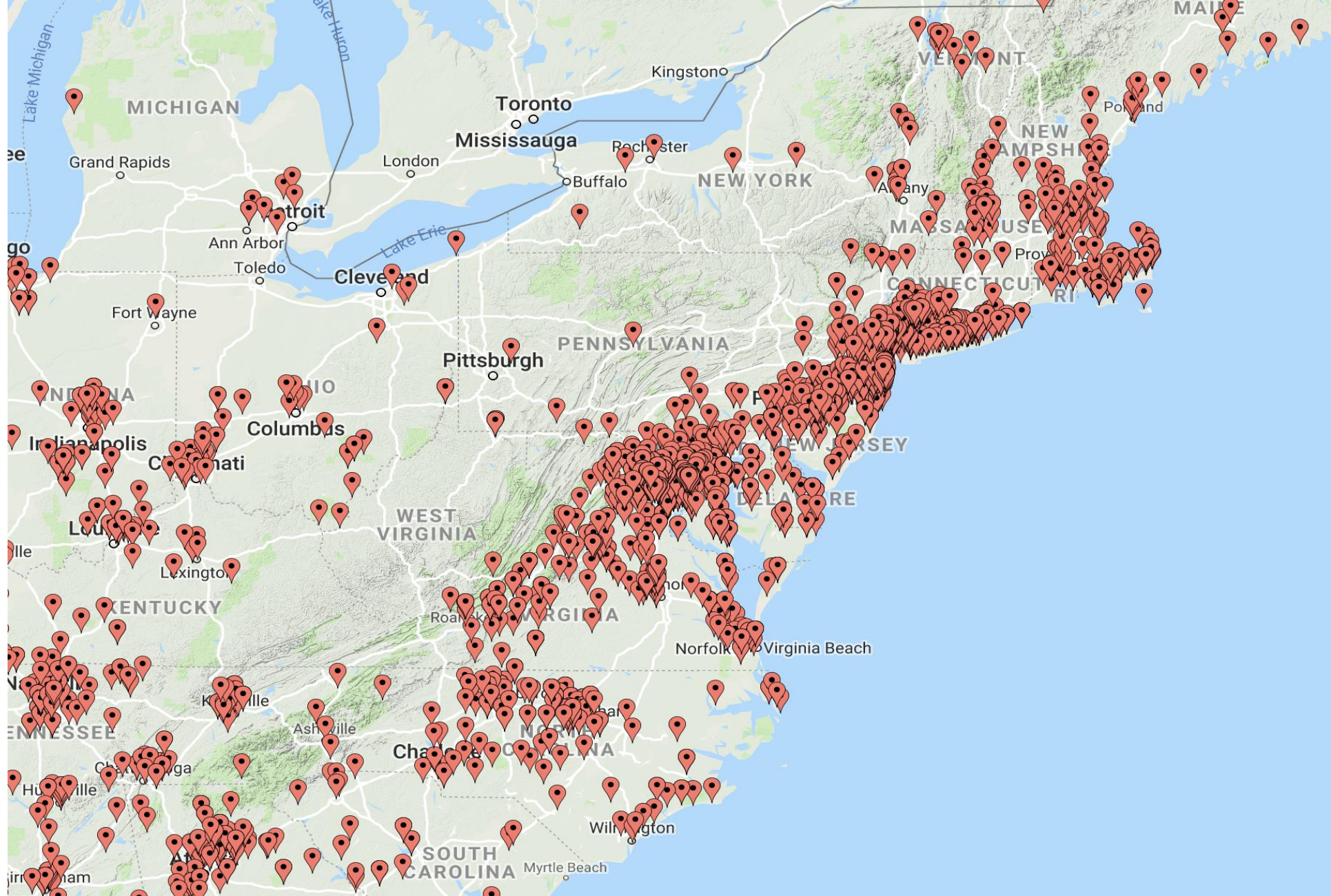
Alpha-Gal Red Meat Allergy



TickReports – Lone star ticks *Amblyomma* (2017-2019)



N=4,931 *Amblyomma* tick bites (36.4K)

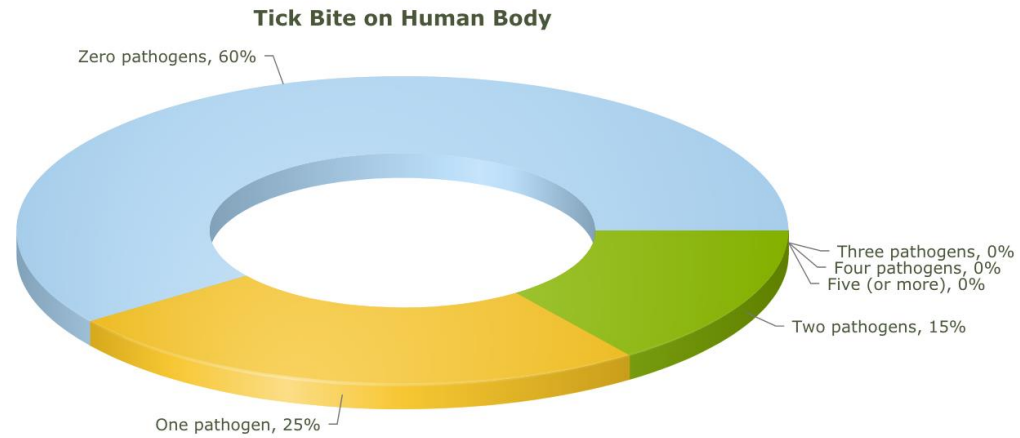


Alpha gal surveillance

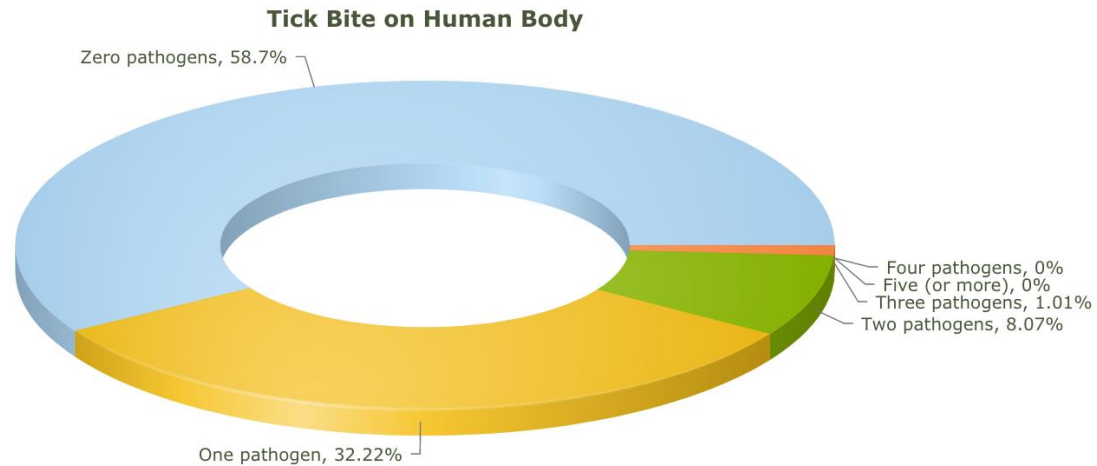
- Human tick-bite data should be part of epidemiological investigations
 - Qualitative and Quantitative aspects of each tick encounter
- Human-biting tick data provides proactive evaluation of tick encounters

What pathogens are involved
in these tick encounters?

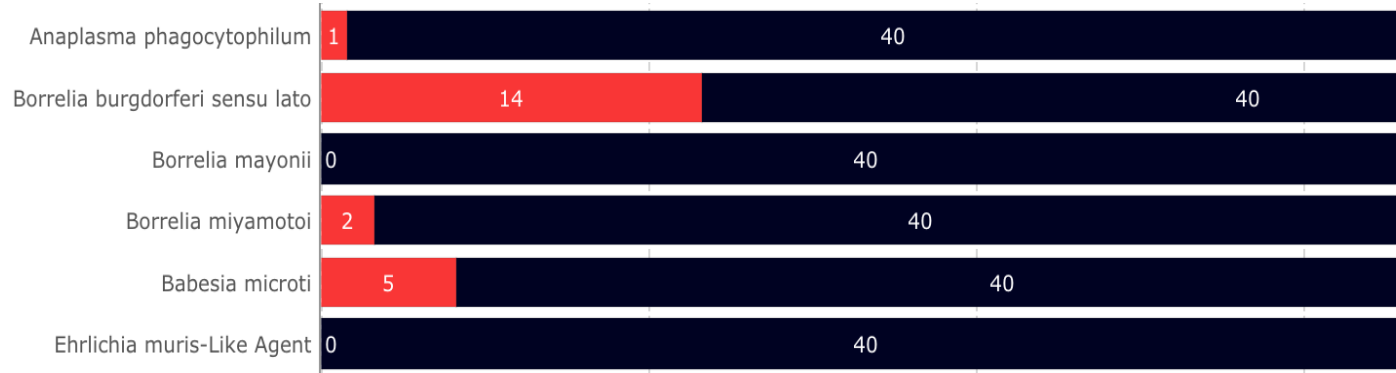
Centerville, MA (2019)



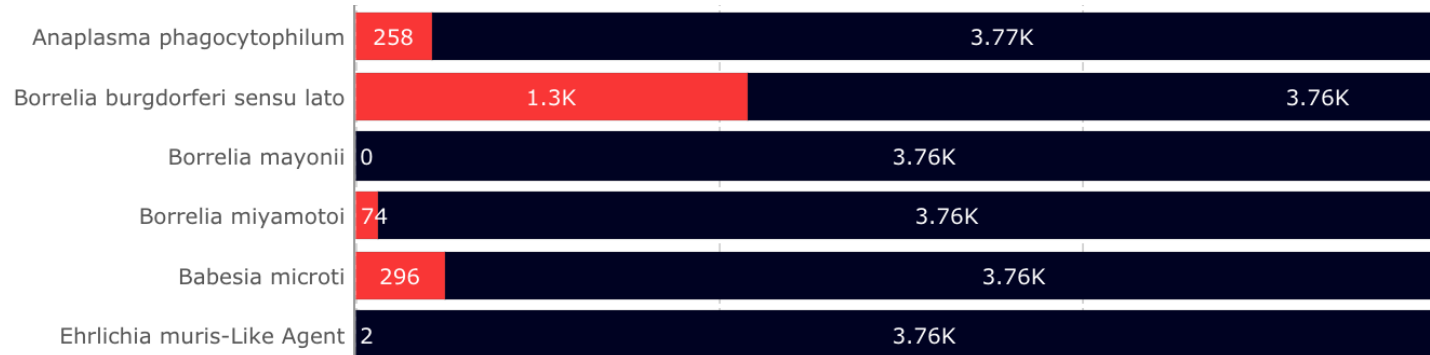
Massachusetts (2019)



Centerville, MA (2019)



Massachusetts (2019)



TBD pathogens and vectors

***Ehrlichia muris* in *Ixodes cookei* Ticks, Northeastern United States, 2016–2017**

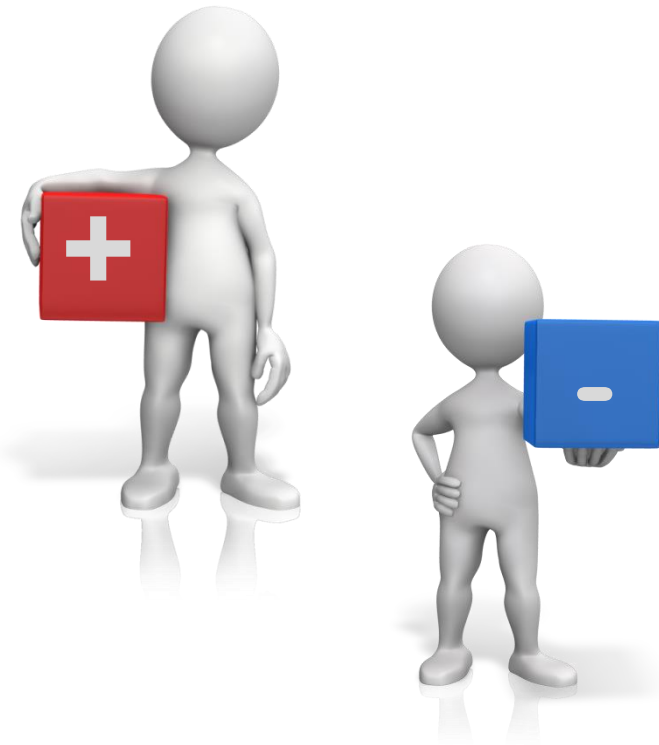
Guang Xu, Patrick Pearson, Stephen M. Rich

Author affiliation: University of Massachusetts–Amherst, Amherst, Massachusetts, USA

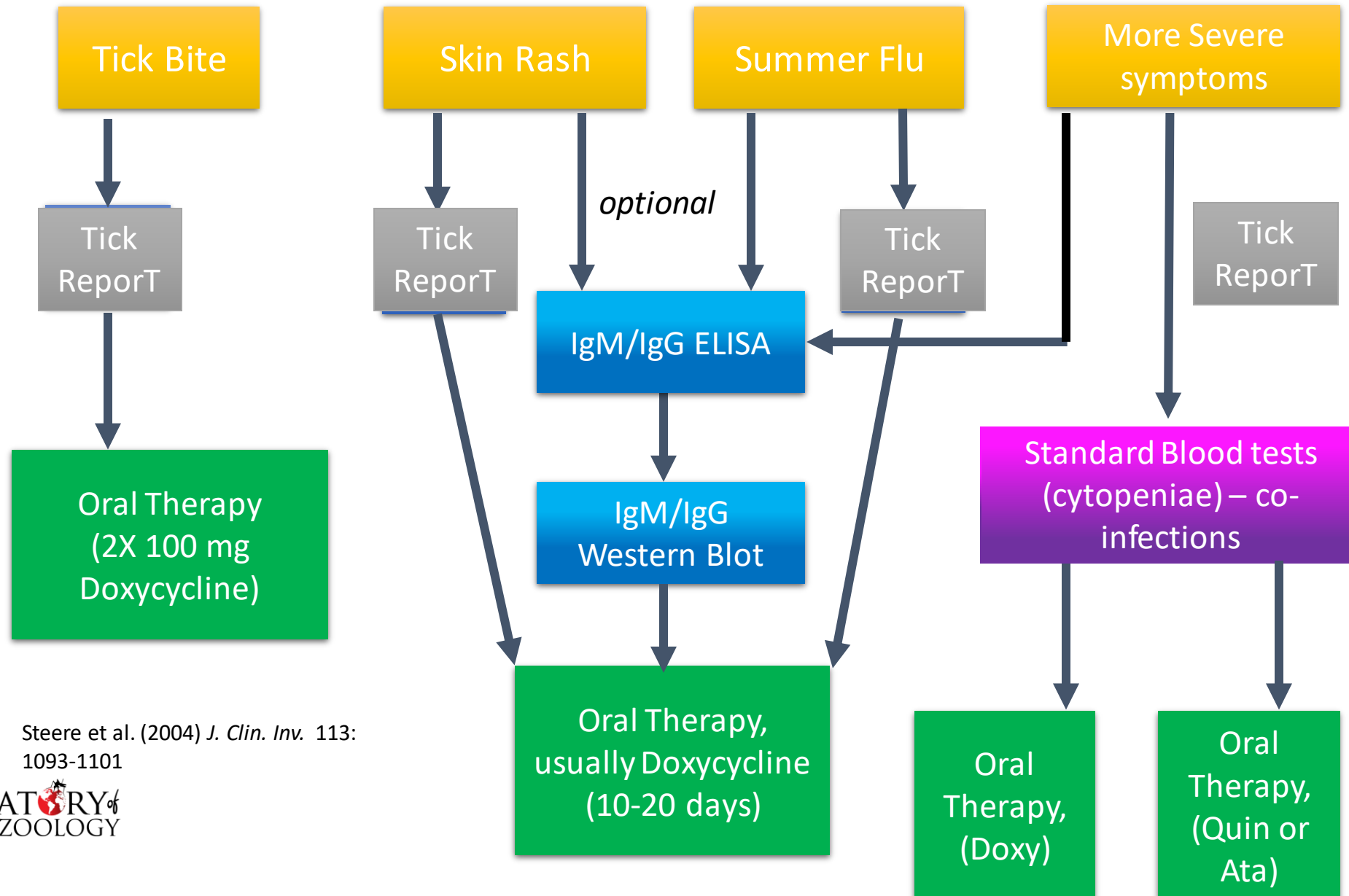
DOI: <https://doi.org/10.3201/eid2406.171755>

Ehrlichia muris is an agent of human ehrlichiosis. To determine its geographic spread in the United States, during 2016–2017, we tested 8,760 ticks from 45 states. A distinct clade of *E. muris* found in 3 *Ixodes cookei* ticks from the northeastern United States suggests transmission by these ticks in this region.

INDIVIDUAL benefits of exposure assessments



Course of action after early summer events



Steere et al. (2004) *J. Clin. Inv.* 113:
1093-1101

Hard Tick Relapsing Fever Caused by *Borrelia Miyamoto* in a Child

eter James Krause, MD,*† Jonathan Schwab, MD,‡ Sukanya Narasimhan, PhD,‡ Janna Brancati
Guang Xu, PhD,§ and Stephen M. Rich, PhD§

“Feeding ticks can be evaluated for tick-borne pathogens using PCR; however, pathogen identification does not mean that transmission of infection has occurred.²² Nonetheless, tick testing does provide information about exposure risk, can alert health care personnel to the possibility of a specific tick-borne infection and might support the diagnosis, as was the case in our patient.²³”



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A piece of data is peace of mind

About

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Find a tick?

Order a comprehensive TickReport™ and learn what disease causing microbes the tick may be carrying, including pathogens that cause Lyme disease.

[Order a TickReport](#)

How it Works

1. Place Your Order

Standard identification and testing for pathogens common to your species of tick, including pathogens that cause Lyme disease, costs \$50 per tick. We also offer expanded packages that test a wider array of pathogens.

[View detailed pricing](#)

2. Mail Your Tick

Place your tick in a plastic bag and mail it to our lab. We'll identify it and determine the correct tests to apply. You may also hand deliver your tick to the laboratory.

We suggest using UPS or FedEx for fastest service.

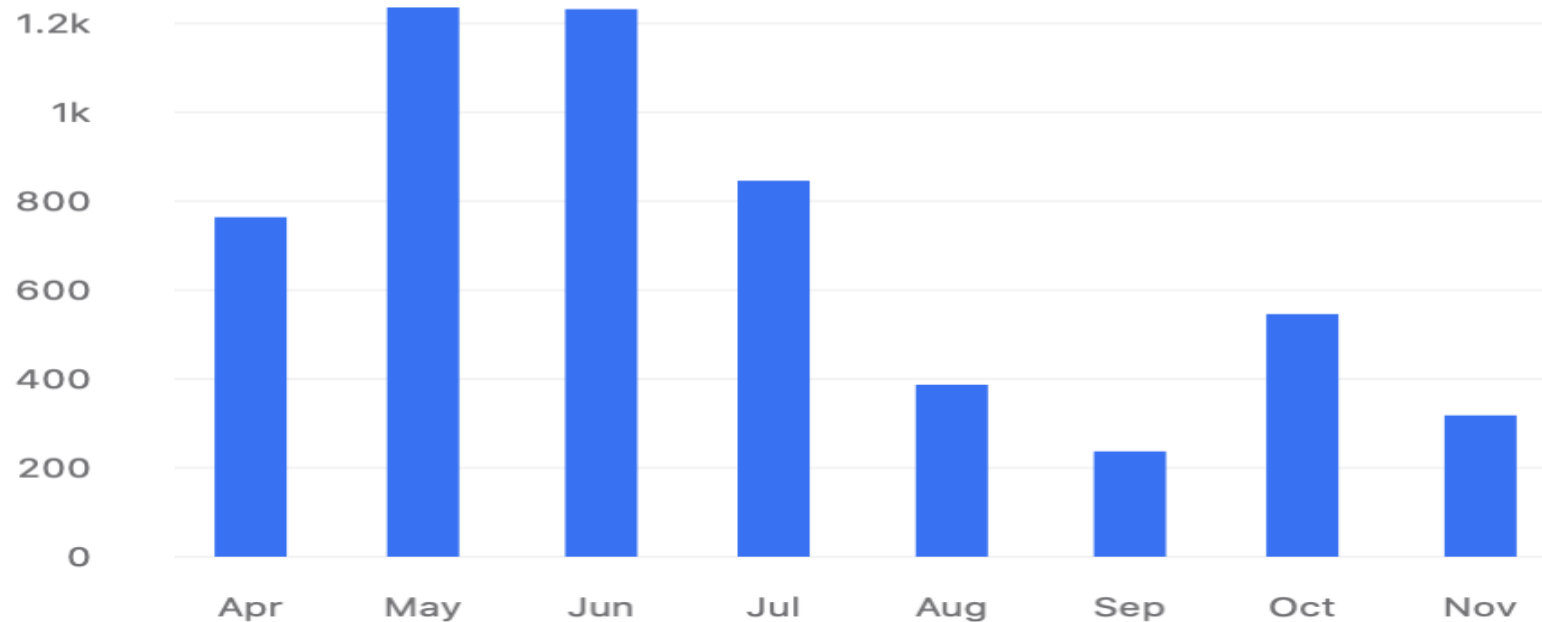
3. Results in 72 hours

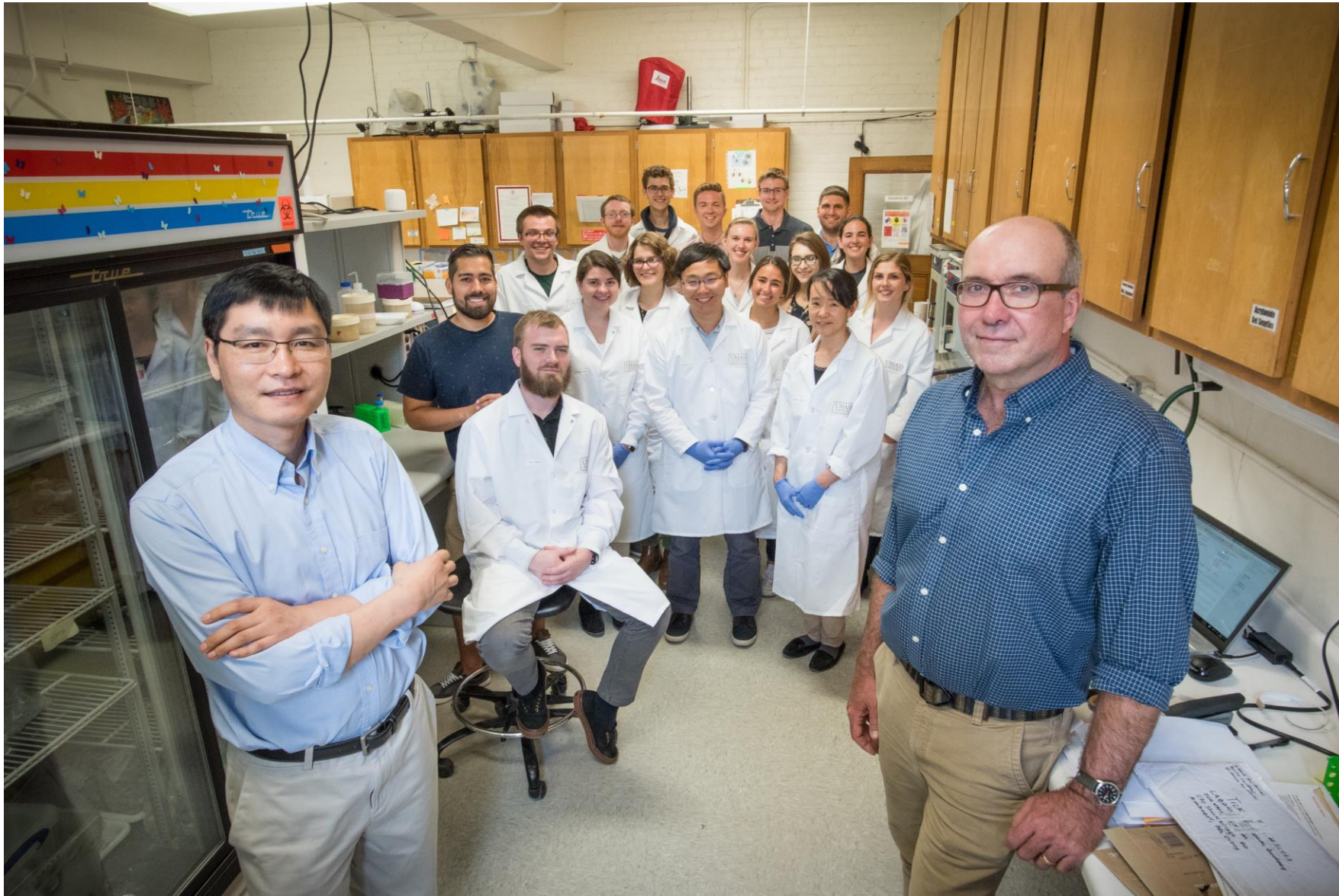
Your results are securely delivered via email within 3 business days after your tick arrives at our lab.



IntercomTM communications

Since April 2019, LMZ had **5566** conversations with tick-bite victims. Median response time of 4 minutes, 23 seconds.





www.TickReport.com

Questions



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Some Questions for You

Find a Colleague

- To post a profile about yourself and your work:
 - <http://neipmc.org/go/APra>
 - “Find a Colleague” site
 - <http://neipmc.org/go/colleagues>

Upcoming Webinars

- **Tick IPM #3: Asian Long-Horned Tick IPM**
Dr. Dina Fonseca and Dr. Matt Bickerton, Rutgers University,
July 13, 2020. 11:00 a.m.
- **Tick IPM #4: Habitat Management for Vector-borne Diseases**
Dr. Allison Gardner, University of Maine,
August 10, 2020. 11:00 a.m.
- **Tick IPM #5: Pathogens Found in Ticks Collected on School Grounds and Public Parks**
Drs. Jody Gangloff-Kaufmann, Joellen Lampman, Matt Frye, NYS IPM Program. Dr. Laura Goodman, College of Veterinary Medicine, Cornell University.
September 14, 2020, 1:00 p.m.
- **Tick IPM #6: Host-Targeted Tick Control – What Works, What Doesn't, and What's New**
Dr. Andrew Li , Research Entomologist, USDA-ARS Invasive Insects Biocontrol and Behavior Laboratory, Beltsville, MD.
September 30, 2020, 11:00 a.m.
- **Tick IPM #7: Leaf Litter/Snow Removal for Tick Reduction**
Dr. Kirby C. Stafford III, Connecticut Agricultural Experiment Station,
October 7, 2020 – 11 a.m.

For Updates: <https://www.northeastipm.org/ipm-in-action/the-ipm-toolbox/>

Recording of Tick IPM Webinar Series

- Past recordings and today's Webinar will be available to view **on demand** in a few business days.
- <http://www.neipmc.org/go/ipmtoolbox>
- You can watch as often as you like.

Acknowledgements



This presentation was funded in part by the Northeastern IPM Center through Grant #2018-70006-28882 from the National Institute of Food and Agriculture, Crop Protection and Pest Management, Regional Coordination Program.

