Fall 2017 Tick-Borne Disease Lab and DOD Human Tick Test Kit Program Update

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U.S. Army Public Health Center
Tick-Borne Disease Laboratory

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Tick-borne Disease is an Occupational Health Risk for Military Personnel
DoD Human Tick Test Kit Program

- Clinical support for health care providers and their tick-bite patients
- Tick identification and analysis
  - Lyme disease
  - Human granulocytic anaplasmosis
  - Babesiosis
  - Human monocytic ehrlichiosis
  - Ewingii ehrlichiosis
  - Tidewater spotted fever
  - Rocky Mountain spotted fever

Directions:
1. Place tick in plastic screw cap vial.
2. Place vial in plastic ziploc bag.
3. Fill out LIDS 850, enclosed.
4. Place plastic bag and LIDS 850 in the mailing envelope and send without delay to:

Army Public Health Center
ATTN: Human Tick Test Kit Program
5150 Blackhawk Road
BLDG E5800
Aberdeen Proving Ground, MD 21010-5403
(410) 436-5421
TICK-BORNE HUMAN PATHOGEN DESCRIBED

1907 - Rocky Mountain spotted fever (RMSF)
1957 - Babesiosis (BAB)
1975 - Lyme disease (LD)
1986 - Human monocytic ehrlichiosis (HME)
1994 - Human granulocytic anaplasmosis (HGA)
1999 - Ewingi ehrlichiosis (EE)
2005 - Tidewater-sorted fever (TWSF)
2006 - Panola Mountain ehrlichiosis (PME)
2009 - Ehrlichia sp. Wisconsin (EML)

US ARMY ACTION
(USAEDA → USACHPPM → USAPHC → APHC)
Locations of DoD Human Tick Test Kit Program Participants
CONUS Distribution of Tick-borne Diseases, CDC
Ticks and their pathogens: Red indicates diseases with agents currently tested for by the HTTKP

**Lone star tick**  
*(Amblyomma americanum)*
- Ehrlichioses
- Heartland virus
- Southern Tick-Associated Rash Illness (STARI)

**American dog tick**  
*(Dermacentor variabilis)*
- Rocky Mountain spotted fever

**Deer or blacklegged tick**  
*(Ixodes scapularis)*
- Anaplasmosis
- Babesiosis
- Borreliosis
- Ehrlichiosis
- Powassan/Deer tick virus
Number of ticks received, 1994 - 2015
Different Tick Species Have Different Geographical Distributions

Surveillance Data Informs Disease Risk

Species Proportions of Ticks Received by DOD Human Tick Test Kit Program
Data Analysis: Selected Army Installations

Tick Distributions (reported or established)
- Blacklegged ticks
- Lone star ticks
- Both species

HTTKP Surveillance Results
- No Data
- Lyme
- Ehrlichiosis
- Lyme + Ehrlichiosis

Tick-Borne Pathogens in Human-Biting Lone Star Ticks at HoF Installations

- Panola Mountain
- Ehrlichiosis Pathogen
- Human monocytic
- Ehrlichiosis Pathogen
- Ewingii ehrlichiosis Pathogen

Army Public Health Center
Data Analysis: Selected Army Installations

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Tick-borne Pathogens in Human-Biting Blacklegged Ticks at HoF Installations 2006-2016

Army Public Health Center

Field-collected ticks, 1996.

- **Encounter rate:**  
  Adults: 39/hour  
  Nymphs: 507/hour

- **E. chaffeensis** infection rate:  
  Adults: 3.5%  
  Nymphs: 0.8%

Photo: Andre Weltman
Stromdahl EY, Williamson PC, Kollars TM Jr, Evans SR, Barry RK, Vince MA, Dobbs NA

- 4,504 ticks
- *B. lonestari* infection rate: 1.2%
- *B. lonestari* in larvae – transovarial transmission

*B. lonestari* is no longer considered a pathogen
Gulf Coast Ticks (Amblyomma maculatum) and Rickettsia parkeri, United States. 2006
Sumner JW, Durden LA, Goddard J, Stromdahl EY, Clark KL, Reeves WK, Paddock CD

- Documented the range of *R. parkeri*.
- Ticks from Florida, Georgia, Kentucky, Mississippi, Oklahoma, South Carolina.
- PCR-positive for *R. parkeri*. 

*Amblyomma maculatum*  A. female, B. male

Photo: James Gathany
Rickettsia amblyommii Infecting Amblyomma americanum larvae.
2008
Stromdahl EY, Vince MA, Billingsley PM, Dobbs NA, Williamson PC

- Larvae from Maryland.
- 33 pools of 40 larvae each from different “clumps”, 100% infected.
- 30 individual larvae from a single clump, 90% infected.
- Evidence of transovarial transmission.

- Pst1 restriction patterns of rompA PCR published.

lane 4, A. americanum tick pool,

Bites of larvae on ankle

Photo: Ellen Stromdahl
Geographic Distribution and Genetic Diversity of the *Ehrlichia* sp. *from Panola Mountain in* *Amblyomma americanum*. 2008
Loftis AD, Mixson TR, Stromdahl EY, Yabsley MJ, Garrison LE, Williamson PC, Fitak RR, 
Fuerst, PA, Kelly DJ, Blount KW

- 3,799 ticks from 23 states
- PME detected in ticks from 10 states
- PME infection rate: 0.9%

Geographic distribution of the Panola Mountain *Ehrlichia* sp.
Molecular detection of *Rickettsia amblyommii* in *Amblyomma americanum* parasitizing humans. 2010

Jiang J, Yarina T, Miller MK, Stromdahl EY, Richards

- 340 ticks from Boy Scouts, 80.5% infected.
- 244/367 individual ticks from military personnel in 17 U.S. states, 66.5% infected.

- Rambl qPCR for *R. amblyommii*
Short report: New spotted fever group *Rickettsia* in a *Rhipicephalus turanicus* tick removed from a child in eastern Sicily, Italy. 2011
Eremeeva ME, Stromdahl EY

- “*Candidatus Rickettsia siciliensis*” was detected in a *Rhipicephalus turanicus* male
- Removed from an asymptomatic 22-month-old female in Sicily
Infrequency of *Rickettsia rickettsii* in *Dermacentor variabilis* removed from humans, with comments on the role of other human-biting ticks associated with spotted fever group *Rickettsiae* in the United States. 2011

Stromdahl EY, Jiang J, Vince MA, Richards AL

- Only one *D. variabilis* (1/5,286) infected with *R. rickettsii*.

- Most cases of RMSF reported from areas of sympatric populations of *D. variabilis* and *A. americanum* (plus *A. maculatum*).
Detection of *Rickettsia parkeri* and *Candidatus Rickettsia andeanae* in *Amblyomma maculatum* Gulf Coast ticks collected from humans in the United States. 2011

Jiang J, Stromdahl EY, Richards AL

- 37 *A. maculatum* from DOD Human Tick Test Kit Program.
- qPCR developed for *R. parkeri* and *R. andeanae*.
- *R. parkeri* detected in 9 ticks from 3 states (AL, KY, VA).
- *R. andeanae* detected in 4 ticks from 2 states (OK, KS).
- *R. felis* detected in 2 ticks from 2 states (VA, MS)

*A. maculatum* positive for Rpark, Rande, Rfelis, 2000-2009. 40.5% (15/37) positive for *Rickettsia*. 

**Amblyomma maculatum**
Comparison of phenology and pathogen prevalence, including infection with the Ehrlichia muris-like (EML) agent, of *Ixodes scapularis* removed from soldiers in the midwestern and the northeastern United States over a 15 year period (1997-2012). 2014

Upper Midwest vs. PA:
- Higher infection rate of all *I. scapularis* pathogens.
- EML infected ticks.
- Adults active with nymphs in summer.

Shorter, compressed summer season
**Borrelia burgdorferi** not confirmed in human-biting *Amblyomma americanum* ticks from the southeastern United States. 2015


- 1,097 *A. americanum* tested with *flaB* primers from Clark et al. 2013.

- Only *Borrelia lonestari* detected, no *B. burgdorferi*.

- The assay produced nonspecific amplification in almost every lane, and results were not repeatable – samples that were positive in one test were negative in a subsequent test.

Stromdahl EY, Jiang J, Vince MA, Richards AL

- *D. variabilis* removed from military personnel throughout the U.S.
- Ecological niche modeling was used to estimate the probability of tick presence in eastern United States using locations of both *R. montanensis* -positive and -negative ticks, climate, and elevation data.

Predicted Areas of *R. montanensis* -positive and -negative ticks
## Future Investigations

<table>
<thead>
<tr>
<th>Virus</th>
<th>Found in lone star tick</th>
<th>Causes human illness</th>
<th>Causes death</th>
<th>Related viral pathogen</th>
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<td>SFTSV</td>
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Controlled burns and tick population control

BY AMANDA ROMINECKI
APG News

Controlled burns may have an interesting unrelated benefit for Team APG: tick control. The idea is so promising that the Army's Public Health Center is in the midst of a several-year study to determine the effectiveness of controlled burns on reducing tick bites and tick-borne disease transmission on APG.

The Defense Department's Human Tick Test Kit Program, or HTTKP, operates out of the Tick-Borne Disease Lab on APG South (Edgewood). For more than 20 years, the Army has identified and tested ticks removed from military personnel through this program. They have tested more than 55,000 ticks removed from personnel at more than 100 military installations.

According to Dr. Robyn Nadolny, a biologist working in the Tick-Borne Disease Lab, long-term prescribed burning has been shown to significantly reduce ticks, particularly lone star and blacklegged ticks, at sites in Georgia and Florida. Lone star and blacklegged ticks account for 80 percent of the ticks submitted for testing by APG personnel.

Because Aberdeen Test Center and the APG Garrison have plans to conduct controlled burns on an annual basis, it provides an excellent, low-cost way for APHC to determine if prescribed burning is effective at reducing ticks on military installations.

"Ticks will be identified to species, counted, and tested for pathogens," Nadolny explained. "Changes in tick abundance, tick species composition, and pathogen prevalence will be monitored over time to determine if there are differences between burned and unburned habitats, or if there is an overall change in the ticks submitted to the HTTKP from APG personnel."

TBDL personnel will methodically collect ticks twice a year in select paired burned and nearby unburned habitats, as well as two unburned sites to serve as controls.

The study will also provide the HTTKP with the opportunity to compare new data with a similar survey of ticks in the environment conducted in the mid-1990s.

This will "enable comparisons to be made over several decades at APG in order to see how ticks in the environment have changed and to determine if the ticks submitted to the HTTKP result in an under-reporting of pathogen infection levels in the tick populations on post," Nadolny said.

The lab anticipates that prescribed burning will reduce the risk of tick bites and tick-borne disease transmission to APG personnel working in and around the burned test ranges.

"If prescribed burning is found to be an effective tool to reduce tick populations, tick bites, and tick-borne disease on APG, other military installations can adopt the practice to mitigate TBD risk," she said.
Human Tick Test Kit Program

A free tick identification and testing service for Department of Defense health care facilities, provided by the APHC.

For additional information or to request services, contact the Tick-borne Disease Lab: by phone (410) 436-5421 or by email usarmy.apg.medcom-aphc.mbx.tickcom@mail.mil.

https://phc.amedd.army.mil/topics/envirohealth/epm/Pages/HumanTickTestKitProgram.aspx
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