**Ehrlichia and lone star ticks:** Pathogen prevalence in counties of varying ehrlichiosis incidence

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**Background**

Ehrlichiosis is a nationally reportable vector-borne disease (VBD). Its incidence has been increasing over the past several decades. Three species of *Ehrlichia* bacteria are known to cause human disease:

- *Ehrlichia chaffeensis* - first described 1987; most commonly reported human disease agent.
- *Ehrlichia universalis* - first described 1955; vector is *Amblyomma americanum*.

Novel Panola Mountain *Ehrlichia* (PM) species - first described in 2006 from an infected goat in Georgia, USA; potential human pathogenicity.

While all life stages are known to feed on humans, only adult and nymphal *A. americanum* ticks are known to be infected with *Ehrlichia* species. Absence of transovarial transmission makes *Ehrlichia* transmission less focal and more widespread.

**Transmission**

- *E. chaffeensis* and *E. ewingii* are transmitted by the lone star tick, *Amblyomma americanum*, the most common biting tick in the southeastern U.S.
- White-tailed deer are a main host for all three lone star tick life stages and are thought to be an important natural reservoir of *Ehrlichia*.
- While all life stages are known to feed on humans, only adult and nymphal *A. americanum* ticks are known to be infected with *Ehrlichia* vectors. Absence of transovarial transmission makes *Ehrlichia* transmission less focal and more widespread.

**Tick Collections**

1,307 *Amblyomma americanum* ticks were collected from 74 sites in 13 counties; 2 sites per county

All lone star ticks were collected from the four Middle Tennessee counties surveyed

50% of confirmed and probable cases hospitalized in 2021

**Ehrlichiosis Incidence Rate by County, 2011-2021**

**Discussion & Analysis**

- **Ehrlichiosis incidence compared to *A. americanum* infection prevalence in four Middle TN counties**

**Methods**

- **Processing**
  - Morphological identification
  - Pooling of species, sex, life stage
  - ≥3 adults, ≥5 nymphs
  - Homogenization
  - Cuticle disrupted with scalpel
  - Heat bead with Tris-Trypsin

- **Nucleic acid extraction**
  - Qiagen extraction kit automated with QIAcube HT

- **Molecular detection**
  - Real-time PCR

**Results**

- **Total positive pools**: 13% of lone star tick pools were positive for an *Ehrlichia* species

- **Ehrlichiosis Testing Results**

**Figure 1. Ehrlichia chaffeensis transmission cycle**

**Figure 2. Average annual reported ehrlichiosis incidence varies widely across the state; however, tick-borne diseases are generally underreported and cases are reported by a patient’s county of residence. The movement and interaction of ticks, animal hosts, bacteria, and humans make it challenging to estimate disease risk from case surveillance alone.**

**Figure 3. Examples of amplification curves from real-time PCR qPCR results for each *Ehrlichia* assay**

**Figure 4. Examples of tick dragging and collections. Photos courtesy of Jennifer Farmer, Public Health Department in Rutherford County, Tennessee**

**Table 1. *A. americanum* collected**

<table>
<thead>
<tr>
<th>County</th>
<th>E. chaffeensis</th>
<th>E. ewingii</th>
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</thead>
<tbody>
<tr>
<td>Davidson</td>
<td>44</td>
<td>16</td>
</tr>
<tr>
<td>Rutherford</td>
<td>34</td>
<td>14</td>
</tr>
</tbody>
</table>

**Table 2. Ehrlichiosis incidence compared to *A. americanum* infection rates in four Middle TN counties**

<table>
<thead>
<tr>
<th>County</th>
<th>E. chaffeensis Incidence Rate*</th>
<th>E. ewingii Incidence Rate*</th>
<th><em>A. americanum</em> Infection Prevalence*%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maury</td>
<td>5.04</td>
<td>2.35</td>
<td>2.0</td>
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<tr>
<td>Davidson</td>
<td>2.06</td>
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<tr>
<td>Maury</td>
<td>0.47</td>
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<td>0.4</td>
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<tr>
<td>Rutherford</td>
<td>0.35</td>
<td>0.23</td>
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</tr>
</tbody>
</table>

**Average annual reported ehrlichiosis rates (per 100,000 population) from 2011-2021. Tick IP point estimates calculated as the Minimum Infection Rate estimate of ticks tested with ticks collected within interval.**

**References**


