Ticks and Tick Borne Diseases in Virginia

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Tick Life Cycle - After larvae hatch from eggs, ticks must have one good blood meal to transition from each development stage.
Tick Borne Diseases in Virginia: Rocky Mountain Spotted Fever, Lyme Disease, Ehrlichiosis, Babesiosis, and Tularemia.

Three Important Vector Tick Species Found in Virginia:

- **American dog tick**: Very common
- **Lone star tick**: Very common
- **Black legged tick (deer tick)**: Uncommon or locally common
Vector Tick Species Found in Virginia (human biting behavior)

**American dog tick**
(bites by adult ticks only)

**Deer tick**
(bites by adults and nymphs)

**Lone star tick**
(bites by adults and nymphs)
Rocky Mountain Spotted Fever (RSMF)

Causative Agent – Bacteria – 
*Rickettsia rickettsii*

Tick Vector species – 
American dog tick.

RMSF: Transmission

<table>
<thead>
<tr>
<th>Transmission Season (90% of U.S. cases)</th>
<th>April-September</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Tick Bite Duration for Transmission</td>
<td>3-6 hours</td>
</tr>
</tbody>
</table>
## Rocky Mountain Spotted Fever (RMSF): Symptoms

<table>
<thead>
<tr>
<th>Initial Symptoms</th>
<th>Fever, nausea, vomiting, severe headache, muscle pain, loss of appetite.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Later Symptoms</td>
<td>Rash, abdominal pain, joint pain, diarrhea. This is a severe disease and untreated cases have a 30% fatality rate. Fatality rate in treated cases is 3-5%.</td>
</tr>
</tbody>
</table>

Rash may occur in only 35-60% of patients,
## Rocky Mountain Spotted Fever (RSMF): Symptoms & Treatment

<table>
<thead>
<tr>
<th>Manifestations from Severe Illness (untreated or treated too late)</th>
<th>Damage to multiple organ systems, respiratory system, neurological damage, partial paralysis of lower extremities, and gangrene resulting in limb amputation.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treatment</strong></td>
<td>Doxycycline, Tetracycline. If RMSF is suspected, treat immediately; do not wait for confirming lab test results.</td>
</tr>
</tbody>
</table>

Rocky Mountain Spotted Fever is a misnomer. Although it was discovered, and can occur in the Rocky Mountains of the west, most of the cases in the United States occur in North Carolina, Arkansas, or other near-by southeastern and south central states.
Tick Transmission of Rocky Mountain Spotted Fever (RSMF):

Larval and nymphal American dog ticks may become infected with *R. rickettsii* by feeding on several small rodent species that serve as reservoirs.

Infected, adult, female American dog ticks may also lay infected eggs that then become infected ticks.

*R. rickettsii* is detrimental to infected ticks, so very few infected larvae survive to become adult ticks.

Only adult American dog ticks feed on humans, so only adult ticks can transmit RMSF to humans.

Fewer than 3% of adult ticks will be infected in epidemic areas.
Tick Transmission of Rocky Mountain Spotted Fever (RSMF):

Although the American dog tick is the principal vector of RMSF, several other Virginia tick species have been found infected with *R. rickettsii*.

Therefore, although uncommon, it is conceivable that RMSF could also be transmitted by lone star ticks or deer ticks.
**Ehrlichiosis (Human Monocytic and Granulocytic)**

**Human Monocytic Ehrlichiosis (HME)**

Causative Agent – Bacteria -  
*Ehrlichia chaffeensis & E. ewingii*

Tick Vector Species – *Lone star tick.*

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**Human Granulocytic Anaplasmosis (HGA) (Formerly known as Ehrlichiosis; HGE)**

Causative Agent – Bacteria - *Anaplasma phagocytophia*

Tick Vector Species – *Black legged tick* (a.k.a. *deer tick*).
### Human Monocytic Ehrlichiosis (HME) Transmission

<table>
<thead>
<tr>
<th>Transmission Season (when 80 to 90% of U.S. cases occur)</th>
<th>April-September</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Tick Bite Duration for Transmission</td>
<td>24 hours</td>
</tr>
</tbody>
</table>

Most HME transmission occurs in the areas of southeastern and south central U.S. (            ) where lone star ticks occur.
Tick Transmission of HME:

White tailed deer serve as the primary disease reservoir where larval, nymphal and adult lone star ticks can become infected with *E. chaffeensis*.

**Proposed transmission cycle for *Ehrlichia chaffeensis* in lone star ticks**
Tick Transmission of HME:

**Only nymphal and adult - lone star ticks feed on humans or transmit HME to humans.**

**Adult ticks are the most important vectors.**

**Dogs and deer may also serve as disease reservoirs where ticks become infected with E. ewingii.**

**Several other tick species have tested positive for E. chaffeensis and it is possible that American dog ticks play a small role in HME transmission.**
Human Granulocytic Anaplasmosis (HGA) Transmission

<table>
<thead>
<tr>
<th>Transmission Season (when 80 to 90% of U.S. cases occur)</th>
<th>April-September</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Tick Bite Duration for Transmission</td>
<td>24 hours</td>
</tr>
</tbody>
</table>

Most HGE transmission occurs in the areas of northeastern and north central U.S. ( □ ) where deer ticks are common.

Deer tick distribution
Lone star tick distribution
Overlapping distribution (deer ticks and lone star ticks)
# Ehrlichiosis / Anaplasmosis: Incubation, Symptoms & Treatment

<table>
<thead>
<tr>
<th>Incubation Period (days from bite to onset of symptoms)</th>
<th>5-10 days</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial Symptoms</strong></td>
<td>Fever, headache, chills, fatigue, muscle pain, joint pain, nausea, vomiting, diarrhea, cough and a rash (20% of adults get rash; 60% of children get rash).</td>
</tr>
<tr>
<td><strong>Later Symptoms (if untreated, or treated too late)</strong></td>
<td>Prolonged fever, renal failure, respiratory distress, seizures, coma and death (2-3% of hospitalized patients may die).</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>Doxycycline, Tetracyclines</td>
</tr>
</tbody>
</table>

**Adults over the age of 40 have the highest incidence of Ehrlichiosis / Anaplasmosis**
Tick Transmission of HGA:

Small rodents serve as the primary disease reservoir where larval, nymphal and adult deer ticks can become infected with *Anaplasma phagocytophila*.

Proposed transmission cycle for *Anaplasma phagocytophyla* in deer ticks
Tick Transmission of HGA:

**Only nymphal and adult - deer ticks feed on humans.**

Both nymphal and adult deer tick stages can transmit HGE to humans, but nymphal deer ticks are more important as vectors.

Because the deer tick is involved in Lyme disease transmission, HGE may be common wherever Lyme disease is common.

No other tick species are known to play a role in HGE transmission.
**Lyme Disease**

Causative Agent – Bacteria (spirochete) – *Borrelia burgdorferi*

Tick Vector Species – **Black legged tick** (a.k.a. deer tick).

**Lyme Disease: Incubation & Symptoms**

<table>
<thead>
<tr>
<th>Incubation Period (days from bite to onset of symptoms)</th>
<th>7-14 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Symptoms</td>
<td>Bulls-eye rash (80% of patients get a bulls-eye rash), fever, headache, fatigue, muscle pain, stiff neck, joint pain, (initial infection may be without any symptoms).</td>
</tr>
</tbody>
</table>
Lyme Disease: Symptoms

Bulls-eye Rash (erythema-migrans) occurs in 80% of cases.
## Lyme Disease: Symptoms & Treatment

<table>
<thead>
<tr>
<th>Later Manifestations (if untreated or not treated in time).</th>
<th>Intermittent swelling and pain in large joints, neurological disorders (facial palsy, cognitive disorders, inflammation of sensory nerves, meningitis, encephalitis), and (rarely) cardiac problems. Later symptoms may occur even if initial disease symptoms never occurred. Late manifestations may be more difficult to cure and may cause long term disabilities.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>Doxycycline or amoxicillin for 3-4 weeks</td>
</tr>
</tbody>
</table>
Distribution of deer ticks and Lyme disease in U.S.

Note: This map demonstrates an approximate distribution of predicted Lyme disease risk in the United States. The true relative risk in any given county compared with other counties might differ from that shown here and might change from year to year. Risk categories are defined in the accompanying text. Information on risk distribution within states and counties is best obtained from state and local public health authorities.
Lyme Disease Transmission

Transmission Season
(when most cases occur)

May-July (when nymphal deer ticks are feeding)

Minimum Tick Bite Duration for Transmission

24 hours

American Lyme Disease foundation
Lyme Disease Transmission

Small rodents serve as food for larval ticks and as the reservoir hosts for Lyme disease.

Nymphal deer ticks feed on mammals (rodents, dogs, deer), and birds some of which may also play roles as reservoirs for Lyme disease.

Only nymphal and adult - deer ticks feed on humans or transmit Lyme disease to humans.

Nymphal deer ticks are the most important vectors.

No other tick species are known to play a role in Lyme disease transmission.
Transmission of Babesiosis

<table>
<thead>
<tr>
<th>Transmission Season (when most U.S. cases occur)</th>
<th>June-September</th>
</tr>
</thead>
</table>

Causative Agent – Protozoa – *Babesia microti*

Vector Species – Black legged tick (a.k.a. deer tick).

Larval deer ticks feed on small rodents which serve as the reservoir hosts for *Babesia microti*. 
Transmission of Babesiosis

Nymphal and adult - deer ticks transmit *B. microti* to humans.

Since its discovery in 1969, most human cases of Babesiosis have been recorded in the coastal northeastern states (New Jersey, New York, Connecticut, Rhode island and Massachusetts), but it has also occurred in Minnesota and Wisconsin.
## Transmission of Tularemia

<table>
<thead>
<tr>
<th>Transmission Season (when most U.S. cases occur)</th>
<th>May-August</th>
</tr>
</thead>
</table>

### Causative Agent – Bacteria – *Francisella tularensis*

Although Tularemia can be spread in many ways (e.g., aerosol, contaminated water, deer fly bites, etc.) the majority of American cases result from transmission by tick vectors.

### Tick Vector Species – *American dog ticks* and *lone star ticks*
Transmission of Tularemia

Larval and nymphal ticks are infected when feeding on rabbits and voles.

Reported cases of Tularemia in the United States, 1990-2000
Prevention of Tick Borne Diseases

Avoidance of Tick Habitats and Ticks

Avoid prolonged periods in tick habitats (humid forest environments with dense undergrowth and/or heavy leaf litter; tall weeds along forest margins, tree lines, forest trails and small forest clearings).

Wear repellents (DEET or Permethrin) on clothing and shoes.

Wear light colored clothing and tuck pants legs under socks.

Thoroughly check yourself (clothing and body) after spending time in tick habitats; use a full length mirror if possible.
Prevention of Tick Borne Diseases

Tick Removal

The transmission of tick borne diseases may require hours or days of feeding time, so prompt tick removal greatly reduces the chance of disease transmission.

Carefully remove tick using tweezers.

Wash and disinfect tick bite site.

Save tick in vial of alcohol for future identification. If you subsequently become ill, tick identification might provide a clue as to the nature of your illness.
Prevention of Tick Borne Diseases

Tick Removal

Tick removal must be done carefully to prevent tick from regurgitating into the wound or losing tick mouth parts in your skin.

Use pointed tweezers to grasp the tick by the head; do not squeeze its body.

Pull slowly and steadily until the tick releases; do not jerk or twist the tick.
Tick and Disease Control Tactics

Application of Insecticides

Residual insecticides can be sprayed on foliage brush and the ground around kennels, or in a perimeter around property. Granular insecticides can be broadcast over large areas of forest floor around residential areas.

Habitat Management

When in proximity to areas of human activity, brush and leaf litter that may serve as harborage for rodents and ticks can be mowed or removed.
Tick and Disease Control Tactics

Deer Management

Deer are the most important source of food for adults of several tick species.

Blood acquired from deer allows adult ticks to lay eggs.

Deer are also a source of several tick borne pathogens.

Management / reduction of local deer populations reduces the source of food and diseases for ticks.
Tick and Disease Control Tactics

Control of Ticks on Deer using a “4-Poster Device”

Experimental deer feeding station called a 4-Poster.

By applying insecticide to deer’s ears, the 4-Poster has been able to reduce local tick populations by > 95% in several locations.

American Lyme Disease foundation
Tick and Disease Control Tactics

Rodent Management

Larvae and nymphs of many tick species feed on rodents and acquire pathogens. Reduction of local rodent populations will reduce the source of food and disease for ticks.

Control of Ticks on Rodents Using Treated Bait Stations

Studies are being conducted by the CDC using rodent bait boxes containing insecticide treated rollers that kill larval and nymphal ticks on wild rodent populations when rodents come to feed on bait.