Ticks

Precautions against tick-transmitted diseases:

Hungry (questing) ticks are generally found on grasses or brush, at a height appropriate for desired hosts

Avoid thick brush, tall grasses

Wear long pants, preferably light color (easier to see ticks, which are darkly colored)

Tuck pants into socks

Examine yourself, especially legs, frequently if in tick habitat

Check yourself thoroughly after leaving tick habitat (remove clothes if possible). Be sure to examine your hair and back. Have someone else check you if possible.

Check children at least once daily if they have been in tick habitat

Prevention!

Proper tick removal technique:

Grasp tick against skin, preferably with forceps. Be careful if using fingers to remove tick, since it’s body fluids can be infectious.

Pull tick straight out, better not to twist it

Disinfect bite wound with antiseptic

Be alert for rash or flu-like symptoms in days following tick bite

Do NOT use Vaseline, alcohol, hot match, etc. to get rid of tick.

- Hard tick has hyposome (?) → like mouth/head
  - secr. cement-like glue so that it stays in.
  - pool: feeders → prest. anti-coagulants, etc. → don’t dev. inflam. response
    → painkillers → don’t notice it.

- DO NOT fly. → Arachnids, like spiders
  - stay on grass, tree leaf, etc. w/ back legs & front legs hang out
  - sens. to CO₂ & use light sensing “eyes” to find us.
All the following pathogens are obligate intracellular bacteria

\*only survive inside human cells

\*Tetracyclines or Chloramphenicol for children & pregnant women

\*Tetracyclines are useless against these infections! \*be careful.

Recommended:

- Tetracyclines for adults

Rocky Mountain Spotted Fever

*Rickettsia rickettsii* and some other spotted fever group (SFG) rickettsiae

Primarily found in eastern and southern USA \*rare in Rocky Mts.

500-1000 cases reported each year in US, incidence probably much higher

Carried by many types of ticks, including those found in Kentucky

In some areas, many ticks may be infected by a SFG *Rickettsia*, but not all are pathogenic for humans. Cytoplasmic incompatibility apparently restricts ticks to infection by only one species of *Rickettsia*.

SFG *Rickettsia* in ticks are passed transovarially (through eggs). Can be maintained for several generations in this manner, but gradually lose viability. Must pass through vertebrate to restore viability. Therefore RMSF requires a tick-mammal infectious cycle to persist in nature.

\*only virulent tick passes, not non-infeks (weeded out)
Known virulence determinants:

**OmpA** (outer membrane protein A, also called rOmpA)
- Involved with adherence to host cells
- Hasn't been inactivated

Capsule ("reactivation" required for infectiousness) → slime layer
- Required for mammalian infection
- Diminishes w/ tick infection
- "Re-act" of lact reagent for mammalian infxn → warmth of blood induces lact

**Pathogenesis of RMSF**

Transmitted via tick saliva into bite wound. All other tick tissues are infectious. Bacteria disseminate through body via blood. (bacteremia)
- Attach to endothelial cells via OmpA, promote own phagocytosis
- Escape phagosome
- Replicate in cytoplasm
- Spread through cell and to other cells via actin tail filament propulsion
- May also spread by lysing cells
- Local vascular permeability increases.
- Localized edema, hemorrhage.
- Tissue damage can lead to organ failure and death

**Symptoms of RMSF**

Initial symptom is "flu-like illness". Greater than 2/3 RMSF cases are missed at this stage.

Rash appears on ~14% of patients on day 1, 50% by day 3.
- First appears on wrists and ankles, then spreads to rest of body.
- Early rash consists of macules, blanch on compression.
- Rash not seen until day 6 in 20% of patients.
- Rash never seen in 10% of patients.
- Later rash consists of petechiae, as blood vessel rupture and area fills with blood, these do not blanch. Petechiae appear in only about half of cases.

Be alert for RMSF triad:
1. exposure to ticks
2. flu-like illness
3. rash

* don't need all 3 for RMSF dx!!
* High incidence of dz in CHILDREN!
Disease progresses rapidly, so early diagnosis and treatment is critical.

In pre-antibiotic era, 20-25% of cases died

Presently, approx. 5% of cases die, even with appropriate antibiotics, primarily due to late diagnosis and treatment

Highest incidence of RMSF with children. Also have high mortality. (see MMWR article attached to handout)

* most likely to encounter ticks
* least likely to notice tick

Survivors may be faced with other complications from tissue damage. Gangrene requiring amputation is not uncommon.

**Diagnosis of RMSF**

Serodiagnosis is relatively simple, but may be negative for a week or more after infection.

- Latex bead agglutination assay is fairly accurate and sensitive
- Indirect immunofluorescence is most accurate and sensitive
- Weil-Felix test is obsolete and inaccurate.

**Immunohistochemistry** → **GOOD!!**

**Cultivation** is not done because of danger to lab workers

* be very careful working w/ it.
  - can get RMSF from infected tissue.
Other spotted fevers **throughout the world**

Caused by other *Rickettsia* species → Tick transmitted.

Some, such as Mediterranean spotted fever, characterized by black eschar at bite site
- Always look @ tick bite

---

**Endemic Typhus (flea-borne typhus)**

*R. typhi, R. felis* 100 cases in US/yr → under-ax.

Associated with rats and rat fleas, but occasionally also cat fleas.
Transmitted by flea bite, rat bite, or inhalation of flea feces.

Most cases from southern Texas and southern California

Flu-like initial symptoms
Macular to macromacular rash in 50% of cases by day 6. But 50% never develop rash
- *NOT* petechiae!!

Pulmonary involvement common - ICU hospitalization in ~10% of cases
- Hacking, nonproductive cough
- Chest X-ray often reveals pulmonary densities
- May require ventilation

Other organs may be affected, e.g. cerebral hemorrhage

*Increased susceptibility with age, underlying disease, or treatment with sulfa drug* (~1% fatalities in this group)

In one study, 50% of infected children experienced only night-time fevers.
Epidemic Typhus (louse-borne typhus)

*R. prowazekii*  
only feed on humans  
very diff spp. → all live in these areas  
only!

Spread by human body louse. Not to be confused with head lice or pubic (crab) lice. Lice are extremely host-specific. Lice live in folds of clothing, travelling to skin to feed on blood. Associated with poor hygiene. Washing clothes at >50°C kills lice and eggs. Epidemics frequently accompany war and associated disturbances such as refugee camps and concentration camps.

* trench deaths*

May also be transmitted by flying squirrel fleas in eastern US.

Rash begins on upper trunk, generally by day 5. Spreads to rest of body except face, palms and soles (compare with RMSF). Initially macular, may progress to petechial.

Majority of patients manifest CNS abnormalities, including confusion, stupor.

Cough is frequent.

Approx. 40% of untreated cases are fatal.

**Brill-Zinsser Disease**

Recrudescence, milder form of epidemic typhus. Occurs several years after primary infection, usually in elderly. Important consideration if patients is from endemic area. History is important - recent typhus outbreaks in Eastern Europe, Africa.

Milder, shorter than primary disease. No rash or headache, probably due to residual immunity from initial disease.

Generally not fatal.

* Indicates potential for *Rickettsia* to chronically infect in a subclinical state.
Rickettsialpox (one word)

Caused by *R. akari*

~100 cases reported in US annually

Maintained in nature by mouse-mite cycle.

Generally transmitted by mouse bite

Flu-like symptoms with macular rash. Lasts 6-10 days. No reported fatalities.

& resists

*But treat anyway in case it’s RMSF.*


Scrub Typhus

*Orietia tsutsugamushi* (formerly *R. tsutsugamushi*)

Spread by chiggers (mites) in eastern and southern Asia and western Pacific

Maculopapular rash, may fade rapidly

*Not in US.*
**Ehrlichiosis / Anaplasmosis**

Human Monocytic Ehrlichiosis (HME):

*Ehrlichia chaffensis*

Spread by many types of ticks, especially Lonestar tick (*Amblyomma americanum*), which is found in Kentucky

Human Anaplasmosis

also called Human Granulocytic Ehrlichiosis (HGE) affects granulocytes.

*Anaplasma phagocytophilum*

Formerly called *E. canis*, *E. phagocytophila*, or "agent of HGE"

Spread primarily by *Ixodes* spp. ticks

(*Ixodes* also spread Lyme disease and babesiosis)

- Not in Ky

Symptoms are similar:

- Flu-like initially
- Rashes are rare
- Leukopenia and/or thrombocytopenia common, may assist diagnosis
- May cause organ damage and failure, with 2-5% fatality rate

May observe morulae (clusters of cells within vacuole) in appropriate leukocyte, although this is not very common in HME

* Find with Giemsa stain
Q Fever (Q = Query)

*Coxiella burnetti* → not rel. to rickettsia (actually closer to legionella)

Spread by ticks among many wild and domestic animals. Human infections usually occur through contact with contaminated meat, hides or wool, or by ingestion of contaminated meat or milk, but Q fever can be contracted by tick bite. (but doesn't have to be)

Bacteria form spores that resist desiccation, can persist in contaminated soil for years.

"Flu-like illness" initially
Pulmonary involvement is common: cough, pneumonia
Thrombocytopenia common

Death is rare

Tick paralysis

Not caused by an infectious agent

Caused by reaction to substance in tick saliva (allergy?)

Symptoms generally clear after removal of tick.

Paralysis may involve entire body, leading to death