13.03.2023

Rickettsiae

(MBBS, M.Phil, Ph.D, CBact, CHPE)

Mass grave of typhus victims in Belsen concentration camp, Germany
April 1945

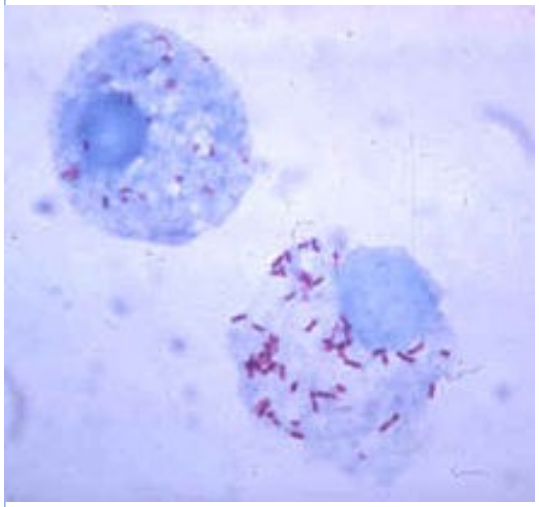
LECTURE OBJECTIVES

At the end of the session students should be able to

1. Define Rickettsia
2. Describe important properties, pathophysiology, and lab diagnosis of diseases caused by Rickettsial.

Rickettsia

- obligate intracellular,
- **gram-negative**, non-motile coccobacilli. Poorly stained
- Contain RNA & DNA, and enzymes
- Surrounded by microcapsule & **slime layer**
- Unable to generate sufficient energy (Defficient with pyruvic acid)
- multiply by binary fission



Epidemiology

- WHO estimates current death rate from typhus is about one of every 5-millions people per year.
- rocky mountain spotted fever *(R rickettsiaii*) and Q-fever in found in US). Typhus (endemic, epidemic, scrub typhus) is important in developing countries.
- Q fever risk is for veterinarian, shepherds, abattoir workers and lab workers.
- Only a few areas of epidemic typhus exist today; reported in Burundi, Rwanda, Ethiopia, Algeria, and a few areas in South and Central America.

Typhus

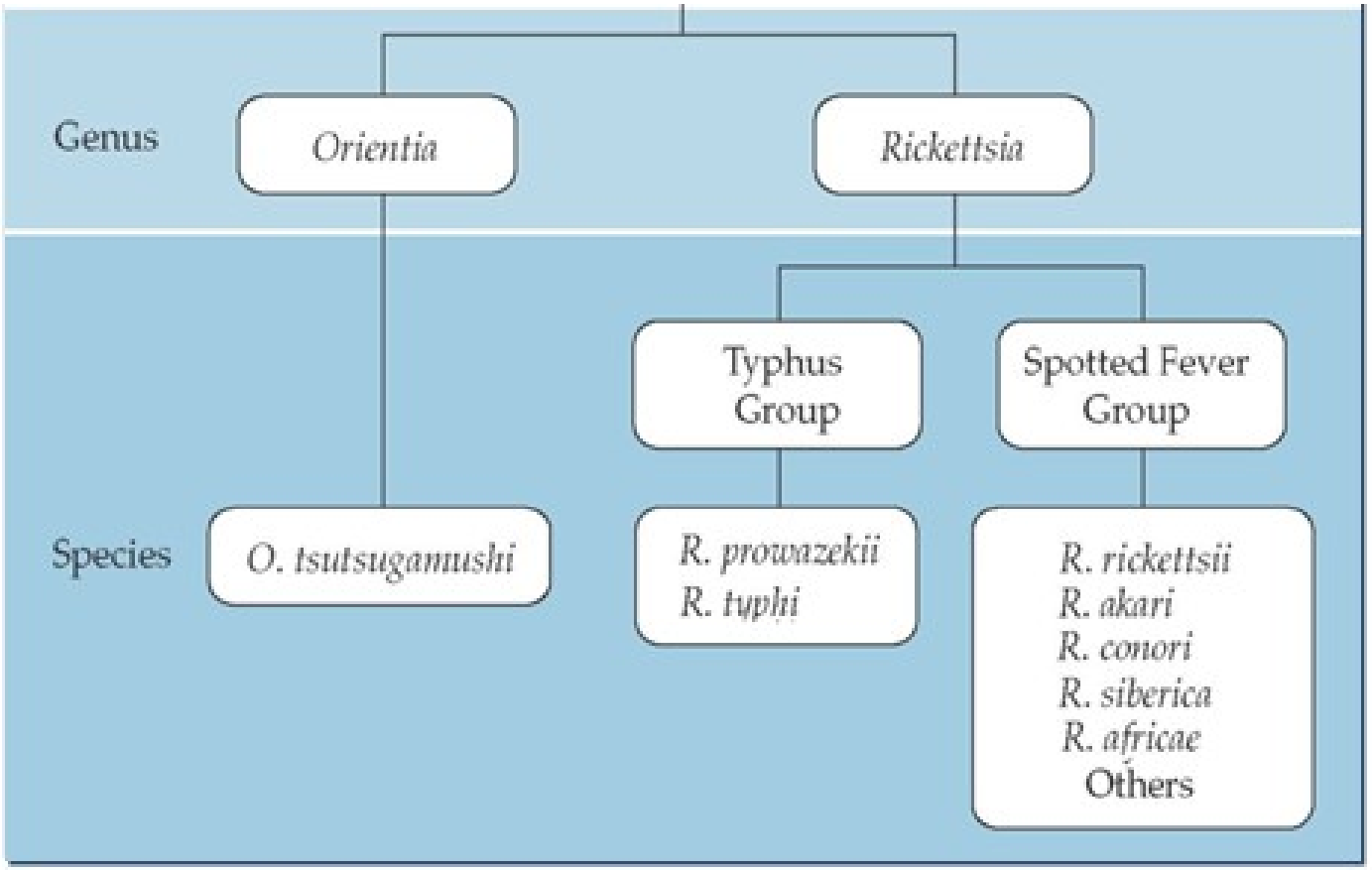
There are three main kinds of typhus.

- **Murine typhus** is passed by fleas to people if the fleas bite infected animals, mainly rats. Most U.S. cases have been reported in California, Hawaii, and Texas.
- **Epidemic typhus** is a rare variety spread by infected body lice. Very rare type of epidemic typhus can be spread by infected flying squirrels.
- **Scrub typhus** is spread by infected chiggers, or mites, mainly found in rural parts of Southeast Asia, China, Japan, India, and northern Australia.

Rickettsia

- Genus

  Rickettsia, ,Orientia, Ehrlichia, Coxiella



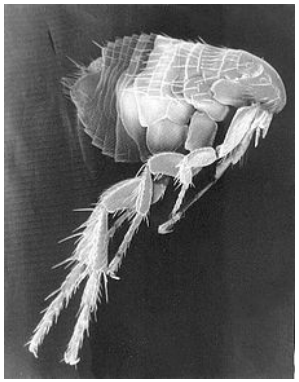
Rickettsial diseases

Disease	Organism	Arthropod vector	Mammalian reservoir
Spotted fever			
Rocky Mountain Spotted fever	*R. rickettsii*	Dog tick	Dogs, rodents, tick
Rickettsial pox	R. akari	Mite	Mice
Typhus group			
Epidemic typhus	*R. prowazeki*	Lice	Human
Endemic (urban) typhus	*R. typhi*	Flea	Rodents
Scrub typhus	*R. tsutsugamushi*	Mites	Rodents
Others			
Q fever (mainly involves lungs pneumonia and hepatitis)	*C. burnetii*	None	Cattle, sheep, goats

Vector and reservoirs

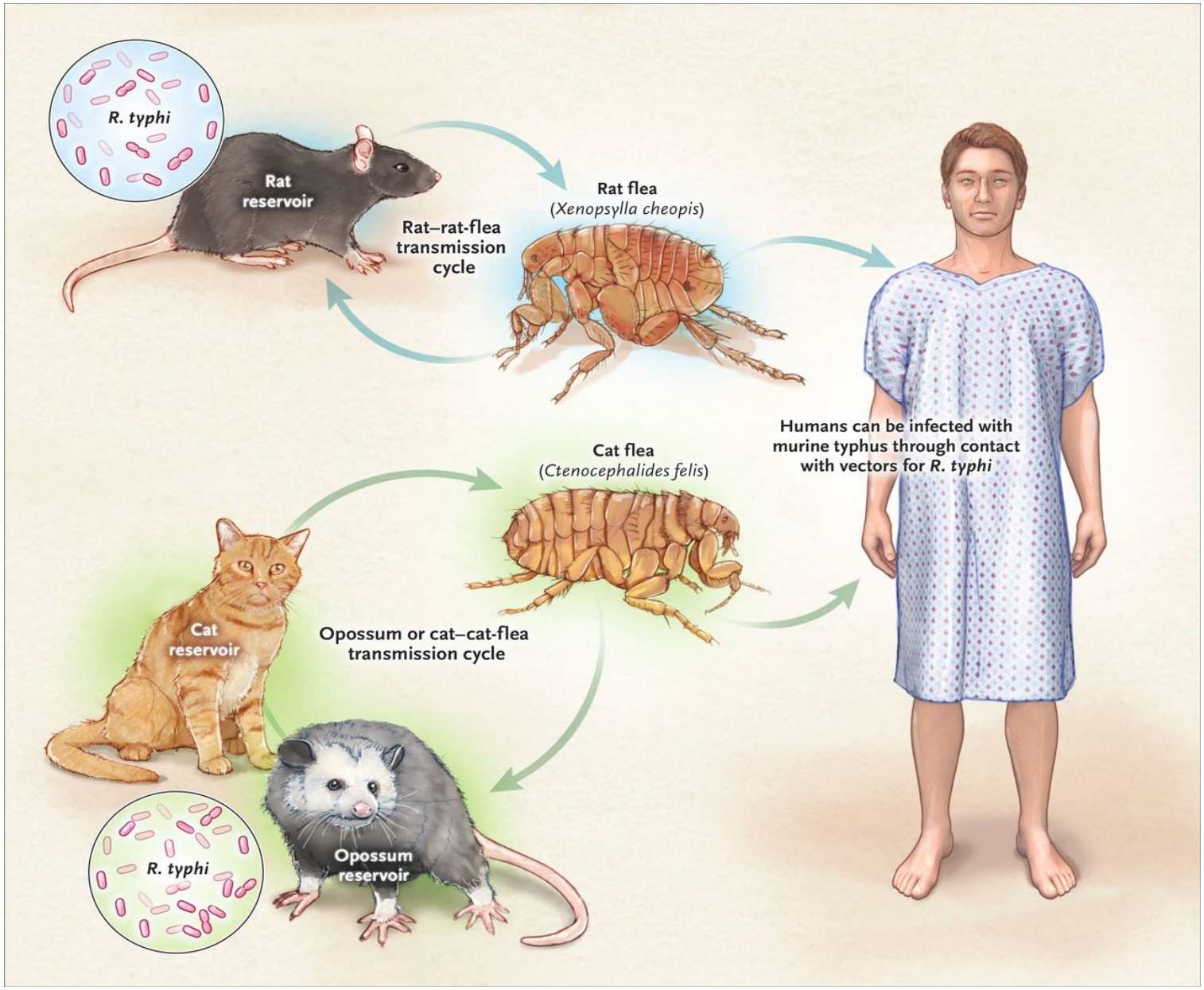
Tick	Lice	Fleas	Dust mites	chiggers

Ixodes ricinus



orthropodes & Leeches

Human is an **accidental host**, and transmits the disease via person to person contact, & through body louse


R. typhi
Rat reservoir
Rat–rat-flea transmission cycle
Rat flea
(Xenopsylla cheopis)
Humans can be infected with murine typhus through contact with vectors for R. typhi
Cat flea
(Ctenocephalides felis)
Cat reservoir
Opossum or cat–cat-flea transmission cycle
R. typhi
Opossum reservoir

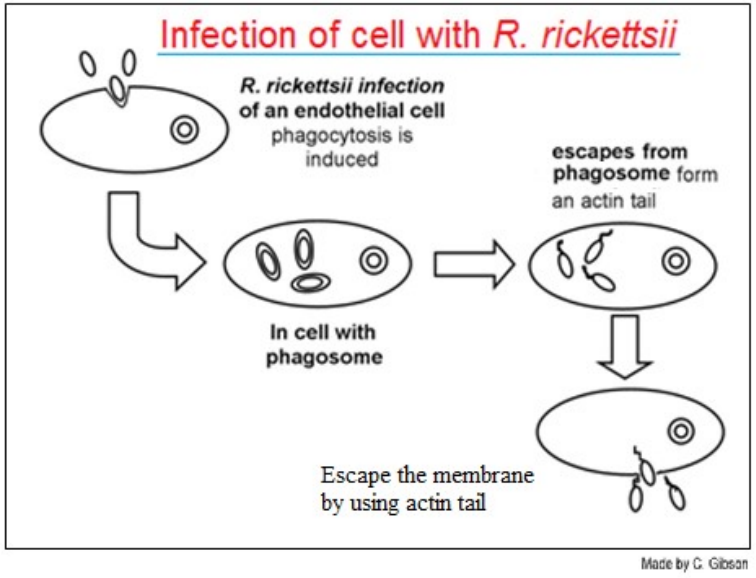
Infection occur

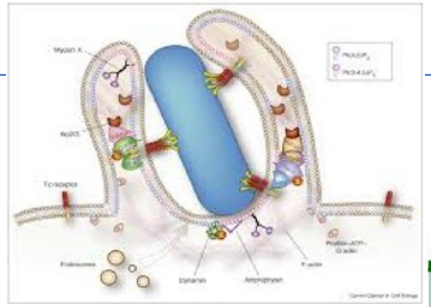
- By bite, or scratching infectious lice-feces onto the skin.
- Inhaling dust contaminated with dried feces of infected lice or flea,
- Transmission via blood transfusion is rare but has been reported during the asymptomatic incubation period.
- Typhus, spotted fever and trench fever are transmitted via arthropod vectors,
- Q fever is acquired by inhalation or ingestion of contaminated milk or food.

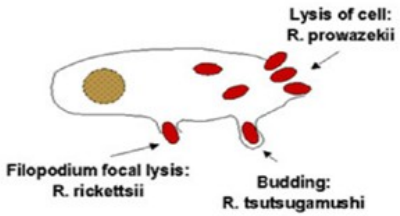
cattle, sheep, goats, cats, rabbits, birds, dogs

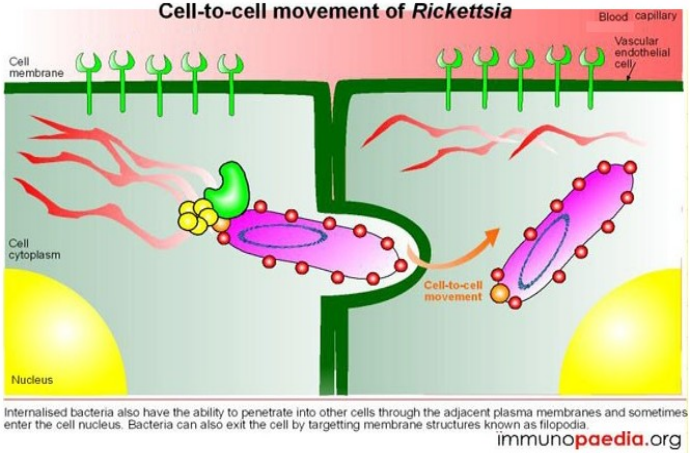
Pathogenesis

- Typically they cause vasculitis (in the endothelium), damage to skin vessels and increased capillary permeability (due to ? Endotoxin)
- Rickettsia are opsonized (with antibody) and phagocytosed macrophages
- delayed type hypersensitivity develops following rickettsial infections.









Pathogenesis

- Spread to many organs through blood and lyphatics. Invade and damage endothelial lining of capillaries, leading to vasculitis, & leaking vessels (rash, edema, hemorrhages)
- Perivascular extravasation of fluid from capillaries leads to hypoproteinemia, hypovolemia, hypoperfusion, multi organs failure and death.

H2O2

Petechial rash caused by rocky mountain spotted fe

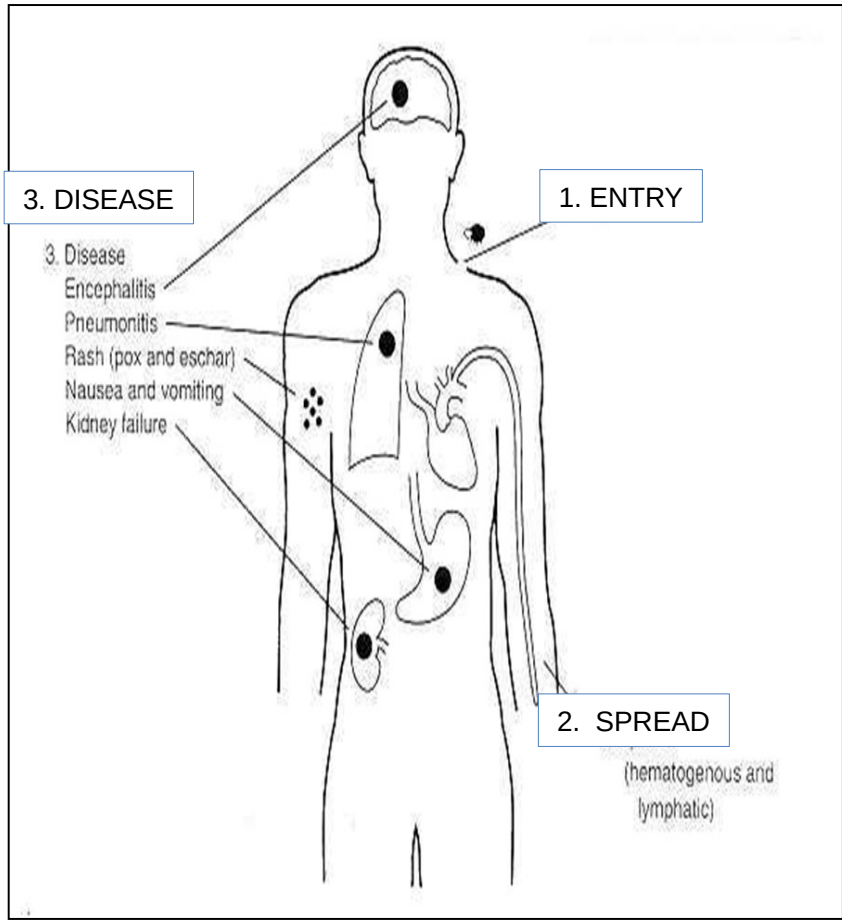
Clinical presentation

Symptoms:

headaches, shaking chills, conjunctivitis, fever (104 -105°F), anorexia, general apathy and lymphadenopathy,

Diagnostic clues:

1. rash,
2. a history of visit to endemic area,
3. bite-sore



Common clinical manifestations of the rickettsial diseases

Clinical Presentation

- The incubation period about 10-12 days (6 d to 21 d).

- Patients present with characteristic triad of symptoms: fever, headache and rash (no rash with Q fever).
  - continuous high grade fever, severe headache and body & joint pain,
  - visceral involvement; (with nausea, vomiting and abdominal pain),
  - hypotension, acute renal failure, respiratory distress and bad-cough,

Clinical Presentation

- capillaries block and bleed in severe infections,
- Splenomegaly, maculae (spot) or maculo-papular rash (Raised papules)
- Brain damage leads to mental dullness, confusion, delirium & coma,
- Death due to encephalitis, myocarditis or pneumonia

Presentation

Both humoral and cell mediated immunity are important in recovery from infection.

As of 2020, **no vaccine** is commercially available.

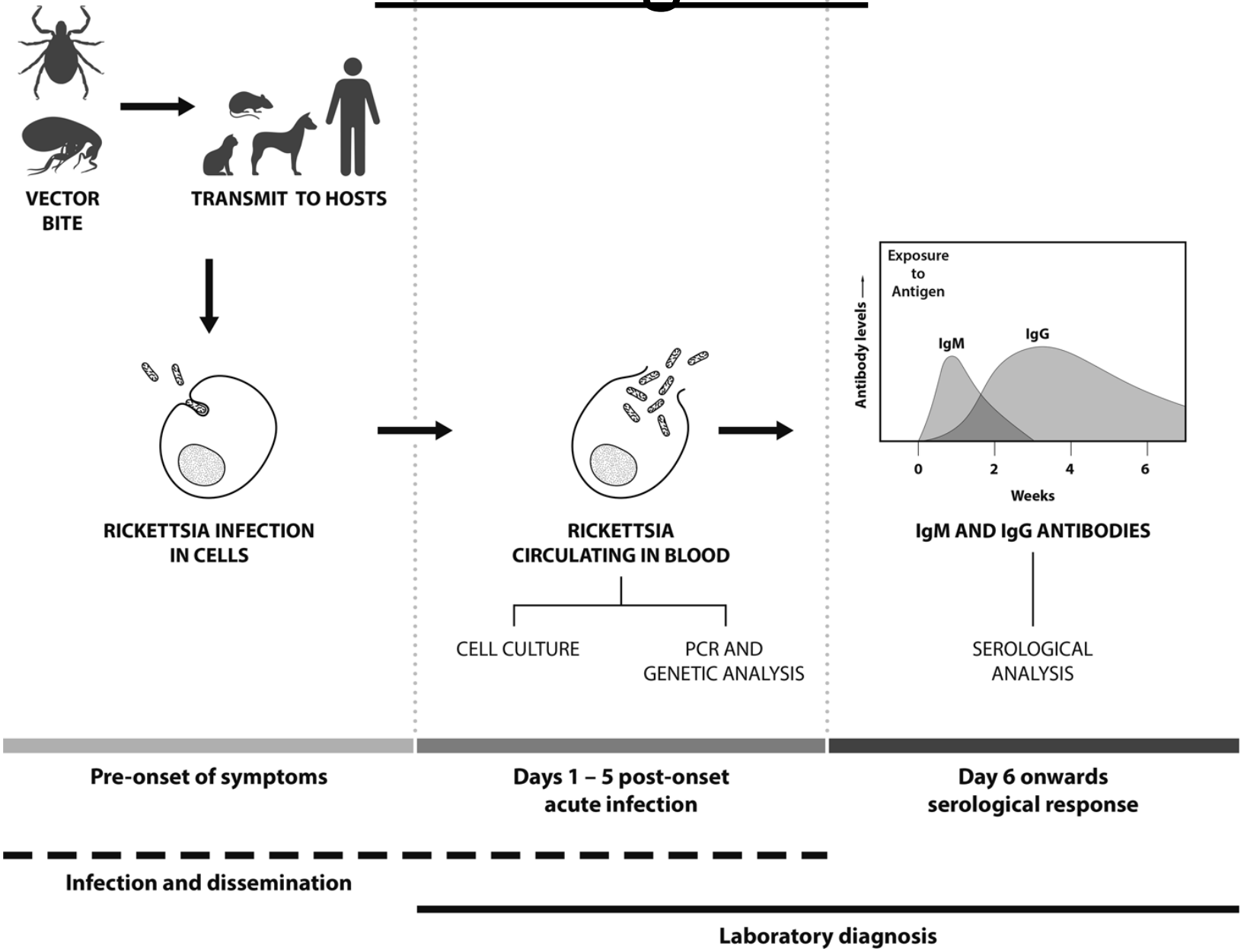
A vaccine against *R prowazekii* is available for US military during war time.

Chattopadhyay S, Richards AL (2007).
"Scrub typhus vaccines: past history and recent developments". *Human Vaccines*. **3** (3):73-80. doi:10.4161/hv.3.3.4009. PMID 17375000

Lab Diagnosis

- Serology (antibody detection),
- Histopathological examination
- Polymerase chain reaction (PCR)

Lab Diagnosis



Diagnosis

- The standard serologic test is the indirect immunofluorescence antibody **(IFA) assay** for immunoglobulin G (IgG).
- Antibody titers are frequently **negative** in the first week of illness.
- Immunoglobulin M (IgM) IFA assays are less specific and only available in some reference laboratories,
- Antibodies to *R. rickettsii* might remain elevated for many months after recovery (up to four years after the acute illness).
- 10% or more of healthy people in some areas might have elevated antibody titer due to past exposure.

Laboratory Studies

1. Test of choice are serologic tests for antibodies in serum
2. Indirect immunofluorescent antibody test is sensitive and provides results in a couple of hours.
3. Complement fixation test, ELISA, latex agglutination tests
4. PCR (on serum or eschar) may be rapid diagnostic test for scrub typhus in the early, acute stage.
5. The Weil-Felix test (poor sensitivity 33%) is used for diagnosis of scrub typhus (the antibodies in serum agglutinate certain strains of *Proteus* species (Ag). This test is not positive until the second week of illness.

No longer performed

Proteus OX2, OX19 & OXK antigen suspensions

- Prompt treatment with antibiotics cures most patients.
    - Azithromycin (one-drug therapy)
    - Doxycycline
    - Tetracycline
    - Chloramphenicol (less common)

Control

Sanitary: Arthropod and rodent control

Personal hygiene and delousing with DDT


Thank You