Chlamydia
Spirochetes
Mycoplasma, Ureaplasma
Ricketsia
Ehrlichia
Coxiella
Rochalimea

Chlamydiaceae

- **Genera: *Chlamydia* and *Chlamydophila***
- **Species: *Chlamydia trachomatis***
  Chlamydophila psittaci
  Chlamydophila pneumoniae

Organism	Historical Derivation
Chlamydia	*chlamydis,* a cloak
C. trachomatis	*trachomatis,* of trachoma or rough (the disease trachoma is characterized by rough granulations on the conjunctival surfaces that lead to chronic inflammation and blindness)
Chlamydophila	*chlamydis,* a cloak; *phila,* dear (dear to the cloak; related to *Chlamydia*)
C. pneumoniae	*pneumoniae,* pneumonia
C. psittaci	*psittacus,* a parrot (disease associated with birds)

Other species - uncommon human pathogens (not discussed)

Chlamydiaceae

- **obligate intracellular parasites**
- small (like viruses)

Properties of bacteria:

- (1) possess inner and outer membranes
  (similar to G- bacteria)
- (2) contain both DNA and RNA
- (3) prokaryotic ribosomes
- (4) synthesize proteins, nucleic acids, and
  lipids
- (5) susceptible to antibacterial antibiotics

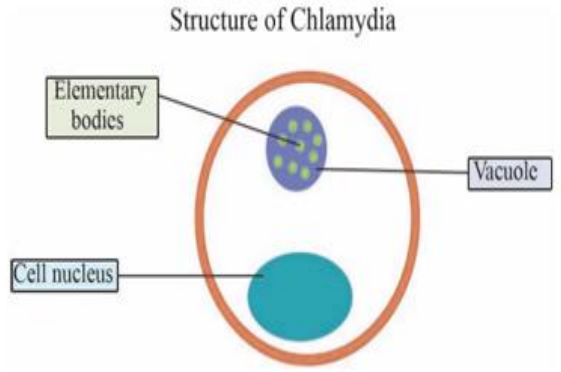
- coccoid-shaped
- non-motile
- absence of biosynthetic and energy metabolism
- unable to produce ATP
- parasitic life cycle

Chlamydiaceae

- unique developmental cycle

- metabolically inactive infectious forms **(elementary bodies [EBs])**

- metabolically active noninfectious forms **(reticulate bodies [RBs])**



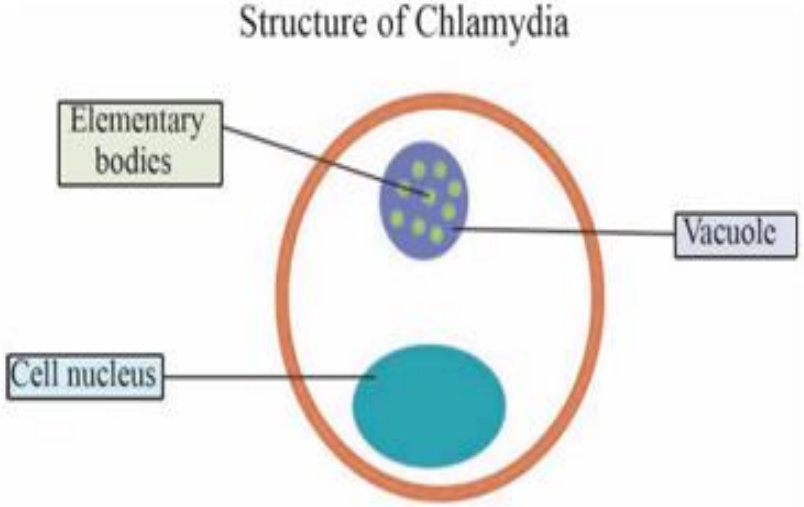
https://www.chegg.com/learn/biology/introduction-to-biology/chlamydia-in-bacteria

Property	*Chlamydia trachomatis*	*Chlamydophila pneumoniae*	*Chlamydophila psittaci*
Host range	Primarily human pathogen	Primarily human pathogen	Primarily animal pathogen; occasionally infects humans
Biovars	LGV and trachoma	TWAR	Many
Diseases	LGV; ocular trachoma, oculogenital disease, infant pneumonia	Bronchitis, pneumonia, sinusitis, pharyngitis, coronary artery disease (?)	Pneumonia (psittacosis)
Elementary body morphology	Round, narrow periplasmic space	Pear-shaped, large periplasmic space	Round, narrow periplasmic space
Inclusion body morphology	Single round inclusion per cell	Multiple uniform inclusions per cell	Multiple variably sized inclusions per cell
Plasmid DNA	Yes	No	Yes
Iodine-staining glycogen in inclusions	Yes	No	No
Susceptibility to sulfonamides	Yes	No	No

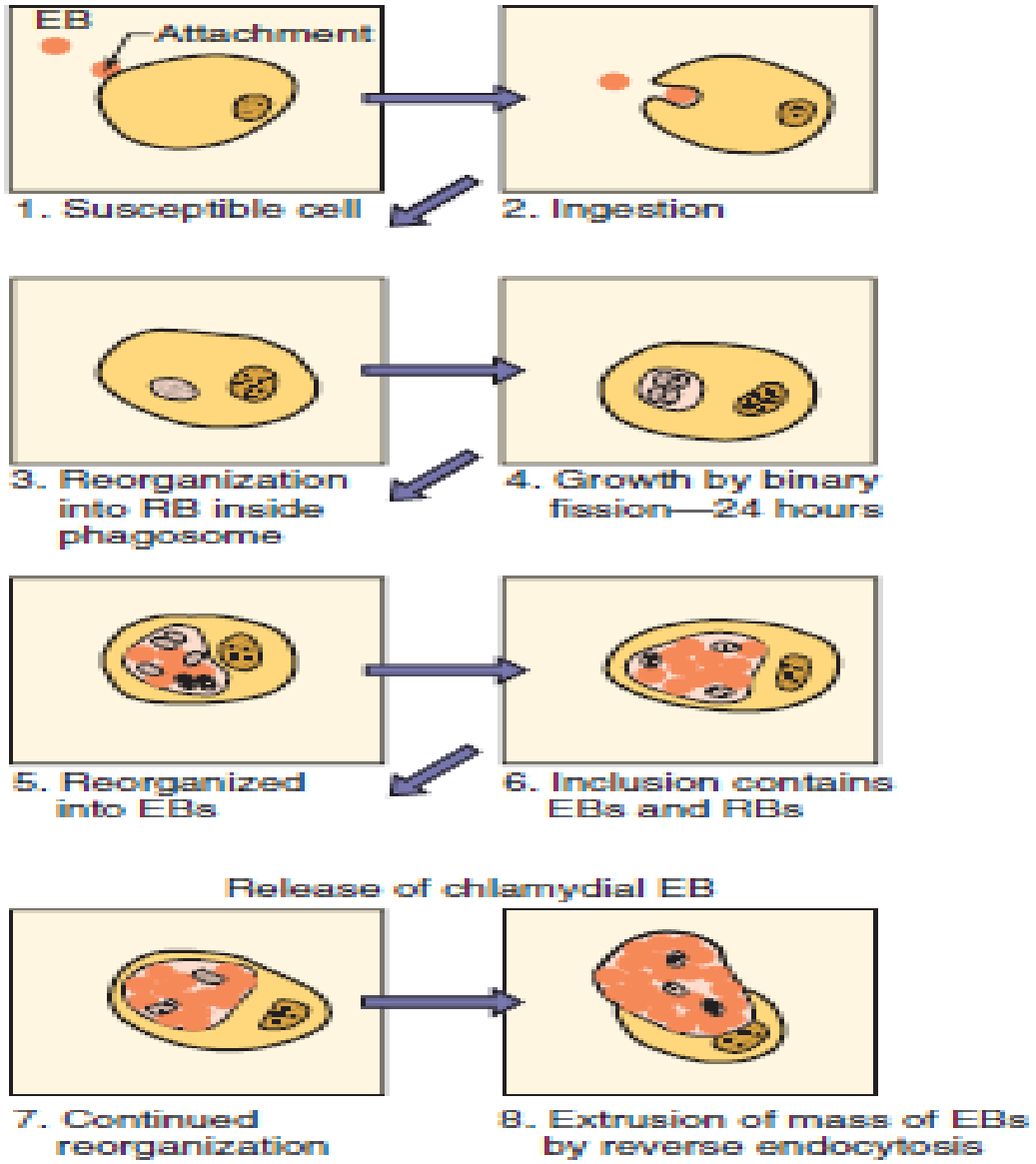
DNA, Deoxyribonucleic acid; *LGV*, lymphogranuloma venereum.

Chlamydiaceae – Structure and Physiology

- EBs - resistant to environmental factors
- EBs - central dense core
- cytoplasmic membrane
- double-layer outer membrane
- cell wall
- **lipopolysaccharide (LPS) - weak endotoxin activity**
- **major outer membrane protein (MOMP)** in the cell wall, structural component of the outer membrane, unique for each species
- *C. trachomatis, C. psittaci* - many serologic variants (called **serovars**)
- *C. pneumoniae* - only single serovar
- **OMP 2 -** all members, provides the stability in the EBs.



Chlamydiaceae – life cycle



- **unique growth cycle** - within susceptible host cells
- **energy parasites** because they use host cell adenosine triphosphate for their energy requirements
- **EBs** - cannot replicate, are infectious- can bind to receptors on host cells – stimulate uptake by the infected cell
- bacteria remain within cytoplasmic phagosomes
- Within 6 to 8 hours - EBs reorganize into metabolically active RBs
- **RBs** - replicate - binary fission - phagosome with accumulated RBs -**inclusion**
- 18 to 24 hours - RBs reorganize into EBs
- 48 - 72 hours - host cell ruptures - releases bacteria.
- RBs - metabolically active replicating chlamydial form

Chlamydia trachomatis

- two **biovars:**
- **trachoma**
- **lymphogranuloma venereum (LGV)**
- biovars - divided into **serovars** (acc. to Ag diff.)

Serovars	Disease
A, B, Ba, C	Trachoma
D-K	Urogenital tract disease
L1, L2, L2a, L2b, L3	Lymphogranuloma venereum

- Limited range of cells can be infected
  - urethra, endocervix, endometrium, fallopian tubes, anorectum, respiratory tract, conjunctivae
- (1) the direct destruction of cells during replication and
- (2) the proinflammatory cytokine response
- access – abrasions, lacerations
- inflammatory response - neutrophils, lymphocytes, plasma cells
- Infection - not confer long-lasting immunity - reinfection

Chlamydia trachomatis – clinical diseases

Trachoma

- **(serovars A, B, Ba, C)**
- **chronic disease**
- initially - **follicular conjunctivitis**
- diffuse inflammation, scarred conjunctiva,eyelids to turn inward, corneal ulceration, pannus formation (invasion of vessels into the cornea)
- loss of vision

Chlamydia trachomatis – clinical diseases

Adult Inclusion Conjunctivitis

- (serovars A, B, Ba, D to K)
- sexually active adults
- mucopurulent discharge, keratitis, corneal infiltrates,
- corneal scarring - in chronic infection

- **Neonatal Conjunctivitis**
- **infants exposed to *C. trachomatis* at birth**
- after 5 to 12 days, the infant's eyelids swell, hyperemia, purulent discharge
- untreated – infection lasts 12 months -risk for *C. trachomatis* pneumonia
- conjunctival scarring, corneal vascularization

Chlamydia trachomatis – urogenital infections

Women

- asymptomatic (70-80%)
- bartholinitis, cervicitis, endometritis, perihepatitis, salpingitis, urethritis
- symptomatic infection - mucopurulent discharge
- urethritis -with or without cervical infection

Men

- symptomatic (75%)
- dual infections *C. trachomatis* and *Neisseria gonorrhoeae*
- urethral infection – purulent discharge
- specific diagnostic tests - both organisms

Reiter syndrome (urethritis, conjunctivitis, polyarthritis, and mucocutaneous lesions

› initiated by genital infection with *C. trachomatis*.

› chlamydial EBs - in synovial fluid, tissue

› Infection - young white men

› more than 80% of men with Reiter syndrome - preceding /concurrent infection with *C. trachomatis*.

C. trachomatis – Lymphogranuloma venereum

- *C. trachomatis* serotypes L1, L2, L2a, L2b, and L3
- **incubation** - 1 to 4 weeks – small, painles primary lesion (penis, urethra, glans, scrotum, vaginal wall, cervix, vulva)
- **second stage** – inflammation, swelling of lymph nodes - painful, **buboes** – enlarged, rupture
- **systemic manifestations** - fever, chills, anorexia, headache, meningismus, myalgias, arthralgia
- **Proctitis** - **women** - lymphatic spread from cervix or vagina

  - **men** - anal intercourse or lymphatic spread from the urethra

C. trachomatis – laboratory diagnosis

- (1) cytologic, serologic, culture
- (2) direct detection of antigen in clinical specimens
- (3) nucleic acid–based tests

C. trachomatis – laboratory diagnosis

- (1) cell culture

- the most **specific**
- **relatively insensitive**
- restricted range of cell lines in vitro
- sensitivity of the findings by endocervical specimen - 70% to 85%

C. trachomatis – laboratory diagnosis

- (1) serologic

Antibody Detection
- limited value
- test cannot differentiate between current and past infections
- significant increase in antibody levels - may not be demonstrated for a month or longer, particularly in patients who receive antibiotic treatment
- (Ig)M antibodies - may not be detected in adolescents and adults (exception - IgM antibodies in infants with chlamydial pneumonitis)

Antibody tests - LGV - antibody response - complement fixation (CF), microimmunofluorescence (MIF), enzyme immunoassay (EIA)

C. trachomatis – laboratory diagnosis

- **(2) direct detection of antigen in clinical specimens**

- **direct immunofluorescence staining**
- **enzyme-linked immunosorbent assays**
- antibodies - against chlamydial MOMP or cell wall LPS
- antigenic determinants on LPS - may be shared with other bacteria - tests are less specific
- sensitivity - neither is considered as sensitive as culture or nucleic acid–based tests

C. trachomatis – laboratory diagnosis

- (3) nucleic acid–based tests

- test of choice
- 90% to 98% sensitive and very specific
- urine, urethral discharge
- !!! prevent cross-contamination of specimens

C. trachomatis – treatment, prevention, control

- LGV - **doxycycline** - 21 days
- children younger than 9 years, pregnant women, patients unable to tolerate doxycycline – **erythromycin**
- ocular, genital infections (adults) - **azithromycin** or **doxycycline** - 7 days
- newborn conjunctivitis and pneumonia - **erythromycin** - 10 to 14 days

- trachoma prevention - difficult - endemic disease -limited access to medical care
- blindness -prompt treatment
- difficult to eradicate
- *Chlamydia* conjunctivitis, genital infections - safe sex practices, prompt treatment of symptomatic patients, sexual partners

Chlamydophila pneumoniae

- **human pathogen**
- sinusitis, pharyngitis, bronchitis, pneumonia
- person to person - respiratory secretions
- **asymptomatic,mild** - persistent cough and malaise
- **severe respiratory tract infections** - involve single lobe of the lungs

  - cannot be differentiated from other atypical pneumonias (caused by *Mycoplasma pneumoniae, Legionella pneumophila,* respiratory viruses)

C. pneumoniae – laboratory diagnosis, treatment

- difficult
- do not grow in the cell lines used for the isolation of *C. trachomatis*
- grow in the HEp-2 cell line - not used in most clinical laboratories.
- detection by NAATs - significant interlaboratory variation
- MIF test - only acceptable test for serodiagnosis

Criteria for the diagnosis of **acute infection**

- single IgM titer of greater than 16

  or

- fourfold increase in IgG titer
- IgG antibodies - do not appear for 6 to 8 weeks after infection – limited value

Treatment:
Macrolides:
(erythromycin, azithromycin, clarithromycin)
Doxycycline
Levofloxacin

Chlamydophila psittaci

- psittacosis (parrot fever) -transmitted to humans
- respiratory tract
- spread to reticuloendothelial cells- liver, spleen – multiplication - focal necrosis
- hematogenous spread - lymphocytic inflammatory response in the alveolar and interstitial spaces
- edema, thickening of the alveolar wall, infiltration of macrophages, necrosis, occasionally hemorrhage
- mucous plugs - in bronchioles - cyanosis and anoxia

C. psittaci – laboratory diagnosis, treatment

- **serologic**
  - fourfold increase in Ab titer
  - CF , species-specific MIF test - confirm diagnosis
- **cell culture** - 5 to 10 days of incubation
  - rarely performed

- **doxycycline, macrolides**
- **prevention** - control of infections in domestic and imported pet birds
- birds - chlortetracycline hydrochloride - 45 days
- vaccine - not available

Mycoplasma and *Ureaplasma*

- order Mycoplasmatales

Clinically significant genera:

- *Mycoplasma* (124 species)
- *Ureaplasma* (7 species)

Important species:

- ***Mycoplasma pneumoniae*** **(Eaton agent)**
- *Mycoplasma genitalium*
- *Mycoplasma hominis*
- ***Ureaplasma urealyticum***

Organism	Site	Human Disease
Mycoplasma pneumoniae	Respiratory tract	Tracheobronchitis, pharyngitis, pneumonia, secondary complications (neurologic, pericarditis, hemolytic anemia, arthritis, mucocutaneous lesions)
Mycoplasma genitalium	Genitourinary tract	Nongonococcal urethritis, pelvic inflammatory disease
Mycoplasma hominis	Respiratory tract, genitourinary tract	Pyelonephritis, postpartum fever, systemic infections in immunocompromised patients
Ureaplasma urealyticum	Respiratory tract, genitourinary tract	Nongonococcal urethritis, pyelonephritis, spontaneous abortion, premature birth

Mycoplasma, Ureaplasma- characteristics

- **smallest free-living bacteria**
- **do not have a cell wall**
- cell membrane contains **sterols**
- absence of the cell wall
  - **resistant** to antibiotics that interfere with **synthesis of the cell wall** (penicillins, cephalosporins, vancomycin, and other)

- pleomorphic - coccoid forms to rods
- divide by binary fission
- grow on artificial cell-free media
- contain ribonucleic acid (RNA) and deoxyribonucleic acid (DNA).
- facultatively anaerobic - (except *M. pneumoniae,* which is a **strict aerobe**)
- require exogenous sterols - animal serum added to the growth medium
- **grow slowly -** form small colonies, extended incubation

Mycoplasma – pathogenesis, immunity

- *M. pneumoniae*
- extracellular pathogen
- adheres to the respiratory epithelium - attachment - **P1 adhesin** - interacts with cilia (and erythrocytes) - ciliostasis
- loss of normal clearance -bacteria spread - lower respiratory tract
- persistent cough

M. pneumoniae:

- Superantigen
- Stimulation of inflammatory cells
- migrate to the site of infection
- release cytokines(TNF-α , IL-1, IL-6

Mycoplasma sp.:

- change expression of surface lipoproteins
- evading host immune response
- establishing persistent or chronic infections

Mycoplasma – clinical diseases

M. pneumoniae

- colonizes nose, throat, trachea, lower airways
- spread - large respiratory droplets
- **asymptomatic carriage**
- **Tracheobronchitis** (low-grade fever, malaise, headache, dry, nonproductive cough)
- Acute **pharyngitis**
- Pneumonia (primary **atypical pneumonia**)
- Secondary complications - neurologic abnormalities (meningoencephalitis, paralysis, myelitis), pericarditis

Mycoplasma – laboratory diagnosis

Test	Assessment
Microscopy	Test is not useful because organisms do not have a cell wall and do not stain with conventional reagents
Culture	Test is slow (2 to 6 weeks before positive diagnosis) and insensitive; it is not available in most laboratories
Molecular diagnosis	Polymerase chain reaction–based amplification assays, with excellent sensitivity; specificity is not well defined
Serology	
Complement fixation	Antibody titers versus glycolipid antigens peak in 4 weeks and persist for 6 to 12 months; poor sensitivity and specificity; rarely used today
Enzyme immunoassays	Multiple assays available, with varying sensitivity and specificity; assays directed versus P1 adhesin protein may be most specific
Cold agglutinin	Sensitivity and specificity poor, with cross-reactions with other respiratory pathogens (e.g., Epstein-Barr virus, cytomegalovirus, adenovirus); test commonly used but not recommended

Mycoplasma – treatment, prevention , control

M. pneumoniae:

- Erythromycin
- Tetracyclines
- Fluoroquinolones

M. hominis :

- Clindamycin (resistant to erythromycin and tetracyclines)

- *M. hominis, M. genitalium,* and *Ureaplasma*
- transmitted by sexual contact
- prevention - protected sexual activity

Ureaplasma

Organism	Site	Human Disease
Mycoplasma pneumoniae	Respiratory tract	Tracheobronchitis, pharyngitis, pneumonia, secondary complications (neurologic, pericarditis, hemolytic anemia, arthritis, mucocutaneous lesions)
Mycoplasma genitalium	Genitourinary tract	Nongonococcal urethritis, pelvic inflammatory disease
Mycoplasma hominis	Respiratory tract, genitourinary tract	Pyelonephritis, postpartum fever, systemic infections in immunocompromised patients
Ureaplasma urealyticum	Respiratory tract, genitourinary tract	Nongonococcal urethritis, pyelonephritis, spontaneous abortion, premature birth

- 45% - 75% sexually active men and women - colonized with *Ureaplasma*
- requires urea for growth
- Erythromycin (resistant to tetracyclin)
- prevention - protected sexual activity

Order: Spirochaetales

- common morphologic properties
  - thin, helical (0.1 to 0.5 × 5 to 20 µm)
  - gram-negative bacteria

Spirochaetales	Human Disease	Etiologic Agent
Family Spirochaetaceae		
Genus *Borrelia*	Epidemic relapsing fever	*B. recurrentis*
	Endemic relapsing fever	Many *Borrelia* species
	Lyme borreliosis	*B. burgdorferi, B. garinii, B. afzelii*
Genus *Treponema*	Venereal syphilis	*T. pallidum* subsp. *pallidum*
	Endemic syphilis (bejel)	*T. pallidum* subsp. *endemicum*
	Yaws	*T. pallidum* subsp. *pertenue*
Family Leptospiraceae		
Genus *Leptospira*	Leptospirosis	*Leptospira* spp.

Genus *Borrelia* - characteristics

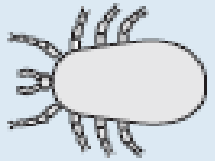
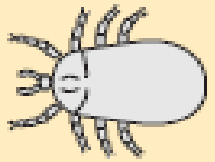
- neither gram-positive nor gram-negative (but outer membrane similar to gram-negative)
- aniline dyes (Giemsa or Wright stain)
- microaerophilic
- difficult to grow - complex nutritional needs
- Serology – Lyme disease
- Microscopy – relapsing fever

Genus *Borrelia*

Borrelia burgdorferi

Borrelia recurrentis

Other Borreliae

Infection	Reservoir	Vector
Relapsing fever epidemic (louse-borne)	Humans	Body louse 
Relapsing fever endemic (tick-borne)	Rodents, soft ticks	Soft tick 
Lyme disease	Rodents, deer, domestic pets, hard ticks	Hard tick 

B. burgdorferi – Lyme disease

Clinical Case Definition

Either of the Following:

Erythema migrans (≈5 cm in diameter)

At least one late manifestation (i.e., musculoskeletal, nervous system, or cardiovascular involvement) and laboratory confirmation of infection

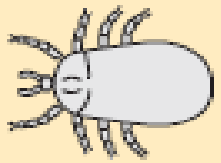
Laboratory Criteria for Diagnosis

At Least One of the Following:

Isolation of *Borrelia burgdorferi*

Demonstration of diagnostic levels of immunoglobulin (Ig)M or IgG antibodies to the spirochetes

Significant increase in antibody titer between acute and convalescent serum samples

Lyme disease	Rodents, deer, domestic pets, hard ticks	Hard tick 

- Hematogenous dissemination - systemic signs

untreated Lyme disease:

- **arthritis**
- **neurologic manifestations**
- **cardiac complications**
- **acrodermatitis chronica atrophicans –** skin discoloration, swelling

Diagnosis:

Serology - **immunofluorescence assay (IFA)** and **EIA**

- IgM - 2 to 4 weeks after the onset of erythema
- IgG antibodies - after 4 to 6 months of illness - persist during late manifestations

Therapy:

- orally administered **amoxicillin, doxycycline, cefuroxime**

Borrelia recurentis

- **Relapsing fever**
- recurrent episodes of fever and septicemia separated by afebrile periods
- **two forms :**

Borrelia recurrentis:

- **epidemic relapsing fever- (louse-borne)** (*Pediculus humanus)*

other species of borreliae:

- **endemic relapsing fever** (**soft ticks -** *Ornithodoros*)

Infection	Reservoir	Vector
Relapsing fever epidemic (louse-borne)	Humans	Body louse 
Relapsing fever endemic (tick-borne)	Rodents, soft ticks	Soft tick 

- mechanisms – not fully understood
- Bacteria do not produce recognized toxins
- Bacteria removed rapidly by specific antibody response
- periodic febrile and afebrile cycles - ability of the borreliae to undergo antigenic variation
- specific antibodies - agglutination with complement-mediated lysis of bacteria

but

- Bacteria - switching of the gene - new population of spirochetes
- antigenic shifts - serology tests - not used for **relapsing fever**
- **clinical presentations of epidemic louse-borne and endemic tick-borne relapsing fever are essentially the same**
- **Microscopy, cultivation**
- **Tetracyclines, penicillins**

Genus Treponema

Treponema	*trepo*, turn; *nema*, a thread (a turning thread; refers to the morphology of the bacteria)
T. pallidum	*pallidum*, pale (refers to the fact that these organisms are not stained with traditional dyes)

Genus *Treponema*	Venereal syphilis	*T. pallidum* subsp. *pallidum*
	Endemic syphilis (bejel)	*T. pallidum* subsp. *endemicum*
	Yaws	*T. pallidum* subsp. *pertenue*

Genus Treponema – physiology, structure

***T. pallidum* and related pathogenic treponemes:**

- thin, tightly coiled spirochetes (0.1 to 0.2 × 6 to 20 µm

Microscopy and culture:

- too thin to be seen in light microscope
- do not grow in cell-free cultures
- limited growth - in rabbit epithelial cells

- **inability to grow** - limited detection of specific virulence factors in this organism.
- **lipoproteins** - anchored in the bacterial cytoplasmic membrane - not exposed on outer membrane
- treponema - evade the immune system
- able to **resist phagocytosis**
- **adhere to host fibronectin** - direct interaction with the host tissues
- **destruction** and **lesions** in syphilis - consequence of the patient's immune response

Syphilis

T. pallidum subspecies *pallidum* (referred to as *T. pallidum)*

- ***3 stages***

1. ***primary*** – 10 to 90 days after the initial infection - **painless ulcer, chancres (skin lesions),** *lymphadenopathy* - **infectious**

2. ***secondary*** - disseminated disease -skin lesions dispersed over the entire body surface - flu like symptoms, lymphadenopathy, condylomata lata - **infectious**

- spontaneous remission, or latent or clinically inactive stage, or progress to the **late phase**

3. **tertiary** - one third of untreated patients - develops after an asymptomatic period of a few years to decades - devastating destruction of any organ or tissue (e.g., arteritis, dementia, blindness) - granulomatous lesions **(gummas)** - bone, skin, other tissues - neurosyphilis, cardiovascular syphilis

CONGENITAL syphilis

- in utero infection - latent infections, multiorgan malformations, or death of the fetus
- teeth and bone malformation, blindness, deafness, and cardiovascular syphilis - untreated infants

Syphilis – laboratory diagnosis

Diagnostic Test	Method or Examination
Microscopy	Darkfield
	Direct fluorescent antibody staining
Culture	Not available
Serology	Nontreponemal tests: Venereal Disease Research Laboratory (VDRL) test Rapid plasma reagin (RPR) test Unheated serum reagin (USR) test Toluidine red unheated serum test (TRUST)
	Treponemal tests: Fluorescent treponemal antibody-absorption (FTA-ABS) *Treponema pallidum* particle agglutination (TP-PA) test Enzyme immunoassay (EIA)

Syphilis - Treatment and control

- penicillin
- single intramuscular dose of long-acting benzathine **penicillin G** - early stages of syphilis
- three doses - weekly intervals - congenital and late syphilis
- **Doxycycline** or **azithromycin -** alternative (allergy to penicillin)
- only penicillin - treatment of neurosyphilis, pregnant women
- vaccines - not available
- safe-sex techniques
- adequate contact
- treatment of sex partners
- control of syphilis -complicated - prostitution among drug abusers, high-risk sexual practices (homosexual males)

Leptospira - Physiology and Structure

- **thin, coiled spirochetes** (0.1 × 6.0 to 20.0 µm)
- hook at one or both pointed ends
- two periplasmic flagella anchored at opposite ends
- obligate aerobes
- optimum growth at 28° C to 30° C
- media supplemented with vitamins, long-chain fatty acids, and ammonium salts

Leptospira – pathogenesis and immunity

- thin and highly motile bacteria
- **penetrate intact mucous membranes or skin through small cuts or abrasions**
- spread in the blood to all tissues
- *L. interrogans* - damages endothelium of small blood vessels- meningitis, hepatic and renal dysfunction, hemorrhage
- **Bacteria found in blood and CSF early in the disease and in urine during the later stages.**

- Clearance of leptospires - humoral immunity
- Some clinical manifestations - from immunologic reactions
- meningitis develops - after organisms have been removed from the CSF
- immune complexes - renal lesions

Leptospira – clinical diseases

- **reservoirs – rodents, small mammals -** asymptomatic infections - spirochetes colonize renal tubules - shed in urine
- Contaminated water, direct exposure - source for infection in **incidental hosts** (e.g., dogs, farm animals, rodents, humans).

- subclinical infection
- mild influenza-like febrile illness
- severe systemic disease **(Weil disease)** - renal and hepatic failure, extensive vasculitis, myocarditis, death

Leptospira – laboratory diagnosis, treatment

- Microscopy – cannot be seen
- Culture – special media
- Nucleic Acid–Based Tests PCR
- **Antibody detection:**

- **microscopic agglutination test (MAT)**

- indirect hemagglutination, slide agglutination, ELISA - less sensitive and specific

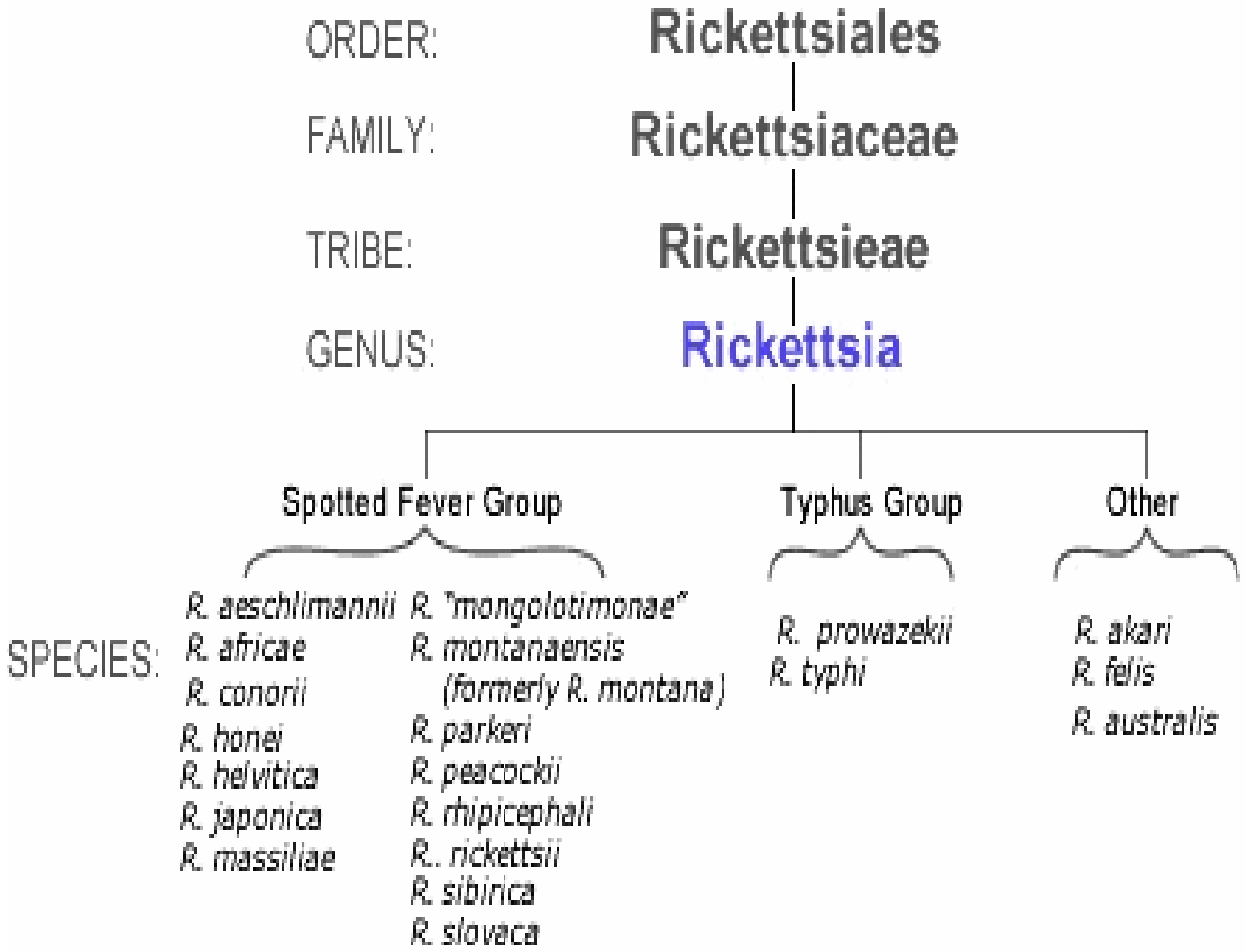
- intravenously – pe**nicillin, doxycycline**
- Doxycycline- used to prevent disease
- difficult to eradicate leptospirosis
- vaccination of livestock and pets
  - reduced incidence

RICKETTSIA, EHRLICHIA, COXIELLA AND RELATED BACTERIA

- historically classified - family Rickettsiaceae
- obligate aerobic, intracellular, gram-negative rods
- Now - three separate families
- Rickettsiaceae - genera ***Rickettsia*** and ***Orientia***
- Anaplasmataceae - genera ***Ehrlichia*** and ***Anaplasma***
- Coxiellaceae -genus **Coxiella**

FAMILY	**Coxiellaceae**
GENUS	***Coxiella***
SPECIES	***Coxiella burnetii***

Rickettsia



https://textbookofbacteriology.net/Rickettsia.html

drug of choice - rickettsial infections - **doxycycline**

- **1. Spotted Fever Group (SFG) -** *Rickettsia rickettsii* - **Rocky Mountain spotted fever (RMSF)** – America - bite of infected ticks
- **2. Typhus group -** *R. prowazekii* - **epidemic (louse-borne) typhus** South America, Africa, **- human body louse -** *Pediculus humanus*.
- **3. Scrub typhus group -** *Orientia (Rickettsia) tsutsugamushi* - **scrub typhus**- Asia, Australia - bite of trombiculid mites (chiggers)

Ehrlichia

- *Ehrlichia chaffeensis:* **human monocytic ehrlichiosis (high fever,** headache, malaise, **rash, leukopenia, thrombocytopenia, elevated serum transaminases)**

- *Ehrlichia ewingii:* **human granulocytic ehrlichiosis (high fever,** headache, malaise, **rash, leukopenia, thrombocytopenia, elevated serum transaminases)**

- *Anaplasma phagocytophilum:* **human granulocytic anaplasmosis (**granulocytes - neutrophils, eosinophils, basophils- are primarily infected, flulike illness, high fever, headache, malaise, myalgias, rash is less common)

Coxiella

- *C. burnetii*
- **asymptomatic infection**
- **flulike symptoms**
- less than 5% - **hepatitis, pneumonia, fever**
- **Q fever (symptoms lasting >6 months**) - months to years after initial exposure (in patients with valvular heart disease, immunosuppression)

  - subacute endocarditis

SOURCES

- Patrick R. Murray, PhD, Ken S. Rosenthal, PhD and Michael A. Pfaller, MD ***Medical Microbiology, 8th Edition,*** ISBN: 9780323359528, Copyright: 2016, Page Count: 888, Elsevier

- https://www.mayoclinic.org/diseases-conditions/rocky-mountain-spotted-fever/symptoms-causes/syc-20361032
- https://www.medicinenet.com/typhus/article.htm