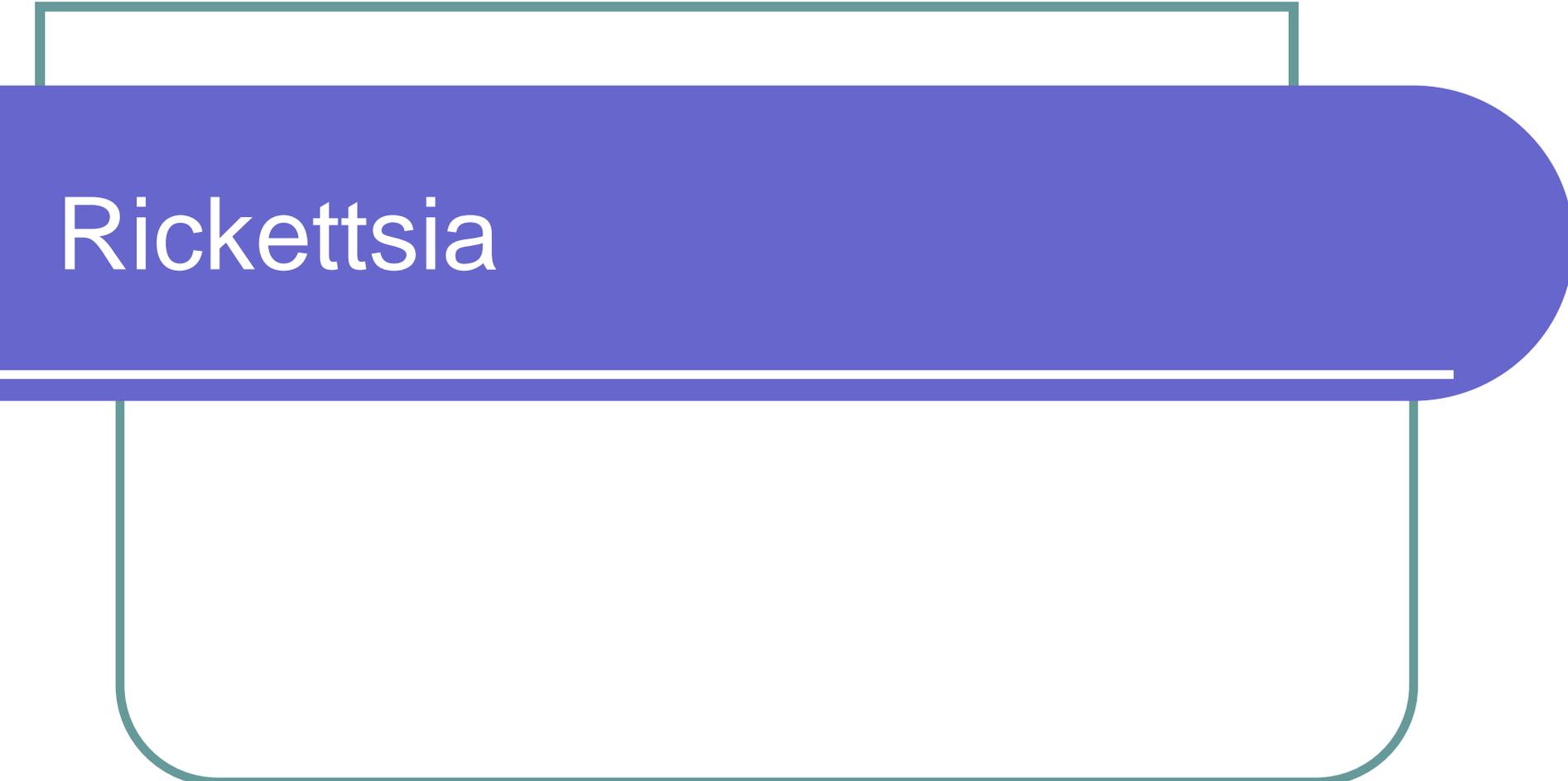


Rickettsia, Chlamydia,

Everything else to the end.....



Rickettsia

Rickettsia

- Morphology and cultural characteristics
 - Obligate intracellular parasites (can grow in both phagocytic and nonphagocytic cells.)
 - In lab grown in embryonated eggs or tissue culture
 - Cultivation is costly and hazardous because aerosol transmission can easily occur
 - Small, pleomorphic coccobacilli
 - Gram stain poorly, but appear to be Gram -Ve
 - Stain readily with Giemsa
 - Transmitted by arthropod vectors(Bugs).

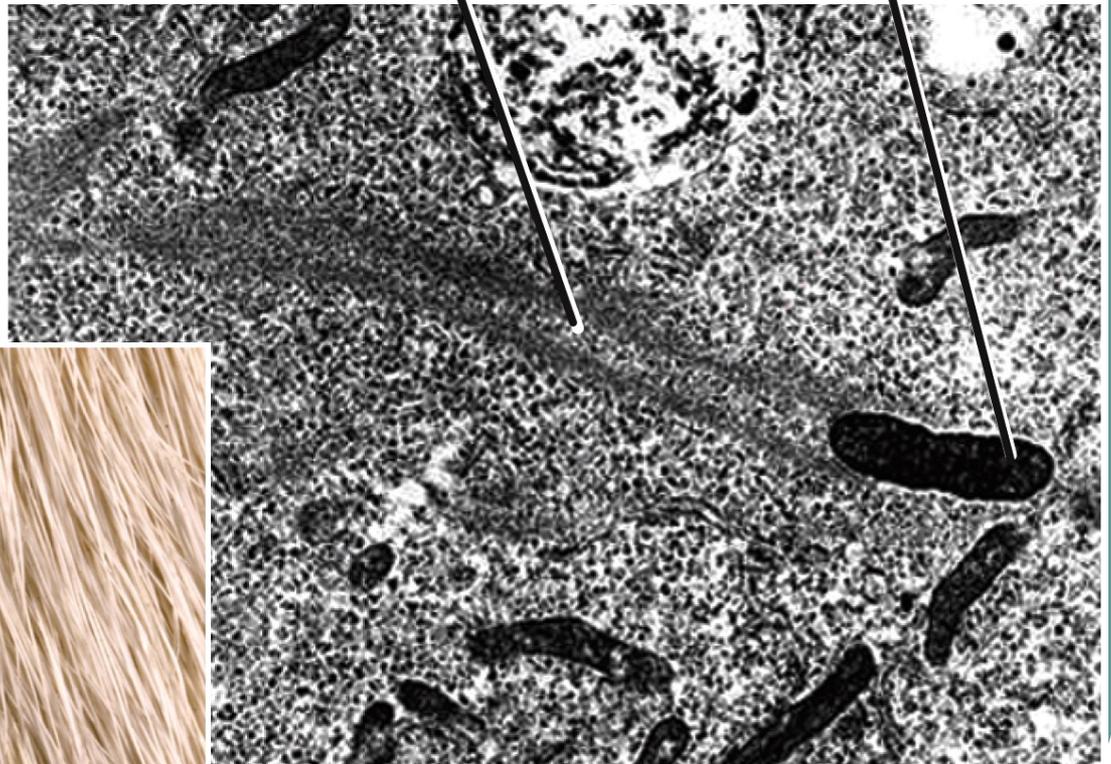
Examples of Pathogenic Rickettsiae

Disease	Organism	Commonest Geographic Distribution	Zoonotic Cycle	
			Vector	Reservoir
Spotted fever group				
Rocky Mountain spotted fever	<i>Rickettsia rickettsii</i>	North and South America	Tick	Rodents Dogs
Rickettsialpox	<i>Rickettsia akari</i>	United States, Soviet Union, Korea, Africa	Mite	Mouse
Typhus group				
Epidemic	<i>Rickettsia prowazekii</i>	Africa, Asia, South America	Body louse	Humans ^a
Brill's	<i>Rickettsia prowazekii</i>	Worldwide ^b	None ^c	Humans
Murine	<i>Rickettsia typhi</i>	Worldwide (pockets)	Flea	Rodents
Scrub	<i>Rickettsia tsutsugamushi</i>	South Pacific, Asia	Mite	Rodents
Trench fever	<i>Rickettsia quintana</i> ^d (<i>Rochalimaea quintana</i>)	Europe, Africa, Asia	Body louse	Humans

Rickettsia rickettsii

Actin tail

Rickettsia



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Rickettsia

- Clinical significance – the diseases caused by *Rickettsia* are all characterized by fever, headache, myalgias, and usually a rash.
- Typhus fevers –
 - incubation is 5-18 days.
 - Symptoms include a severe headache, chills, fever, and after a fourth day, a maculopapular rash caused by subcutaneous hemorrhaging as *Rickettsia* invade the blood vessels.
 - The rash begins on the upper trunk and spread to involve the whole body except the face, palms of the hands, and the soles of the feet.
 - The disease lasts about 2 weeks and the patient may have a prolonged convalescence.
 - Two types of typhus may occur:

Rickettsia

- Epidemic typhus – caused by *R. prowazekii* and transmitted by human lice as it bites and defecates in the wound.
- This occurs in crowded areas causing epidemics. Mortality rates are high in untreated cases. Following an initial attack, some individuals may harbor the organism of a latent infection with occasional relapses = Brill-Zinsser disease
- Endemic typhus – caused by *R. typhi* and transmitted to man by rat fleas.
- The disease occurs sporadically, but is clinically the same, but less severe than epidemic typhus.

Rickettsia

Rocky mountain spotted fever

- caused by *R. rickettsii*
- transmitted by ticks that must remain attached for hours in order to transmit the disease.
- An incubation of 2-6 days is followed by a severe headache, chills, fever, aching, and nausea.
- After 2-6 days a maculopapular rash develops, first on the extremities, including palms and soles, and spreading to the chest and abdomen.
- If left untreated, the rash will become petechial with hemorrhages in the skin and mucous membranes due to vascular damage as the organism invades the blood vessels.
- Death may occur during the end of the second week due to kidney or heart failure.

Rocky mountain spotted fever

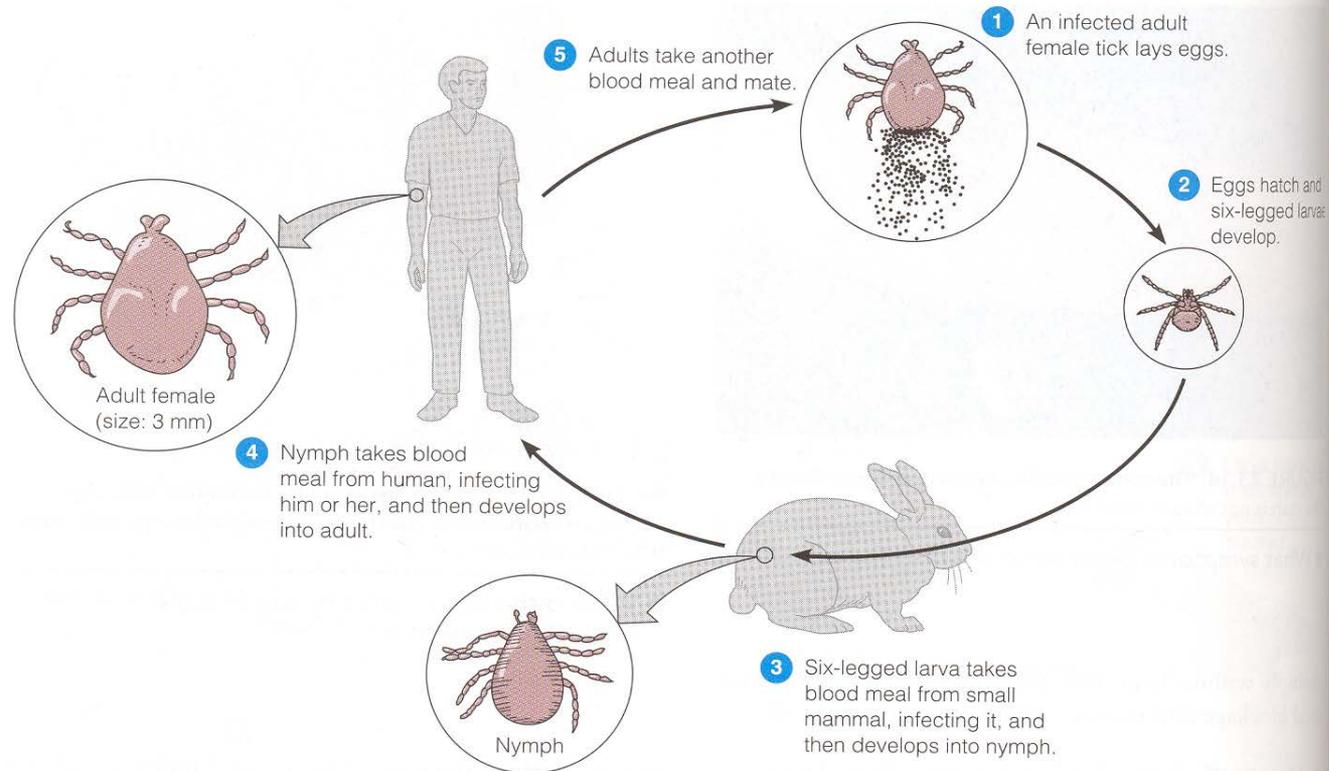


FIGURE 23.16 The life cycle of the tick vector (*Dermacentor* spp.) of Rocky Mountain spotted fever. Mammals are not essential to survival of the pathogen, *Rickettsia rickettsii*, in the tick population; the bacteria may be passed by transovarian passage, so new ticks are infected upon hatching. A blood meal is required for ticks to advance to the next stage in the life cycle.

Rocky mountain spotted fever



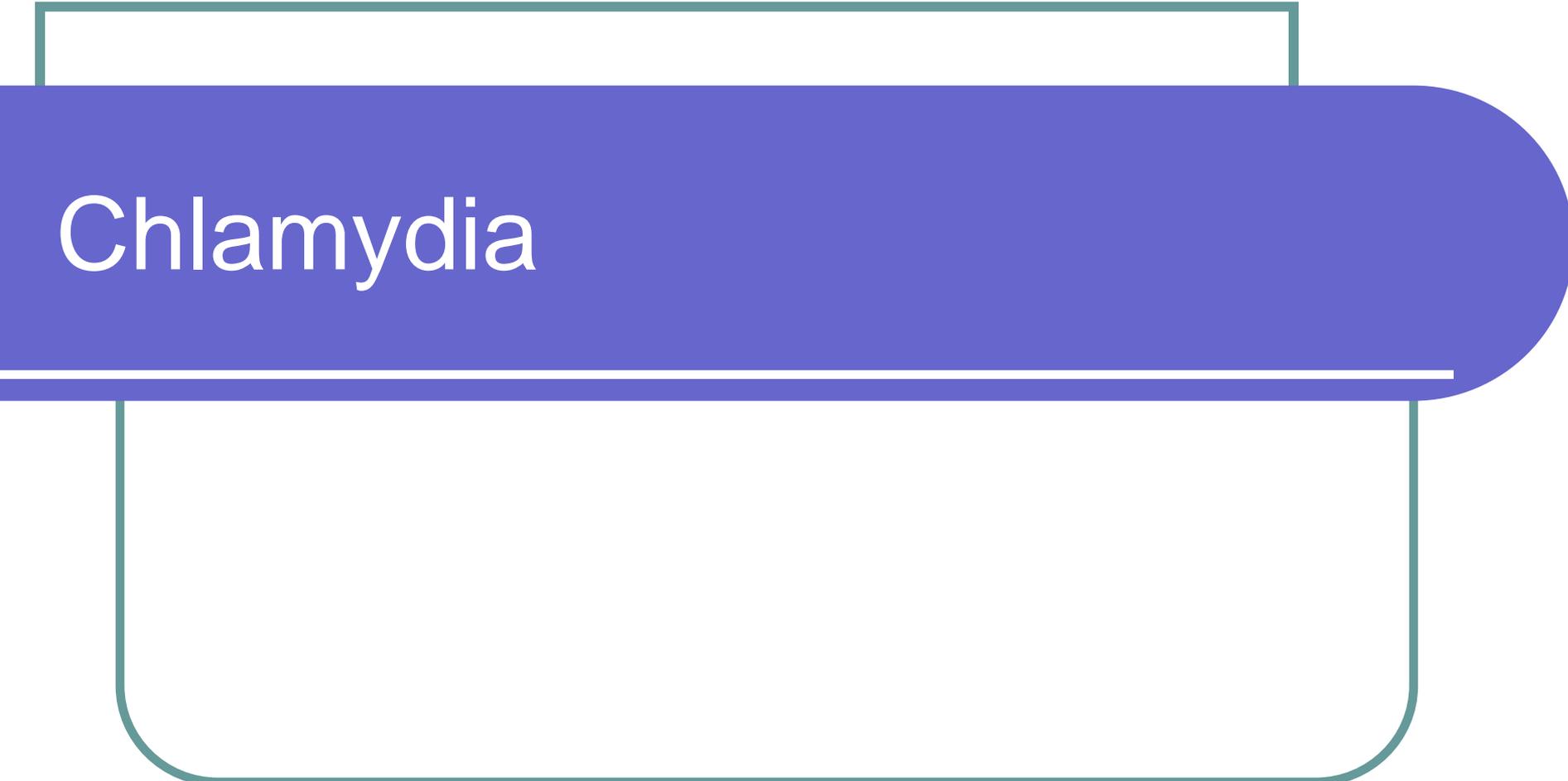
FIGURE 23.17 The rash caused by Rocky Mountain spotted fever. This rash is often mistaken for measles. People with dark skin have a higher mortality rate because the rash is often not recognized early enough for effective treatment.

Rickettsia

- Rickettsial pox –
 - caused by *R. akari* and transmitted by a mouse mite.
 - After a 1-2 day incubation a papule develops at the entry site and within 1-2 weeks a fever, malaise, and headache develop followed by a rash.
 - The disease is mild and usually not fatal.
- Q fever –
 - caused by *Coxiella burnetii*. The infection is acquired by inhalation of infectious material.
 - After an incubation of 14-26 days there is a sudden onset of fever, chills, and headache, but no rash.
 - The disease is characteristically an atypical pneumonia lasting 5-14 days with a low mortality rate.

Epidemiology

1. Seasonal incidence in temperate climates in developed countries
2. Endemic in poorer countries associated with overcrowding (e.g. epidemic typhus)
3. In North America, associated with campers, hikers, backpackers, etc.
4. Historically associated with Rocky Mountain states (RMSF) but may now be geographically diverse



Chlamydia



What is Chlamydia?

- Chlamydia is a sexually transmitted infection caused by a bacterium *Chlamydia trachomatis*
- It is the most common sexually transmitted bacterial infection



How can Chlamydia spread

- Unprotected vaginal sex
- Unprotected anal sex
- Unprotected oral sex
- Genital contact with an infected person

Chlamydia

- Classification – order Chlamydiales – contains one medically important genus – *Chlamydia*
 - Are obligate intracellular parasites
 - Cell walls are similar to the cell walls of Gram ve-Bacillus, but lack muramic acid
 - Are energy parasites that use ATP produced by the host cell
 - A Giemsa stain can be used to visualize chlamydial inclusions in tissues.
 - Have a complex developmental cycle

Chlamydia life cycle

- The infectious form is called an elementary body (EB) which is circular in form and is taken into the cell by induced phagocytosis.
- Inside the phagocytic vesicle replication takes place
- Over the next 6-8 hours, the EB reorganizes into the noninfectious, but metabolically active reticulate body (RB) which is larger and less dense than the EB.
- For 18-24 hours the RB synthesized new materials and divides by binary division to form inclusion bodies that reorganize and condense into EBs.
- Between 48-72 hours, the cell lyses and releases the EB which begin the cycle again.

Chlamydia life cycle

Chlamydia developmental cycle

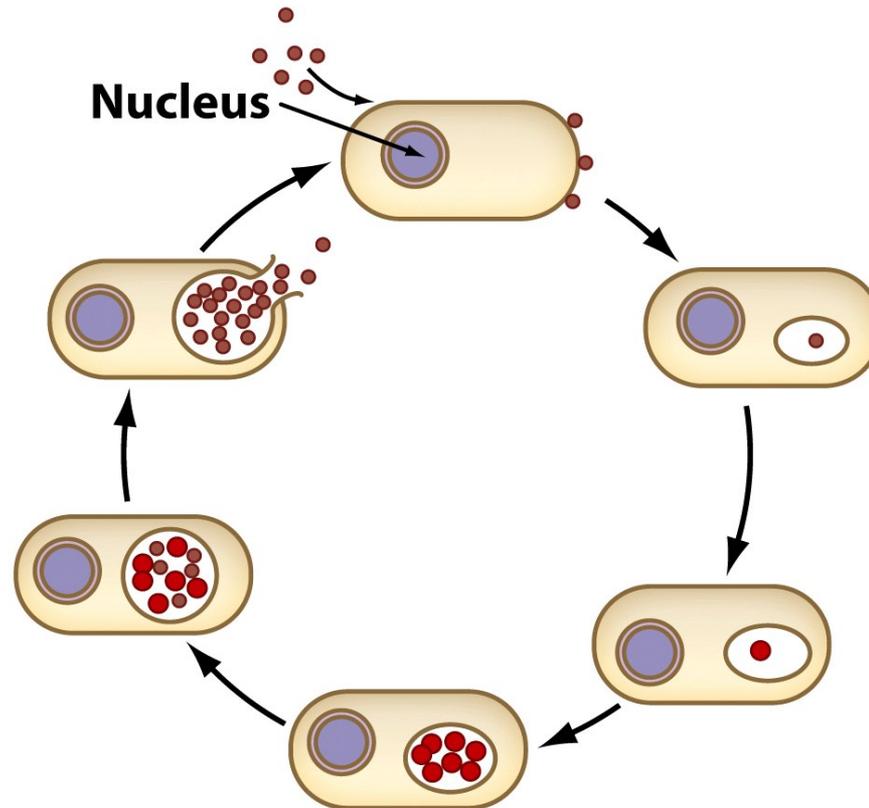


Figure 18.45b Microbiology: An Evolving Science
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Chlamydia in tissues

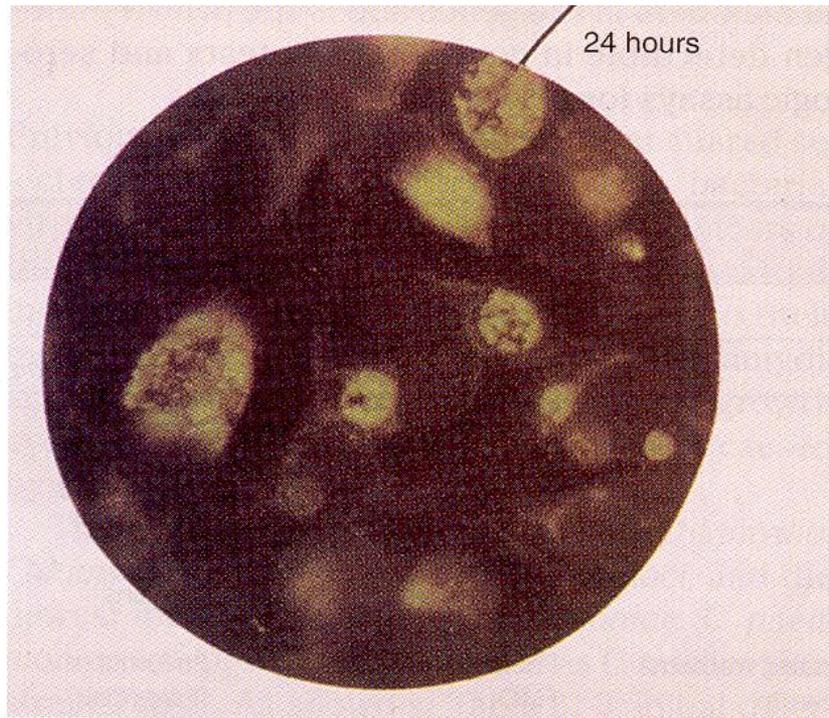


Figure 21-2

Chlamydia spp. growth cycle highlighting reticulate bodies (RBs), sometimes referred to as *initial bodies*. (Courtesy Syva-Microtrak, Palo Alto, Calif.)

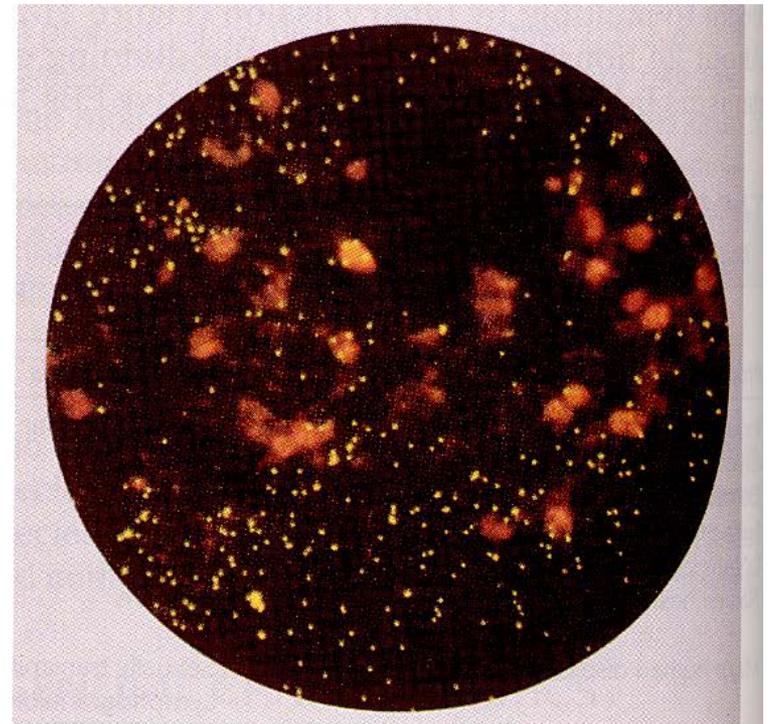
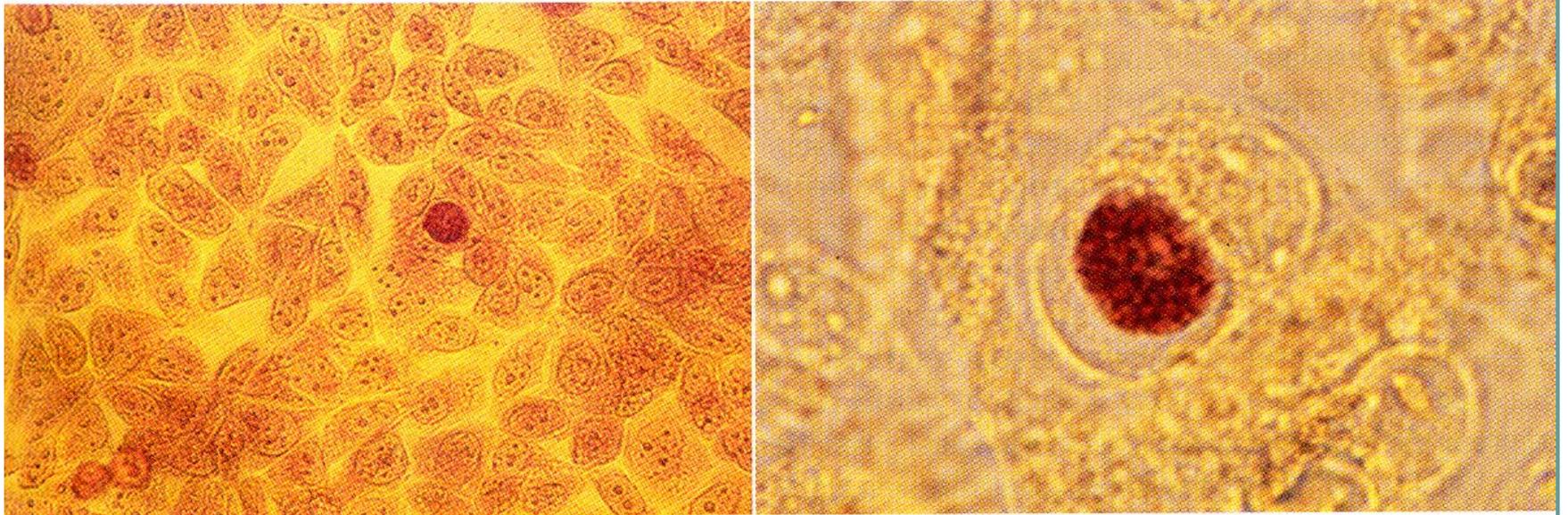


Figure 21-3

Elementary bodies (EBs) and cells in *Chlamydia trachomatis*-positive direct specimen. (Courtesy Syva Microtrak, Palo Alto, Calif.)

Chlamydia inclusion bodies



Chlamydia

- Clinical significance
 - Chlamydia trachomatis –
 - Genital tract infection
 - is the major cause of nongonococcal urethritis; is sexually transmitted and frequently found concomitantly with *N. gonorrhoeae*
 - In males symptoms include urethritis, dysuria and it sometimes progresses to epididymitis

Chlamydia

- In females symptoms include mucopurulent cervical inflammation which can progress to salpingitis and PID.
- Inclusion conjunctivitis – this occurs in both newborns and adults and a genital tract infection is the source of the infection
 - a benign, self-limited conjunctivitis which heals with no scarring
 - Newborns – are infected during the birth process and the infection manifests 1-2 weeks after birth as a mucopurulent discharge that lasts 2 weeks and then subsides.
 - Some may develop an afebrile, chronic pneumonia

Chlamydia

- In adults – causes an acute follicular conjunctivitis with little discharge.
- Trachoma – is the single, greatest cause of blindness in underdeveloped countries.
 - Transmission is by direct contact and in poor, less developed countries children may be infected in the first three months of life.
 - Chronic infection and reinfection are common and result in conjunctival scarring and corneal vascularization.
 - The scars contract causing the upper lid to turn in so that the eyelashes cause corneal abrasions.
 - This leads to secondary bacterial infections and results in blindness.

Trachoma



Chlamydia

Lymphogranuloma venereum

- is a venereal disease that occurs in poor, tropical areas.
 - Upon infection, widespread dissemination takes place and a primary, painless lesion (either a vesicle or an ulcer) occurs at the site of entry within a few days.
 - This heals with no scarring.
 - A secondary stage occurs 2-6 weeks later with symptoms of regional suppurative lymphadenopathy (buboes) that may drain for a long time and be accompanied by fever and chills.
 - Arthritis, conjunctival, and CNS symptoms may also occur.
 - A tertiary stage may occur and is called the urethrogenital perineal syndrome.
 - This is characterized by structural changes such as non-destructive elephantiasis of the genitals and rectal stenosis.

Chlamydia

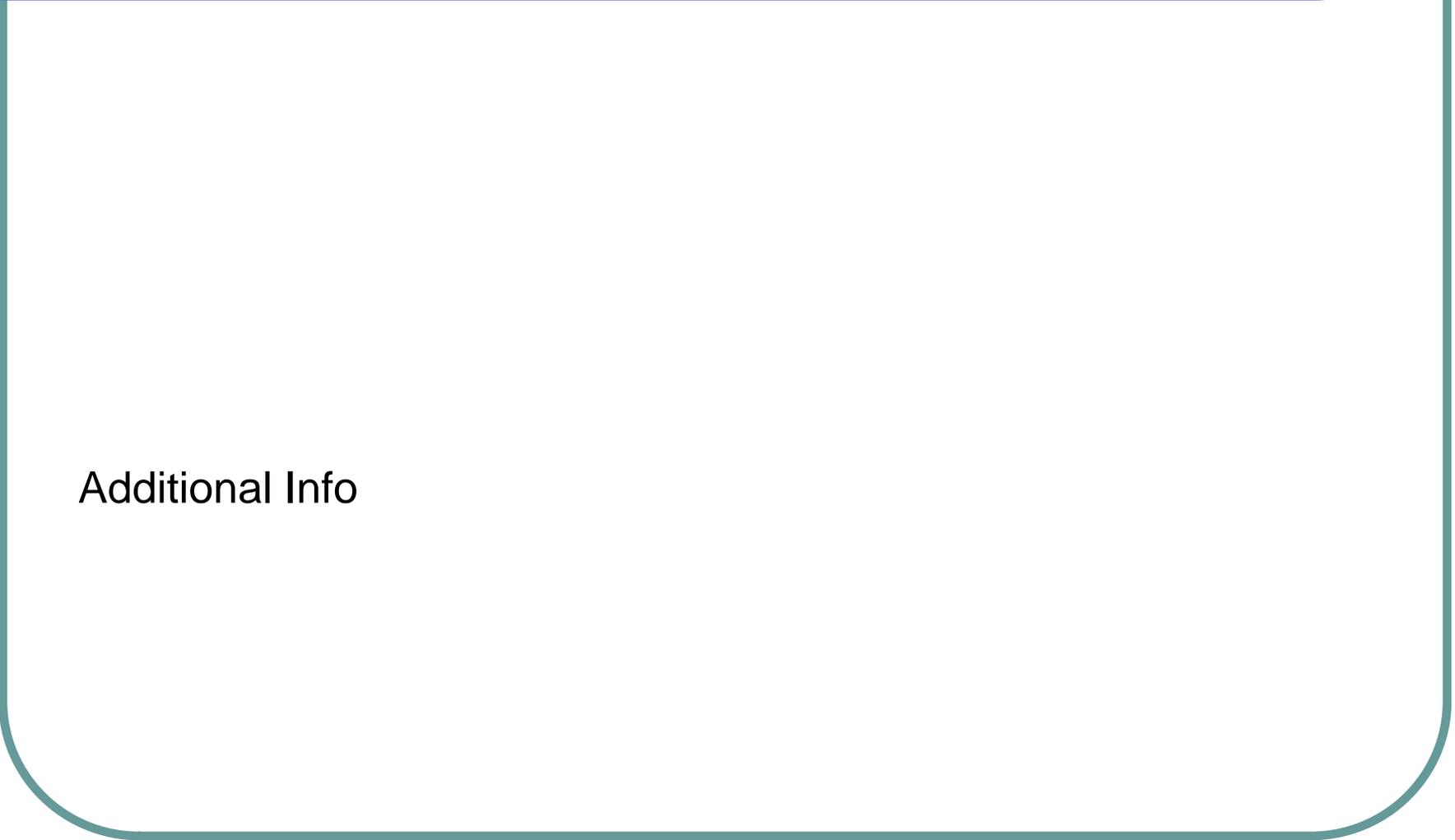
- *Chlamydia psittaci* – naturally infects avian species and non-primate animals causing mild to severe illness.
 - In man causes psittacosis (ornithosis) and is acquired by contact with an infected animal.
 - Infection can range from subclinical to fatal pneumonia.
 - Most commonly causes an atypical pneumonia with fever, chills, dry cough, headache, sore throat, nausea, and vomiting.

Chlamydia

- Treatment/antimicrobial susceptibility
 - *C. trachomatis* –
 - *Trachoma* – systemic tetracycline, erythromycin; long term therapy is necessary
 - Genital tract infections and conjunctivitis – tetracyclines and erythromycin
 - *C. psittaci* – same as above



Additional Info



Rickettsia cell-to-cell spread

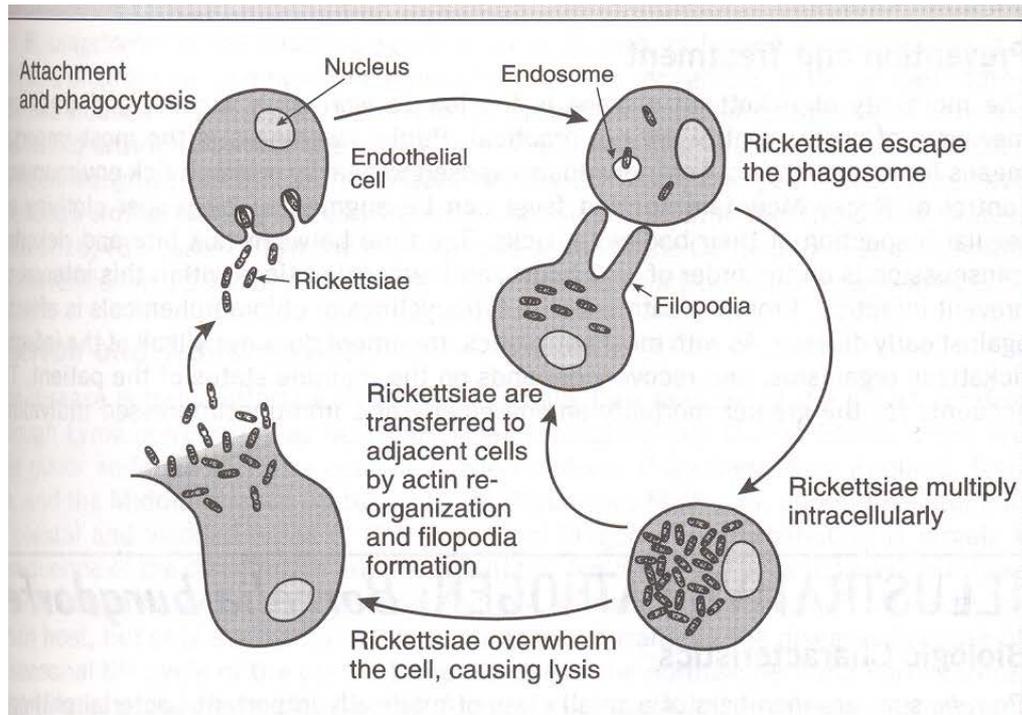


FIGURE 8-3
Cell-to-Cell Spread by Rickettsia rickettsii

Pathogenesis of Rickettsia

1. Adhesion
2. Internalization
3. Release from phagosome
4. Intracellular growth
5. Release from infected cell
6. Host cell response to infection

Adhesion

1. In mammals, primarily endothelial cells
2. Low affinity receptors on host cells
3. Rate-limiting step during infection
4. Outer membrane proteins (OmpA & B) are involved
5. Adherence to arthropod cells is unknown

Internalization

1. Induced phagocytosis by non-professional cells
2. Signals unknown
3. Host cell microfilament formation required (cytochalasin inhibits)
4. Requires metabolically active (viable) rickettsias
5. Calcium ion dependent (calmodulin inhibits)

Release from vacuole

1. Taken up in vacuole but cannot survive phagosomal/lysosomal fusion
2. Induction of bacterial phospholipase A
3. Lysis of vacuolar membrane
4. Release into cytoplasm

Intracellular growth

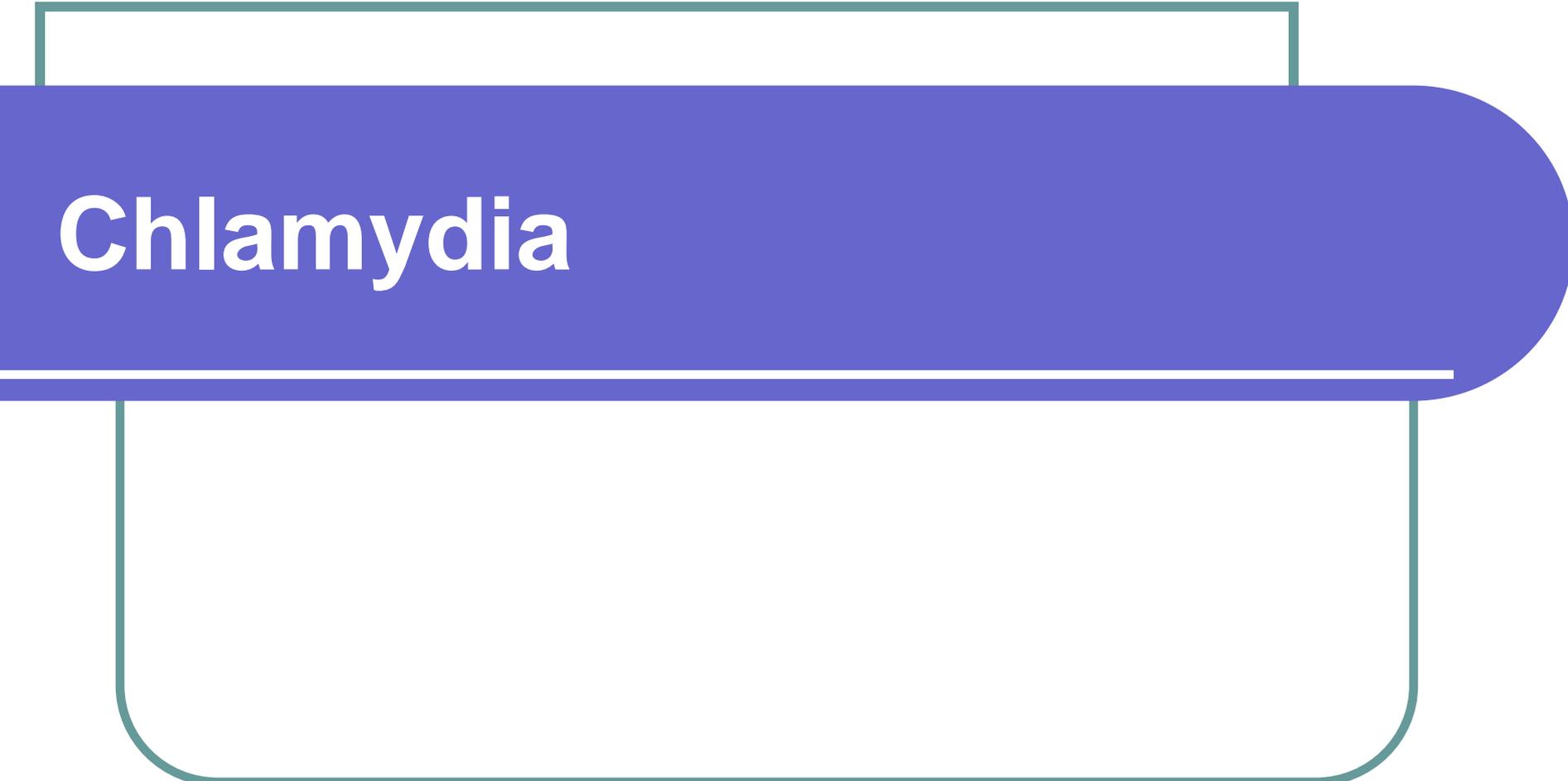
1. Occurs within host cell cytoplasm
2. Generation time – 9-12 hours
3. Turnover of bacterial mRNA is very rapid, ??
4. Division by binary fission
5. Specific transporters move host molecules into bacteria cell
6. Intracellular spread may occur by process similar to that observed in *Shigella* species
7. Actin tails (up to 70 microns) form at bacterial poles

Release from infected cells

1. Usually results in host cell death
2. Cell bursts
3. Mechanism of lysis unknown
4. Two possibilities of intracellular spread:
Extracellular and Intracellular

Host cell response

1. Increase in surface expression of host cell surface markers, e.g. E-selectin, ICAM, etc.
2. Increase in cytokine (IL-1, IL-6, IL-8) expression
3. Varied effects on procoagulant factors, e.g. fibrinogen
4. Effects due to activation of NF- κ B



Chlamydia



What are the symptoms of Chlamydia?

- There are often no symptoms!!!!
- 70% of women and 50% of men have no symptoms

Symptoms in women

- Pain passing urine
- Change in vaginal discharge
- Mild to severe lower abdominal pain
- Pain during sex, bleeding between periods or after sex

Long term complications

- Pelvic Inflammatory Disease
- Chronic pelvic pain
- Ectopic pregnancies
- Can be passed on to baby during childbirth
- Joint inflammation – a form of arthritis called Reiter's syndrome
- Infertility

Symptoms in men

- Penile irritation and discharge
- Urethritis - Inflammation of the tube leading from bladder, causing pain when passing urine
- Epididymitis - Inflammation of tube leading from the testes
- Resulting in...Painful and swollen testicles!!!

Long term Complications

- Painful infection in the testicles
- Reduced fertility
- In some men it can cause the prostate gland to become inflamed
- Joint inflammation – a form of arthritis called Reiter's syndrome

How can Chlamydia be prevented?

- Use protection!!!!
- A Chlamydia test is recommended every time you have a new partner



- Annual sexual health check
- It is very unlikely that Chlamydia will go away without treatment