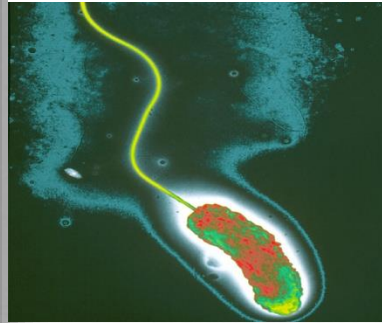




Spirulina



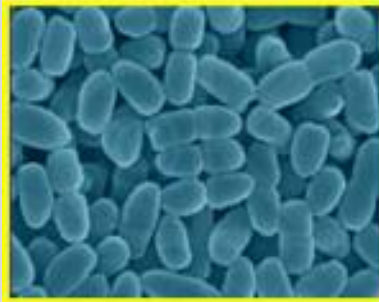
Vibrio cholera



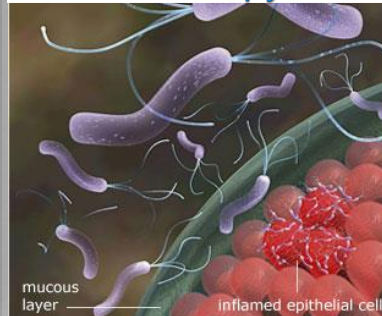
Escherichia



Bordetella



Helicobacter pylori



Salmonella

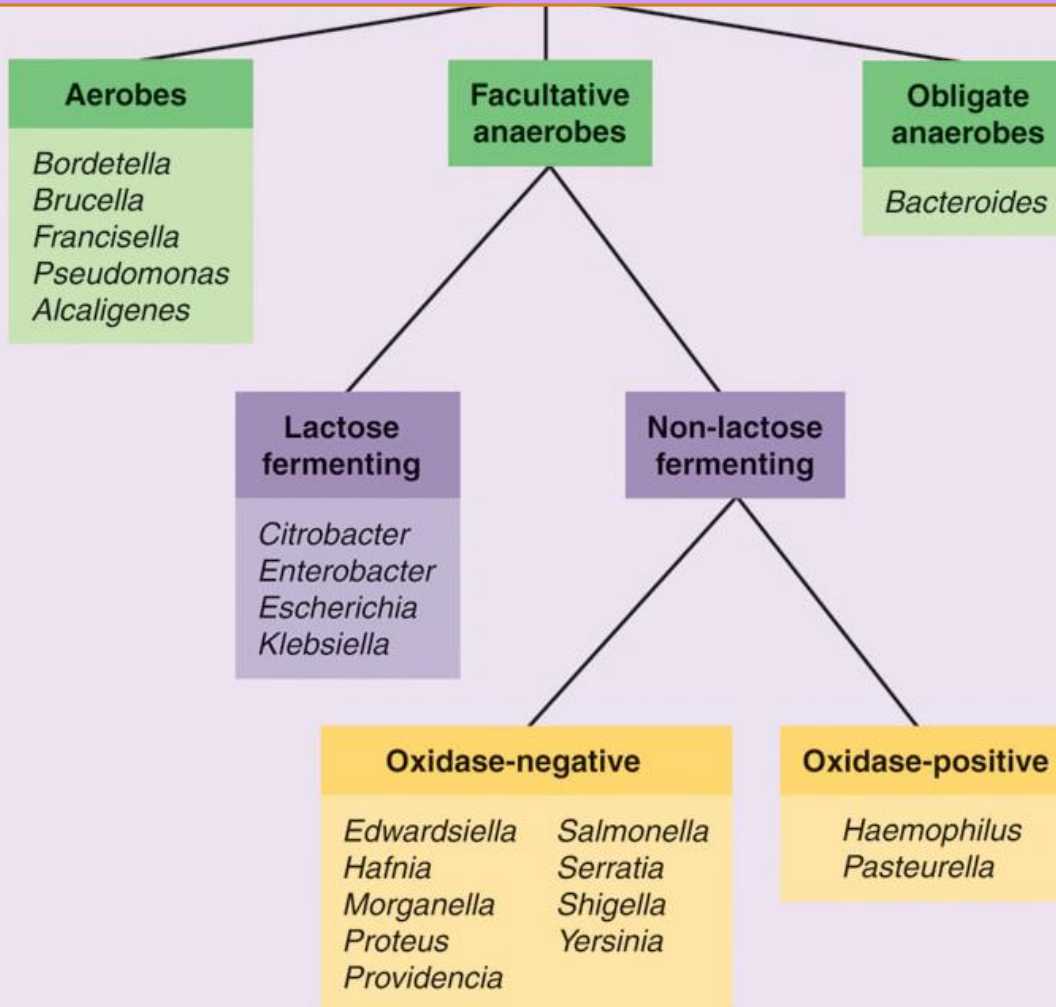


Gram Negative Bacilli

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University of Basra College of Nursing

2017-2018

Gram Negative Bacilli



Aerobic Gram-Negative Bacilli

- o *Pseudomonas - aeruginosa, cepacia, pituita*
- o *Brucella - abortus, suis*
- o *Francisella tularensis*: causative agent of tularemia, the pneumonic form
- o *Bordetella pertussis*
- o *Legionella pneumophila*
- o *Alcaligenes*
- o *Pseudomonas* : an opportunistic pathogen
- o *Brucella & Francisella* : zoonotic pathogens
- o *Bordetella & Legionella* : mainly human pathogens
- o *Alcaligenes* : opportunistic pathogen

Genus *Pseudomonas* and related organisms

Pseudomonas aeruginosa: important opportunist bacteria

Burkholderia pseudomallea : cause of melioidosis, a disease of restricted geographic distribution.

Burkholderia cepacia : respiratory tract infections in cystic fibrosis patients.

Actinobacter baumannii : opportunistic pathogen causing a variety of infections (wound, respiratory tract, urinary tract)

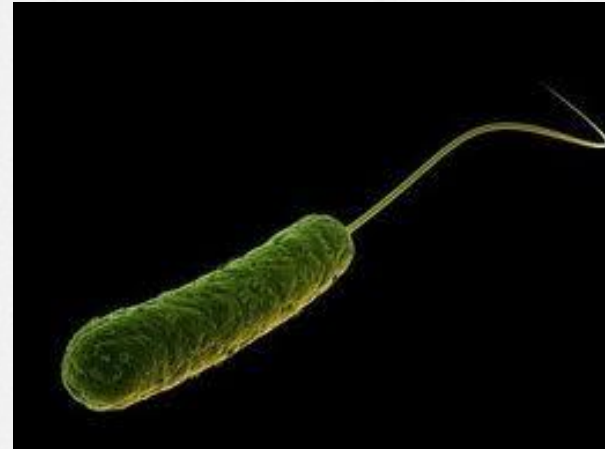
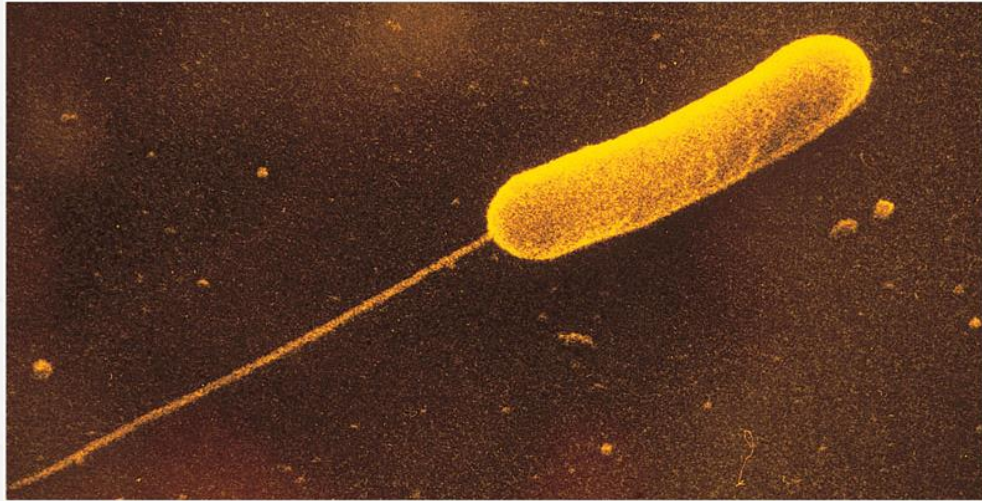
Stenotrophomonas maltophilia : an opportunistic pathogen also commonly associated with nosocomial infection.

Pseudomonas

Properties:

- o small gram-negative rods
- o Aerobic
- o Motile by means of single polar flagellum,
- o produce oxidase & catalase
- o highly versatile metabolism
- o grapelike odor
- o Grow over a wide temperature range
- o Most strains produce pigments (a blue-green pigment in *P. aeruginosa*)

Pseudomonas aeruginosa



Pseudomonas aeruginosa

- o Saprophyte, common inhabitant of soil & water
- o intestinal resident in 10% normal people
- o resistant to soaps, dyes, quaternary ammonium disinfectants, drugs, drying
- o frequent contaminant of ventilators, IV solutions, anesthesia equipment
- o opportunistic pathogen. A nosocomial pathogen

Pseudomonas aeruginosa

- o An opportunist pathogen that infect almost any body site .
- o nosocomial infections . It causes infections of skin and in hosts with burns
- o It is a major lung pathogen in cystic fibrosis and can cause pneumonia
- o UTI, abscesses, otitis, & corneal disease
- o Sinus infections, meningitis, bronchopneumonia

Treatment and prevention

- o Resistant to many antibacterial agents .
- o **Treatment** with aminoglycosides and beta-lactam antibiotic
- o **Prevention** depends upon good aseptic practice in hospitals

Bordetella pertussis



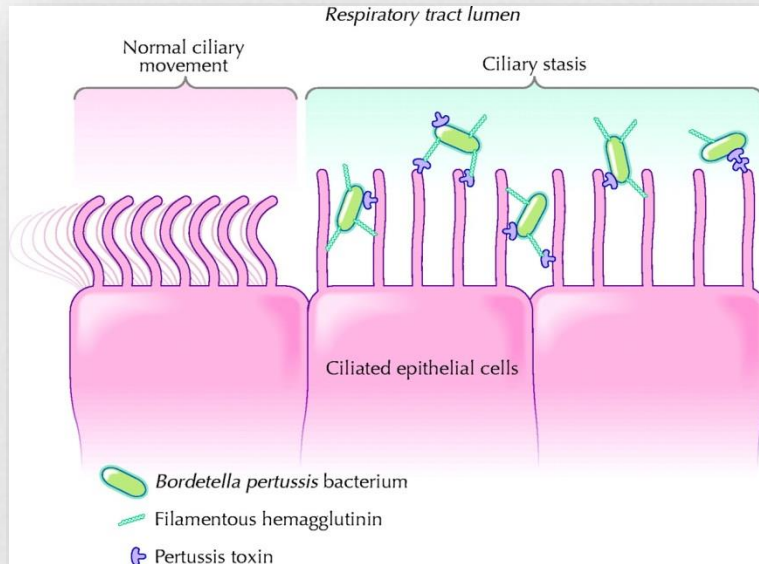
- Gram-negative , extremely small, strictly aerobic,
- non-motile cocobacillus (short rod).

o Found among the respiratory flora of humans & other animals

o Causes: Pertussis

o Virulence factors:

- ❖ Pilli for attachment
- ❖ Filamentous hemoagglutinin
- ❖ Pertossis toxin
- ❖ Dermonecrotic toxin(damage epithelia)
- ❖ Tracheal cytotoxin (kills ciliated cells in the respiratory tract
- ❖ LPS



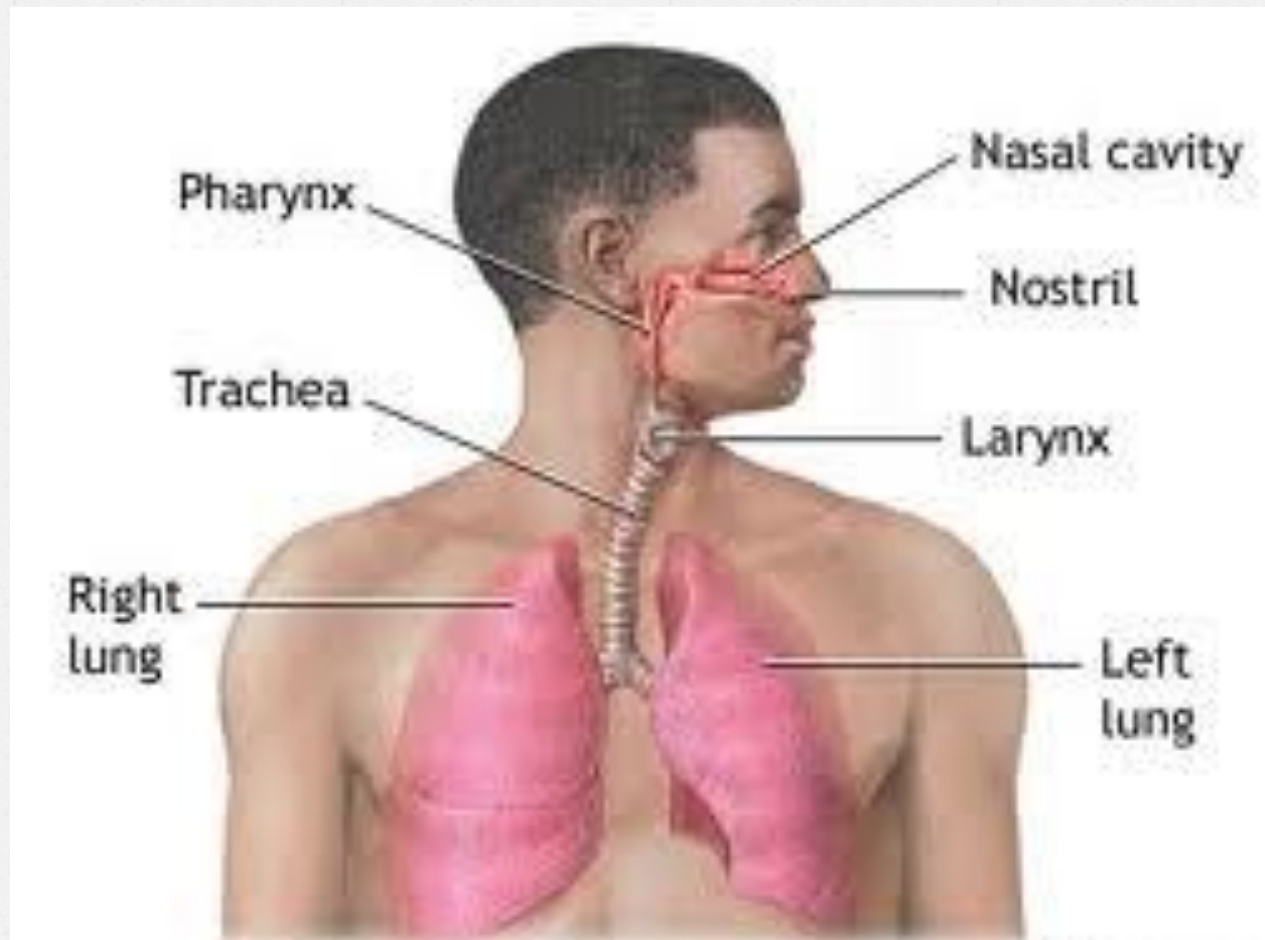
allow secondary

infections(pneumonia) by staphylococci of *H. influenzae*

Transmission and Symptoms

- Airborne contact with infected persons
 - Upper respiratory tract infection; may be severe in children & elderly
 - Difficulty breathing; staccato cough (“whooping cough”)
 - Usually does not spread into bloodstream
- child has pertussis. It is difficult for him to stop coughing and to get air. Coughing spasms with a "whooping" sound that follows the cough are typical. The sound means child is trying to catch his breath before the next round of coughing





Treatment and Vaccination

- o Erythromycin
- o Toxoid and acellular Pertussis vaccine



Legionella pneumophila

- Causes: Legionellosis

- 1976 outbreak

- Properties :

- Aerobic, Gram-negative rods, fastidious motile
 - Ubiquitous
 - Found in highly aerated, moist environments
 - May parasitize certain aquatic protozoa
 - Can contaminate building ventilation systems, air filters, etc.
 -



- Transmission & Symptoms

- Airborne
 - Contact with infected persons or environments
 - Mild to Moderate Pneumonia



Facultative Anaerobes Gram Negative Bacilli

o Enterobacteriaceae Family (Coliforms)

□ Enteric - *lactose fermenting*

o *Escherichia coli*

o *Klebsiella pneumoniae*, *Enterobacter*, *Citrobacter*

Enteric - *non-lactose fermenting*

o *Proteus*

o *Salmonella* & *Shigella*

□ Non-Enteric

o *Yersinia pestis*

o *Hemophilus - influenzae*, *aegyptius* , *ducreyi*

Q: *How can you distinguish between Enteric and Non-Enteric???*

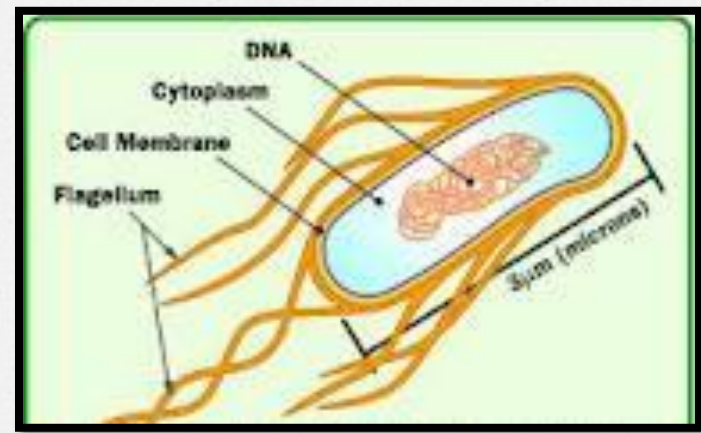
Enterobacteriaceae Family

- o facultative anaerobes, grow best in air
- o small, non-sporing rods
- o enterics
- o large family of gram-negative bacteria
- o many members inhabit soil, water, & decaying matter & common occupants of large bowel of humans & animals
- o cause diarrhea through enterotoxins
- o divided into coliforms (lactose fermenters) and non-coliforms (non lactose fermenters)

Escherichia coli

the most prevalent enteric bacillus

- Gram negative rod, motile , with or without capsule , non-fastidious , facultative anaerobe, bile tolerant, capable of growth at 44 C. **flagella are.....?**
- Caused UTI . Diarrheal diseases. Neonatal meningitis. Septicemia



Escherichia coli

- o pathogenic strains frequent agents of infantile diarrhea – greatest cause of mortality among babies
- o causes ~70% of traveler's diarrhea
- o causes 50-80% UTI
- o Neonatal meningitis, septicemia
- o indicator of fecal contamination in water

Pathogenesis

A variety of virulence factors:

- o Endotoxine: present in all strains
- o Adhesion
- o Capsule: present in some strains
- o Enterotoxins: associated with diarrheal disease

Treatment & prevention

- o Wide range of antibacterial agents potentially available , but incidence of resistance variable ; must be determined by susceptibility testing .
- o Specific treatment of diarrheal disease usually not required
- o No currently available vaccine .

Other coliforms

- o *Klebsiella pneumoniae* – normal inhabitant of respiratory tract, has large capsule, cause of nosocomial pneumonia, meningitis, bacteremia, wound infections & UTIs
- o *Enterobacter* – UTIs, surgical wounds
- o *Serratia marcescens* – produces a red pigment; causes pneumonia, burn & wound infections, septicemia & meningitis
- o *Citrobacter* – opportunistic UTIs & bacteremia

Noncoliform lactose-negative enterics

- o *Proteus*
- o *Salmonella & Shigella*

Proteus

- Gram-negative rod, non-fastidious ;
- facultative anaerobe.
- Contains several species, of which two are of medical importance . *P. mirabilis* ; *P. vulgaris*
- Swarm on surface of moist agar in a concentric pattern
- Cause UTI, hospital-acquired wound infections, pneumonia, septicemia, & infant diarrhea

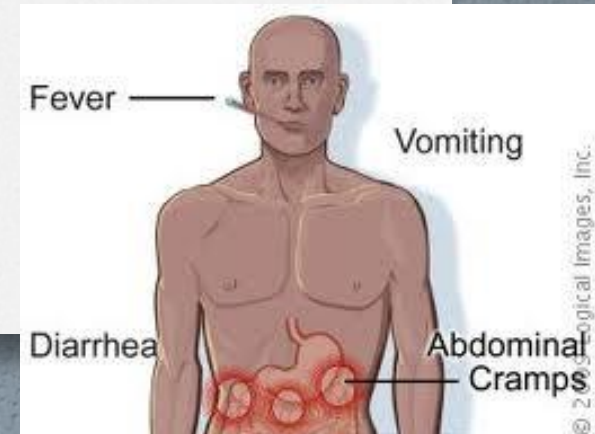


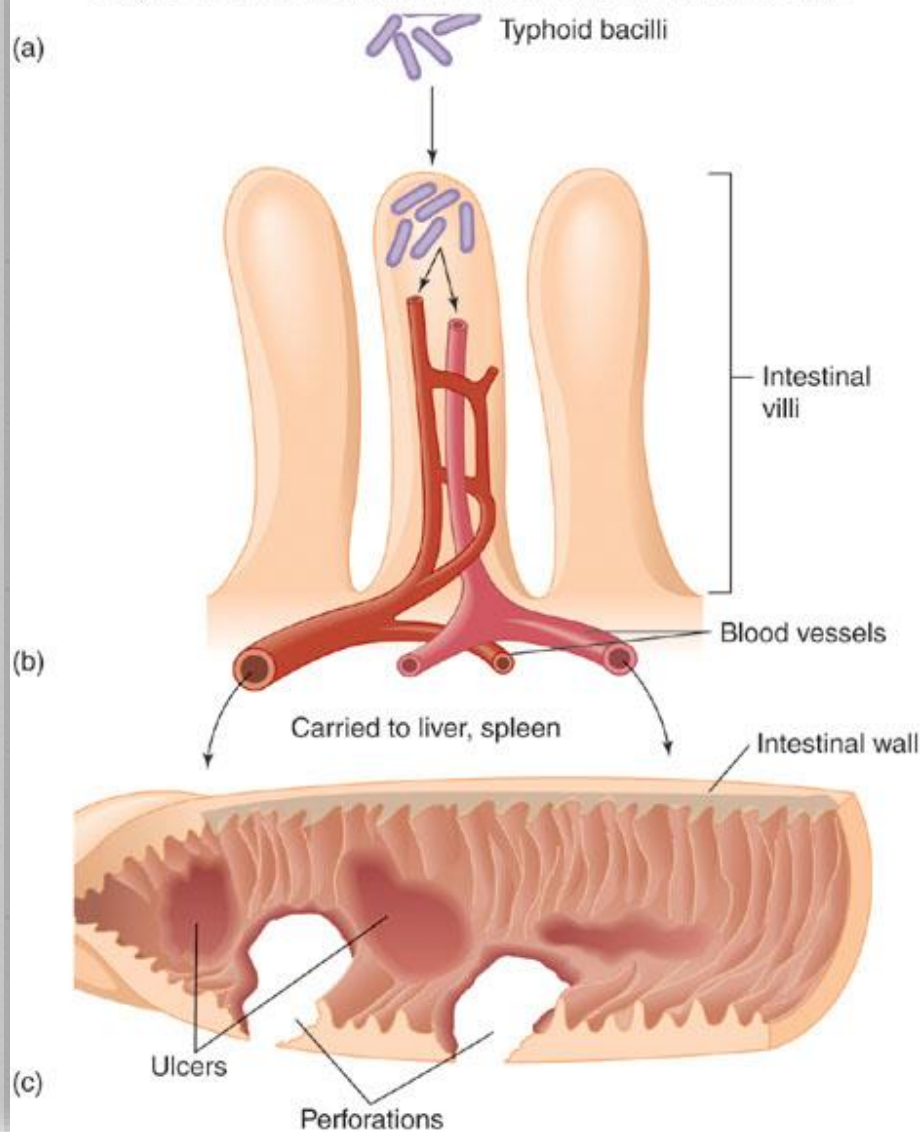
Salmonella

- o motile; ferments glucose ,non-sporing rod, All except *S.typhi* are non-capsulate .non-fastidious, oxidase negative
- o resistant to chemicals –bile & dyes
- o Typhoid and paratyphoid (enteric fevers) .
- o *S. typhi* ,- typhoid fever – ingested bacilli adhere to small intestine, cause invasive diarrhea that leads to septicemia
 - o 2 new vaccines
- o *S. cholerae-suis* - pigs
- o *S. enteritidis* – 1,700 serotypes- salmonellosis – zoonotic

Transmission

- Widespread in animals; encountered in food chain(especially in poultry, eggs, meat, milk and cream.
- Acquired by ingestion of contaminated food and water , or person to person via fecal-oral route.
- *S. typhi* and *S. paratyphi* are human pathogens only





Treatment & prevention

- o *S. typhi* and *S. paratyphi* infections should be treated with systemic antibiotics based on susceptibility tests.
- o Antibiotic resistance is an increasing problem in many countries(important implications for travelers).
- o **Salmonella diarrhea should not be treated with antibiotics unless there is evidence of invasive disease**
- o **Prevention** depends upon interrupting fecal-oral transmission and on eliminating opportunities for transmission via the food chain .
- o **Vaccines** are available to protect against *S. typhi* and *S. paratyphi*

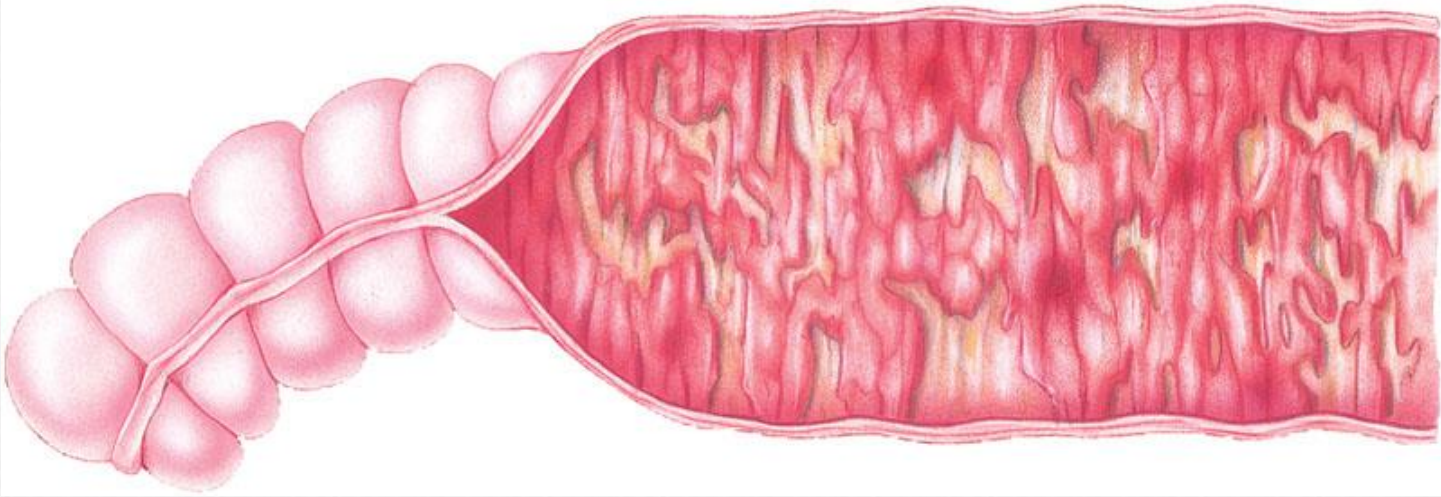
Shigella

- o Shigellae are Gram-negative, non-spore-forming, facultatively anaerobic, non-motile bacteria. lactose non-fermenters, non-fastidious
- o shigellosis – incapacitating dysentery(bacillary dysentery , (bloody feces associated with intestinal pain)
- o Contains four species of importance to humans as causes of *bacillary dysentery*: *S. dysenteriae* , *S. sonnei*, *S. flexneri* & *S. boydii*
- o produce H₂S or urease
- o invades villus of large intestine, can perforate intestine or invade blood
- o **Transmission** : human pathogens spread by fecal-oral route, specially in crowded conditions

Treatment & prevention

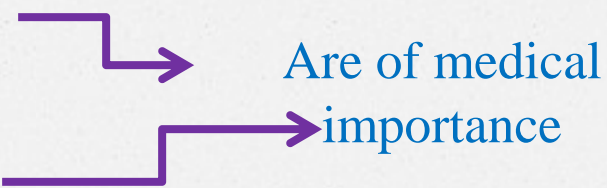
- o **Treatment** : antibiotic therapy (e.g. fluoroquinolones ,Trimethoprim-sulfamethoxazole) should only be given for severe diarrhea
- o fluid replacement & ciprofloxacin & sulfa-trimethoprim
- o **Prevention** : depends upon interrupting fecal-oral spread; hand hygiene important
- o No vaccine available.

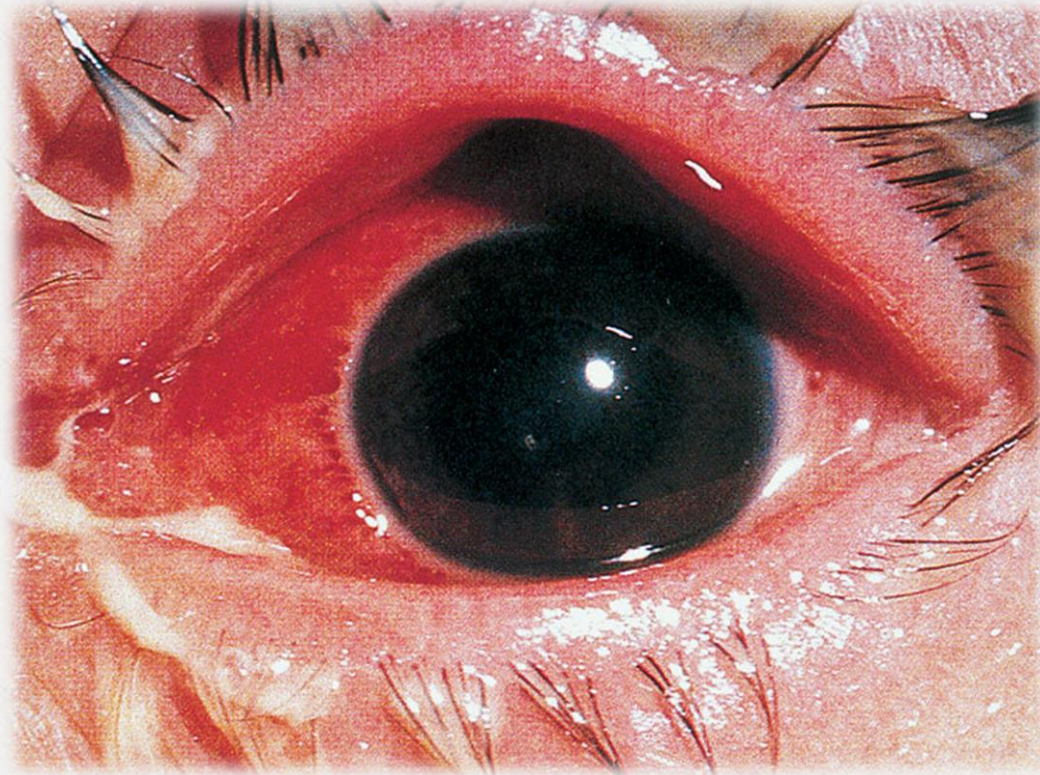
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**Invasion of ileum and colon causes damage ,
which results in diarrhea**

Hemophilus

- o The genus contains many species.
 - o *H. influenzae* – secondary pneumonia
 - o *H. ducreyi* – **chancroid STD**
 - o *H. aegyptius* – conjunctivitis, pink eye
 - o *H. parainfluenzae* & *H. aphrophilus* – normal oral & nasopharyngeal flora; infective endocarditis
- Are of medical importance
- 



Hemophilus aegyptius
conjunctivitis, pink eye

Hemophilus influenzae

- o **Properties** : Small Gram-negative rod , frequently coccobacillary, non-motile, fastidious requires chocolate agar to grow, facultative anaerobic, may capsule when isolated from site of infection.
- o **Diseases** : Capsular type b *H. influenzae* causes meningitis, osteomyelitis, epiglottitis, otitis. All are more common in children than older age groups
- o Polysaccharide capsule is important **virulence factor**.

Treatment & prevention

- o Ampicillin (or amoxicillin) may be used if isolates are susceptible .
- o Rifampicin prophylaxis.

Miscellaneous Bacterial Agents of Disease

- *Treponema pallidum*
- *Leptospira* – *biflexa*, *interrogans*
- *Borrelia* – *hermsii*, *burgdorferi*
- *Vibrio cholera*, *parahaemolyticus*, *vulnificus*
- *Helicobacter pylori*
- *Rickettsia* - *proWazekii*, *typhi*, *rickettsii*
- *Chlamydia trachomatis*
- *Mycoplasma* - *pneumoniae*, *hominis*

Spirochetes

Treponema

Leptospira: zoonoses disease (cause leptospirosis (rat fever)severe pulmonary haemorrhage syndrome



Leptospirosis symptoms

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Fever



Chills



Headaches



Vomiting



Loss of appetite



Muscle pain

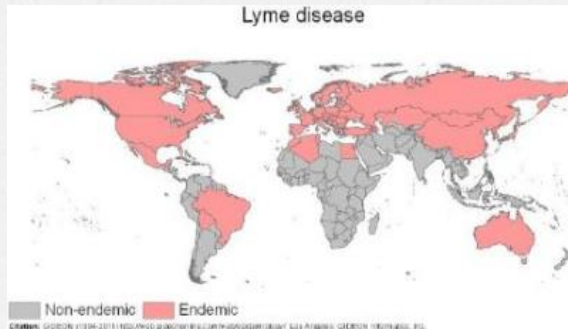


Redness of the eyes

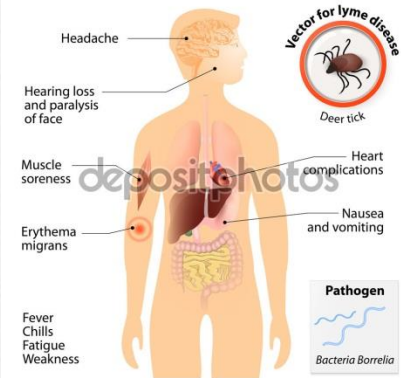


Cough

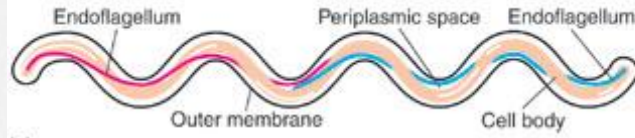
Borrelia: zoonoses diseases (cause borreliosis (lime disease(**erythema migrans**))



LYME DISEASE



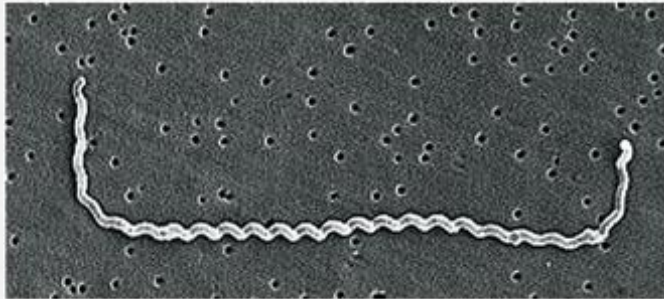
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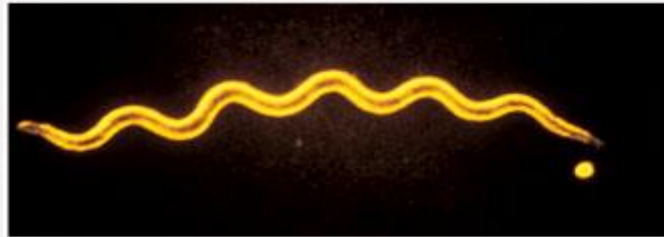
(a)



(b)



(c)



(d)

Treponema

- Thin, regular, coiled spirochetes
- live in the oral cavity, intestinal tract, & perigenital regions of humans & animals
- It is not seen on a Gram stained smear because the organism is too thin.
- pathogens are strict parasites.

Treponema pallidum

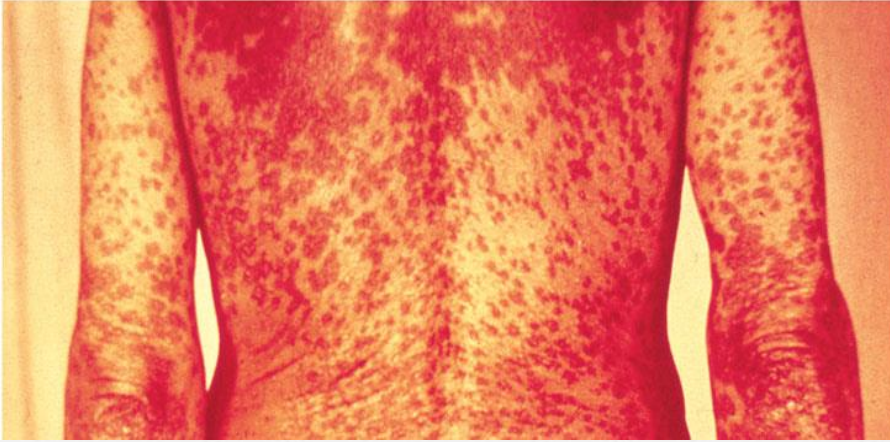
- o Causes syphilis
- o infectious dose is 57 organisms
- o Primary, Secondary and Tertiary syphilis
- o Congenital syphilis (present in utero and at birth) – nasal discharge, skin eruptions, bone deformation, nervous system abnormalities
- o **Transmission** : very susceptible to heat and drying , so **successful transmission depends upon very close contact.**
- o *T. pallidum* is spread by close sexual contact and may also be vertically transmitted in utero. No animal reservoir.
- o **Treatment**: penicillin in chronic syphilis; Doxycycline or tetracycline may be given to penicillin-allergic patients
- o **Prevention**; depends upon detection and treatment of cases.
- o There is **no vaccine** for syphilis

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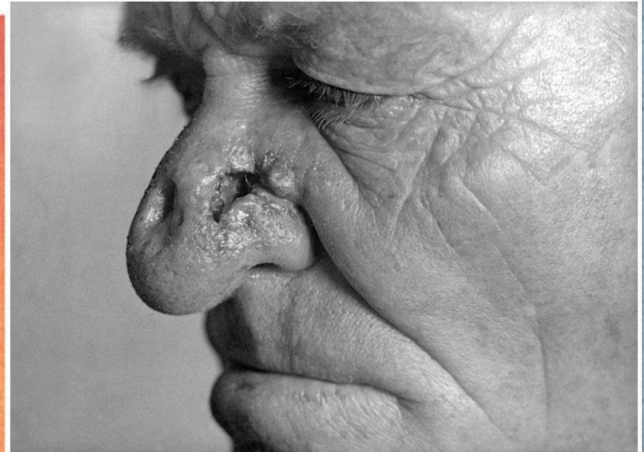


Treponema pallidum

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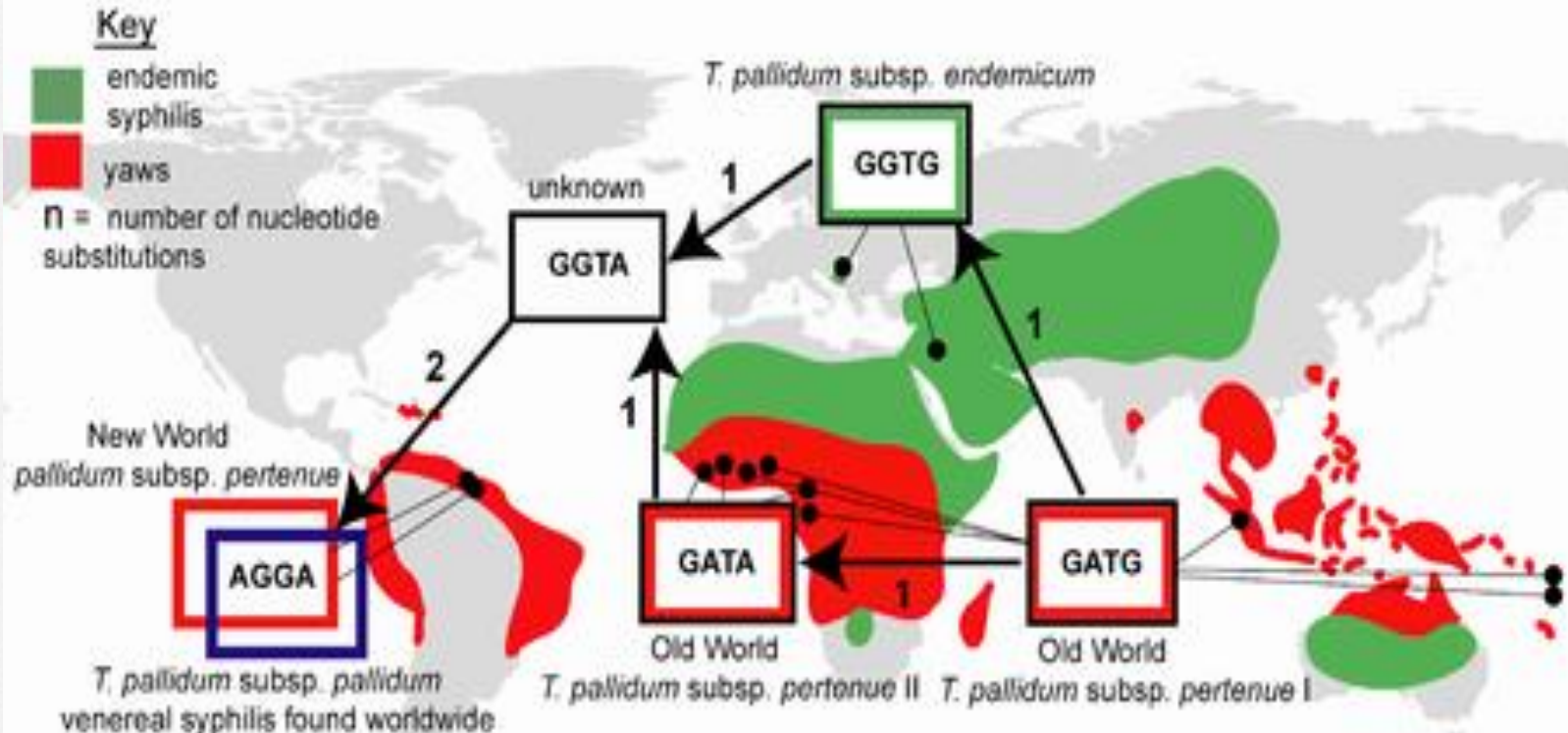
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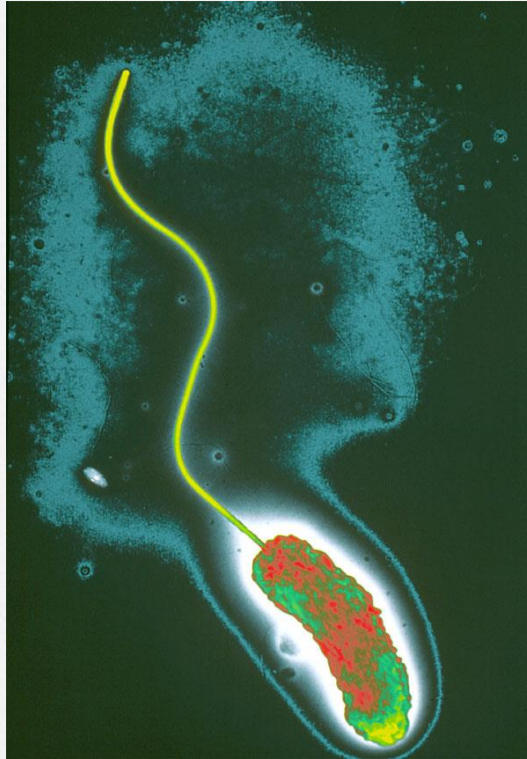
Syphilis distribution



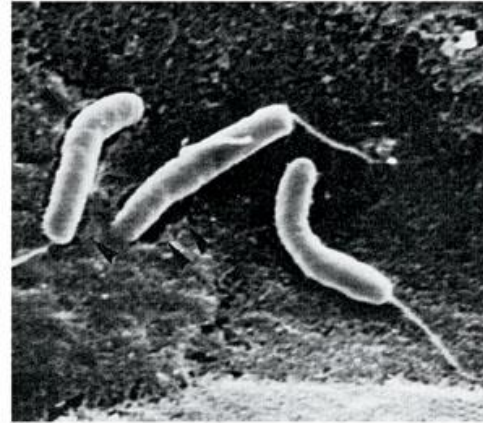
Vibrio cholera

- comma-shaped (curved rods), aerobic , motile, oxidase positive .
- Vibrios may become straight rod that resemble the gram negative enteric bacteria.
- **Caused Cholera** : is an infection of the small intestine caused by the bacterium *Vibrio cholerae*. The main symptoms are **profuse watery diarrhea** and **vomiting**. Transmission is primarily through consuming **contaminated drinking water or food**.
- **top 7 causes of morbidity & mortality**
- **infectious dose 10⁸**
- **infects surface of small intestine, noninvasive**
- **cholera toxin causes electrolyte & water loss through secretory diarrhea, resulting dehydration leads to muscle, circulatory, & neurological symptoms**
- **treatment:** oral rehydration, tetracycline
- **Vaccine:** A number of safe and effective oral vaccines for cholera are available

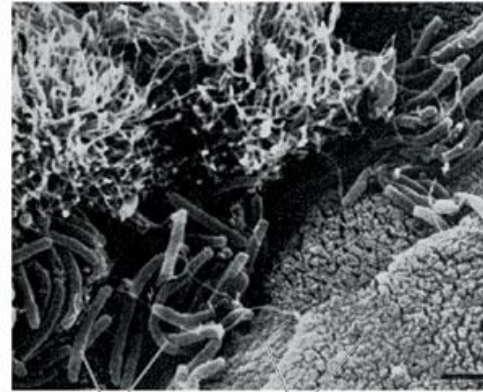
Vibrio cholerae



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(a)



(b)

Vibrios

Villus surface

symptoms

- The primary symptoms of cholera are **profuse painless diarrhea** and **vomiting** of clear fluid. These symptoms usually start **suddenly**, one to five days after ingestion of the bacteria. The diarrhea is frequently described as "**rice water**" in nature and may have a fishy odor. An untreated person with cholera may produce 10-20 liters of diarrhea a day. For every symptomatic person there are 3 to 100 people who get the infection but remain asymptomatic.
- If the severe diarrhea and vomiting are not aggressively treated it can, within hours, result in **dehydration** and **electrolyte imbalances**. The typical symptoms of dehydration include **low blood pressure**, **poor skin turgor** (wrinkled hands), **sunken eyes**, and a **rapid pulse**.

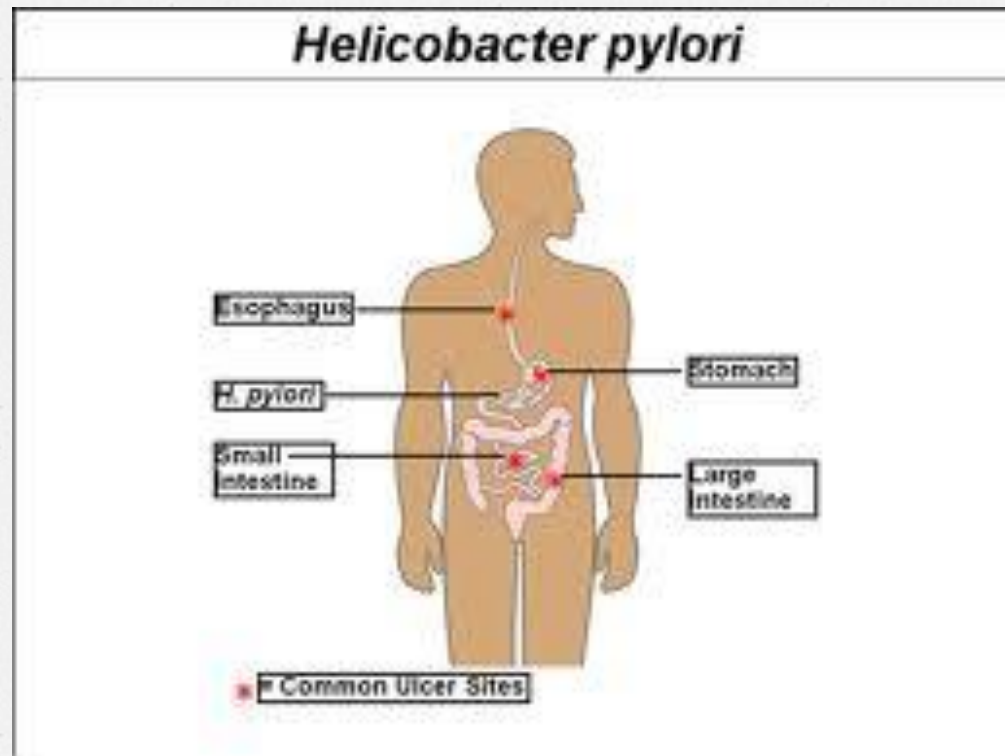
other Vibrio

- o salt-tolerant inhabitants of coastal waters, associate with marine invertebrates
- o *Vibrio parahaemolyticus* – caused acute gastroenteritis from raw seafood
- o *Vibrio vulnificus* – can caused severe wound infections, bacteremia , probably gastroenteritis

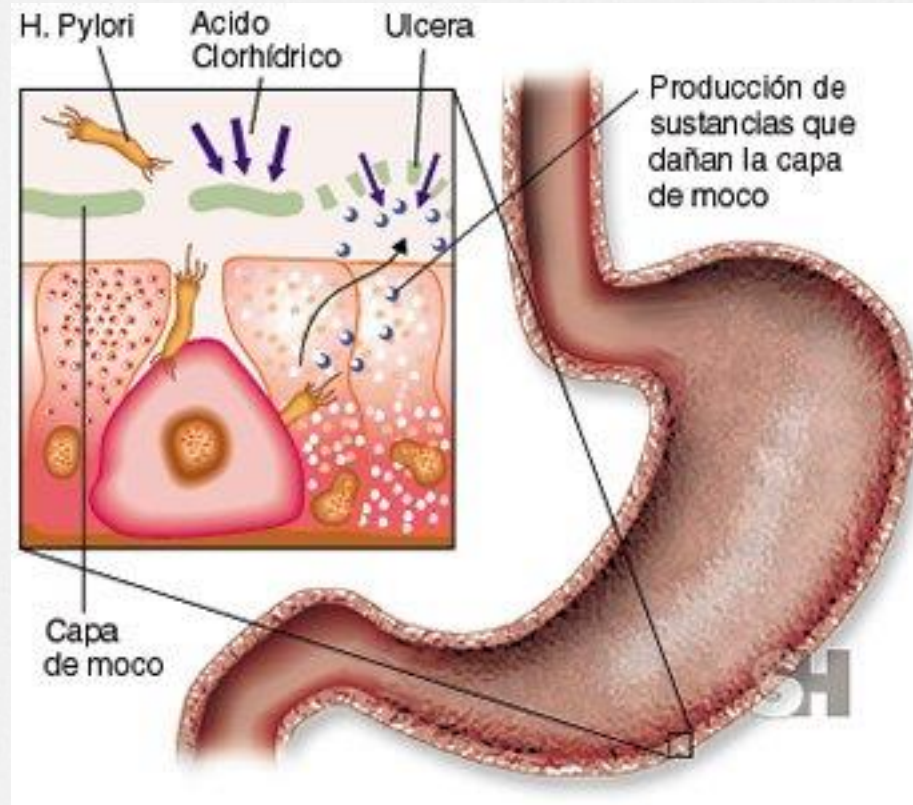
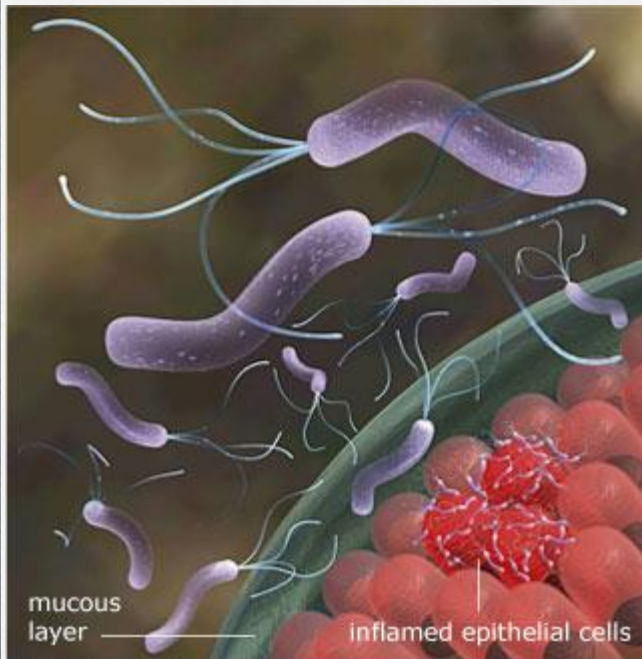
Helicobacter pylori

- o Spiral shaped gram negative bacteria rods, oxidase and catalase positive
- o curved cells discovered in 1979 in stomach biopsied specimens
- o **microaerophilic bacterium** that can inhabit various areas of the stomach. It causes a chronic low-level inflammation of the stomach lining and is strongly linked to the development of **duodenal** and **gastric ulcers** and **stomach cancer**. Over 80% of individuals infected with the bacterium are asymptomatic.
- o causes 90% of stomach & duodenal ulcers
- o people with type O blood have a 1.5-2X higher rate of ulcers
- o produces large amounts of urease
- o May be a major risk factor for gastric cancer

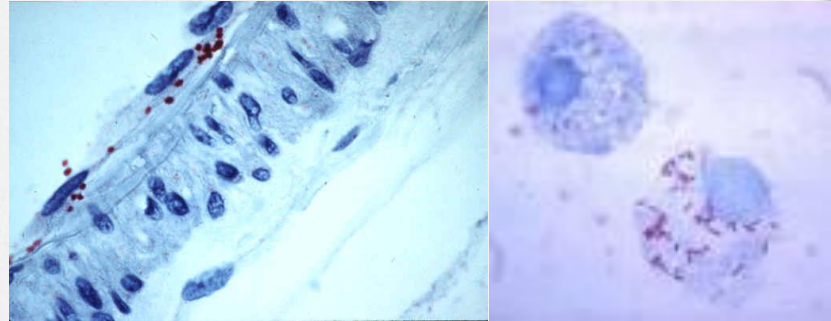
- Toxins and lipopolysaccharide may damage the mucosal cells, and the ammonia produced by the urease activity may directly damage the cells also.



Helicobacter pylori



Rickettsia

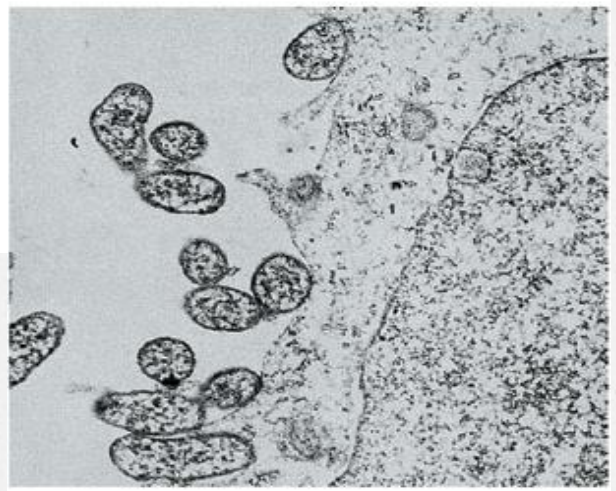
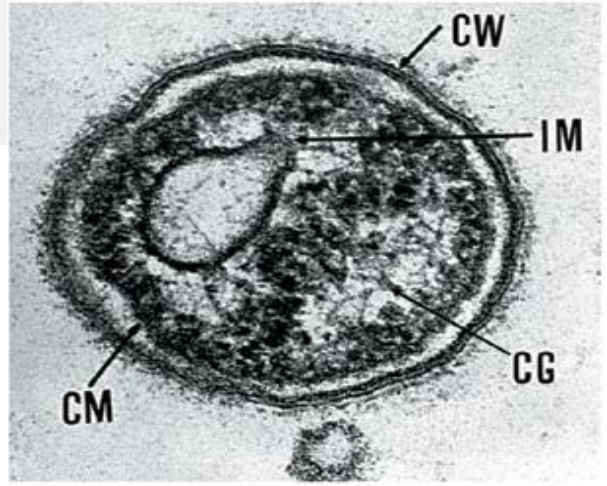
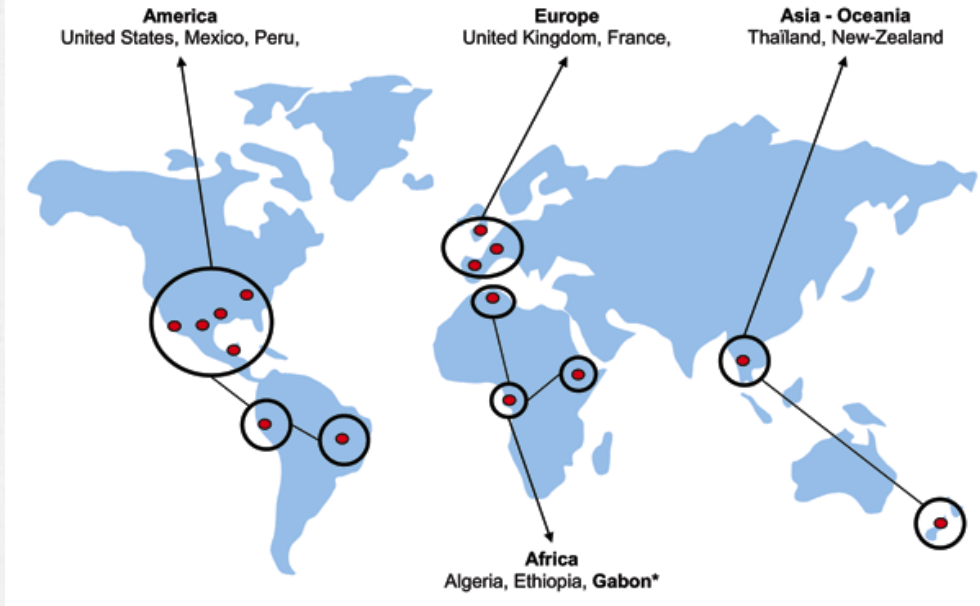


- o obligate intracellular parasites
- o gram-negative cell wall
- o among the smallest bacteria (0.1um)
- o nonmotile pleomorphic rods or coccobacilli
- o ticks, fleas & louse are involved in their life cycle
- o bacteria enter endothelial cells & cause necrosis of the vascular lining – vasculitis, vascular leakage & thrombosis
- o treat with tetracycline & chloramphenicol

4 types of rickettsioses

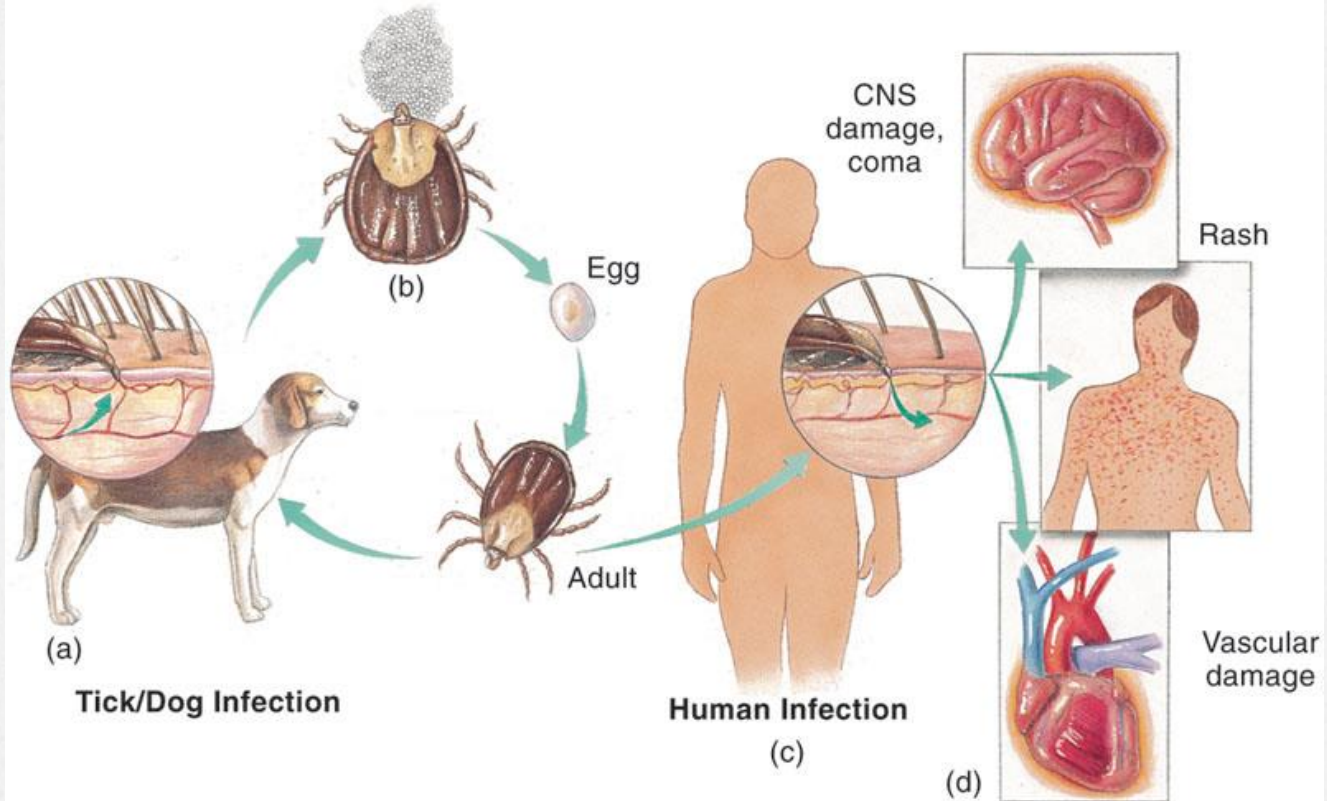
1. **epidemic typhus** – *R. prowazekii* carried by lice; starts with a high fever, chills, headache, rash.
2. **endemic typhus** – *R. typhi*, harbored by mice & rats; occurs sporadically in areas of high flea infestation; milder symptoms
3. **Rocky Mountain spotted fever** – *R. rickettsii* zoonosis carried by dog & wood ticks; most cases on eastern seaboard; distinct spotted rash; may damage heart & CNS
4. ***Ehrlichia*** genus contains 2 species of rickettsias; tickborne bacteria cause human monocytic & granulocytic ehrlichiosis(kill white blood cells)

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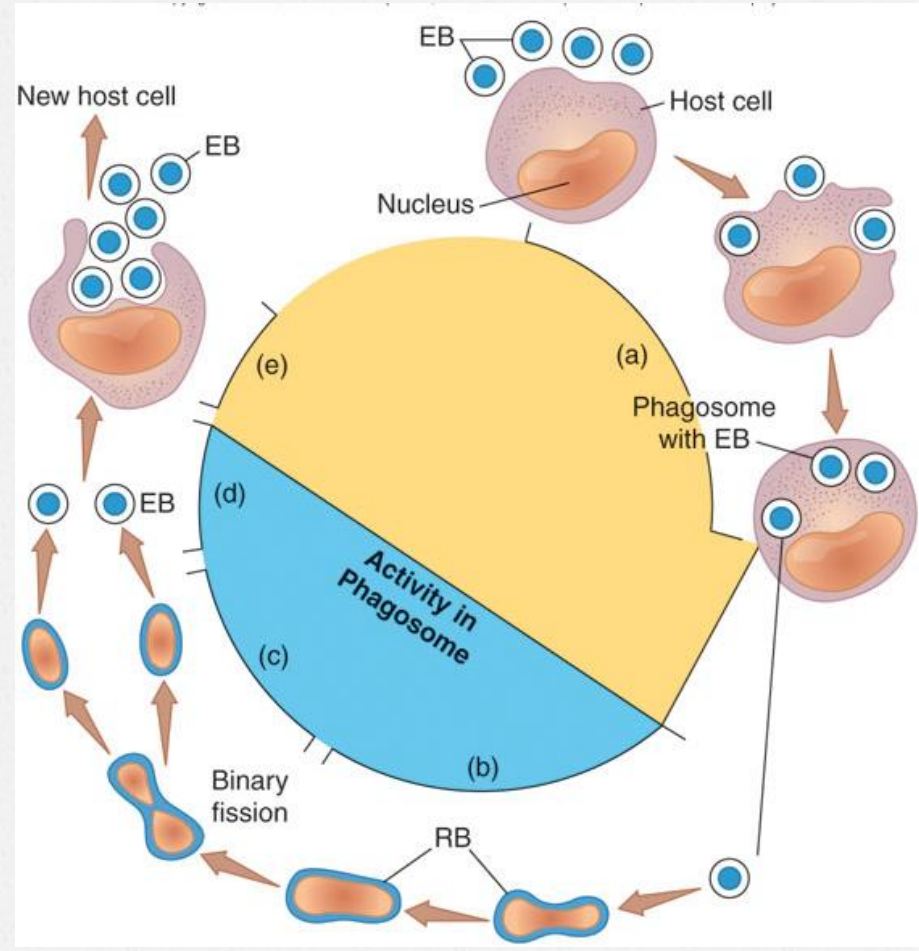


Chlamydia

- o obligate intracellular parasites: lack mechanisms for the production of metabolic energy and cannot synthesize ATP.
- o small gram-negative cell wall
- o alternate between 2 stages
 - o elementary body – small metabolically inactive, extracellular, infectious form
 - o reticulate body – grows within host cell vacuoles

elementary bodies *Chlamydia*

EB= ELEMENTARY BODIES



Chlamydia trachomatis

- STD – urethritis, cervicitis, infertility, scarring
- ✘ Trachoma – is an ancient eye disease, attacks the mucous membranes of the eyes, genitourinary tract & lungs
 - + ocular trachoma – severe infection, deforms eyelid & cornea, may cause blindness
 - + inclusion conjunctivitis – occurs as babies pass through birth canal.

Chlamydia trachomatis

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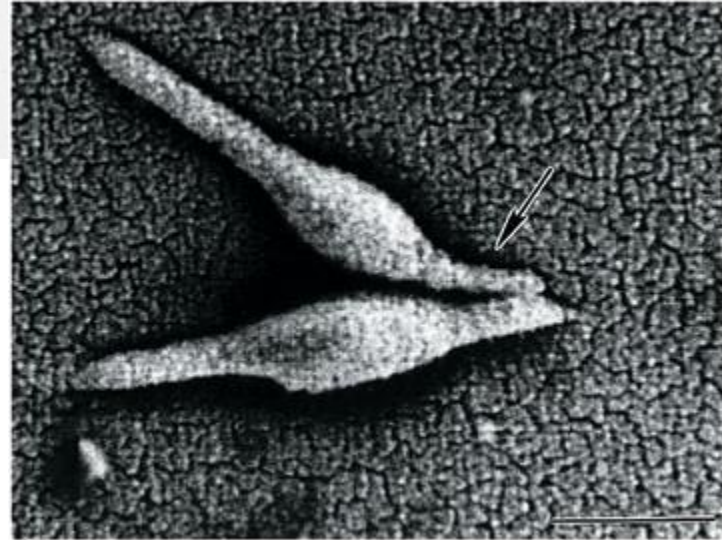
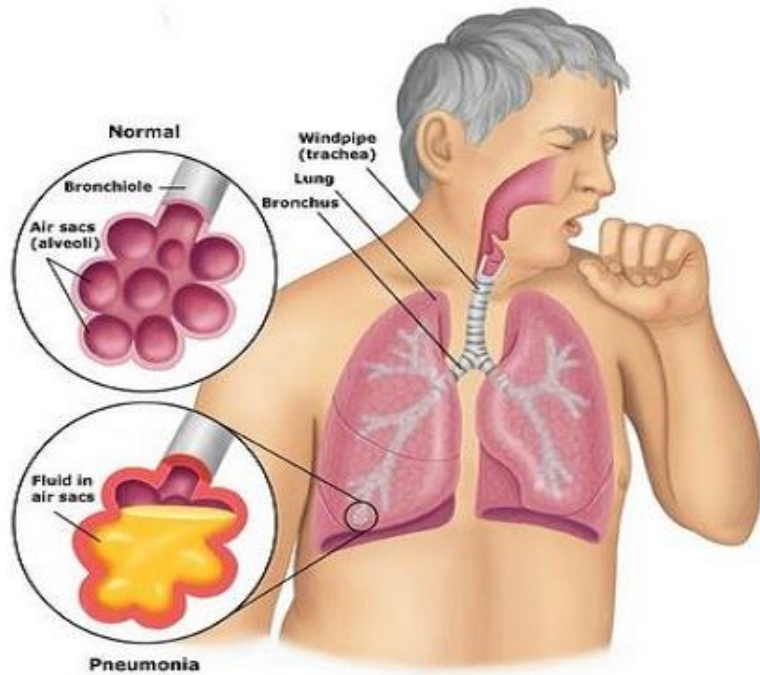
(a)



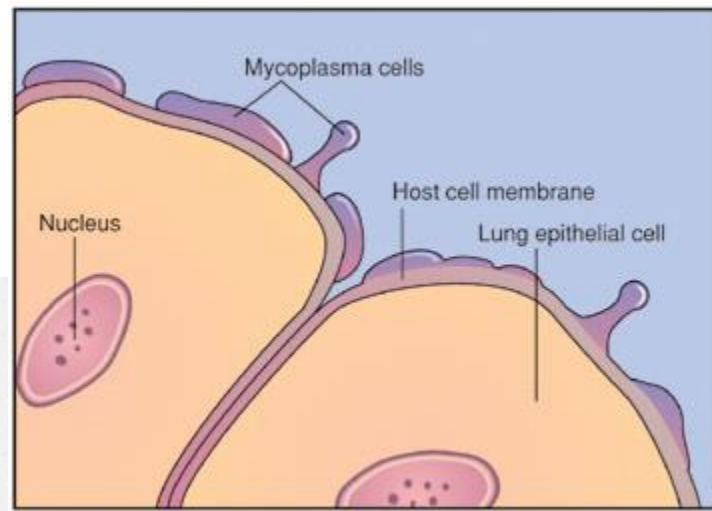
(b)

Mycoplasma

- ✗ naturally lack cell walls, highly pleomorphic
- ✗ require special lipids from host membranes
- ✗ treated with tetracycline, erythromycin
- ✗ *M. pneumoniae* – primary atypical pneumonia; pathogen slowly spreads over interior respiratory surfaces, causing fever, chest pain & sore throat.
- ✗ *M. hominis* & *Ureplasma urealyticum* – weak sexually transmitted pathogens



(a)



(b)

9