

GRAM POSITIVE BACILLI

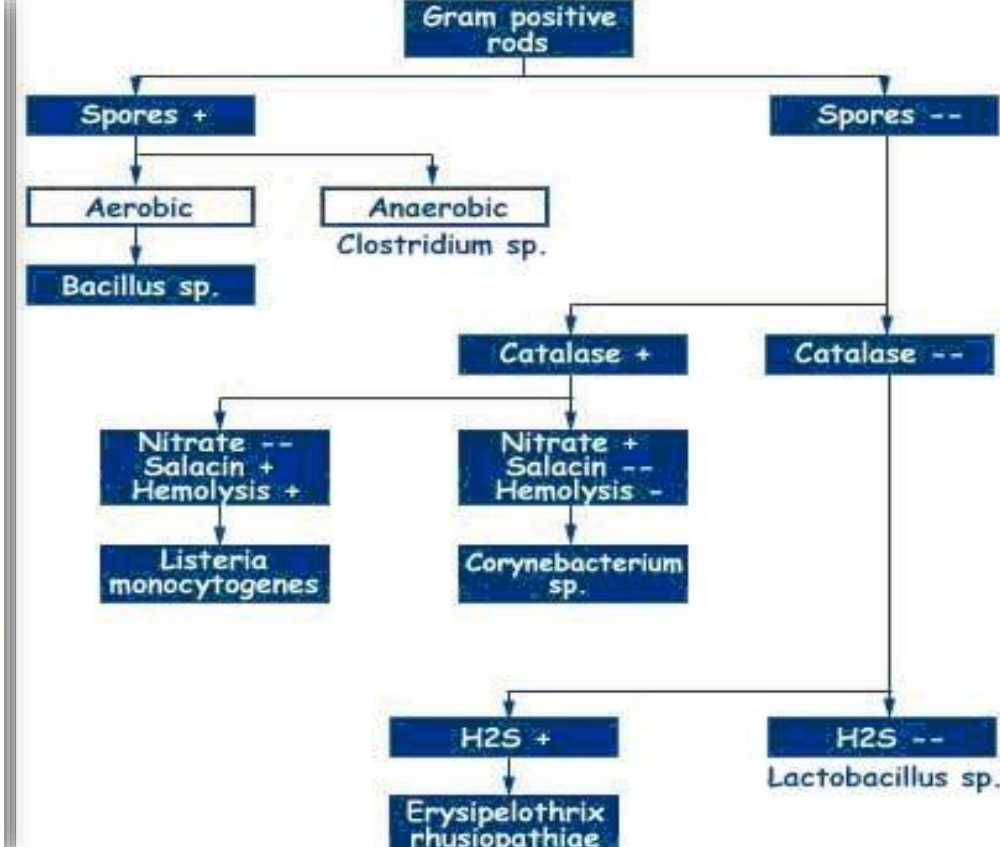
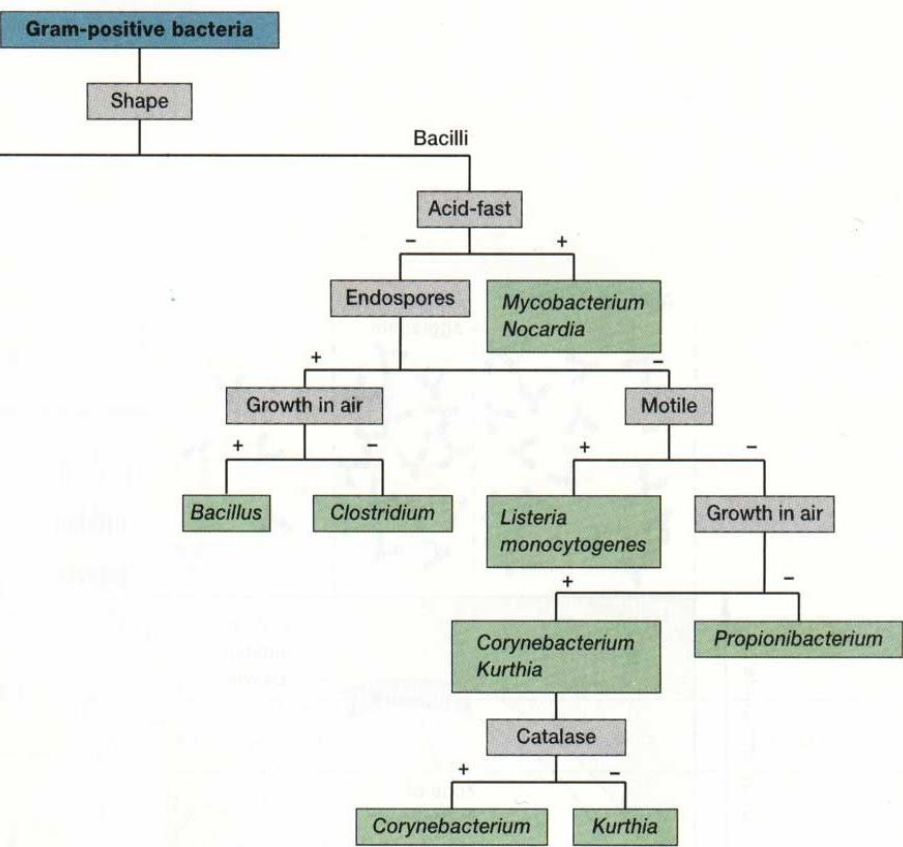
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Gram Positive Bacilli



GRAM POSITIVE BACILLI

- *Clostridium tetanus, botulinum, perfringens*
- *Bacillus anthracis, cereus, subtilis*
- *Corynebacterium diphtheriae*
- *Listeria monocytogenes*
- *Mycobacterium tuberculosis, leprae*

CLOSTRIDIUM

GRAM-POSITIVE

- bacillus-shaped (rod), club-shaped(endospores form club end)
- **Obligate anaerobe**, catalase negative
- **All species form endospores.**
- **All have a strictly fermentative**
- Widely distributed, especially in soil
 - Play important role in biodegradation
- Vegetative cells are killed by exposure to O₂, but their endospores are able to survive long periods of exposure to air.
- Known to produce a variety of toxins, some of which are fatal.

Clostridium tetani = agent of **tetanus**

C. botulinum = agent of **botulism**

C. perfringens = one of the agents of **gas gangrene**

C. difficile = part of natural intestinal flora, but resistant strains can proliferate and cause **pseudomembranous colitis**.



C. tetani

CLOSTRIDIUM TETANI

- ⊙ Soil/Vagina/ Intestine (gastrointestinal tracts of animals(sheep, cattle, dogs, horses....))
- ⊙ Drum stick appearance
- ⊙ Motile with peritrichous flagella
- ⊙ Obligatory anaerobes
- ⊙ Form terminal endospores
- ⊙ Grow on Robertson's cooked medium

Cause tetanus in both man and animals disease which effect the nervous system of the host.

- Agricultural workers and gardeners are more prone **because**
- the spores are present in the soil.
- At birth under unhygienic conditions baby's can get - tetanus neonatorum.



◎ Susceptibility :

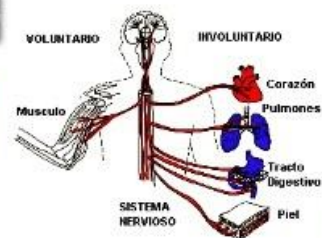
Some strains can withstand boiling for 3hrs/dry heat 160°C for 1hr. but all will destroy at $121^{\circ}\text{C}/15$ min.

TETANUS

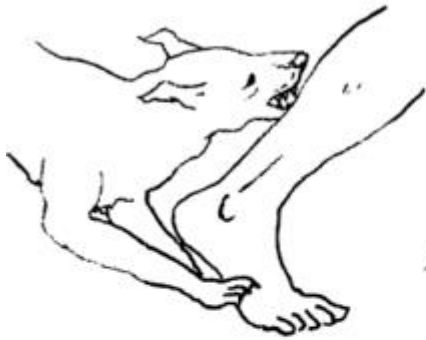
- ◉ *local tetanus* (in the proximity of the wound).
- ◉ *Ascending tetanus* - when toxins spreads upwards along the spinal cord towards C.N.S. Gives generalized spasms.
- ◉ *Descending tetanus* - when toxin is given IV , spasms will appear in the muscles of the head, neck and spreads downwards.



Cuadro clínico Tétanos GENERALIZADO



animal bites, especially those of dogs and pigs



gunshot and knife wounds



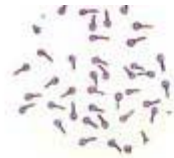
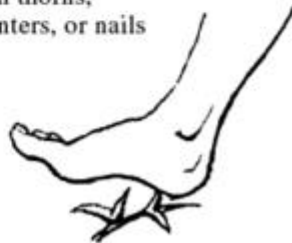
holes made with dirty needles



injuries caused by barbed wire



puncture wounds from thorns, splinters, or nails



Clostridium tetani: gram-positive, spore-bearing rods

Organisms enter through large, small, or even unrecognized wound. Deep, infected punctures are most susceptible, since organisms thrive best anaerobically.

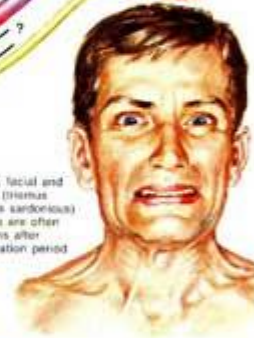


Toxin produced locally passes via bloodstream or along nerves to central nervous system



Motor neurons of spinal cord (anterior horn) and of brainstem become hyperactive because toxin specifically attacks inhibitory (Renshaw) cells

Spasm of jaw, facial and neck muscles (trismus [lockjaw], risus sardonicus) and dysphagia are often early symptoms after variable incubation period



© CMA



Complete tetanic spasm in advanced disease. Patient rigid in moderate opisthotonos, with arms extended, abdomen boardlike. Respiratory arrest may occur

What happens....?

- ◎ Toxin acts at the synaptic junction – prevent the synthesis of acetylcholine. Thus, prevents synaptic transmission.

TREATMENT & PREVENTION

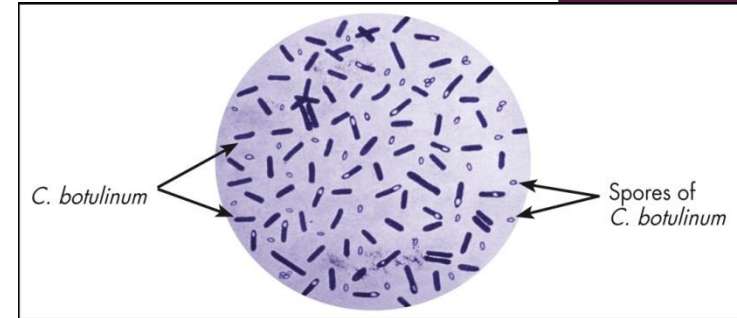
Treatment: Antitoxins plus muscle relaxants

Prevention: Vaccination with tetanus toxoid

(DTP: diphtheria-tetanus-pertussis) Every 10 years

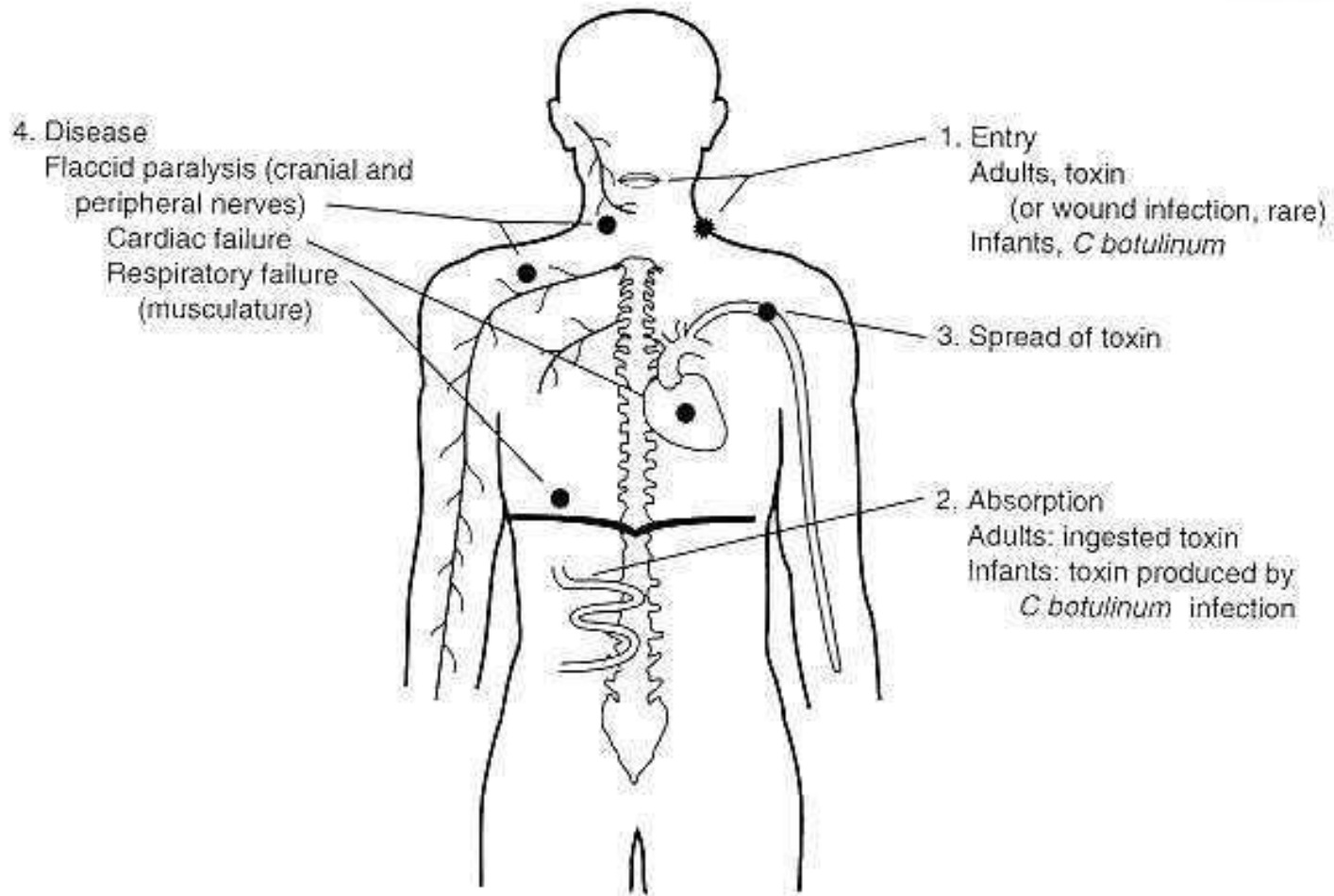
CLOSTRIDIUM BOTULINUM

- ⦿ (anaerobic, intoxication),
- ⦿ **Forms sub-terminal endospores**
 - A few nanograms of toxin can cause illness
- ⦿ **Widely distributed in nature**
- ⦿ **Spores are heat resistant**
- ⦿ **Nature or low acid environments**
- ⦿ **High mortality rate**
- ⦿ **Associated with inadequately processed home canned food**
- ⦿ Almost any type of food that is not very acidic ($\text{pH} > 4.6$) can support growth and toxin production



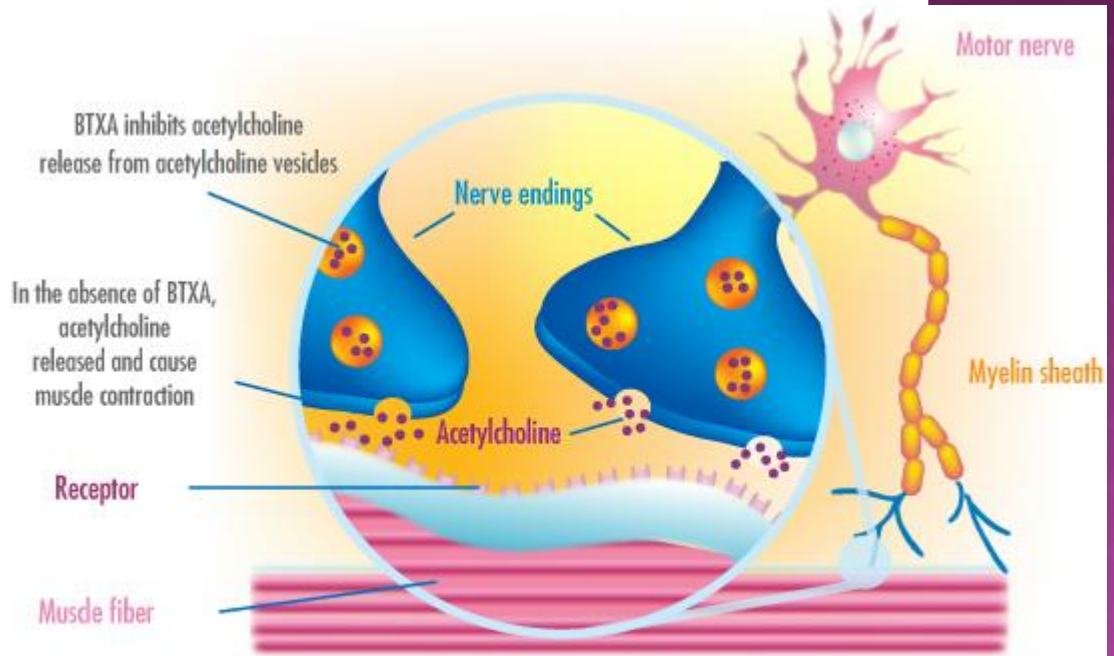
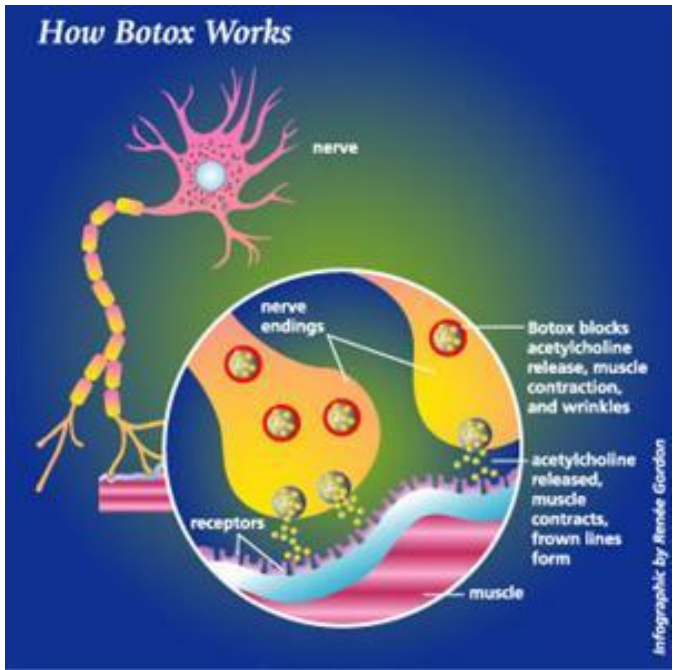
TYPES

- ◉ Food-borne (common)
- ◉ Wound(very rare)
- ◉ Infant(infection in the bowels of infant, common source is honey)
- ◉ Unidentified



SYMPTOMS

- ⦿ Symptoms begins 8-36 hours after ingestion
- ⦿ Weakness, dizziness, dryness of mouth, nausea, vomiting
- ⦿ Blurred vision, inability to swallow, difficulty in speech, descending weakness of skeletal muscles and respiratory paralysis



BTXA Mechanism of Action

PREVENTION

- ⦿ Proper food handling and preparation80C for 10 minutes or longer.
- ⦿ Manufactures use thermal processes designed to destroy spores.
- ⦿ Processors add salt or nitrites to reduced growth or reduce pH.

CLOSTRIDIUM PERFRINGENS

GAS GANGRENE DISEASE

Gram positive bacillus

- Anaerobic, **non-motile**
- Lives in soils and sediments
- Can cause **invasive infections**: Gas gangrene and myonecrosis
- **Four lethal toxins**: Alpha(lecithinase)+the theta toxin has similar hemolytic and necrotizing effects
..DNase and hyaluronidase, a collagenase

Due to a range of tissue destructive enzymes (toxins) produced by the bacteria

- Develops in tissue devoid of blood due to infarction, trauma or peripheral vascular disease
- Tissue blackens and liquifies and gas is produced causing bloating



Clean wound



Gangrenous wound



FOOD POISONING OF *CLOSTRIDIUM PERFRINGENS*

One of the most common **food-borne** illnesses in the west...



CLOSTRIDIUM PERFRINGENS

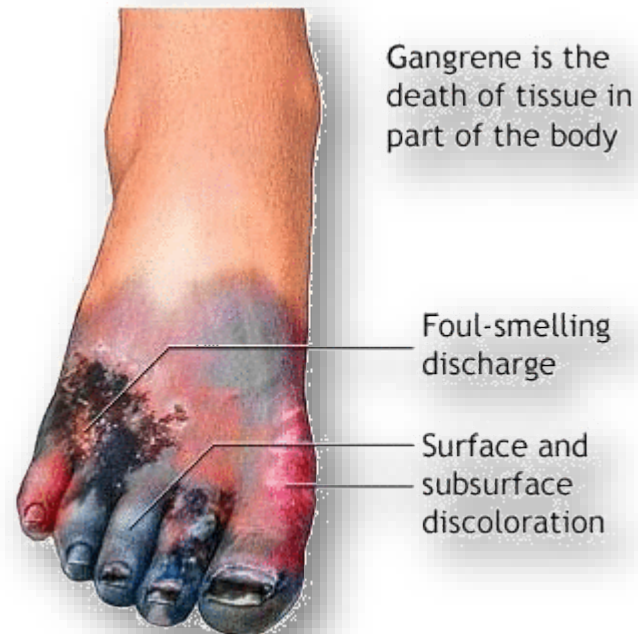
Virulence factors

- ◉ Damage to skin required for gas gangrene

Factors assisting colonization

- ◉ • Enzymes - collagenases, lecithinases, proteases, hyaluronidase
- ◉ • Haemolysins
- ◉ • Toxins - lethal necrotizing

Toxins: Enterotoxins



PREVENTION & TREATMENT

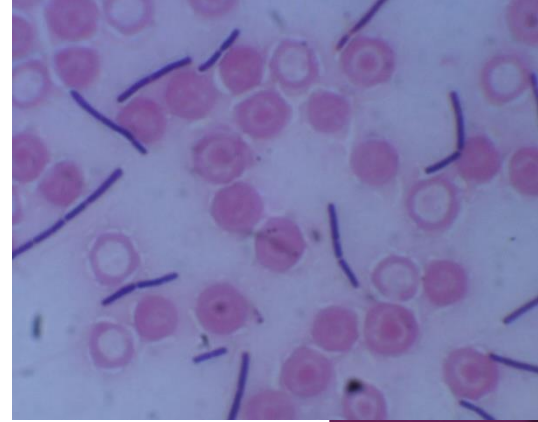
Prevention:

- Handling foods properly especially meats
- Proper care of wounds and cut
- Use of correct temperatures when cooking and cooling food
- Must be cooled quickly and reheated to 165C again

Treatment:

- Penicillin and other antibiotics are used for gas gangrene and wound infections
- Surgery is used for cases in which severe tissue damages occur
- Keep hydrated

BACILLUS



Gram..... rods

Obligate or facultative

- Spore-forming (endospores)

- Found in nature. Widely distributed in soil
- More than 60 species
- Large bacilli
- Catalase positive
- Most are saprophytic and are isolated as contaminants
- *Bacillus anthracis* as a major pathogen
- Others are opportunists

. Only a few species cause disease in humans.

- species that synthesize important antibiotics, and enzymes for detergents.

Due to extreme tolerance to both heat and disinfectants, used to test heat sterilization techniques and chemical disinfectants.

Bacillus anthracis

Gram + bacilli, spore-forming bacterium

Infection can occur in three forms:

- cutaneous (skin)
- inhalation
- gastrointestinal

Transmission:

Spores can live in soil for many years.

Humans can become infected with anthrax by handling products from infected animals or by inhaling anthrax spores.

produce endospores in presence of O₂ but not *in vivo*, produce capsules *in vivo*

Spores survive boiling up to 10 minutes, but not autoclaving or dry heat, 150° C/60 min

Cutaneous Anthrax Infection:

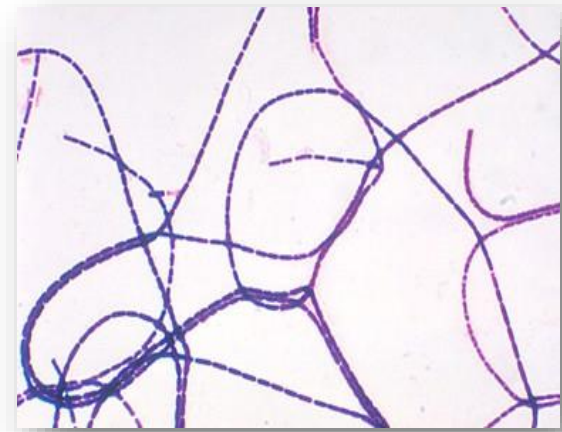
Most (about 95%) anthrax infections occur when the bacterium enters a cut or abrasion on the skin.

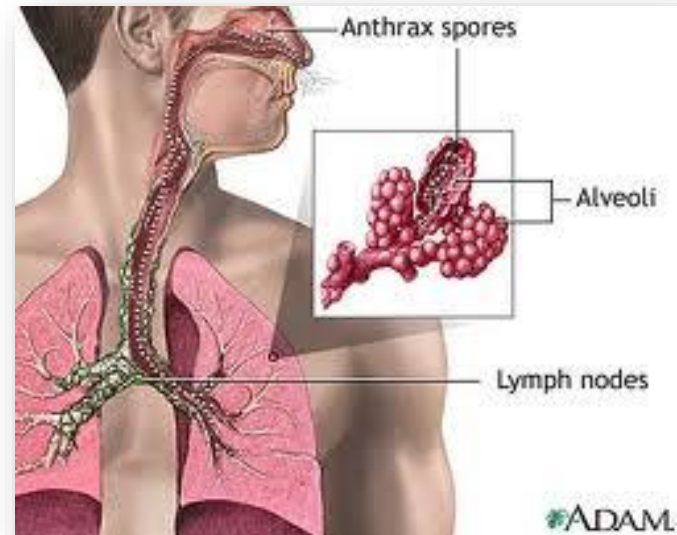
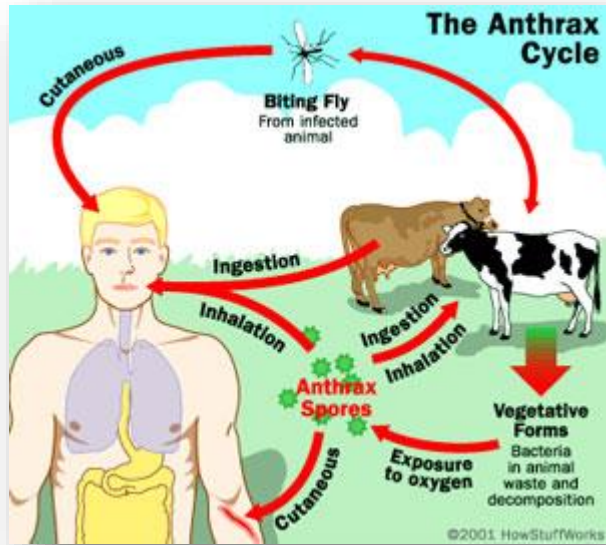
Skin infection begins as a raised itchy bump that resembles an insect bite. Within 1-2 days develops into painless ulcer, with a characteristic black necrotic (eschar)(dying) area in the center.

Septicemia may develop

About 20% of untreated cases result in death.

Virulence factor:.....





TREATMENT, PREVENTION, AND CONTROL

- Ciprofloxacin
- Penicillin, doxycycline, erythromycin or chloramphenicol can be used(if susceptible)
- Vaccination of animal is effective, but human vaccines have limited usefulness

Bacillus cereus

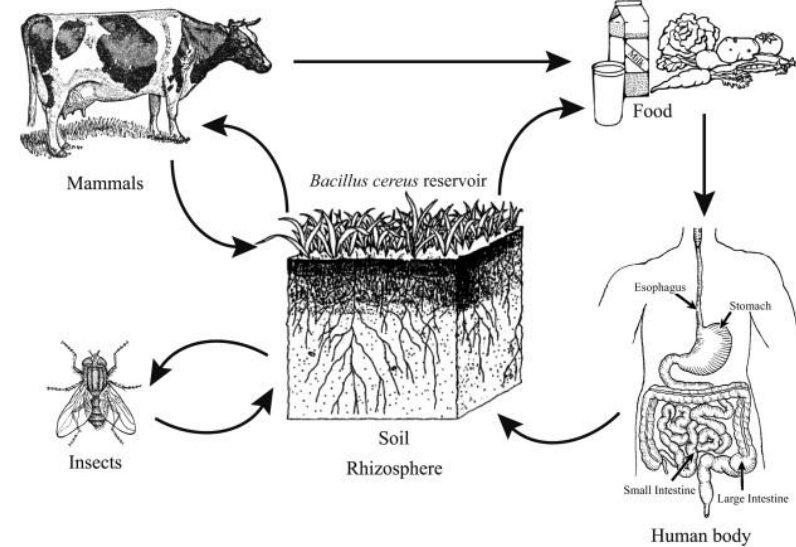
- Causes food poisoning
- An opportunist
- Heat-stable enterotoxin and
- Heat-labile enterotoxin

○ Food poisoning (Gastroenteritis)

- Diarrheal syndrome
 - Associated with meat, poultry, and soups
 - Incubation period of 8 to 16 hours
 - Fever uncommon
 - Resolves within 24 hours
- Emetic form
 - Associated with fried rice
 - Abdominal cramps and vomiting
 - Incubation period of 1 to 5 hours
 - Resolves in 9 hours

○ Infections in the immunosuppressed hosts

- Opportunistic infections of the eye
- Meningitis, septicemia, and osteomyelitis



FOOD POISONING

(Bacillus cereus)



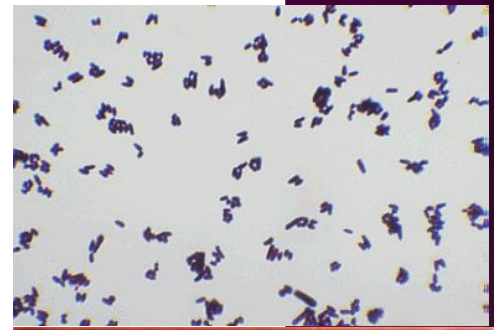
BACILLUS SUBTILIS

- Common laboratory contaminant
- causes disease in severely immunocompromised patients
- It rarely causes food poisoning

Bacillus subtilis

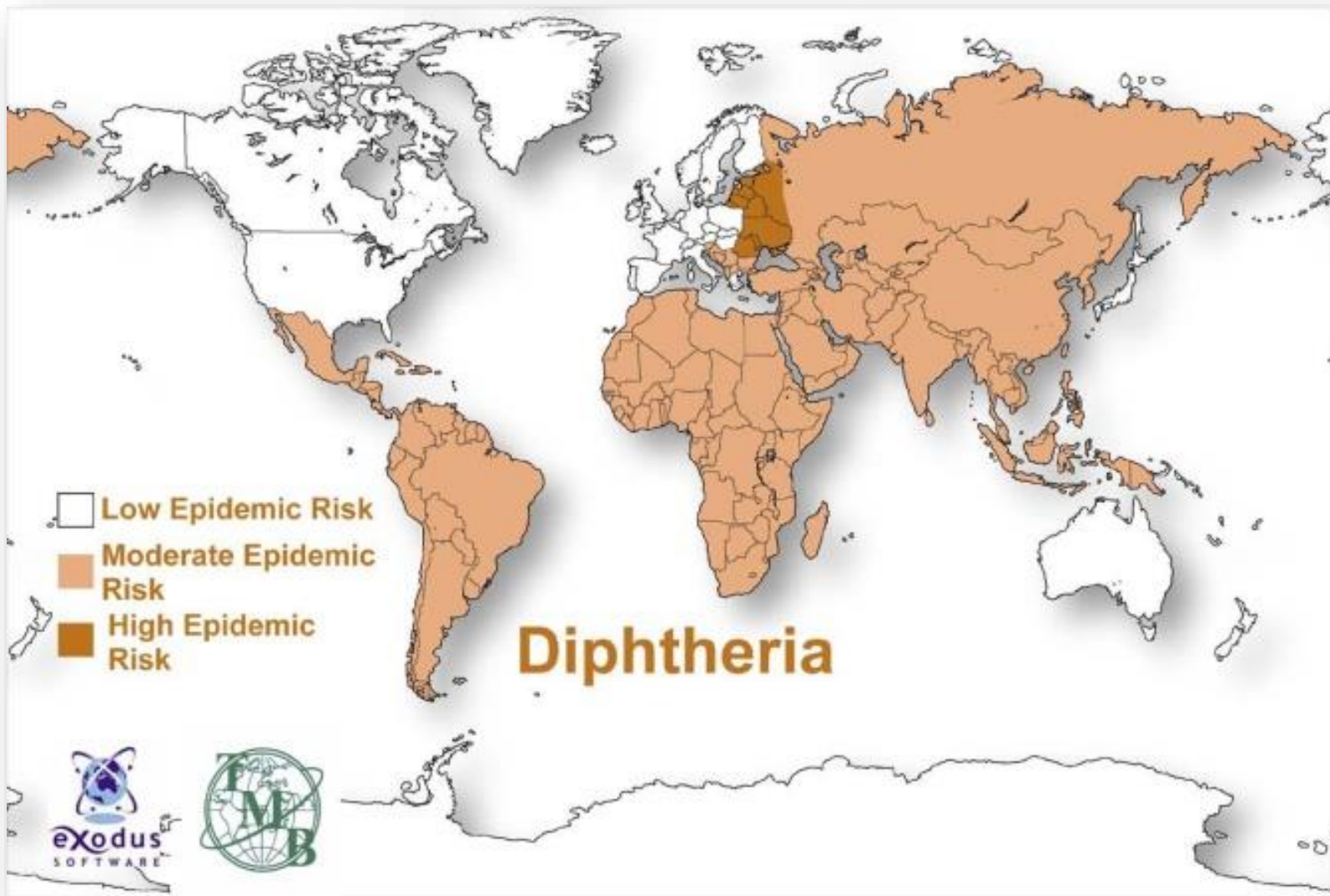


CORYNEBACTERIUM DIPHTHERIAE



- ◉ Gram positive Rods non-spore forming, facultative anaerobic,
- ◉ highly pleomorphic organisms with no particular arrangement
- ◉ • Causative agent of **diphtheria**
- ◉ • Symptoms caused by diphtheria toxin
- ◉ • Vaccine preventable
- ◉ Disease Fever, pharyngitis, cervical
 - Coryneform (diphtheroid) arrangement
 - Metachromatic Granule
 - Frequently found in soil & in the skin flora

Diphtheria toxin: is an exotoxin secreted by *Corynebacterium diphtheriae*, The toxin causes the disease diphtheria in humans by gaining entry into the cell cytoplasm and inhibiting protein synthesis



Diphtheria



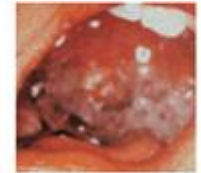
TRANSMISSION & SYMPTOMS

- Airborne; contact with infected persons
- Upper Respiratory Infection
- May Spread into Bloodstream
- Cardiovascular damage

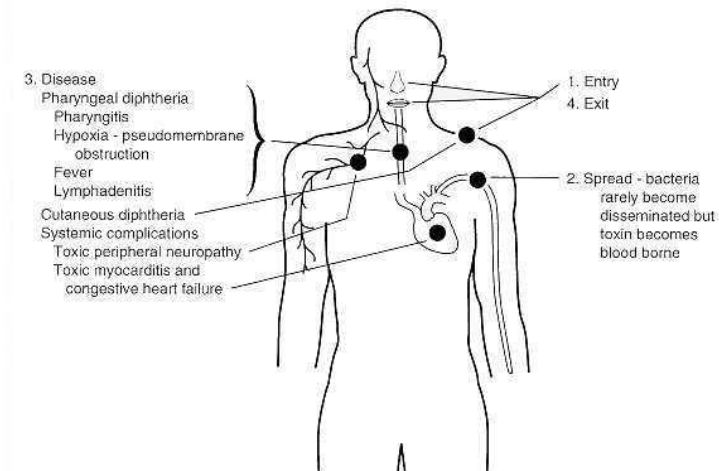
Manifestations



"Bull Neck appearance"



Pseudomembrane formation

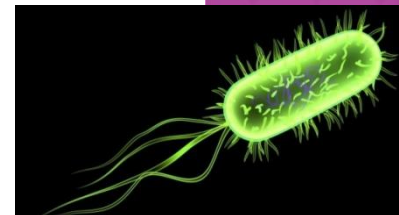
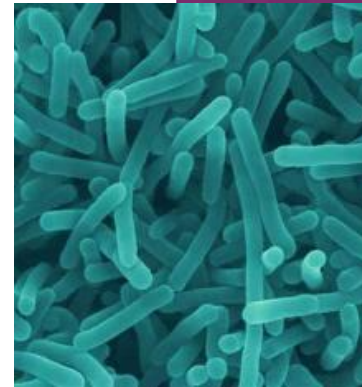


CONTROL AND TREATMENT

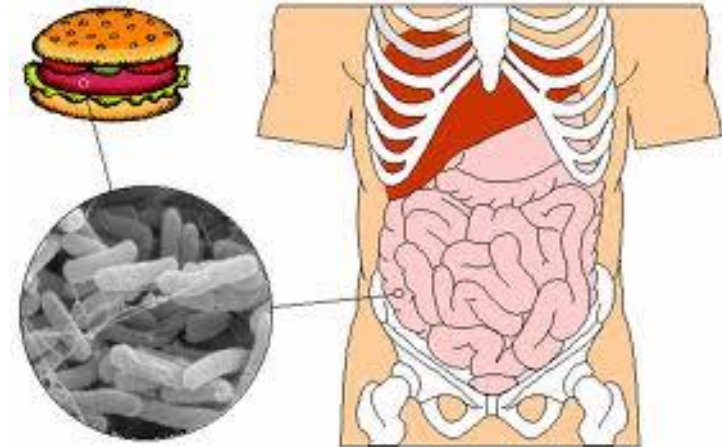
- ◉ Vaccination with diphtheria toxoid vaccine
- ◉ Penicillin, erythromycin or gentamicin

LISTERIA MONOCYTOGENES

- Small Gram-positive rods, Non-spore forming .
- facultative aerobe, acid tolerant, psychrotolerant , salt tolerant
- peritrichous flagella
- Environmentally ubiquitous..... Found in soil; esp in soil contaminated with animal waste
- • Food borne illness
- - Septicemia /meningitis
- - Spontaneous abortion(miscarriage)
- • Affects mainly pregnant women, newborns, elderly and immunocompromised
- **Virulence factors:** Intracellular replication



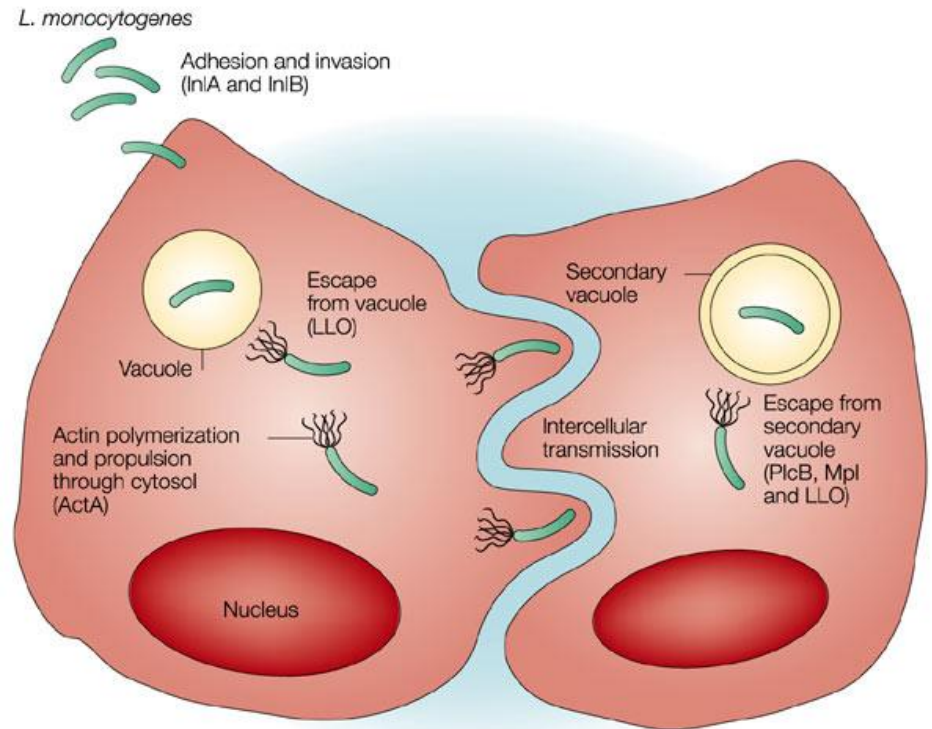
- survives for long periods of time in different environments
- psychrotrophic → cold storage does not inhibit growth
- present in wide variety of foods, milk and dairy products a major source, also raw seafood
- **listeriosis** emerged as one of the major foodborne diseases during the last decade.
- intracellular pathogen, growth in the phagocytes
- **listeriosis** characterized by a variety of severe syndromes
- pregnant women affected in third trimester → spontaneous abortion
- infections of central nervous system
- acute **listeriosis** very rare



LISTERIOSIS

SYMPTOMS

- sudden onset of fever
- • headache
- • backache
- • nausea, vomiting
- • neck stiffness



TRANSMISSION & SYMPTOMS OF LISTERIOSIS

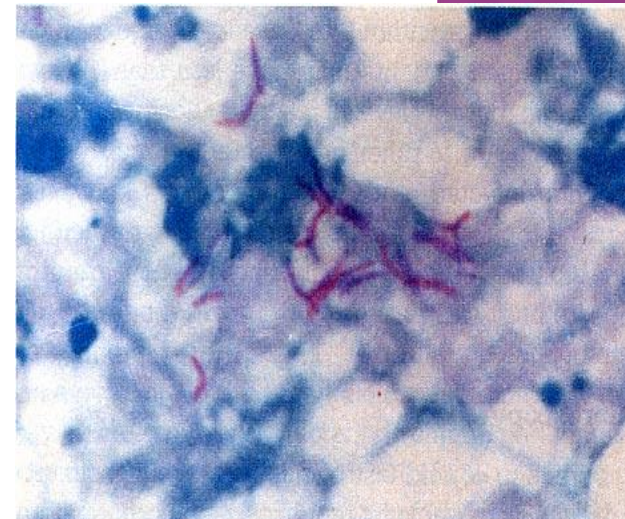
- Contact with contaminated soil
- Also possibly transmitted via contaminated food
- Listeric meningitis
- Blood infection with high white count
- Uterine infections; miscarriage or congenital damage

MYCOBACTERIUM TUBERCULOSIS

- **Properties:** Acid-fast rods
 - Grow slowly; some species are difficult to culture some found in soil and among skin flora
 - *GRAM-variable...?*
 - Doubles population every 18-24 hours

- **Caused tuberculosis:**
- Pulmonary disease (82%)
- Extrapulmonary disease (18%)
- **Frequently infect patients with AIDS**

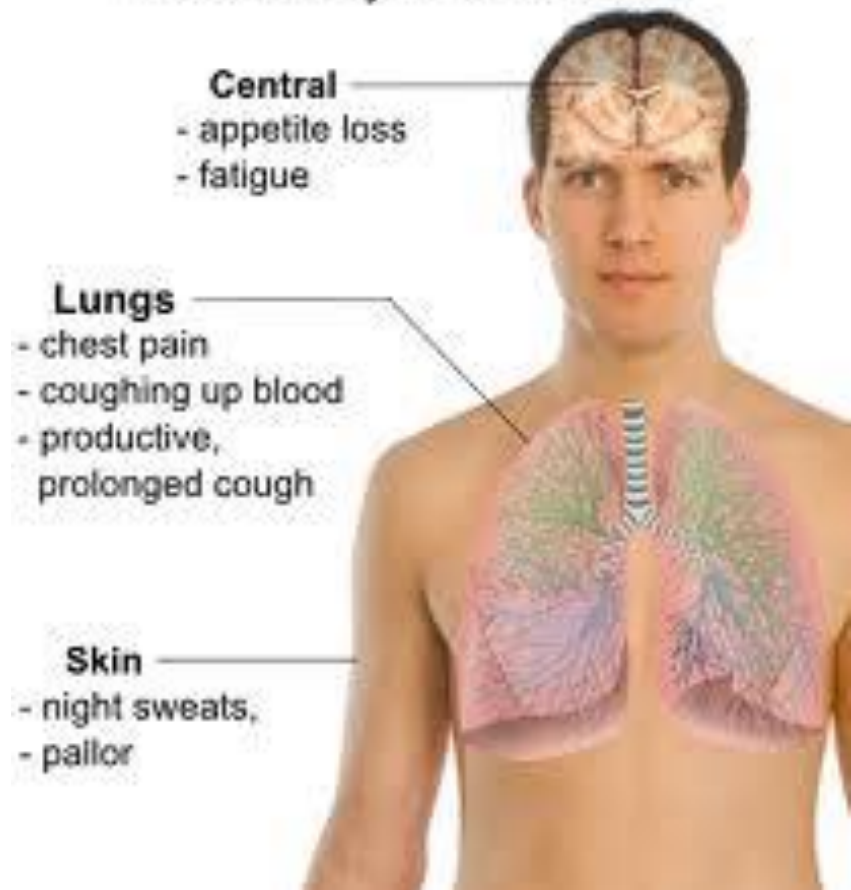
- **Transmission**
 - Airborne Contact
 - Prolonged Exposure
 - Occasionally via skin contact or wounds



Symptoms of Tuberculosis

- Lung Infection
- Destruction of alveoli
- Cough; sputum
- Tubercle Formation
- May remain dormant for years and then become active again
- May spread to other areas of the body

Main symptoms of Pulmonary tuberculosis



TREATMENT (6 MONTHS)

- ◉ *Rifampicin (RIF)*
- ◉ *Pyrazinamide (PZA)*
- ◉ *Streptomycin (STR)*
- ◉ *Isoniazid (INH)*
- ◉ *Ethambutol (EMB)*
- ◉ *First two months (RIF+INH+PZA+EMB)*
- ◉ *Four months (RIF+INH)*

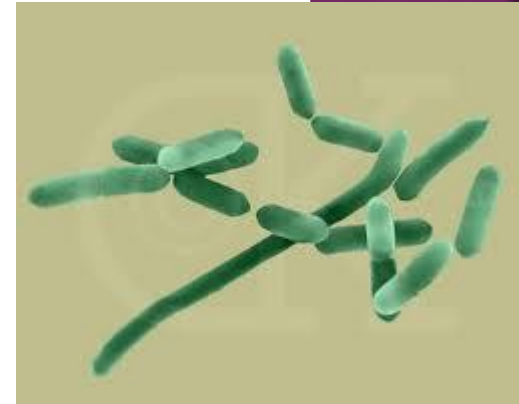
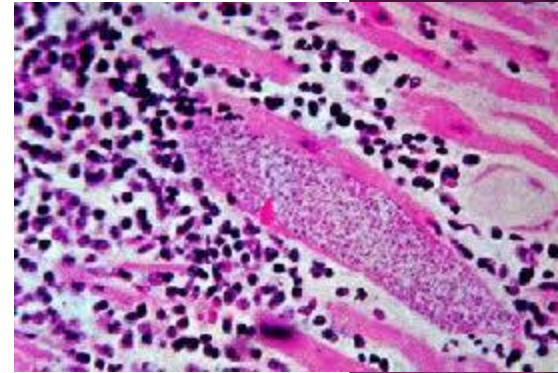
MYCOBACTERIUM LEPRAE

❖ **Caused leprosy**

- Genus Properties: See “**Tuberculosis**”
- Cannot be cultured; detected by skin biopsy
- *M. leprae* doubles population about every 14 days.
- Bacteria are v slow growing
and incubation period may be 5 years

⊙ **Transmission & Symptoms**

- Skin contact; not particularly contagious
- Whitish skin lesions
- Loss of sensation due to nerve damage
- **Disfiguration**(bacteria target Schwann cells, causing nerve damage and hence anaesthesia and paralysis).



Disfiguration of Leprosy



TREATMENT

Dapsone, rifampicin, clofazimine (6-24 months)