Gram-Positive Rods:-

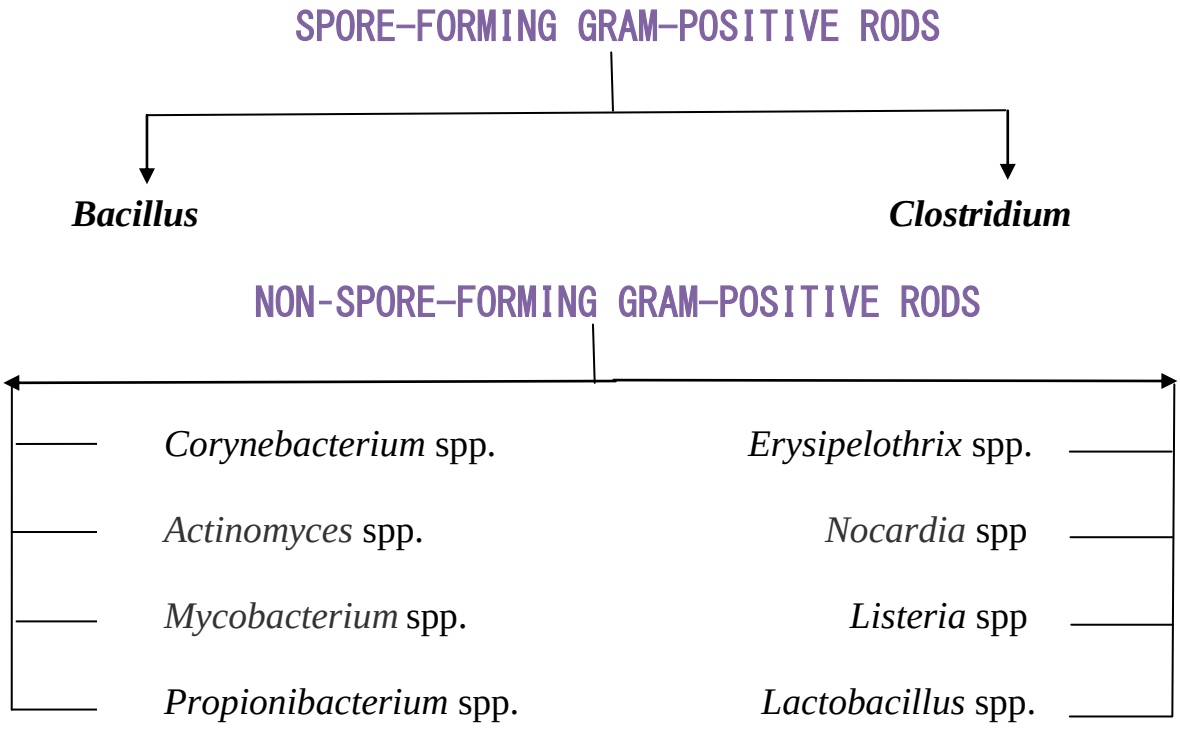
Introduction:

There are some important genera of gram-positive rods:

- *Bacillus* spp.
- *Clostridium* spp.
  - *Bacillus* and *Clostridium* form spores ,whereas other do not form spores:
- *Corynebacterium* spp.
- *Listeria* spp
- *Propionibacterium* spp.
- .*Lactobacillus* spp.
- *Erysipelothrix* spp.
- *Actinomyces* spp.
- *Nocardia* spp.
- *Mycobacterium* spp.

As diagram: (1)

- Diagram :(1)



- **SPORE-FORMIN GRAM-POSITIVE RODS**

- **1- Genus: Bacillus**

  A- Species: Bacillus anthracis

- Distinguishing Features

- Gram (+), spore forming, aerobic rods, Large,boxcar-like, gram-positive, spore-forming rods, Capsule is polypeptide , Potential bioterrorism agent, Contact with animal hides or bioterrorism; eschar or life-threatening pneumonia.

- Reservoir: animals, skins, soils
- Transmission: contact with infected animals or inhalation of spores(bioterrorism)
- Pathogenesis:
  - Capsule polypeptide
  - antiphagocytic
  - immunogenic
  - Anthrax toxin
- Diseases:

1- Cutaneous anthrax: papule with vesicles (malignant pustules) , central necrosis (eschar) with erythematous border often with painful regional lymphadenopathy; fever in 50%

2- Pulmonary (woolsorter's disease): life-threatening pneumonia; cough, fever, malaise, and ultimately facial edema, dyspnea, diaphoresis, cyanosis, and shock with mediastinal hemorrhagic lymphadenitis

3-GI anthrax (rare): edema and blockage of G tract can occur, vomiting and bloody diarrhea, high mortality

- Diagnosis

- Mediastinal widening on chest x-ray
- Gram stain and culture of blood
- respiratory secretions or lesions
- Serology
- PCR

- Treatment: ciprofloxacin or doxycycline.
- Prevention: toxoid vaccine (AVA, acellular vaccine adsorbed) is given to those in high risk occupations such as military; raxibacumab for prophylaxis

B- Species: Bacillus cereus

- **Distinguishing Feature:** Rapid-onset gastroenteritis

Fried rice, Chinese restaurants ,spore forming

- **Reservoir:** found in nature

- **Transmission:**

Foodborne, intoxication, Major association with fried rice from Chinese restaurants, Associated with food kept warm, not hot (buffets)

- **Pathogenesis:** 2 possible toxins:

1- Emetic toxin: preformed fast (1–6 hours), similar to *S. aureus* with vomiting and diarrhea; associated with fried rice

2- Diarrheal toxin produced in vivo (meats, sauces): 18 hours, similar to *E. coli*; LT: increasing cAMP → watery diarrhea

- **Diseases:**
  - Gastroenteritis: nonbloody, ± vomiting
  - Eye infection (rare)
- **Diagnosis:**
  - Clinical grounds
  - Culture and Gram stain of implicated food
- **Treatment:** self-limiting; vancomycin for eye infection

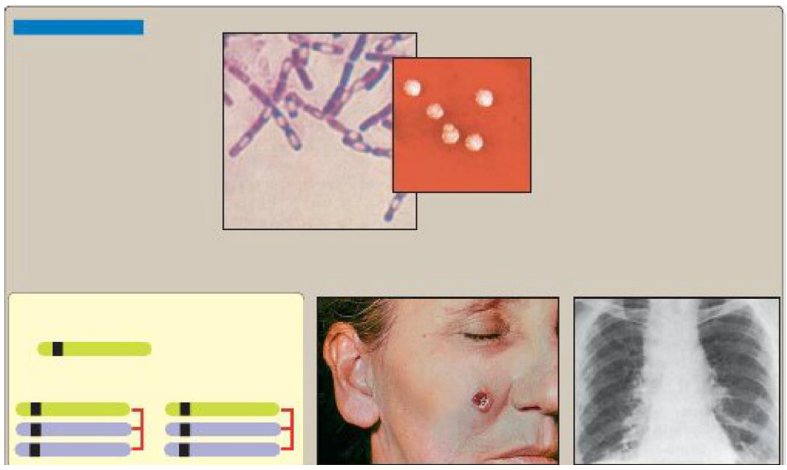


Figure 1 : Summary of anthrax diseases (Bacillu anthracis)

• 2- Genus: Clostridium

- Species of Medical Importance

1- Clostridium tetani
2- *Clostridium botulinum*
3- *Clostridium perfringens*
4- *Clostridium septicum*

5- *Clostridium difficile*

- **1- Clostridium tetani**

Distinguishing Features: Large gram-positive, spore-forming rods; anaerobes; produces tetanus toxin

Reservoir: soil

Transmission: Dirty puncture wounds/trauma (human bites); requires low tissue oxygenation

Pathogenesis:

- Spores germinate in tissues
- producing tetanus toxin (an exotoxin also called tetanospasmin)

Disease:

- tetanus
- Risus sardonicus
- Opisthotonus
- Extreme muscle spasms
- Drooling, hydrophobia

Diagnosis: primarily a clinical diagnosis; organism rarely isolated

Treatment

of Actual Tetanus Hyper immune human globulin to neutralize toxin metronidazole or penicillin, Spasmolytic drugs (diazepam); debride; delay closure

Prevention:

- ✓ Toxoid is formaldehyde-inactivated toxin (important because disinfectants have poor sporicidal action);
- ✓ care of wounds: proper wound cleansing and care plus treatment

- **2- Clostridium difficile**

Distinguishing Features: anaerobic, gram-positive rods Hospitalized patient on antibiotics, Develops colitis, diarrhea

Reservoir: human colon/gastrointestinal tract

Transmission: endogenous

Pathogenesis:

- ✓ Toxin A: enterotoxin damaging mucosa leading to fluid increase; granulocyte attractant
- ✓ Toxin B: cytotoxin: cytopathic

- **Disease(s):** antibiotic-associated (clindamycin, cephalosporins, amoxicillin, ampicillin) diarrhea, colitis, or pseudomembranous colitis (yellow plaques on colon)
- **Diagnosis:** culture is not diagnostic because organism is part of normal flora; stool exam for toxin production
- **Treatment:** Vancomycin for severe disease, metronidazole is alternative, Fecal transplant for chronic infections
  - Discontinuation of other antibiotic therapy for mild disease
- **Prevention:** use caution in overprescribing broad-spectrum antibiotics (consider limited-spectrum drugs first); in nursing home setting, isolate, patients who are symptomatic; use autoclave bed pans (treatment kills spores)

3- Clostridium septicum

- **Distinguishing features:** anaerobic, gram-positive rods
- **Transmission:** endogenous
- **Disease:** septic shock in colon cancer patients

4- Clostridium botulinum

- **Distinguishing Features**
  Anaerobic, Gram-positive spore-forming rods
- **Reservoir:** soil/dust {Vegetables, Home-canned alkaline vegetables, Floppy baby syndrome (infant with flaccid paralysis) Reversible flaccid paralysis}
- **Transmission:** foodborne/traumatic implantation
- **Pathogenesis:**
  Spores survive in soil and dust; germinate in moist, warm, nutritious but nonacidic and anaerobic conditions
- **Disease(s):**
  -Acquisition Preformed toxin, ingested (toxicosis)
  - Poorly canned alkaline,vegetables (green beans)
  -Spores ingested: household dust, honey
  -Toxin produced in gut (toxi-infection)

➢ **References** :

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- Lippincott® Illustrated Reviews: Microbiology, **Fourth Edition, Cynthia Nau Cornelissen, PhD** Department of Microbiology and Immunology School of Medicine Virginia Commonwealth University Richmond, Virginia **Marcia Metzgar Hobbs, PhD.** Departments of Medicine and Microbiology & Immunology School of Medicine University of North Carolina at Chapel Hill, North Carolina **,NEW YORK**