Enterobacteriaceae

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Enterobacteriaceae

- Found in
- soil,
- water,
- vegetable
- and are part of the normal intestinal flora of most animals and humans
Enterobacteriaceae

• Also called:
  – Enteric bacteria
  – Fermentative bacteria
Enterobacteriaceae

- Escherichia coli
- Klebsiella
- Enterobacter
- Proteus
- Citrobacter
- Serratia
- Salmonella
- Shigella
- Yersinia
- Edwardsiella
- Hafnia alvei
- Morganella
- Providencia
- Erwinia
- Kluyvera
- Cedecea
- Ewingella
- Tatumella
Enterobacteriaceae

- **GENERAL CHARACTERISTICS**
- Gram negative bacilli/coccobacilli
- Moderate size 0.5-3 μm
Enterobacteriaceae

- General
- Characteristics
- Motile with peritrichous flagella
- Klebsiella,
- Shigella,
- Yersinia (some species)
- are non-motile)
Enterobacteriaceae

• **General Characteristics**

• Do not form spores

• Many have pili or fimbria (adhesive)

• Some species are encapsulated
  – e.g. Klebsiella
Enterobacteriaceae

• General Characteristics

• Facultative anaerob

• Grow on simple media:
  – Nutrient agar
  – Blood agar
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• General Characteristics

• All enteric bacteria
  – ferment glucose and produce acid,
  – +/- gas
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- General characteristics
- Catalase positive
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- Catalase positive
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- General characteristics
- Oxidase negative
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- Oxidase negative
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• General characteristics
• Reduce nitrat to nitrite
• (Except some strains of yersinia)
Enterobacteriaceae

- Antigenic Structure:
- Somatic O antigen: Induces Ig M
  - Cell wall LPS
  - Heat stable
- H antigen (Flagellar antigen): Induces Ig G
  - Protein
  - Heat-labile
- K antigen (Capsular antigen)
  - Heat-labile polysaccaride
  - Protein: E.coli
  - Polysaccharide: Klebsiella
  - Vi antigen: S. typhi
Enterobacteriaceae/Pathogenesis

Acquisition and transmission of gastrointestinal pathogens

- faeces, from humans or animals containing pathogenic microbes or their toxins
  - food
  - fluids (water, milk)
  - fingers

  Ingestion of organisms and/or toxins

  Gut

  Organisms multiply and toxins produced but infection remains localized in gastrointestinal tract
  - diarrhoea

  Pathogens excreted in faeces

  Organisms invade or toxins absorbed
  - dissemination
  - symptoms of systemic infection (fever, etc.)
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- **VIRULENCE FACTORS**
- **Endotoxin**: Lipid A fraction of LPS
  - Bacteremia
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Exotoxin

• Heat labile enterotoxin
  Adenylate cyclase  cAMP  secretory diarrhea
  e.g. Salmonella, E. coli

• Heat stable enterotoxin
  Guanylate cyclase  cGMP  secretory diarrhea
  e.g. E.coli, Y. enterocolitica

• Shiga and Shiga-like toxins (verotoxin)
  e.g. Shigella, EHEC
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• Exotoxin
  – Hemolysins
  – Especially effective in E.coli infections
  – Most of the uropatogen E.coli release hemolysins
  – Alfa hemolysins are cytotoxic
  – Beta hemolysins are protect neutrophil kemotaxis and phagocytosis
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• Capsule
  – Reduce connection of antibody to the bacteria
  – Protect phagocytosis

• Expression of adhesin factors
  – Colonization factor antigen
    • CFA I, CFA II in E. coli (gastroenteritis)
  – P fimbriae: Uropathogenic E. coli

• Intracellular survival and multiplication
  – Salmonella, Shigella, EIEC, Y. enterocolitica
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- Laboratory Diagnosis

- Direct microscopy
  - Gram stain
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• **Culture Media:**

• Blood agar
  – EMB, endo, MacConkey agar
  – Selenite F SS: Salmonella-Shigella
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- Colony morphology:
  e.g. Klebsiella mucoid

- Motility:
  e.g. Proteus swarming
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- **Lactose fermentation:**
  EMB, endo, MacConkey
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- Production of acid and gas: Triple Sugar Iron (TSI), fermentation medium
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- H$_2$S production:
- Hydrogen sulphide
- TSI,
- SS,
- Urease test
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- IMVIC:
  - Indole production
  - Methyl red test
  - Voges-Proskauer test
  - Citrate utilization
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- Indole Test: +
- Methyl Red Test: +
- VP Test: +
- Citrate Agar: +
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General properties of E. coli:

- Lactose positive
- Colony with a methalic sheen on EMB agar
- IMVICT ++--
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Infections of E. coli

Gastrointestinal infections

- ETEC (Enterotoxigenic E. coli)
- EIEC (Enteroinvasive E. coli)
- EPEC (Enteropathogenic E. coli)
- EHEC (Enterohemorrhagic E. coli)
  - e.g. E. coli O157 H7
- Enteroadherent E. coli
  - EA ggEC (Enteroaggregative E. coli)
  - DAEC (Diffusely adherent E. coli)
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Infections of E.coli:

• Extraintestinal infections:
  – Neonatal meningitis
  – Urinary tract infections
  – Septicemia
  – Pneumonia
  – Osteomyelitis
  – Nosocomial infections
  – Sinusitis, otitis media
Enterobacteriaceae

• General properties of Enterobacter spp.
  – Lactose positive
  – Motile
  – IMVIC --++

• Infections:
  – Urinary tract infections
  – Meningitis
  – Septicemia

Resistance to antibiotics
Enterobacteriaceae

- **General properties of Klebsiella spp.**
  - Lactose positive
  - Non-motile
  - Mucoid colony
  - IMVIC --++

- **Infections:**
  - Community acquired lobar pneumonia (Friedlaender pneumonia): Ages <2 and >40
  - Urinary tract infections
  - Wound and soft tissue infections
Enterobacteriaceae

- **General properties of Proteus spp.**
  - Urease positive
  - Motile, swarming
  - Smell like sewage

- **Infections:**
  - Urinary tract infections
  - Meningitis
  - Septicemia
Don’t forget

stop and sanitize

Clean hands save lives!

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