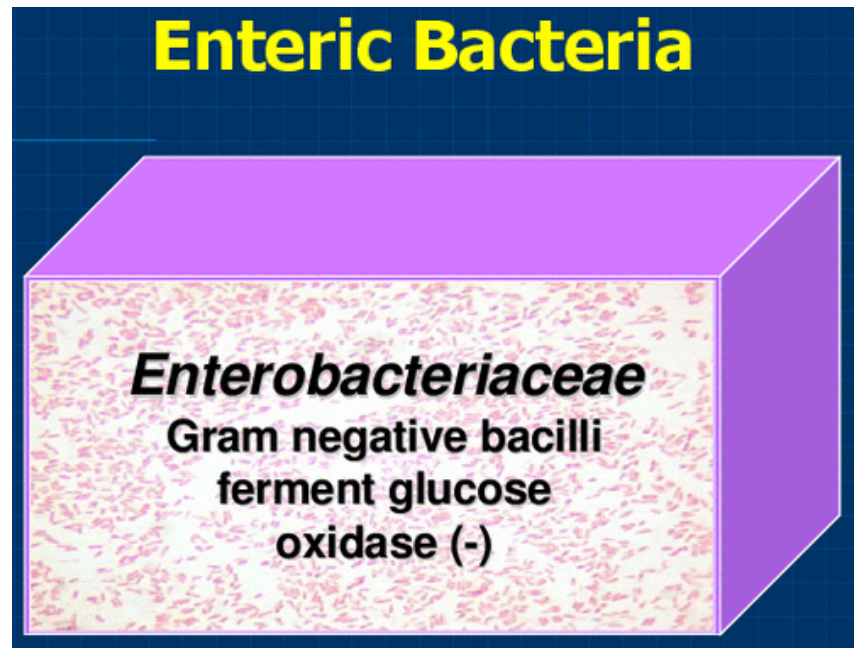


Medical Bacteriology – Lecture 16



Enterobacteriaceae

- Gram-negative rods
- Oxidase negative
- largest group of human pathogens
- **Found as** normal flora in intestinal tract of humans and animals
- environmental sites (soil, water and plants).
- aerobic, facultative anaerobic bacteria.
- Motile or non-motile
- Can diagnosis on selective and differential media
- Most are reduce nitrates to nitrites
- All ferment glucose with strong acid production and often gas.
- Endotoxin.
- Some release exotoxin.
- Wide biochemical and antigenic heterogeneity

Enterobacteriaceae

- **Types of infection disease**

- **Intestinal**

(diarrheal) infections

- **Extra intestinal**

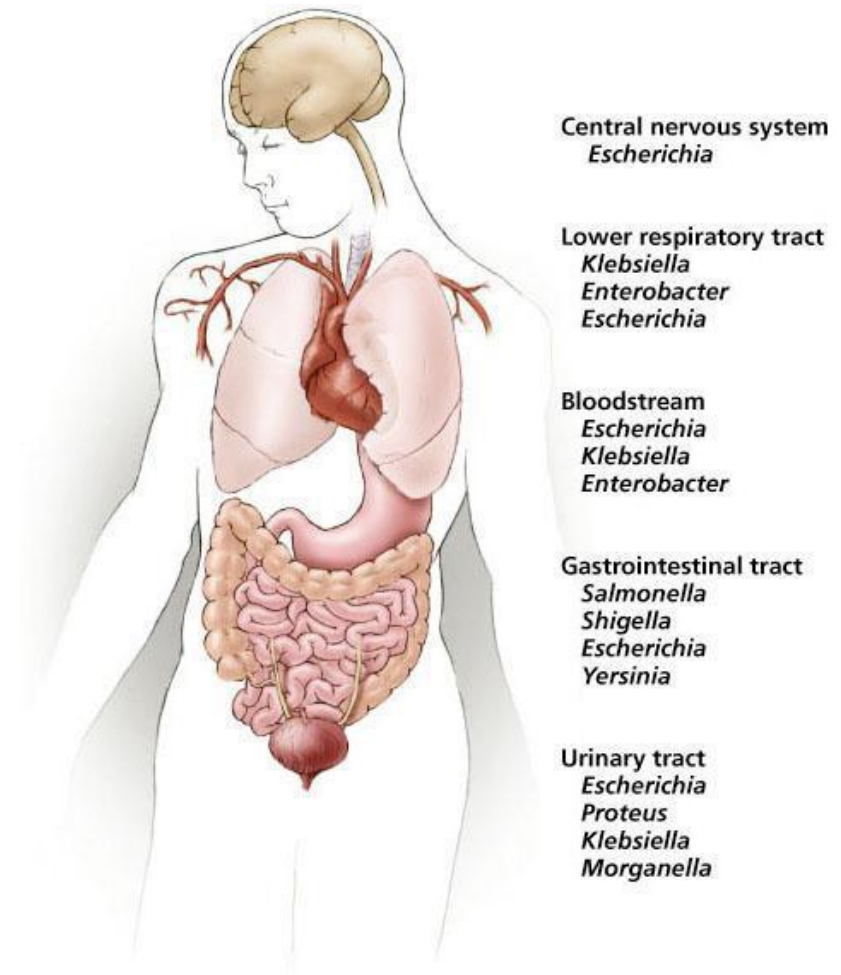
UTI (primarily cystitis)

respiratory (nosocomial pneumonia)

wound (surgical wound infection)

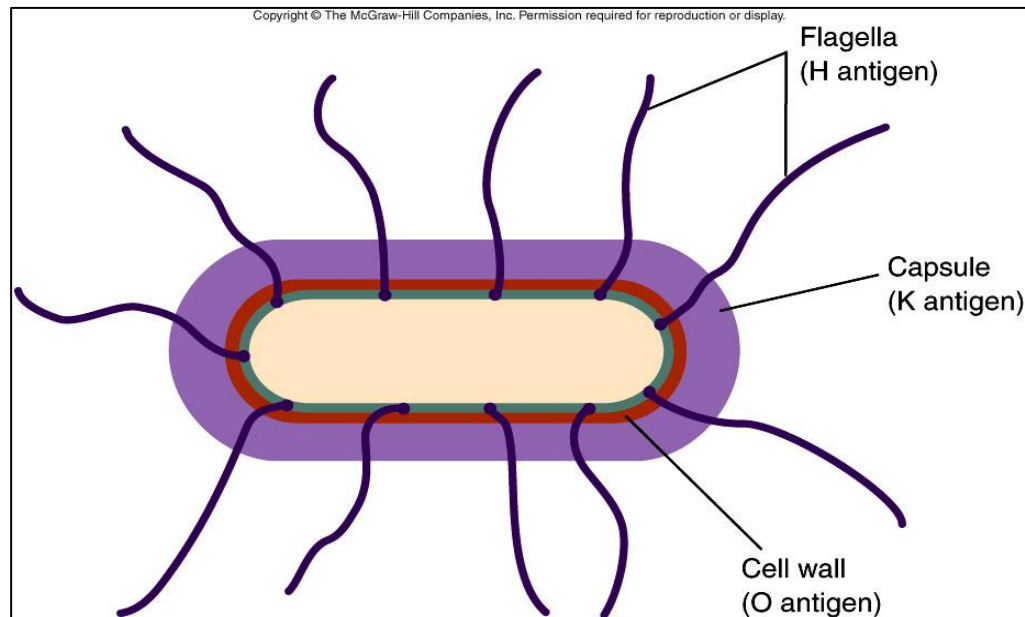
blood stream (gram negative bacteremia)

central nerves system (neonatal meningitides)



Enterobacteriaceae

- Most of them possessed three types of antigens:
- **H antigen** (flagella)
- **K antigen**- (Capsular polysaccharide)
- **O antigen**- (lipid A of outer membrane)



Enterobacteriaceae

- Classification based on lactose fermenter

- **Lactose-fermenters**

Escherichia spp.

Klebsiella spp.

Enterobacter spp.

Citrobacter spp.

- **Non-lactose fermenters**

Salmonella spp.

Shigella spp.

Proteus spp

Lactose fermenter v/s non fermenter



Dr Praveg Gupta MD

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Enterobacteriaceae

Normal flora Coliform	Pathogens Non coliform
Escherichia	Shigella
Klebsiella	Salmonella
Enterobacter	Proteus
Citrobacter	

E. coli

- Normal inhabitant of large intestine
- Motile
- Many pathogenic strains have polysaccharide capsule
- Lactose-fermenting mucoid colonies on MacConkey
- some strains are hemolytic on blood agar
- Produce indole
- Gastroenteritis
- Most common cause of non-nosocomial urinary tract infections)- Wound infections, Neonatal meningitis diarrhea of infants, diarrhea of travelers, pneumonia, endocarditis

E. coli

- **Virulence factors**

- **1) Surface** O antigens

K antigen

Fimbriae

- **2) Toxins** Hemolysis

- Enterotoxins;

- Heat labile (LT), resemble cholera toxin

- Heat stable (ST)

- Verotoxin- shiga like toxin

-

E. coli

- To cause diarrhea it must:

Return from large intestine to small intestine

Possess:

Pili

Somatic antigen -Invasive

Enterotoxins: Heat labile (LT)

Heat stable (ST)

Diarrheal Strains of *E. coli*

Pathogenic strain	Characteristics
Enteropathogenic <i>E. coli</i> = EPEC	Outbreak, sporadic diarrhea self-limiting diarrhea in infants severe diarrhea in adults non invasive not produce enterotoxins
Enteroinvasive <i>E. coli</i> = EIEC	do not ferment lactose invade the colon shigellosis-like dysentery in children traveler's diarrhea
Enterotoxigenic <i>E. coli</i> = ETEC	Colonization small intestine enterotoxin causes watery diarrhea in infants and young adults. traveler's diarrhea
Enterohaemorrhagic <i>E. coli</i> = EHEC	Cytotoxic verotoxin causes haemorrhagic colitis hemolytic uremic syndrome
Enteraggressive <i>E. coli</i> = EAEC	stacked brick formation produce ST-like toxin and hemolysin acute and chronic diarrhea Produce food-borne illness

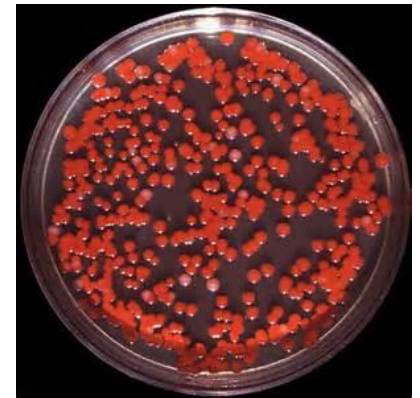
Klebsiella

- lactose-fermenting
- capsulated
- Found in the digestive and respiratory systems of humans and animals
- opportunistic infections- hospital acquired (nosocomial)
- Main species of medical importance:
- *K. pneumoniae*
- causes; Pneumoniae , UTI, Septicemia, meningitis
- found in moist environment in hospitals.
- Produce a capsule ; major virulence factor
- Treatment: Based on sensitivity testing



Serratia

- Produce a red pigment when grown at room temperature
- Can cause life-threatening opportunistic infections in the urinary and respiratory tracts of immunocompromised patients
- Doesn't ferment lactose
- Difficult to treat due to resistance to various antimicrobial drugs
-
- Main species of medical importance:
-
- *Serratia marcescens*



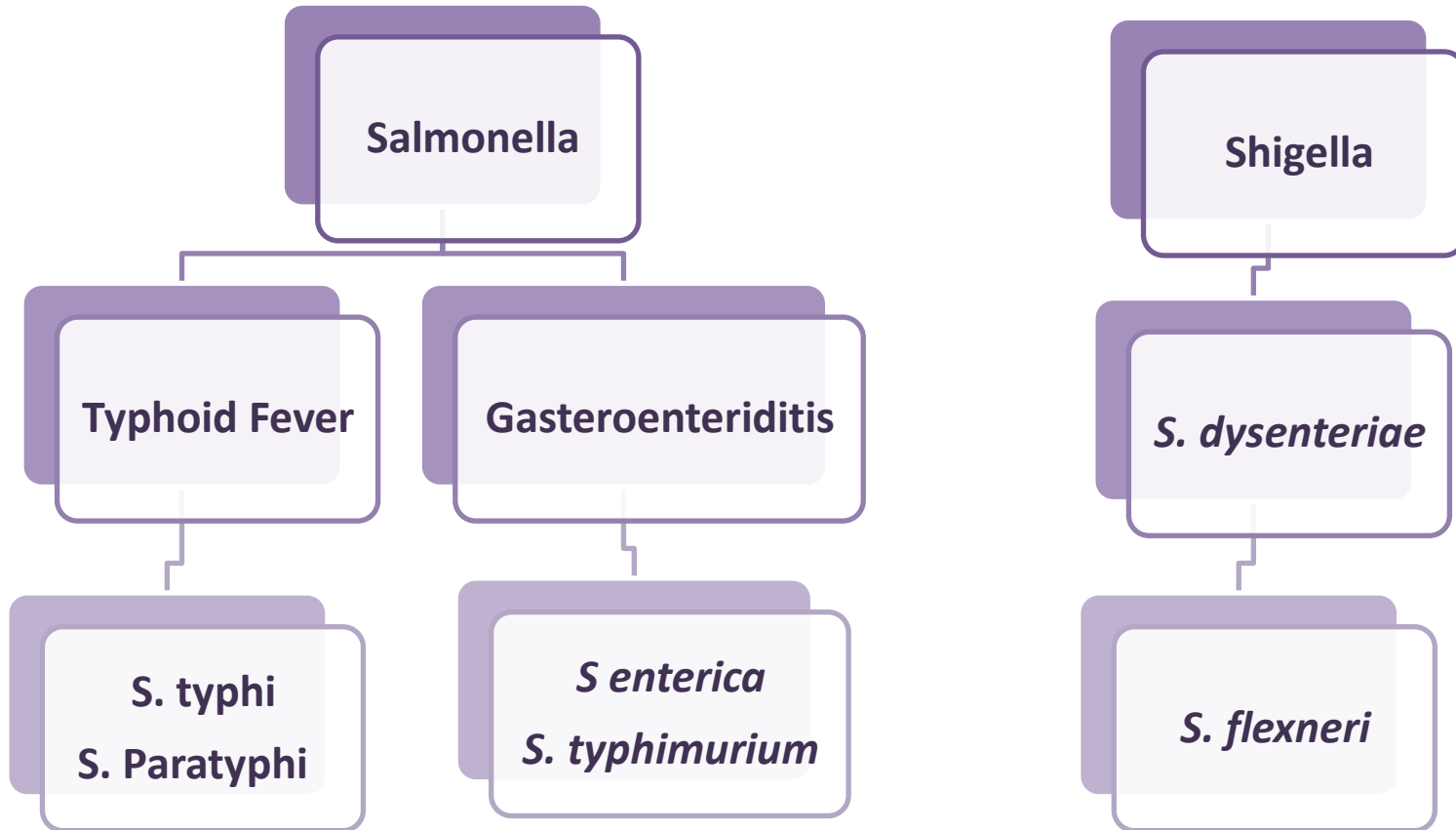
Enterobacter

- lactose fermenting
- motile
- capsulated
- Found in soil, water, vegetable, sewage, the digestive tracts of animals and humans
- opportunistic pathogens- nosocomial infections
- Difficult to treat due to resistance to various antimicrobial drugs
- Medical important species
- *Enterobacter aerogens.*

Citrobacter

- lactose fermenting
- motile
- opportunistic pathogen.
- Medical important species is *Citrobacter freundii*.
- associated with UTI, wound infection and septicaemia in immunocompromised
- Produce Enterotoxigenic similar to the ST enterotoxin of *E. coli*.

Salmonella, Shigella



Salmonella & Shigella

- **Both are**
- **True pathogens**
- **Non lactose fermenter**
- **transmitted through contaminated food and water, personal contact or animals and fomites.**
- **Salmonellosis and shigellosis are more likely to occur in children under 5 years of age and the elderly.**
- **Diarrhea, abdominal pain and fever are the main symptoms in both diseases.**
- **Treatment include replacing fluids lost through diarrhea and antibiotics**

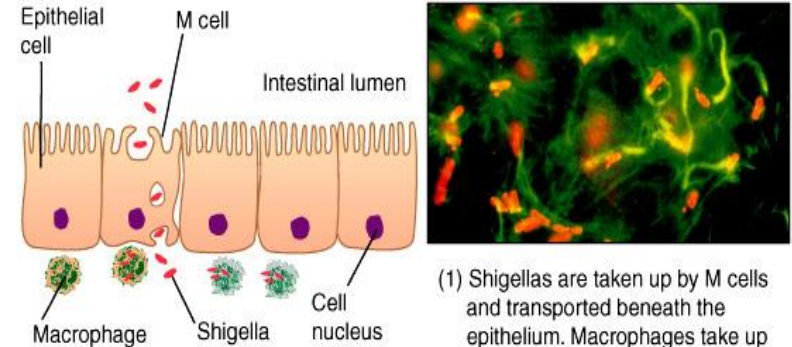
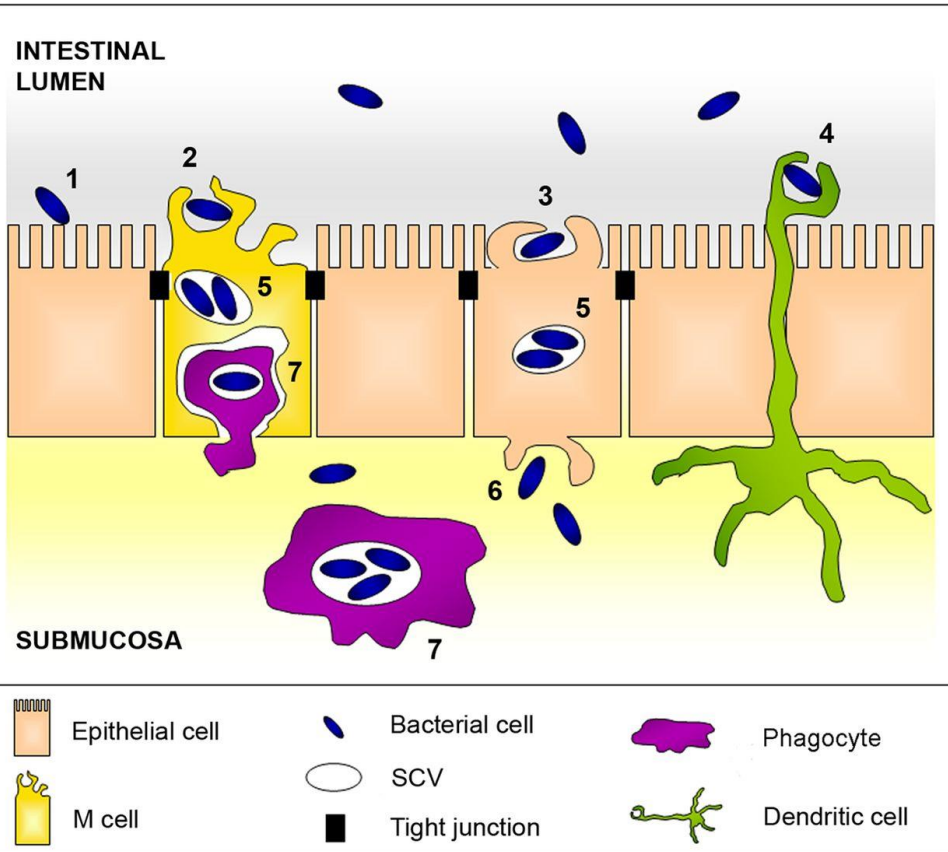
Salmonella vs. Shigella

Salmonella	Shigella
Motile	Non motile
Produce H ₂ S	Not produce H ₂ S
Attack Small intestine	Attack large intestine (colon)
Infectious dose: high	Infectious dose: small
Salmonellosis (typhoid fever) Gastroenteritis	Shigellosis (dysentery)
Invasive	less invasive (localized)
Reach blood stream, spread to body organs	Can not reach blood stream
Watery diarrhea	Bloody mucoid diarrhea
ingesting contaminated raw food is the most common route of transmission of Salmonella	most common way Shigella is transmitted is through direct person-to-person contact

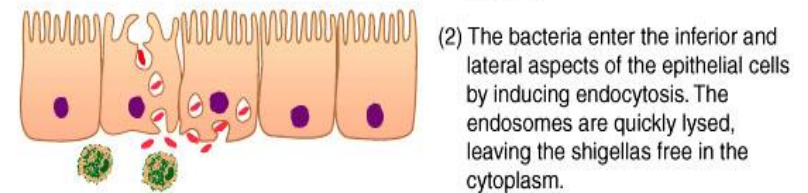
Shigella

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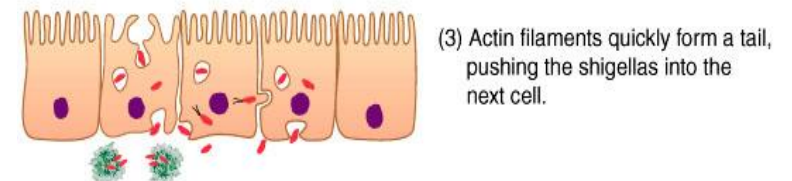
Salmonella



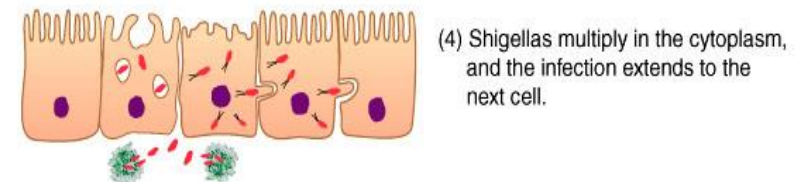
(1) Shigellas are taken up by M cells and transported beneath the epithelium. Macrophages take up shigellas, die and release the bacteria.



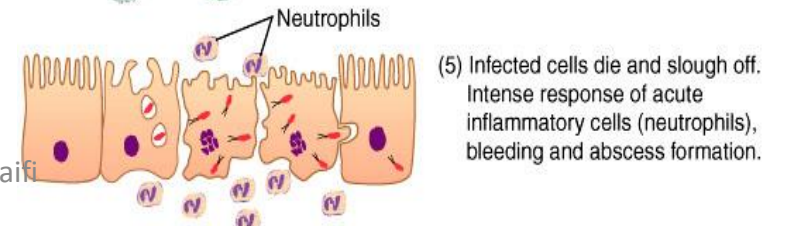
(2) The bacteria enter the inferior and lateral aspects of the epithelial cells by inducing endocytosis. The endosomes are quickly lysed, leaving the shigellas free in the cytoplasm.



(3) Actin filaments quickly form a tail, pushing the shigellas into the next cell.



(4) Shigellas multiply in the cytoplasm, and the infection extends to the next cell.



(5) Infected cells die and slough off. Intense response of acute inflammatory cells (neutrophils), bleeding and abscess formation.

Proteus

- motile
- non-lactose fermenting
- putrefactive (fish) odor
- found in the intestinal tract of humans and animals, soil, sewage and water.
- swarming on nutrient agar and blood agar
- Ditching of culture media prevents spread of Proteus species
- Urease positive
- **Species of medical importance:** *P. mirabilis* (Indole negative)
P. vulgaris (Indole positive)
- *P. mirabilis*
 - UTI, nosocomial infections, pneumonia, Septicemia, wound infection
 - Secondary invader of ulcer, burn
 -
- *P. vulgaris*
 - Important nosocomial pathogen
 - Isolated in wound infection and urinary tract infection