

Enterobacteriaceae

Introduction

- Predominant aerobic bacterial flora of large intestine of human beings.
- Gram negative, non sporing, non acid fast.
- Aerobic & facultative anaerobic
- Grow on ordinary culture media
- Intestinal pathogens: Non LF, e.g. Salmonella, Shigella

- Oxidase negative
- Catalase positive except dysenteriae type 1
- Reduces nitrates to nitrites except some strain of *Erwinia* & *Yersinia*.
- Ferment glucose (A + / G +)
- Found in soil & water, on plants & in intestinal tracts of man & animals.
- May be capsulated or noncapsulated
- Motile by peritrichate flagella or non motile

Classification

- Lactose fermenter : e.g. E.coli, Klebsiella , Enterobacter
- Late lactose fermenter : e.g. Shigella sonnei, Citrobacter
- Non lactose fermenter : e.g. Salmonella, Shigella, Proteus spp.

Enterobacteriaceae

- **Tribe I** : Escherichiae Genus: Escherichia,
Citrobacter, Salmonella, Shigella
- **Tribe II** : Klebsielleae Genus: Klebsiella,
Enterobacter, Serratia, Hafnia
- **Tribe III** : Proteeae Genus: Proteus,
Morganella, Providencia
- **Tribe IV** : Erwinieae Genus: Erwinia

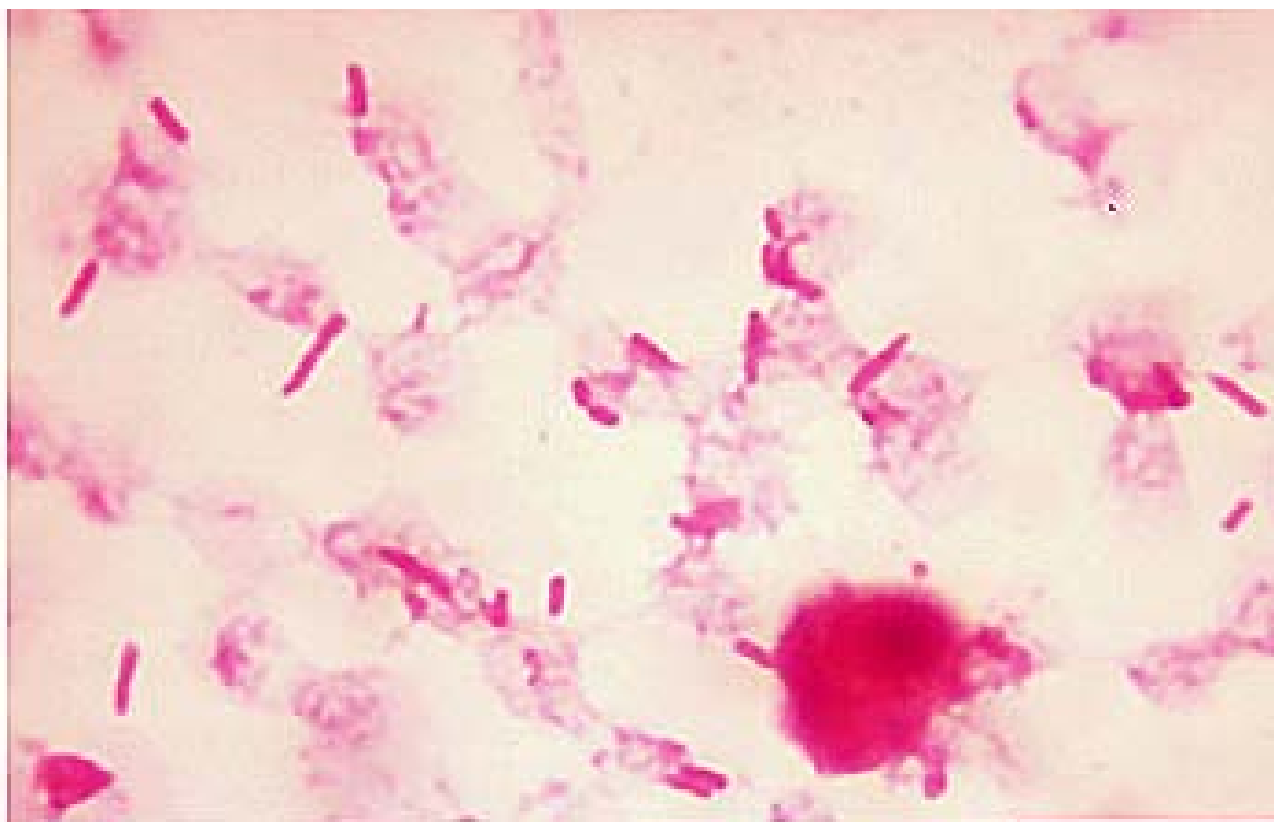
Escherichia coli

- Escherich, first to describe the colon bacillus under the name *Bacterium coli commune*(1885)
- Living only in human or animal intestine.
- Wide spread, does not lead an independent existence outside body.
- Identified as faecal pollution of water & food.

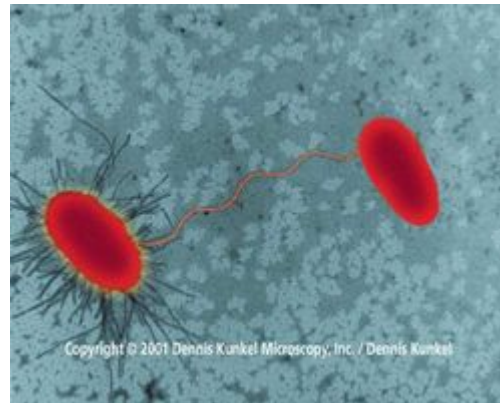
Morphology

- Gram negative, straight rod, arranged singly or in pairs, size 1-3 × 0.4-0.7 μm
- Motile by peritrichate flagella & may be non motile.
- Non sporing
- Some strains produce capsule

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血球は赤く



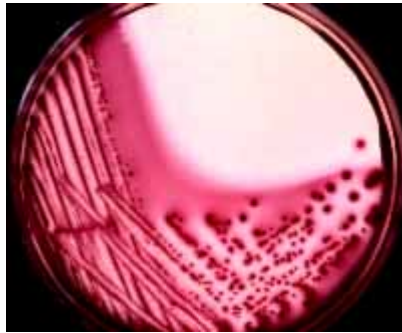
E.Coli – Peritrichous flagella



Culture characters

- Aerobic & facultative anaerobes
- N. agar: Large, thick, greyish white, moist, smooth, opaque, partially translucent.
- Mac- Conkey: Lactose fermenter
- Nutrient broth: Generalized turbidity & heavy deposit, which disperse completely on shaking.

E.Coli on Mac Conkey media



Growth charact.	Nutrient agar	Macconkey agar	EMB agar
size	2-3 mm	1mm	1mm
shape	circular	circular	circular
elevation	Low convex	Low convex	convex
opacity	translucent	opaque	translucent
colour	Colorless to grey	Rose-pink	Metallic sheen

Biochemical reactions

- Sugar fermentation: Acid & Gas in Glucose, Maltose, Lactose, Mannitol
- IMViC : + + - -
- Gelatin liquefaction: Negative
- H₂S is not formed
- Urease test: Negative
- Reduce nitrates to nitrites

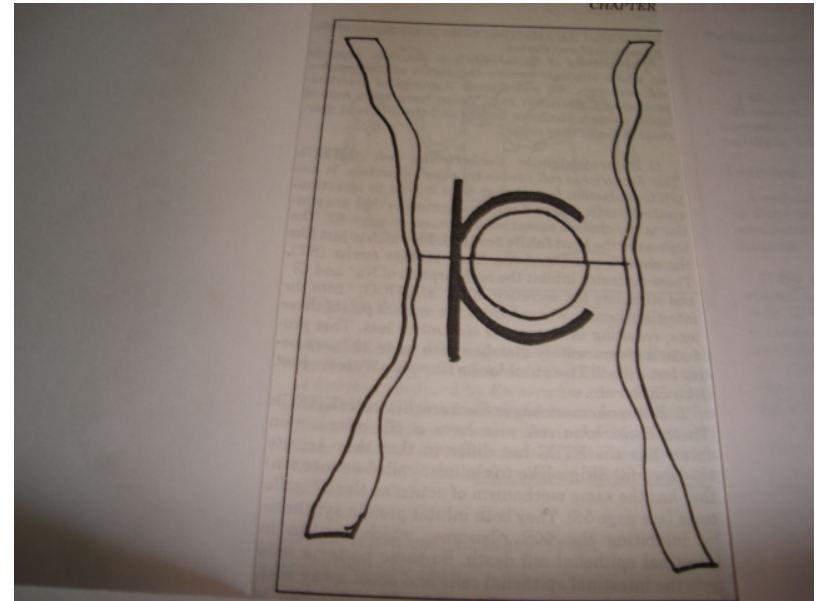
Antigenic structure

- Somatic antigen O --- 170 types
- Capsular antigen K --- 100 types
- Flagellar antigen H --- 75 types

- Normal colon strains: 'early' O groups (1,2,3,4 etc)
- Entero pathogenic strains: 'later' O groups(26,55,86,111 etc)

Antigenic structure

- O antigen forms outer part of the cell membrane
- K antigen wraps around like a capsule
- H antigen is arms of wavy flagella



Virulence factors

- Two types---

Surface antigens

Toxins

E.Coli produce two types of toxins:

1. hemolysins donot relevant in pathogenesis
2. enterotoxin (LT , ST, Vtor ST)

Determinants of pathogenicity

K antigen (surface polysaccharide)	Interfering with phagocytosis / bactericidal C effect
Colonization factor: Fimbriae (pili)	Providing an attachment of the bacterium to the host cells
Endotoxin	Pyrogenicity, invasion, utilization of complement, shock

Determinants of Pathogenicity

Haemolysins	Lysis of RBC
Enterotoxin : (responsible for diarrhoea or mal absorption syndrome) LT(CT) , ST & VT	With the help of colonizing factor antigens, they stick to small bowel in large no.

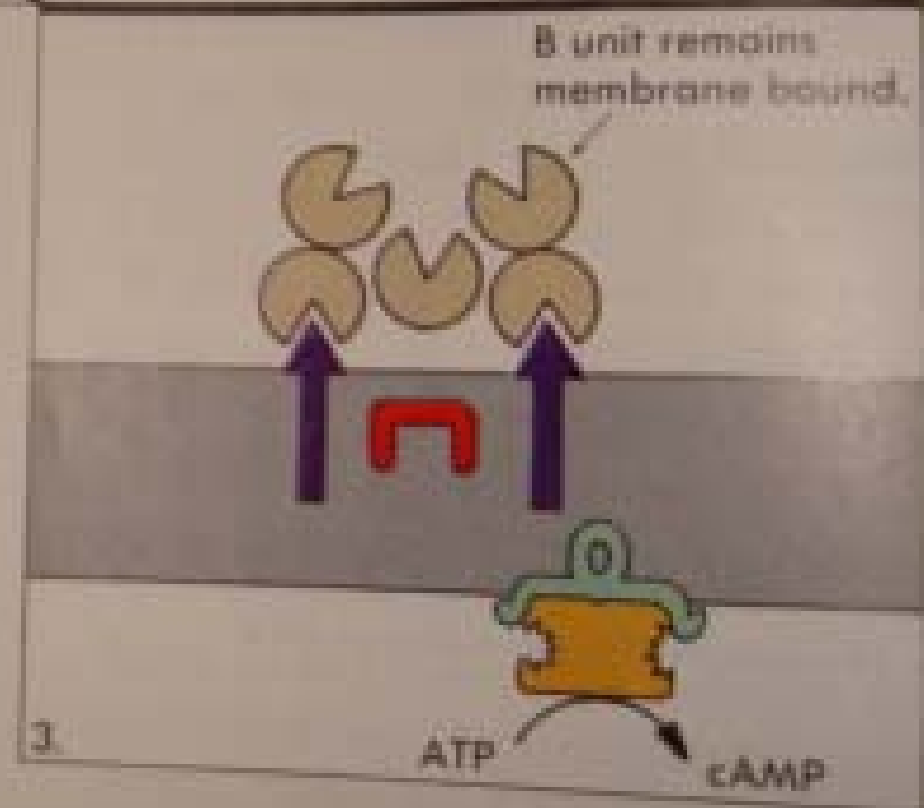


FIGURE 27-3 Diagrammatic representation of the structure and action of cholera toxin.

Clinical syndrome

- Urinary tract infection
- Neonatal meningitis
- Diarrhoea
- Hemorrhagic colitis
- Hemolytic uremic syndrome
- Septicaemia- shock & SIRS
- Pyogenic infection

Types of Diarrheagenic E.coli

- Enteropathogenic E.coli
- Enterotoxigenic E.coli (ETEC)
- Enteroinvasive E.coli
- Enterohaemorrhagic E.coli
- Enteroaggregative E.coli

Enteropathogenic E.coli (EPEC)

- Causes infant diarrhoea with fever, vomiting, nausea & non bloody stool.
- Pathogenesis: Plasmid mediated adherence & destruction of epi. cells of small intestine.

Enterotoxigenic E.coli (ETEC)

- Enterotoxigenic E.coli (ETEC) : Causes traveller's diarrhoea, diarrhoea in developing countries.
- Pathogenesis: Plasmid mediated enterotoxin which stimulates hyper secretion of fluid & electrolytes

Pathogenesis of diarrhoea (1)

- No cell invasion: The bacteria bind to the intestinal epithelial cells but do not enter the cell.
- Release enterotoxins in the G.I.tract, which causes fluid & electrolyte loss from epithelial cells
- Cause watery diarrhoea without systemic symptoms
- E.g. ETEC

Enteroinvasive E.coli (EIEC)

- Prevalent in developing countries.
- Causes fever, cramping, watery diarrhoea followed by develop. of dysentery with scanty bloody stool.
- Pathogenesis: Plasmid mediated, invasion & destruction of epi. cells lining the colon.

Diarrhoea (2)

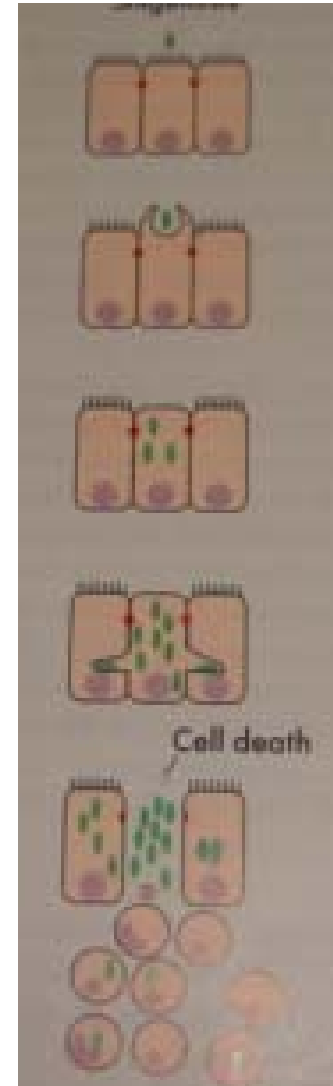
- Invasion of intestinal epithelial cells: The bacteria allow binding & invasion into cells.
- Toxins are released & they destroy the cells.
- Cell penetration results into systemic immune response with leucocytes in the stool & fever.
- E.g. EIEC

Diarrhoea (3)

- Invasion of lymph nodes & blood stream:
Deeper invasion results in systemic symptoms of fever, headache & leucocytosis.
- Deeper invasion can also result in mesenteric ly.node enlargement, bacteremia & sepsis e.g. *Salmonella typhi*

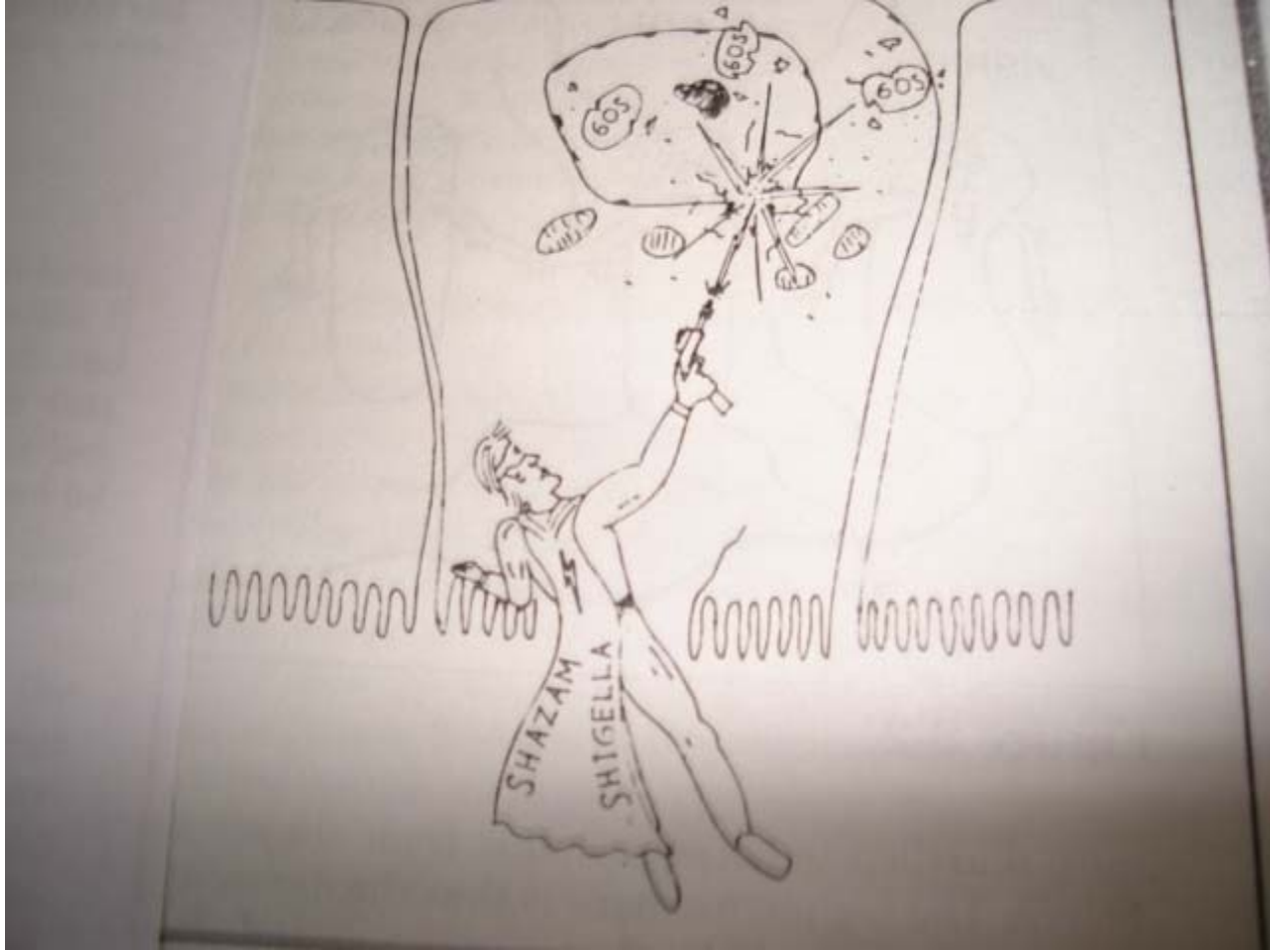
Pathogenesis: EIEC

- Invasion of bacilli
- Endocytosis
- For^m of endocytic vacuole
- Multiplication
- Cell death
- Invasion of adjacent cells & leads to tissue destruction, infl. reaction.



Enterohaemorrhagic E.coli (EHEC)

- Causes hemorrhagic colitis & hemolytic uremic syndrome.
- Pathogenicity : E.coli **adhere** to the intestinal epithelial cells. Then secrete powerful **Shiga like toxins**. They both inhibit protein synthesis, results in cell death.
- Leads to bloody diarrhoea with severe abdominal cramps known as Hemorrhagic colitis



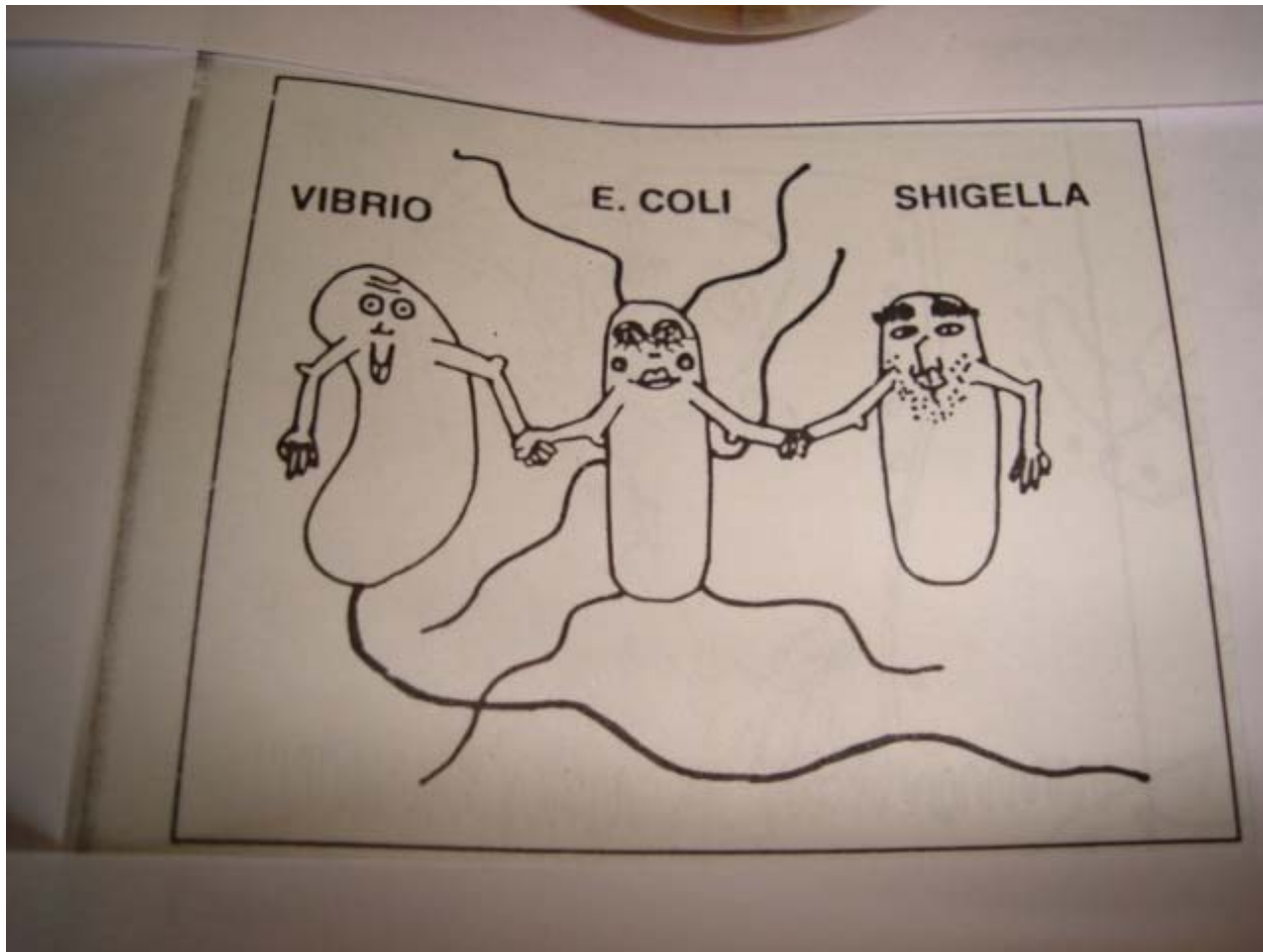
Enterotoagggregative E.coli (EAEC)

- Causes diarrhoea in developing countries.
- Persistent watery diarrhoea with vomiting, dehydration & low grade fever.
- Pathogenesis: Plasmid mediated aggregative adherence which prevents absorption of fluid.

Type	Pathogenesis	Clinical picture
ETEC	Secretory toxins (LT, ST) that do not damage mucosal epi. - enterotoxin	'Traveller's dia.' Profuse watery dia. Abd. Cramps- cholera infantum
EPEC	Adhere & damage to epi. cells	Infant dia., low grade fever, malaise, vomiting, dia. With mucus, no gross blood loss
EIEC	Invade epi cells & destruction, ST & LT not produced	Dysentery (shigellosis) fever, colitis, urgency, tenesmus, blood-mucus with many pus cells

EHEC VTEC STEC	Elaboration of cytotoxin ST & LT disrupt protein synthesis O157:H7 phage mediated	Bloody diarrhoea without pus cells, often fever, abd.pain - HUS
EAggEC	Adhere to epi. cells	diarrhoea, vomiting, dehydration, less commonly abd. pain

Friends.....



THANK U