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## Gram Negative Bacilli

### Family: Enterobacteriaceae

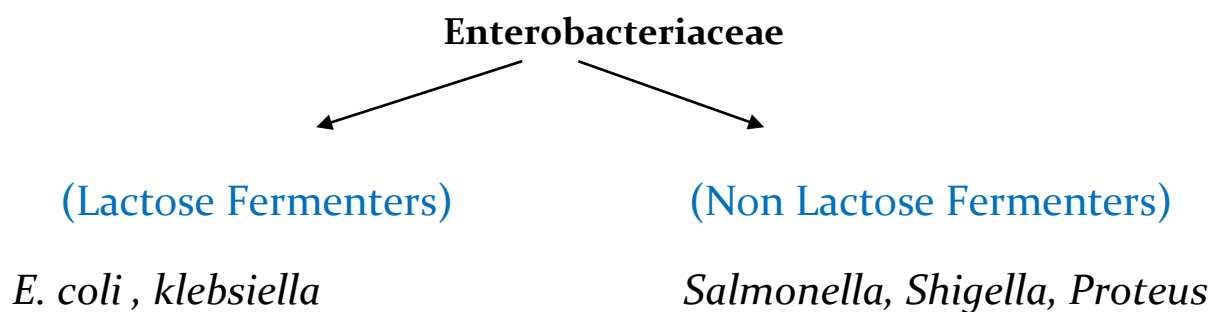
The family **Enterobacteriaceae** consists of a large number of closely related bacterial species that inhabit large intestine of man. These have been referred to enteric bacteria or coliform bacilli. The general features of this family are:

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- Gram negative bacilli.
  - Grow both aerobically and facultative anaerobically.
  - Grow on ordinary laboratory media.
  - Oxidase negative and catalase positive.
  - Ferment glucose with production acid or acid and gas.
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- Classification

- These have been classified on the basis of fermentation of lactose as shown below.
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#### 1- *Escherichia coli* (*E. coli*)

*E. coli* is a bacteria living in the human or animal intestine. Once it is voided in the faeces, it remains viable in the environment only for few days. Therefore, the detection of *E. coli* in water is taken as an evidence of recent pollution with human or animal faeces. These are gram negative non sporing bacteria which are usually motile and sometimes capsulated.

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### Antigenic structure

*E. coli* possesses O (somatic), H (flagellar) and K (capsular) antigens, which are identified.

### Virulence Factors (pathogenicity).

A large number of factors that responsible for pathogenicity like:

- 1- K antigen
- 2- Endotoxin
- 3- Enterotoxin
- 4- Hemolysin
- 5- Cytotoxin

### Diseases

- 1- UTIs    2- Meningitis (especially neonatal)
- 2- Septicemia    4- wound infections    5- pneumonia
- 6- Dysentery    7- Diarrhoea

### Pathogenic strains of *E.coli*

- ETEC = enterotoxigenic *E. coli*      ● EIEC = enteroinvasive *E. coli*
- EPEC = enteropathogenic *E. coli*    ● EHEC = enterohemorrhagic *E. coli*
- EaggEC = enteroaggregative *E. coli*    ● UPEC = uropathogenic *E. coli*

### Diagnosis

Direct demonstration of the organism is possible in specimens such as pus and CSF. From other samples, culture on MacConkey agar and blood agar. Then confirm the agent by gram stain.

### Treatment

*E. coli* isolate from community acquired infections are usually sensitive to most antibiotics except penicillin.

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## 2- Klebsiella

*Klebsiella pneumoniae* is most common species. Klebsiella are non motile, gram negative, short and thick bacilli. They form large capsule which is responsible for mucoid colonies on media.

### Pathogenicity

The diseases caused by Klebsiella include: bronchopneumonia, wound sepsis, bacteraemia, meningitis and UTIs. It role as an important pathogen in nosocomial infections.

Enterotoxin production has also been shown in *Klebsiella pneumoniae*.

### Diagnosis

Sputum is the most commonly collected sample for the diagnosis of pneumonia. Cultured on MacConkeys medium.

### Treatment

No antimicrobial agent is uniformly recommended for use against its infections, especially among the hospital strains.

## 3- Salmonella

### (Typhoid and Paratyphoid Bacilli)

The genus *Salmonella* includes a large number of pathogens of human as well as mammals. Currently more than 200 serotypes of *Salmonella* are known. Most common species are *Salmonella typhi* and *Salmonella paratyphi*.

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## Diseases

The term enteric fever includes both typhoid fever caused by *Salmonella typhi* and paratyphoid fever caused by *Salmonella paratyphi* types A, B and C. It is systematic infection characterized by continuous fever, relative bradycardia and toxemia. The disease is transmitted via the [fecal-oral route](#) or [urine-oral route](#). The incubation period of the disease is about two weeks.

## Diagnosis

The laboratory diagnosis of enteric fever depends upon following three parameters:

- 1- Isolation of causative agent.
- 2- Detecting of microbial antigen.
- 3- Titration of antibody against causative agent.

In case of symptoms associated with bacteremia, blood culturing can be done during first week of illness. Also can isolate the bacteria from faeces of infected person between 3-5 weeks of illness.

## Titration of Antibody

A large number of serological tests have been devised to detect and titer the antibody against enteric fever. (Widal test) is one of the most extensively used tests in practice of bacteriology.

## Treatment

[Chloramphenicol](#) was the drug of choice for the treatment of enteric fever has now been replaced by [ciprofloxacin](#).

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#### 4- *Proteus*

*Proteus sp.* are free living bacteria found in soil, water, vegetation and as commensals in the intestine of man. They are gram negative, motile bacilli. The genus has currently only two species *P. mirabilis* and *P. vulgaris*.

##### Diseases

*Proteus* is most often associated with UTIs. Sometimes also associated with pyogenic infections, especially that of burn and infantile diarrhea. It also plays a role in nosocomial infections.

##### Diagnosis

Diagnosis by isolating of *Proteus* bacteria from urine and other relevant samples. The "swarming phenomena" of colonies on blood agar are the indicating character for it. Growth of *Proteus*, emits a characteristic odour like "fishy" or "seminal" odour.

##### Treatment

Most strains are sensitive to aminoclycosides such as gentamycin, amikacin and cephalosporines.

*Nitrofurantoin* is useful in the treatment of UTI.

#### 5- *Shigella* (Dysentery Bacilli)

*Dysentery* is a clinical condition characterized by the passage of loose stools with blood and mucus. The bacilli causing dysentery belong to the genus *Shigella*, which are gram negative, non motile rods. They are divided into four serogroups:

A- *Shigella dysenteriae*

B- *Shigella flexneri*

C- *Shigella boydii*

D- *Shigella sonnei*

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## Diseases

**Dysentery** is characteristic of **shigellosis** but diarrhea is often common and precedes it. Incubation period on an average is 2 days. The severity of disease may vary from acute **fulminating dysentery** to **mild diarrhea**. It may be associated with gripping pain and tenesmus, with or without fever and vomiting.

## Diagnosis

**Stool samples** may be collected and directly plated on to selective media like **DCA** (deoxycholate citrate agar) without delay. Confirmation can be done by biochemical and serological tests.

## Treatment

Antibiotics tend to prolong the excretion of *Shigellae* and therefore, should be avoided except in serious illness. **Ampicillin** and **ciprofloxacin** has shown to be life saving in such situations.