



# Microbiology

Slide #: 8-Enteric Bacteria  
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Sheet  Slide

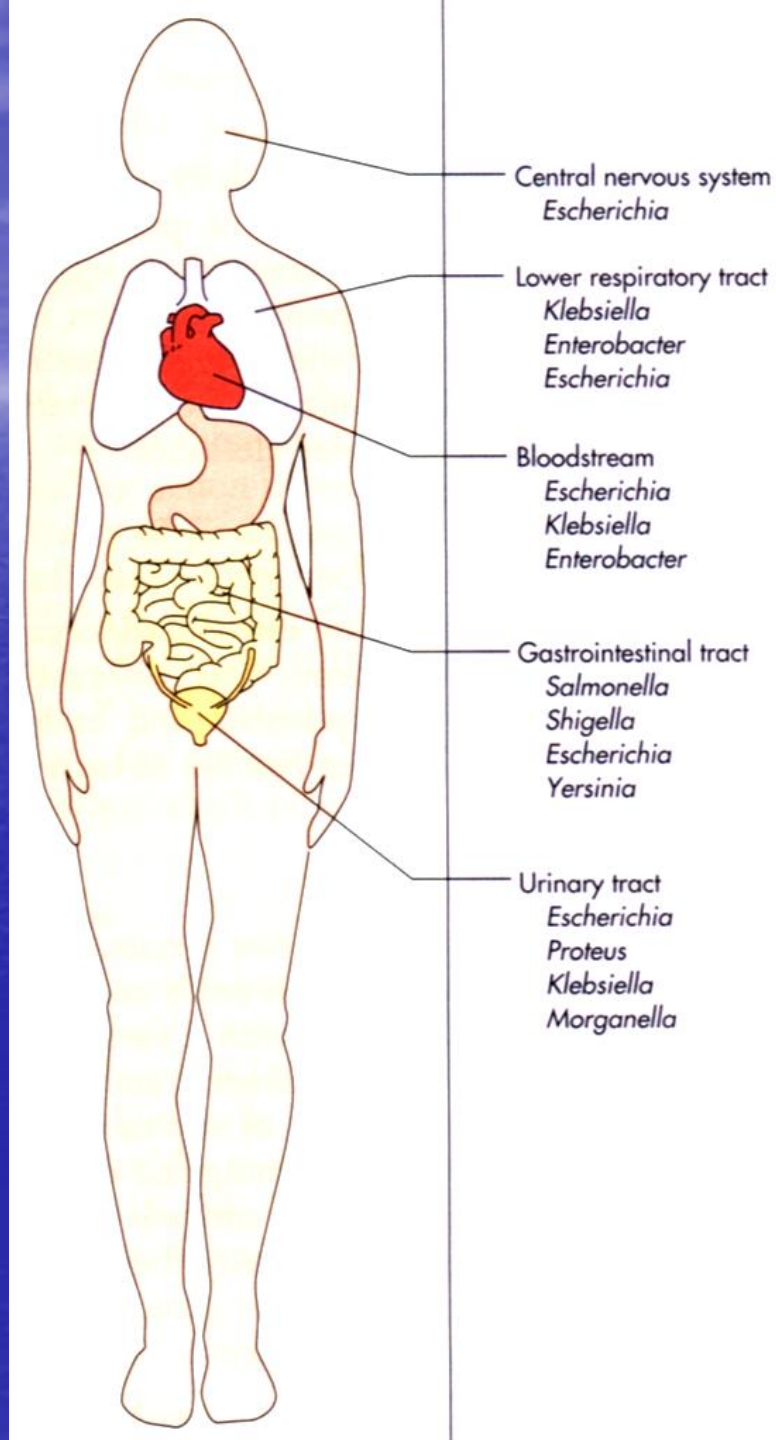


# Enteric Bacteria

*By*

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- *Enterobacteriaceae*
- *E.coli*
- *Klebsiella-Enterobacter species*
- *Proteus-Providencia species*
- *Salmonella and Shigella*
  
- *Pseudomonas aeruginosa*
- *Vibrio cholerae*
- *Campylobacter*
- *Helicobacter*
- *Brucella*



# Enteric Bacteria (Escherichia, Klebsiella, Enterobacter, Proteus, Salmonella, Shigella, Yersinia )

- **General Characteristics:**
  - Gram - ve bacilli,
  - Facultative anaerobes,
  - Intestinal normal flora..
  - Humans, animals, birds..
  - Common waste water, natural water, soil, vegetation
  - Lactose fermenters and Lactose non fermenters
  - Catalase +ve & Oxidase -ve
- **Opportunistic Pathogens & Obligate Pathogens**
  - Causing all types of human infection, some common nosocomial infections.

- **Pathogenicity:**

- Various Enterotoxins,
- Endotoxins
- Capsule,
- Flagella,
- O-H-K-Antigens. Develop specific antibodies following blood infections

- **Coliform Group:**

1. **Escherichia coli:**

Common Urinary Tract Infection (40-80%)

Single organism, Septicemia, Neonatal Meningitis, Wounds.

# *Diarrheagenic E. coli Types*

6 major types causing diarrhea: Common types.

## **1- Enteropathogenic (EPEC)**

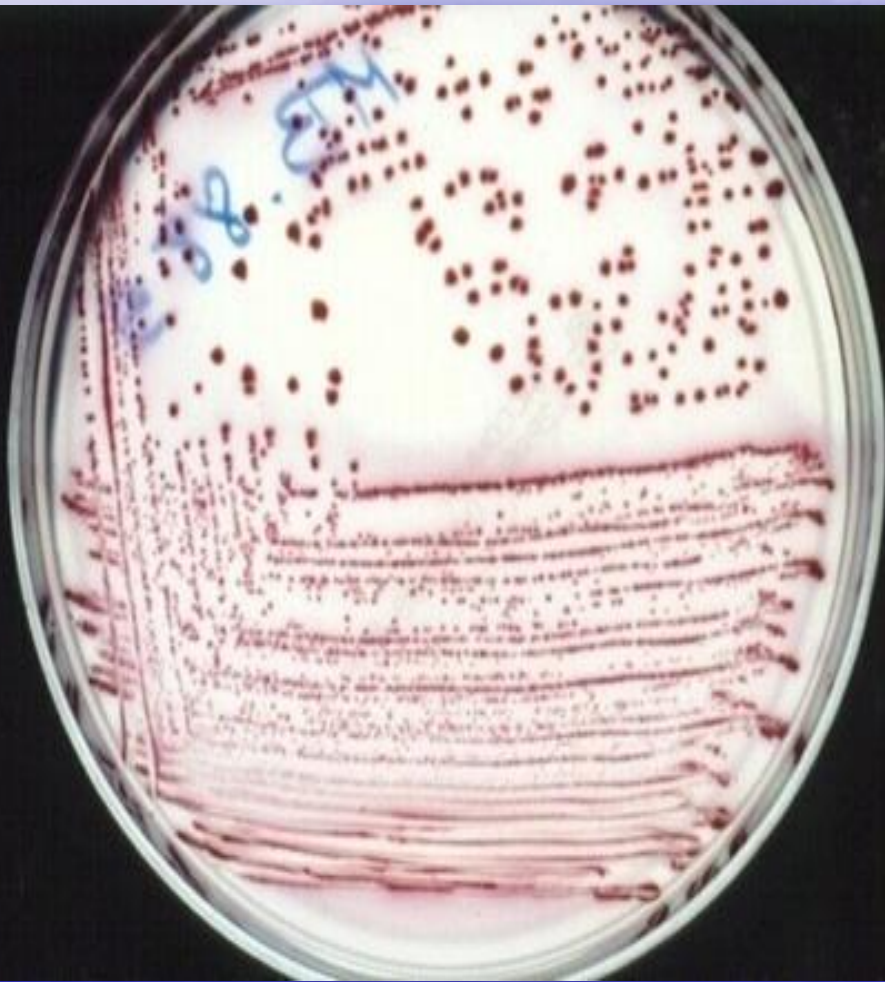
- Numerous strains (mostly infants 1-6 months), Watery diarrhea, less Vomiting, Chronic cases/ fatal.

## **2-Enterotoxigenic (ETEC)**

- (Heat-labile/stable enterotoxins)/ watery diarrhea, Children more than adults, Traveler's diarrhea, fecal water contamination /vegetables / fresh food, Indicator standard of hygiene,
- Self-limited diarrhea and no antibiotics treatment.

**3 Enterohaemorrhagic (EHEC):** O157:H7, Verotoxins, Common in intestinal Cattle, Contamination Ground meat/Hamburger, Dairy products, bloody diarrhea, Haemolytic-uremic syndrome (HUS), fatal

*E. coli* Culture – Red color on MacConkey agar indicates Lactose positive & Gram-stain



# Coli-form Bacteria

## 2. *Klebsiella - Enterobacter species*:

UTI, Septicemia, Wounds.. Rare Meningitis..  
Common Hospitalized patients..

Encapsulated *K. pneumoniae* cause  
Nosocomial infections and Pneumonia

## 3. *Proteus-Providencia species*:

UTI, Septicemia, Wounds, Nosocomial  
infection.

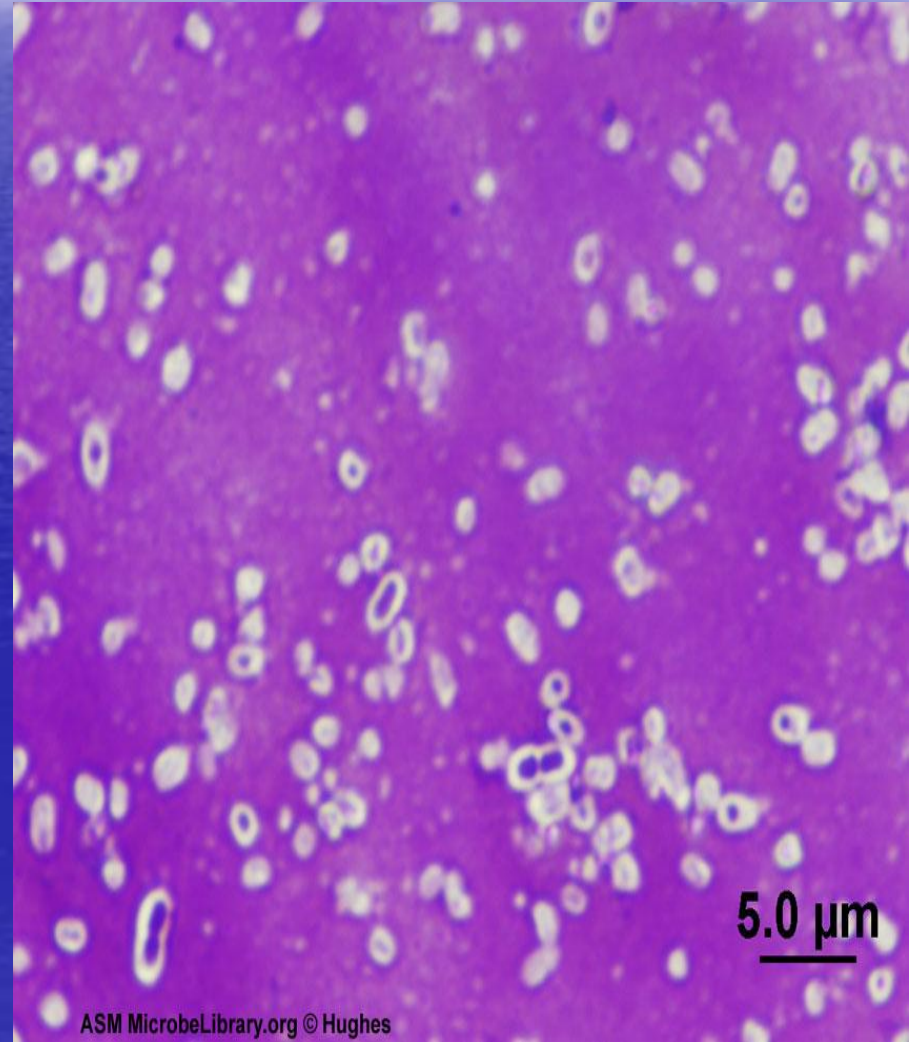
Proteus causes renal stones. Urease positive



# 3. Pseudomonas group

- **Pseudomonas species** , Gram-ve bacilli , Facultative anaerobe, oxidase+ve and Lactose-ve.. Found in soil, water, plants , animals. . Survive under harsh condition, including Alcohol used in aseptic procedure. More than 20 pseudomonal species can cause human infections.
- ***P. aeruginosa*** :opportunistic pathogen.. colonize URT & intestine humans.. Produce blue-green pigmentation / pyocyanin and fluorescein..release many enzymes. It is the most common species causes a clinically significant infection.. **often causing nosocomial infections..serious and often life-threatening diseases**..wound, blood sepsis, pneumonia, External ear infection..burn cases, Urinary catheters, intravenous [IV] line, endotracheal tubes. ***P. aeruginosa*** .. innate resistance to many antibiotics.. Develop rapidly resistance to antimicrobial agents.

*E. coli*- Flagella- Fimbriae - Pili  
*Klebsiella pneumoniae*-Capsule



# Salmonella group

- Gram-ve bacilli..
- Facultative anaerobes
- Lactose-non fermenters
- Endotoxin / LPS.
- Common in Nature (water and soil), Humans, Animals, Birds. They are not part of the normal human flora.
- O/H Antigens with specific antibodies.
- Pathogenic when ingested causing enteritis, systemic infections and enteric fever.
- **1. Nontyphoidal Salmonellosis / Gastroenteritis / Food-poisoning *S. enterica/enteritidis*.. 2000 Serotypes..**

- Zoonotic .. Common Birds, Farm Chickens, Pets, Reptiles..  
Contamination fresh food, Chicken, Meat-Eggs, Dairy products..  
Large number of Salmonella cells causing diarrhea
- Food borne disease , Incubation 8-24 h..
- Mild-severe watery-bloody diarrhea, Vomiting, Fever
- Self-Limiting in healthy persons
- Rarely Septicemia - Meningitis Infant / young Children..  
Immunocompromised patients.
- Human healthy carriers.. Short periods..animals long period carriers

## ■ Lab Diagnosis

Culture Feces or Food.. Prevention and Control , Sanitation & hygiene in restaurants & slaughter houses and food-handlers

# Salmonella/ Flagella



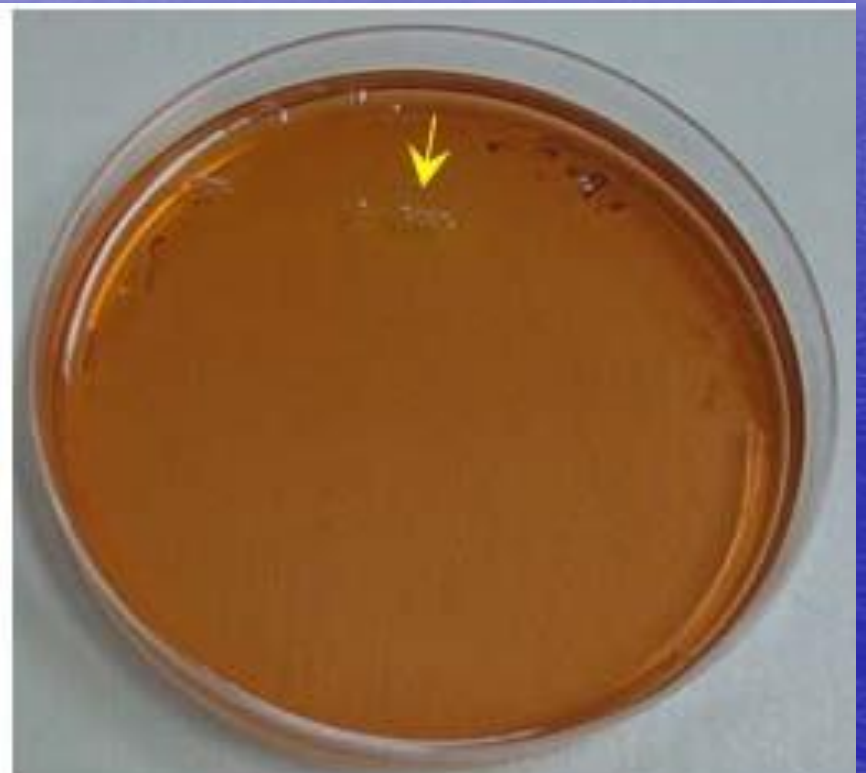
Hektoen–Enteric agar: *Salmonella* transparent colonies, +H<sub>2</sub>S  
Lactose-ve. *Shigella* : transparent, lactose-ve  
*E. coli* : orange colonies, Lactose-ve



**SS agar for Salmonella & Shigella**  
**Salmonella..Transparent colonies+H<sub>2</sub>S.. Others fecal flora will be inhibited to 98%**



*Salmonella*



*Shigella*

# Typhoidal Salmonella

- **2- Typhoidal Salmonella**: (Human Enteric Fever)
  - *Salmonella enterica /typhi & paratyphi A, B, C*
  - Few cells Invasive, Only infect human, Fecal-Oral
  - Water , Food.. Incubation:1-3 Weeks
  - High continuous fever, Bloody Diarrhea and constipation, Septicemia, Meningitis, osteomyelitis, Hepatosplenomegaly, Intestinal perforation.
  - Healthy Carriers: Gallbladder, Intestine, Short period or Life Long .
  - Human Healthy Carriers ..mostly women, Gallbladder (1-3%)
- **Lab Diagnosis**: Culture Feces, blood, Urine, CSF, Bone marrow, Selective Media: S-S Agar, Hektoen-enteric.
- Serological **Widal Test** for detection of specific antibodies against O & H antigens (Titer > 160)  
Antibiotics, Human vaccine is available..



# *Shigella* group

Common serotypes: ***S. Sonnei, S.boydii, S. dysenteriae***

- Gram -ve, Lactose-ve , Susceptible to dryness, acid, Low-High Temperature
- Fecal-Oral infection. Water, fresh Vegetations,
- Few serotypes.. Infect only humans. Incubation 1-2 Days
- **Pathogenicity:**
  - Endo/Enterotoxins released intestine.. Purulent-Bloody-Diarrhea.. (bacillary dysentery) with abdominal pain, fever, not invasive. No chronic or healthy carriers
- ***S. dysenteriae (Shiga type toxins)***
  - Enterotoxin /Neurocytotoxin, Severe intestinal Necrosis, Fever, Severe Purulent-Bloody-Diarrhea, Abdominal Cramps, CNS. Rare Septicemia.. Can be fatal without treatment.

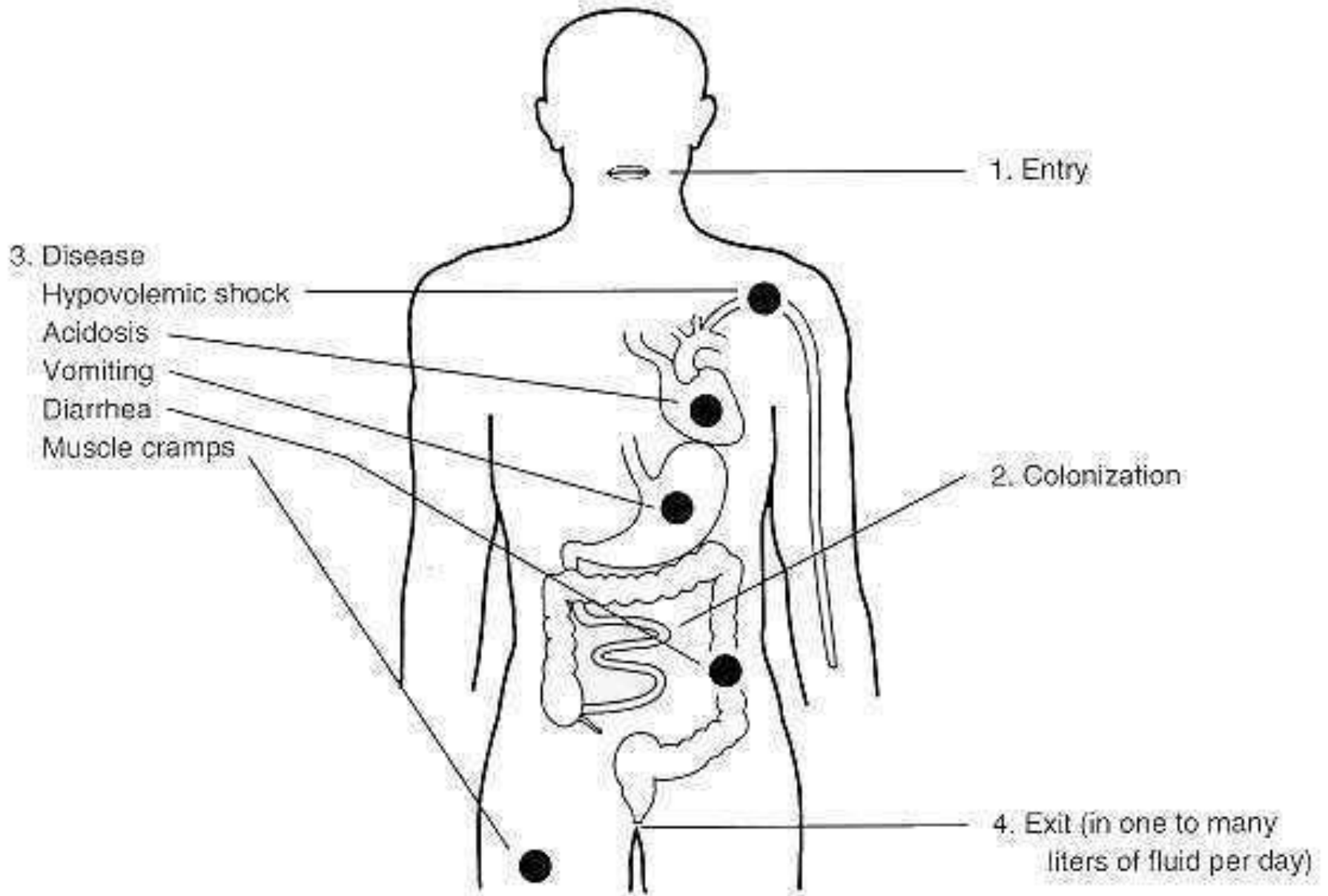
## **Lab Diagnosis:**

Rapid culture Feces/rectal swabs on S-S Agar, Hektoen –Enteric Agar.. Recommended Antimicrobials Treatment.. Control Sanitation & hygiene food .. Foodhandlers

# *Vibrio cholerae*

- Gram-ve Vibrios 'comma shaped' , motile.
- Lactose-ve, oxidase positive,
- Aerobic Growth and alkaline medium (pH >8-9)..
- Water.. Fresh Food.. **Reservoir contaminated water**. Salt tolerant.
- Endemic In India/Bangladesh but epidemic Disease, causing human Outbreaks.. Asymptomatic/symptomatic person
- **V. cholerae-01**: Type El-Tor..
- Only Human, Fecal-oral infection.. Raw Sea/ Fresh Foods,
- Small Intestine Infect.
- Cholera toxin- enterotoxin, Incubation 8-48 h, Heat labile toxin
- Severe water diarrhea (rice water stool), Severe dehydration, Blood acidosis, Shock, Death within hours. No invasion.
- **Lab Diagnosis**: Feces Culture.. Selective TCBS agar.
- **Treatment**: Rapid replacement fluids & electrolytes.. Antibiotic.. Public Health sanitation measurements. Human Vaccine.

# Cholera



# TCBS agar for isolation of *V. cholerae*



# Brucella species

## Brucellosis/Malta Fever

- Gram-ve coccobacilli, Microaerophilic.. Endotoxins ..Highly infectious
- Primarily pathogens of animals (Zoonosis), Localized Infection in animal reproductive Organs, Sepsis ..Abortions.
- ***B. abortus*** (Cattle), ***B. melitensis*** (Goats/Sheep).
- Rare other species in Jordan & Arab countries.
- **Transmitted to Humans:**  
The bacteria are transmitted from animals to humans by ingestion infected food products (Dairy ), direct contact with an infected animal, inhalation of aerosols.
- **Pathogenicity:**  
Enter through GI, skin abrasions, eye, inhalation/Droplets  
Intracellular (macrophages), Incubation:1-6 Weeks.. Intermittent fever, headaches, fatigue, joint and bone pain, GI Symptoms, Sweats, septicemia, meningitis, chronic disease with complication on CNS
- **Lab Diagnosis:** Blood, CSF, Bone marrow cultures, Brucella ..1-4 weeks culture incubation. agglutination Test. Specific Antibodies (IgM and IgG)..**Treatment:** 6-8 Weeks with Antimicrobial drugs

# Campylobacter Species

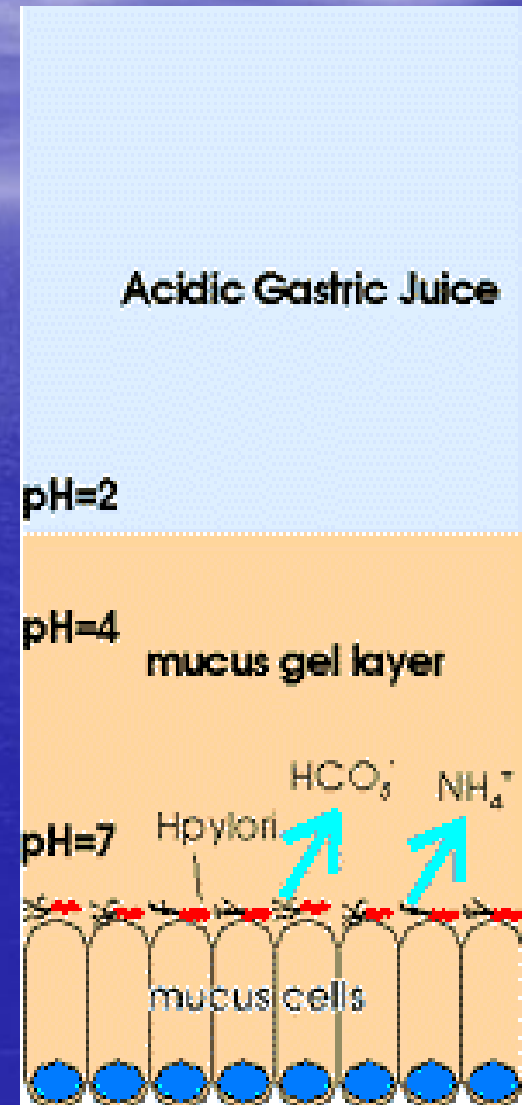
- **Many species.. Most human infection *C. jejuni*, *C. infantis***
- Microaerophilic.. **Optimal Growth 42 C** , Gram-negative thin- curved, Motile Bacilli/Bipolar flagella , Grow slowly over 3-6 days in vitro culture... This bacterium became important enteric pathogen since 1976.. Widely spread in small animals, dogs, cats, birds. It is primarily an animal pathogen causing **abortion and enteritis in sheep and cattle.**
- **Human illness** usually occurs 2-5 days after ingestion of the contaminated Chicken meat, Milk, fresh food , water.
- Multiply in the small intestine → invade the epithelium → produce mild inflammation → cause bloody-watery/ mild-moderate.. Few fecal **leukocytes** in feces..causes occasionally blood sepsis in children
- Other symptoms often present are fever, abdominal pain, nausea, headache and muscle pain.. Infection may be associated with arthritis
- **Diagnosis:** Stool culture .. **Selective Campylobacter Media** including 3 antibiotics/ biochemical tests.. Or direct detection of bacteria by PCR.

# Flagella of *Helicobacter pylori* & *Campylobacter jejuni* , Modified G-stain



# Helicobacter Species

- ***Helicobacter pylori***
  - Spiral shaped bacterium with multiple flagella.
  - Lives in the mucus lining stomach & duodenum causes chronic inflammation.. **Gastritis/Ulcers**
  - Only pathogenic in human
- Release urease, converted urea into  $\text{CO}_2$ /bicarbonate & ammonia → neutralize stomach acidity and protects colonizing .
- ***H. pylori***
  - Found worldwide, up to 10% of children - 80% of adults can have evidence of an *H. pylori* colonization/ mild infection - usually without having any clinical signs or symptoms..
- **Transmission route..**
  - Close personal contact.





# Helicobacter Species-2

- **Common symptoms:**
  - Gastritis /Peptic ulcer..Painful sores or ulcers in Stomach or duodenum...Duodenal ulcers , Nausea, Vomiting.
- Persistence of ulcers → increased risk of stomach cancer and Lymphoma.
- ***H. pylori*** can be successfully eradicated (95%) using a combination of certain antibiotics and medicines that suppress stomach acid production. Common Re-occurrence within few weeks - months. No vaccine
- **Diagnosis:**
  - Urea Breath test, Culture biopsy stomach .. Selective Medium with 3 antibiotics.. Incubation 37C, 4-6 days.
  - Serological test: ***H. pylori* antibodies** not significant for clinical diagnosis alone.

# *Acinetobacter* group

- Many species.. Pleomorphic aerobic gram-negative bacillus, aerobic
- Catalase +, Oxidase-ve, lactose-ve.. Commonly found in water, moist hospital environment ..contaminate irrigating solutions and intravenous solutions and respiratory equipments, catheters
- Asymptomatic skin carriage, nasopharyngeal carriage
- Commensal, low virulence .. **Opportunistic pathogen**

## ***A. baumannii*** :

Common species, often represent colonization rather than infection  
Found in skin, urine, wound & sputum hospitalized patients.

**Nosocomial infections:** in Immunodeficient patients & others ICUs--  
Patients . **Infections:** Pneumonia, Bloodstream Wound, Meningitis ..  
Develop rapidly resistance to most used antibiotics .. Multidrug-  
resistant ***A baumannii*** is a new emerging pathogen in hospitals  
worldwide with high mortality.