Enteric Bacteria

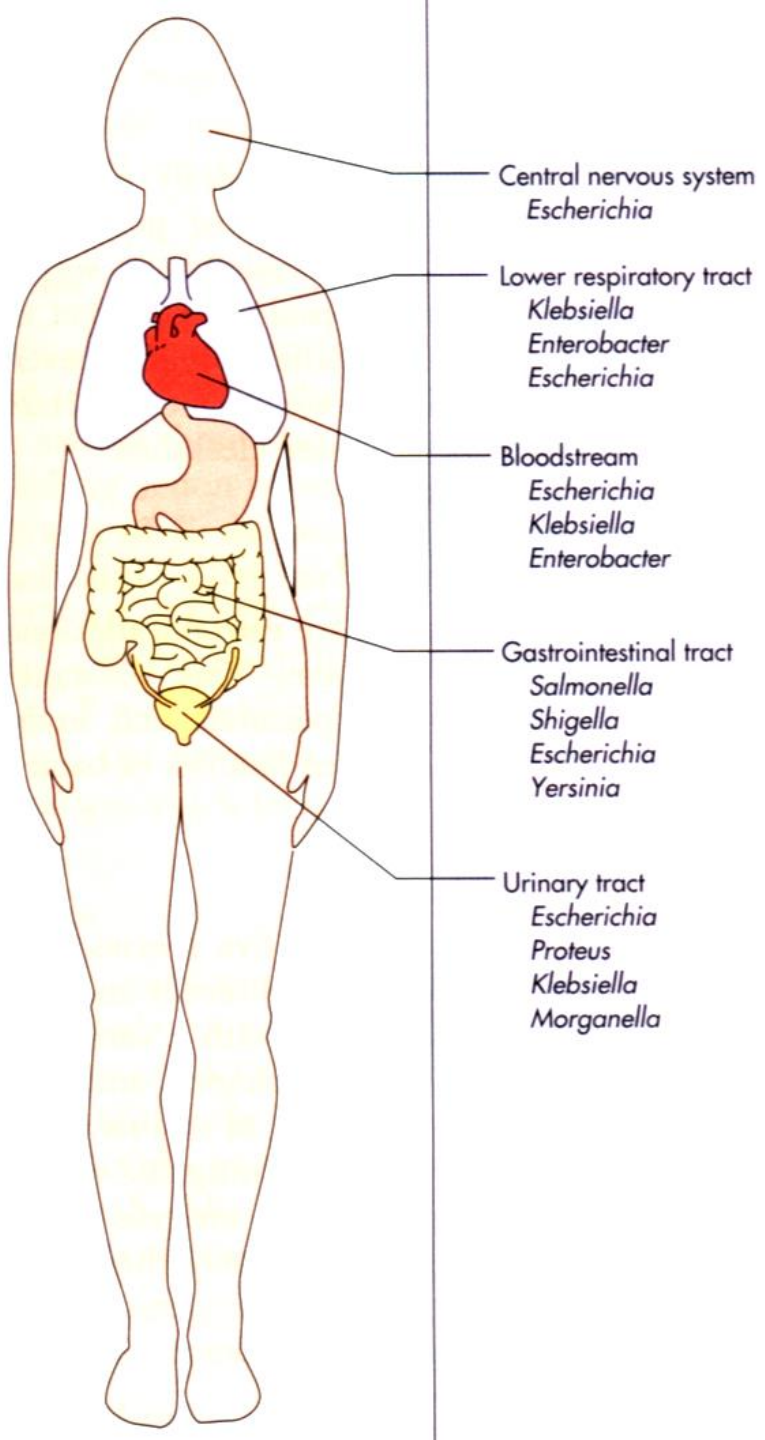
By

Prof. Dr. Asem Shehabi and Dr. Suzan Matar

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, fresh green vegetation ..rapid growth on culture media 24 hours
- Lactose -fermenters and Lactose non-fermenters
- Catalase +ve & Oxidase -ve

- **Opportunistic Pathogens & Obligate Pathogens**

- Causing all types of human infection, mostly urinary tract & wounds.. 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: The common 3 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, VerotoxinslShika-like toxins, Common intestinal Cattle, Contamination Ground meat/Hamburger, Dairy products, bloody diarrhea, later its toxin causes Haemolytic-uremic syndrome (HUS), fatal without treatment.

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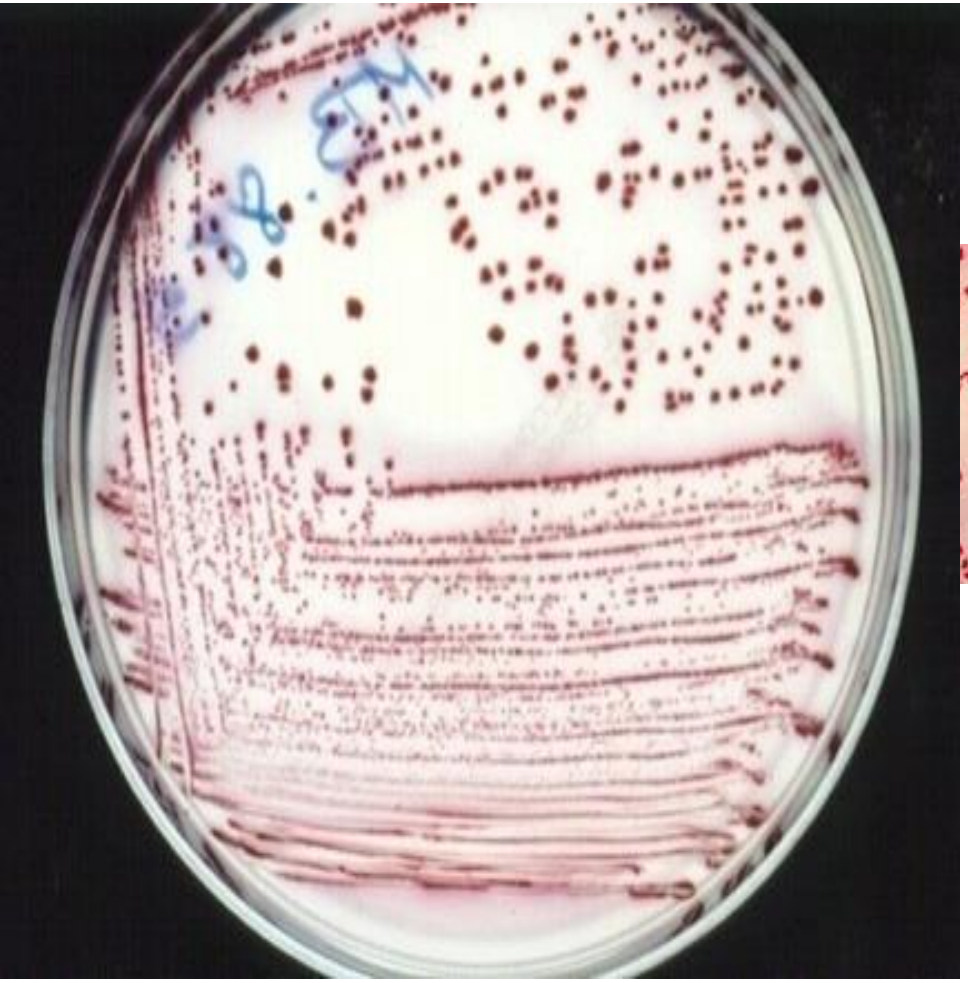
E. coli Culture – Red color on MacConkey agar indicates Lactose positive & Gram-stain



Coli-form Bacteria

2. ***Klebsiella - Enterobacter species*** :

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

Encapsulated *K. pneumoniae* more pathogenic & Multidrug-resistant than other coliforms.. causes fatal pneumonia.. Common Outbreak Nosocomial infection

3. ***Proteus- Morganella -Providencia species***: Lactose-ve, Low incidence in human & animal intestine.. cause about 3% of all UTIs, Less incidence Septicemia, Wounds, Nosocomial infection.

Proteus & Morgenella spp. causes renal stones. All Urease positive..Providencia spp. 50%.

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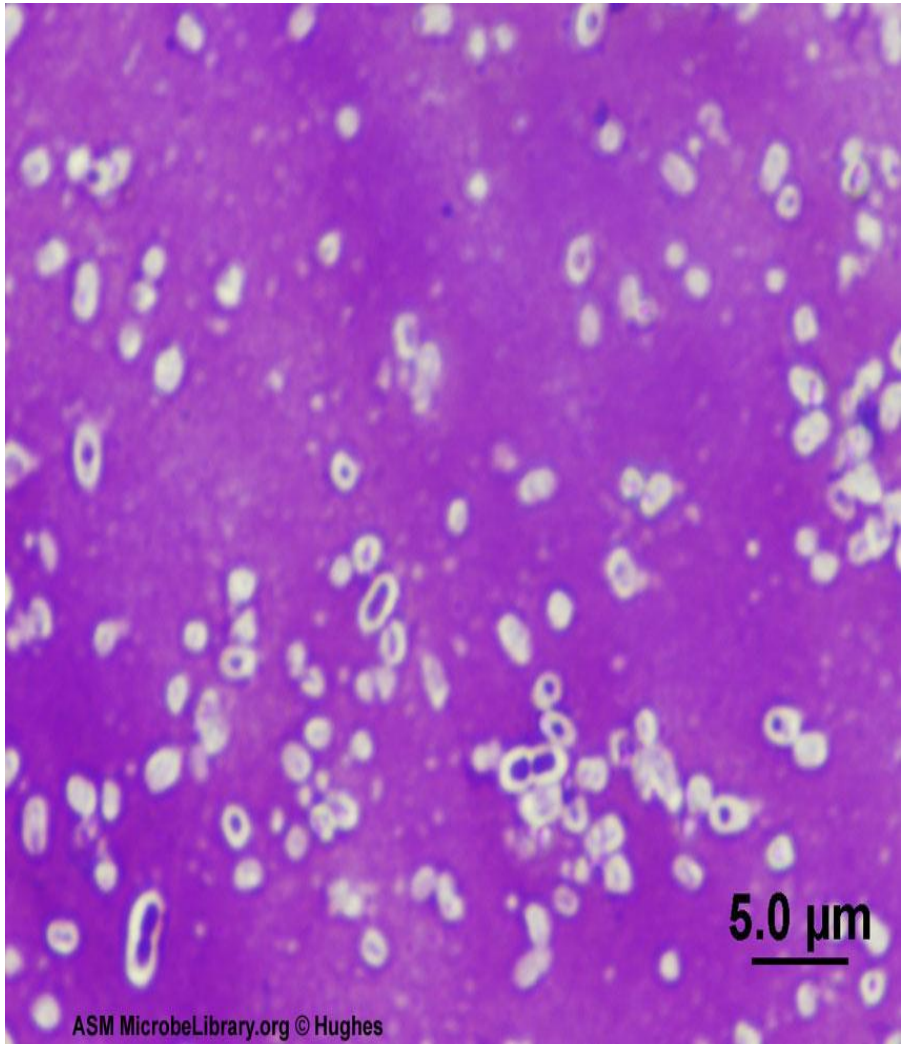
E. coli- Flagella- Fimbriae - Pili
Klebsiella pneumonia-Capsule



Salmonella group

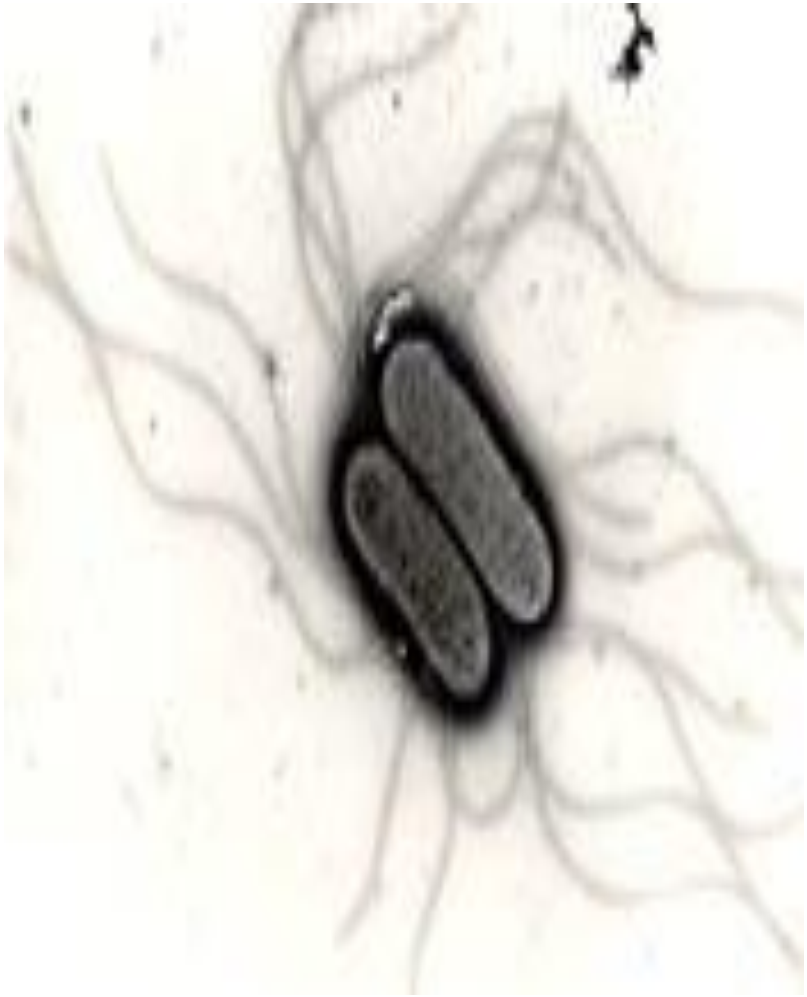
- Gram-ve bacilli..
- Facultative anaerobes
- Lactose-non fermenters
- Endotoxin / LPS.
- Common in Nature (water and soil), Humans, Animals, Birds. They are not part of the normal human flora.
- O/H Antigens with specific antibodies.
- Pathogenic when ingested causing enteritis, systemic infections 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.. Fever less vomiting
- Self-Limiting in healthy persons
- Rarely Septicemia - Meningitis Infant / young Children.. Immunocompromised patients.
- Human healthy carriers.. Short periods..animals long period crriers

Lab Diagnosis

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

Salmonella/ Flagella



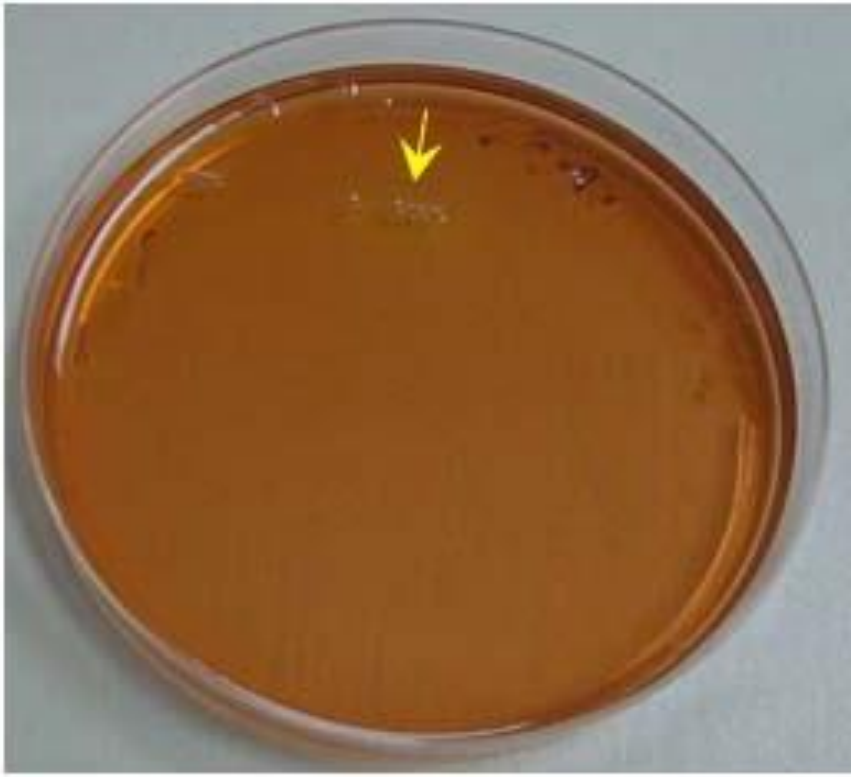
Hektoen–Enteric agar: ***Salmonella*** transparent colonies, +H_2s Lactose-ve. ***Shigella*** : transparent,lactose-ve

E. coli : orange colonies, Lactose-*ve*

SS agar for Salmonella & Shigella

Salmonella..Transparent colonies+H_2s.. Ohers 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.

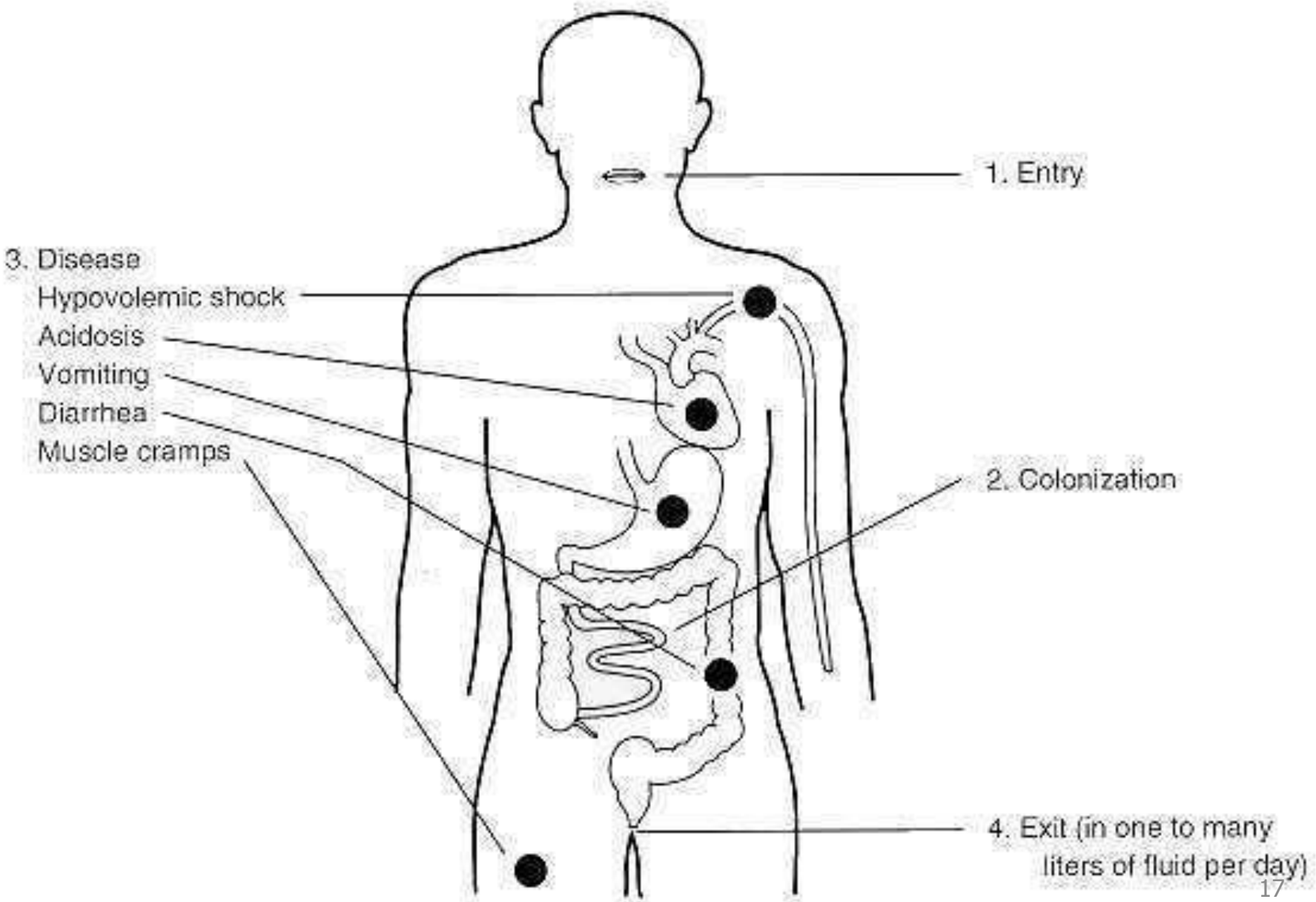
Lab Diagnosis:

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/Bangladish 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 Heath sanitation measurements. Human Vaccine.

Cholera


1. Entry
3. Disease
Hypovolemic shock
Acidosis
Vomiting
Diarrhea
Muscle cramps
2. Colonization
4. Exit (in one to many liters of fluid per day)

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

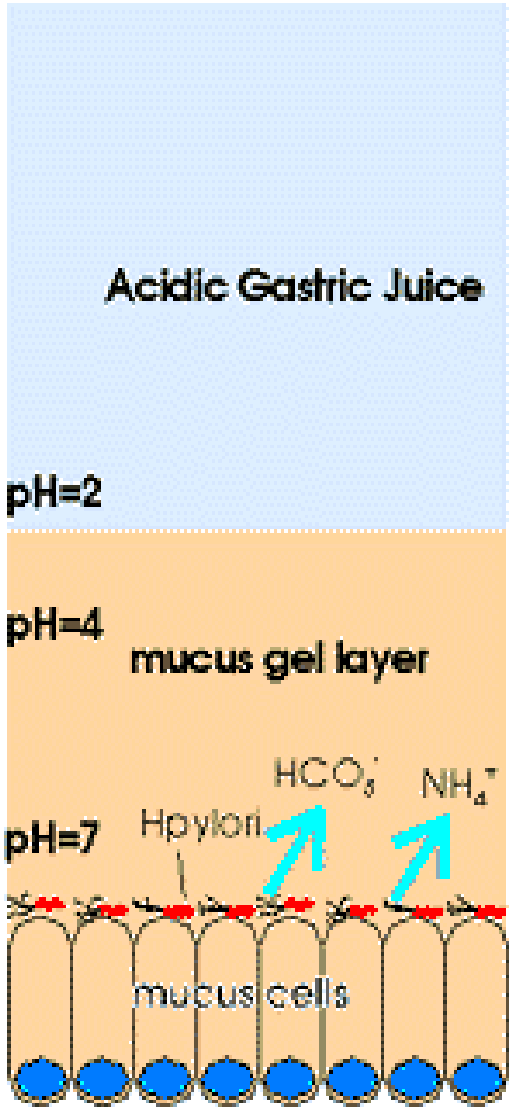
- Release urease, converted urea into CO_2/bicarbonate & ammonia →neutralize stomach acidity and protects colonizing .

- ***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.

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 pseudomonas species can cause human infections.
- ***P. aeruginosa*** :opportunistic pathogen.. colonize URT & intestine humans.. Produce blue-green pigmention / pyocyanin and fluorescein..release many enzymes. It is the most common species causes a clinically significant infection.. often associated with **Burn cases** ,**nosocomial infections**..serious and often life-threatening diseases..wound, blood sepsis, External ear infection, Urinary catheters, intravenous [IV] line, endotracheal tubes/ pneumonia, ***P. aeruginosa ..*** innate resistance to many antibiotics.. Develop rapidly resistance to antimicrobial agents.

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 in skin, urine, wound & sputum hospitalized patients.
Nosocomial infections: Invasive surgical procedures. IV Catheters - 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.