Public Health
Pharmacy college
4th stage
Lec 2
COMMUNICABLE DISEASES: INFECTIONS THROUGH THE GASTRO-INTESTINAL TRACT

Dr. Noor Hassoon

INFECTIVE AGENTS

- A number of important pathogens gain entry through the gastro-intestinal tract. Some of these cause **diarrhoeal diseases** (e.g. *Salmonella* and *Shigella* spp.) whilst others pass through the intestinal tract to cause **disease in other organs** (e.g. poliomyelitis, viral hepatitis).

The pathogens include:

- **Viral infections :** Poliomyelitis (poliovirus)

Viral hepatitis (hepatitis A and E viruses)

- **Bacterial infections:** Enteric fevers (*Salmonella typhi, S. paratyphi*)

Gastro-enteritis (*Escherichia coli*, *Campylobacter* spp.)

- **Protozoal infections:** Amoebiasis (*Entamoeba histolytica*)

Giardiasis (*Giardia lamblia*)

- **Helminthic infections**

Nematodes (roundworms)

Cestodes (tapeworms)

Trematodes (flukes)

Transmission

- Enteric pathogens exploit specific environmental and behavioral vectors. Public health multi-barrier interventions must deliberately target each node in the transmission chain.
- **The '5 Fs' Matrix**



Fingers

Contaminated hands serving as primary vectors; mitigated by rigorous hand hygiene education and alcohol-based rubs.



Flies

Mechanical vectors transporting pathogens from open defecation sites to prepared food; controlled via vector management.



Fields

Agricultural runoff and soil contamination via untreated sewage fertilizers; managed by strict sanitary farming practices.



Fluids

Water supplies serving as major reservoirs for wide-scale outbreaks; neutralized by point-of-use chlorination and filtration.



Food

Undercooked meats, unpasteurized dairy, and cross-contaminated surfaces; resolved via proper thermal processing and storage.

Epidemic patterns in relation to the mode of transmission

- Some of the infections that are acquired through the gastro-intestinal tract characteristically occur in **epidemic form,** for example typhoid.
- The pattern of an epidemic is affected by the route of transmission.
- A **water-borne** epidemic is typically **explosive**: it may affect people over a wide area who have no other traceable connection but the use of the same water supply.
- **Food-borne** outbreaks may be more **localized**.

Home work

❖ Define: Sporadic, endemic, outbreak, epidemic and pandemic disease with examples.

CONTROL OF THE INFECTIONS ACQUIRED THROUGH THE GASTRO-INTESTINAL TRACT

Control can operate on each of the three components of infection:

1. The infective agent:

- ✓ Sanitary disposal of feces.
- ✓ Elimination of human and animal reservoirs.

2 .The route of transmission:

- ✓ Provision of safe water supply.
- ✓ Protection of food from contamination.
- ✓ Control of flies.
- ✓ Improvement of personal hygiene.

3 .The host:

- ✓ Specific immunization.
- ✓ Chemoprophylaxis.
- ✓ Specific treatment.

DIARRHOEAL DISEASES

Secretory (Watery) Diarrhea

Primary Site: Small intestine epithelium.

Mechanism: Enterotoxins stimulate intracellular secondary messengers (cAMP, cGMP, or Ca2+) without structural tissue destruction.

Fluid Dynamics: Massive, uninhibited efflux of Cl- ions into the lumen, sequentially dragging water and Na+ passively along.

Clinical Profile: High-volume, watery stools ('rice-water'). Dehydration occurs rapidly. Fecal leukocytes and blood are strictly absent.

Prototypical Pathogens: Rota virus, Vibrio cholerae, Enterotoxigenic E. coli (ETEC).

Inflammatory Diarrhea (Dysentery)

Primary Site: Large intestine (colon) mucosa.

Mechanism: Direct invasion of mucosal epithelial cells or production of cytotoxic micro-abscesses and ulcerations leading to disruption of normal colonic absorptive capacity accompanied by inflammatory exudation of mucus, proteins, and cellular debris.

Fluid Dynamics: Frequent, low-volume stools containing visible blood, mucus, and sheets of fecal leukocytes.

Clinical Profile: Marked by high fever and severe tenesmus.

Prototypical Pathogens: Salmonella enterica, Campylobacter jejuni, Shigella spp.

Shiga Toxin *Escherichia coli* (STEC) (bacterial)

- **Primary Diarrhea Type:** Cytotoxic / Inflammatory progressing rapidly to profuse bright red blood.
- **Mode of Transmission:** Fecal-oral; undercooked ground beef, unpasteurized dairy/juice, cattle feces-contaminated water.
- **Epidemiology & At-Risk Groups:** High incidence in developed nations. Highest risk of severe disease in young children (< 5 years) and elderly.
- **Extraintestinal Complications:** Hemolytic Uremic Syndrome (HUS) Acute renal failure, microangiopathic hemolytic anemia, thrombocytopenia.
- **First-Line Systemic Management:** ANTIBIOTICS STRICTLY AVOIDED ⊘. Antibiotics trigger massive Shiga toxin dump, worsening renal damage. Support / dialysis only.

Shigella dysenteriae (bacterial)

- **Primary Diarrhea Type:** Invasive / Dysentery Frequent, small-volume stools composed purely of blood, mucus, and pus; painful straining.
- **Mode of Transmission:** Fecal-oral; highly contagious person-to-person via extremely low infectious dose (~10 organisms).
- **Epidemiology & At-Risk Groups:** Endemic in developing countries. Outbreaks common in daycare centers, refugee camps, and institutions.
- **Extraintestinal Complications:** HUS and Ekiri Syndrome -rapidly fatal neurotoxicity, cerebral edema, and severe seizures- in children.
- **First-Line Systemic Management:** Ciprofloxacin (Azithromycin or Ceftriaxone if fluoroquinolone-resistant).

Campylobacter jejuni (bacterial)

- **Primary Diarrhea Type:** Invasive / Inflammatory. Foul-smelling, loose stools characteristically progressing to bloody/mucoid.
- **Mode of Transmission:** Fecal-oral; undercooked poultry, raw milk, or surface water contaminated by avian reservoirs.
- **Epidemiology & At-Risk Groups:** A leading bacterial cause of foodborne gastroenteritis globally. Hyper-endemic in developing nations.
- **Extraintestinal Complications:** Guillain-Barré Syndrome (GBS) Ascending neuro-paralysis via molecular mimicry. Also Reactive Arthritis.
- **First-Line Systemic Management:** Azithromycin (Note: GBS is autoimmune; antibiotics do not reverse paralysis once initiated).

Salmonella enterica (Non-typhoidal) (bacterial)

- **Primary Diarrhea Type:** Invasive / Inflammatory. Loose, green-to-brown slimy stools; occasionally bloody; prominent fever.
- **Mode of Transmission:** Fecal-oral; contaminated poultry, eggs, unpasteurized dairy, or direct handling of reptiles.
- **Epidemiology & At-Risk Groups:** Highly spreadable worldwide. Bacteremia highest in infants, neonates, and immunocompromised.
- **Extraintestinal Complications:** Osteomyelitis (classic in Sickle Cell Disease) and Infective Endocarditis (heart valves).
- **First-Line Systemic Management:** Ceftriaxone or Ciprofloxacin (Indicated only for systemic infection or high-risk; mild cases omit antibiotics).

Vibrio cholera (bacterial)

- **Primary Diarrhea Type:** Secretory. Profuse, painless, massive-volume watery diarrhea; classic 'rice-water' stool.
- **Mode of Transmission:** Fecal-oral; contaminated water or shellfish. Deeply tied to marine and estuarine environments.
- **Epidemiology & At-Risk Groups:** Explosive epidemics in disaster zones, refugee camps, and environments lacking water infrastructure.
- **Extraintestinal Complications:** Acute Kidney Injury (AKI) and fatal Cardiac Arrhythmias driven by severe hypovolemic shock.
- **First-Line Systemic Management:** Doxycycline (or Azithromycin) + aggressive, immediate intravenous **Lactated Ringer's**.

Clostridioides difficile (*C. diff*) (bacterial)

- **Primary Diarrhea Type:** Watery, non-bloody diarrhea (can progress to pseudomembranous colitis).
- **Mode of Transmission:** Fecal-oral (ingestion of highly resilient bacterial spores).
- **Epidemiology & At-Risk Groups:** Primarily healthcare-associated, rising in communities, mainly affecting adults aged 65+.
- **Extraintestinal Complications:** Rare bacteremia/abscesses; reactive arthritis; dehydration leading to acute kidney injury.
- **First-Line Systemic Management:** Discontinue inciting antibiotic; start oral fidaxomicin or vancomycin or metronidazole.

Entamoeba histolytica (Parasite)

- **Primary Diarrhea Type:** Invasive / Amebic Dysentery. Dark, bloody diarrhea with thick mucus; classic 'raspberry jelly' stool.
- **Mode of Transmission:** Fecal-oral; ingestion of mature cysts via water or food contaminated with human feces.
- **Epidemiology & At-Risk Groups:** Prevalent in tropical/subtropical regions with poor sanitation. High-risk in travelers.
- **Extraintestinal Complications:** Amebic Liver Abscess 'Anchovy paste' abscess via portal vein migration; can track to lungs/brain.
- **First-Line Systemic Management:** Metronidazole (or Tinidazole) for tissue trophozoites, followed by luminal Paromomycin.

Giardia lamblia (Parasite)

- **Primary Diarrhea Type:** Malabsorptive / Osmotic. Pale, bulky, grease-laden, frothy, floatable stools; distinctly foul; no blood.
- **Mode of Transmission:** Fecal-oral; sturdy cysts from wilderness streams, municipal water, or daycare contacts.
- **Epidemiology & At-Risk Groups:** wide spread worldwide. Frequently infects backpackers ('Beaver fever'), toddlers, and travelers.
- **Extraintestinal Complications:** Systemic Reactive Arthritis, chronic Urticaria (hives), and profound malabsorptive weight loss.
- **First-Line Systemic Management:** Metronidazole or Tinidazole.

Rotavirus & Norovirus (Viruses)

- **Primary Diarrhea Type:** Osmotic & Secretory. Explosive, watery, non-bloody stools heavily accompanied by forceful emesis.
- **Mode of Transmission:** Fecal-oral; airborne droplets from vomitus, contaminated surfaces (fomites), food/water.
- **Epidemiology & At-Risk Groups:** Rotavirus targets infants globally (vaccine reduced). Norovirus is the #1 cause of outbreaks (cruise ships).
- **Extraintestinal Complications:** Benign Convulsions associated with mild gastroenteritis and rare viral Encephalitis.
- **First-Line Systemic Management:** NO ANTIBIOTICS ⊘ . Purely supportive fluid maintenance, metabolic tracking, and antipyretics.

Non-Diarrheal GI Pathogens Affecting Other Organs

Helicobacter pylori (Bacteria)

- **Mode of Transmission:** Person-to-person (fecal-oral or oral-oral route); often acquired during childhood.
- **Primary GI Presentation:** Chronic gastritis, dyspepsia, peptic ulcer disease, or completely asymptomatic.
- **Extraintestinal Complication:** Gastric Adenocarcinoma and MALT Lymphoma (Mucosa-Associated Lymphoid Tissue Lymphoma) - Stomach cancers driven by chronic inflammation-.
- **Epidemiology & Risk Factors:** Infects over 50% of the world's population; highest prevalence in lower socioeconomic regions.
- **First-Line Systemic Management:** Triple/Quadruple Therapy: Proton Pump Inhibitor (PPI) + Clarithromycin + Amoxicillin (or Metronidazole/Bismuth).

Salmonella Typhi (Bacteria - Typhoid Fever)

- **Mode of Transmission:** Fecal-oral, via food or water heavily contaminated by human feces or asymptomatic chronic carriers.
- **Primary GI Presentation:** High step-ladder fever, profound constipation (especially in adults), and severe abdominal pain/bloating.
- **Extraintestinal Complication:** Splenomegaly, Hepatomegaly, and intestinal perforation (due to necrosis of Peyer's patches in the ileum).
- **Epidemiology & Risk Factors:** Endemic to South Asia, parts of Africa, and Latin America with limited clean water access.
- **First-Line Systemic Management:** Ceftriaxone or Azithromycin (Fluoroquinolones like Ciprofloxacin are avoided due to high resistance).

Poliovirus (Virus)

- **Mode of Transmission:** Fecal-oral, via contaminated water, hands, or raw food.
- **Primary GI Presentation:** Asymptomatic replication in the gut or mild sore throat/fever.
- **Extraintestinal Complication:** Acute Flaccid Paralysis / Poliomyelitis (Destruction of motor neurons in the spinal cord).
- **Epidemiology & Risk Factors:** Eradicated in most of the world via vaccines; currently remains endemic only in specific geographic pockets.
- **First-Line Systemic Management:** No Antivirals ⊘ (Purely supportive care, physical therapy, and mechanical ventilation support if needed).

Toxoplasma gondii (Parasite)

- **Mode of Transmission:** Fecal-oral, ingestion of oocysts from soil/cat litter, or eating undercooked tissue cysts in meat.
- **Primary GI Presentation:** Asymptomatic gut entry; does not cause structural gut irritation or diarrhea.
- **Extraintestinal Complication:** CNS Toxoplasmosis (Brain abscesses, seizures) and Congenital Toxoplasmosis (Chorioretinitis, blindness in fetuses).
- **Epidemiology & Risk Factors:** Highly prevalent worldwide. Severe extraintestinal disease occurs primarily in pregnant women and HIV/AIDS patients.
- **First-Line Systemic Management:** Pyrimethamine + Sulfadiazine (along with Leucovorin to protect bone marrow).

Taenia solium (Parasite - Pork Tapeworm)

- **Mode of Transmission:** Fecal-oral ingestion of *T. solium* eggs via water or food contaminated by human feces.
- **Primary GI Presentation:** Intestinal tapeworms cause minor discomfort, but *ingesting eggs* bypasses the gut without causing diarrhea.
- **Extraintestinal Complication:** Neurocysticercosis (Larval cysts lodge in the brain, serving as a leading cause of adult-onset seizures worldwide).
- **Epidemiology & Risk Factors:** Highly endemic in regions where pigs roam freely and consume human waste (Latin America, Sub-Saharan Africa, Asia).
- **First-Line Systemic Management:** Albendazole or Praziquantel (Crucially paired with Corticosteroids to control brain inflammation during larval death).

Enterobius vermicularis (Pinworm)

- **Primary GI Presentation:** Primary symptom is intense perianal itching, especially at night.
- **Mode of Transmission:** Fecal-oral, (ingestion of eggs via contaminated hands, clothing, bedding, or inhalation of airborne eggs).
- **Epidemiology & Risk Factors:** Worldwide distribution; most common helminthic infection in the US and Europe, predominantly affecting school-aged children and institutionalized settings.
- **Extraintestinal Complication:** Vulvovaginitis, pelvic peritoneal granulomas, salpingitis, and appendicitis (due to ectopic migration of adult worms).
- **First-Line Systemic Management:** Oral Mebendazole or Pyrantel pamoate (single dose, repeated after 2 weeks). **Treat the entire household simultaneously.**

Hepatitis A Virus (HAV)

- **Mode of Transmission:** Fecal-oral, via ingestion of water/food contaminated with feces, or close personal contact.
- **Primary GI Presentation:** Nausea, vomiting, right upper quadrant abdominal pain, and anorexia.
- **Extraintestinal Complication:** Acute Liver Failure (Fulminant hepatitis), severe Jaundice (bilirubin buildup), and prolonged cholestasis.
- **Epidemiology & Risk Factors:** Highly endemic in areas with poor sanitation. Outbreaks occur in daycares, schools, and among international travelers. Vaccine-preventable.
- **First-Line Systemic Management:** No Antivirals ⊘ (Purely supportive care: hydration, rest, avoiding hepatotoxic drugs like acetaminophen).

Hepatitis E Virus (HEV)

- **Mode of Transmission:** Fecal-oral**,** via contaminated drinking water or eating undercooked pork/deer meat.
- **Primary GI Presentation:** Fever, fatigue, loss of appetite, nausea, and abdominal pain.
- **Extraintestinal Complication:** Fulminant Hepatic Failure (specifically in pregnant women) and Neurological syndromes (like Neuralgic Amyotrophy).
- **Epidemiology & Risk Factors:** Waterborne epidemics are common in developing countries. Zoonotic strains are found in industrialized countries. Highly fatal for **pregnant women** (up to 20–25% mortality in the 3rd trimester).
- **First-Line Systemic Management:** **Supportive care** for acute cases. **Ribavirin** can be considered for chronic infections in immunocompromised patients.

Hepatitis B Virus (HBV)

- **Mode of Transmission:** Percutaneous/mucosal exposure to infected blood or body fluids (sexual, IV drug use, vertical transmission).
- **Primary GI Presentation:** Asymptomatic or mild acute right upper quadrant pain and nausea during the initial phase.
- **Extraintestinal Complication:** Liver Cirrhosis, Hepatocellular Carcinoma (HCC), and systemic immune complexes causing Polyarteritis Nodosa (PAN) (blood vessel inflammation).
- **Epidemiology & Risk Factors:** Highly endemic in Sub-Saharan Africa and East Asia. Major risk groups include infants born to infected mothers, healthcare workers, and IV drug users. Vaccine-preventable.
- **First-Line Systemic Management:** Tenofovir or Entecavir (Nucleoside/nucleotide analogues) to suppress viral replication in chronic cases.

Hepatitis C Virus (HCV)

- **Mode of Transmission:** Direct contact with infected **blood** (primarily IV drug use, unsterile medical procedures, or tattooing).
- **Primary GI Presentation:** Mostly asymptomatic or very mild abdominal fatigue during acute infection.
- **Extraintestinal Complication:** Liver Cirrhosis, HCC, and extrahepatic autoimmune conditions like Mixed Cryoglobulinemia (causing vasculitis and kidney damage).
- **Epidemiology & Risk Factors:** Pervasive worldwide. Disproportionately affects people who inject drugs and individuals who received blood transfusions before widespread screening.
- **First-Line Systemic Management:** Direct-Acting Antivirals (DAAs) (e.g., Sofosbuvir/Velpatasvir) taken orally for 8–12 weeks. Achieves a **>95% cure rate**.

Hepatitis D Virus (HDV) (Delta Hepatitis)

- **Mode of Transmission:** Direct contact with infected **blood or body fluids** (injection equipment, sexual, or perinatal transmission)
- **Primary GI Presentation:** Jaundice, nausea, abdominal pain, and fatigue. **Cannot exist without active Hepatitis B (HBV).**
- **Extraintestinal Complication: Accelerated Liver Cirrhosis** and **Hepatocellular Carcinoma (HCC)**, Superinfection on chronic HBV leads to rapid end-stage liver failure.
- **Epidemiology & Risk Factors:** Affects ~5% of people globally with chronic HBV (~12 million people). Hotspots include the Middle East, Mongolia, and Central Africa. High risk in IV drug users.
- **First-Line Systemic Management: Pegylated Interferon-alpha (PEG-IFNα)**

or the entry inhibitor **Bulevirtide** (approved in Europe). Prevention is achieved via the **HBV vaccine**.


Thank
You