

DIARRHEA

Made By:

Pathology Team:

Khuloud Al-Shuwairkh

Roa Al-Sajjan

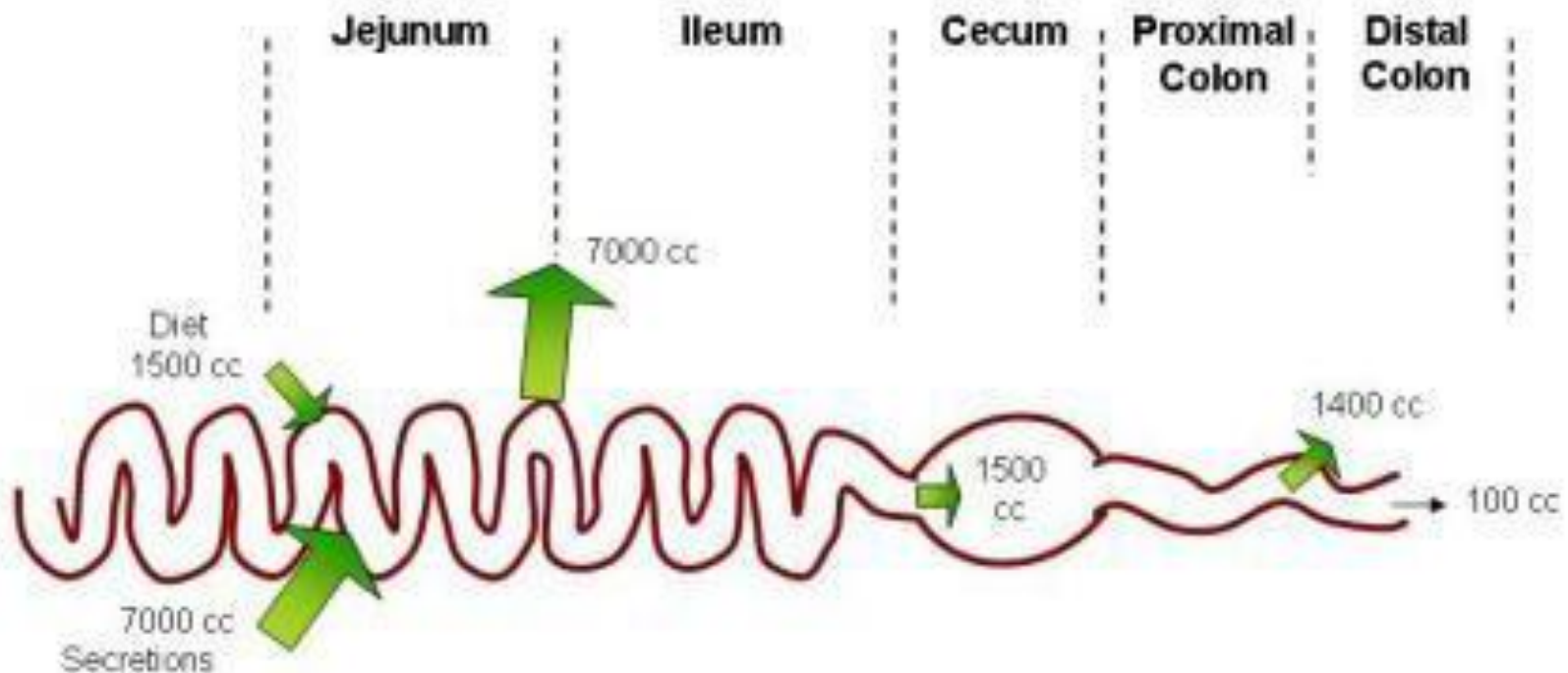
Muhammad Al-Harbi

Norah Al-Saif

Dona Barakah

Physiology of Fluid and small intestine

- The fluid in the bowel is generally considered as part of the transcellular compartment.
Turnover of fluid in the bowel is large.
A net amount of about **9 to 10 liters** of fluid enter the gut each day



About 98% of this fluid is reabsorbed. This is resulting in a faecal water loss of only 100 mls/day (way less)

This reabsorption occurs predominantly in the jejunum and ileum.

About 1500 mls/day enter the colon from the ileum.

This means that over a litre per day is absorbed in the colon.

Bowel fluid loss may be internal or external.

External losses include vomiting, diarrhoea and fistulae losses.

Fistulae: An abnormal duct or passage resulting from injury, disease, or a congenital disorder that connects an abscess, cavity, or hollow organ to the body surface or to another hollow organ

Definition of Diarrhea

- World Health Organization:
 - 3 or more loose or liquid stools per day.
- Abnormally high fluid content of stool
 - > 200-300 gm/day

Fecal osmolarity

- As stool leaves the colon, ***fecal osmolality*** is equal to the ***serum osmolality*** i.e. 290 mosm/kg.
- Under normal circumstances, the major osmoles are made by: Na^+ , K^+ , Cl^- , and HCO_3^- .

Fecal Osmotic Gap

$$290 \text{ mosm/kg H}_2\text{O} - 2 ([\text{Na}^+] + [\text{K}^+])$$

Osmotic diarrhea: > 125

CLASSIFICATION

1. Acute diarrhea.....if 2 weeks,

2. Persistent diarrhea if 2 to 4 weeks,

3. Chronic diarrheaif 4 weeks in duration.

But **mainly** they are 2 types, “acute” and “chronic” only.

Why is it important?

- The loss of fluids through diarrhea can cause ***dehydration*** and ***electrolyte imbalances***.
- Easy to treat but if untreated, may lead to death especially in children.

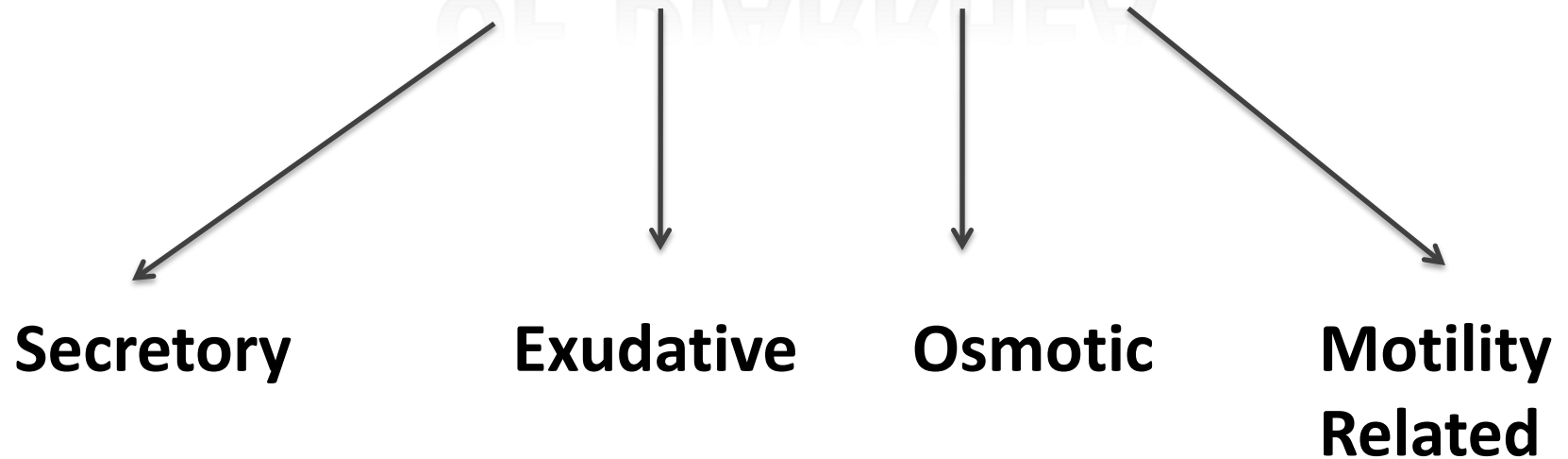
Why is it important?

More than 70 % of almost 11 million child deaths every year are attributable to 6 causes:

1. Diarrhea
2. Malaria
3. neonatal infection
4. Pneumonia
5. preterm delivery
6. lack of oxygen at birth.

UNICEF

MECHANISMS OF DIARRRHEA



A. Secretory

- There is an increase in the active secretion

The most common cause of this type of diarrhea is a **bacterial toxin (E. coli , cholera)** that stimulates the secretion of anions

- ***Cholera toxin*** directly stimulates excessive secretion of electrolytes and fluid from the ***crypts of Lieberkühn*** in the distal ileum and colon. The amount can be 10 to 12 liters per day, although the colon can usually reabsorb a maximum of only 6 to 8 liters per day. Therefore, loss of fluid and electrolytes can be so devastating within several days that death can result

With cholera, no tissue invasion occurs; non-inflammatory diarrhea = nonbloody, no leukocytes

A. Secretory

- High stool output
- Lack of response to fasting; it continues even when there is no oral food intake
- **Normal stool osmotic gap**; isotonic with plasma (< 100 mOsm/kg), because there is no malabsorbed solute
- Also seen in endocrine tumors;

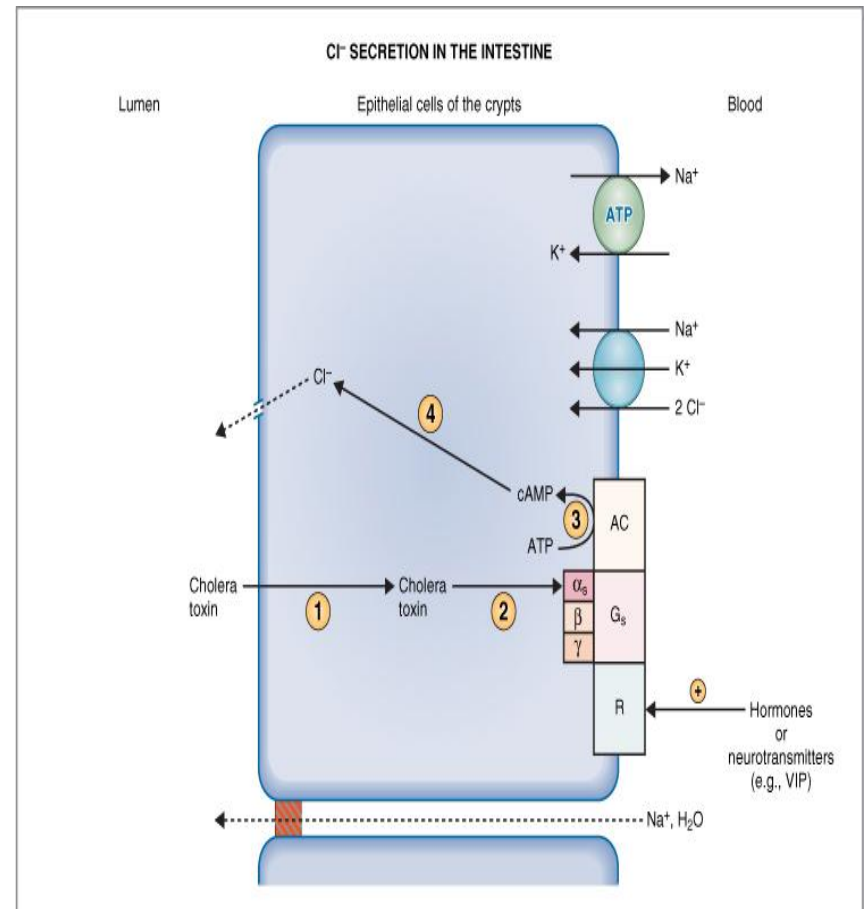
Examples:

- **Metastatic gastrointestinal carcinoid tumors**; result in release of serotonin, histamine & prostaglandins (secretagogues: promote secretions)
- **Gastrinoma**; excessive gastrin secretion causes low intraduodenal pH → inactivation of pancreatic enzymes → fat maldigestion → diarrhea

A. Secretory

Secretory Diarrhea

- Infectious: viral damage to surface epithelium
 - Rotavirus
 - Enteric adenoviruses
- Infectious: enterotoxin-mediated
 - *Vibrio cholerae*
 - *Escherichia coli*
 - *Bacillus cereus*
 - *Clostridium perfringens*
- Neoplastic: tumor elaboration of peptides or serotonin
- Excessive **laxative** use



© Elsevier. Costanzo: Physiology 3E www.studentconsult.com

Laxative: substances or drugs that stimulate the intestines, causing the body to eliminate waste. They are most often taken for [constipation](#).

B. Exudative

- Results from the outpouring of **blood protein**, or **mucus** from an inflamed or ulcerated mucosa
- Presence of **blood** and **pus** in the stool (leukocytes)
- Lack of response to fasting
- Occurs with inflammatory bowel diseases (Crohn's & ulcerative colitis, and invasive infections).

Microbial pathogen → destruction of epithelium + absorptive surface → exudation of blood & serum into lumen + inefficient reabsorption of water

- Bacteria: *Salmonella*, *E. coli*, *Campylobacter*
- Viruses: rotaviruses, coronaviruses, parvoviruses (canine and feline), norovirus
- Protozoa: coccidia species, *Cryptosporium*, *Giardia*

Immune response to inflammatory condition → activation of leukocytes → production of cytokines → ↑ secretions

B. Exudative

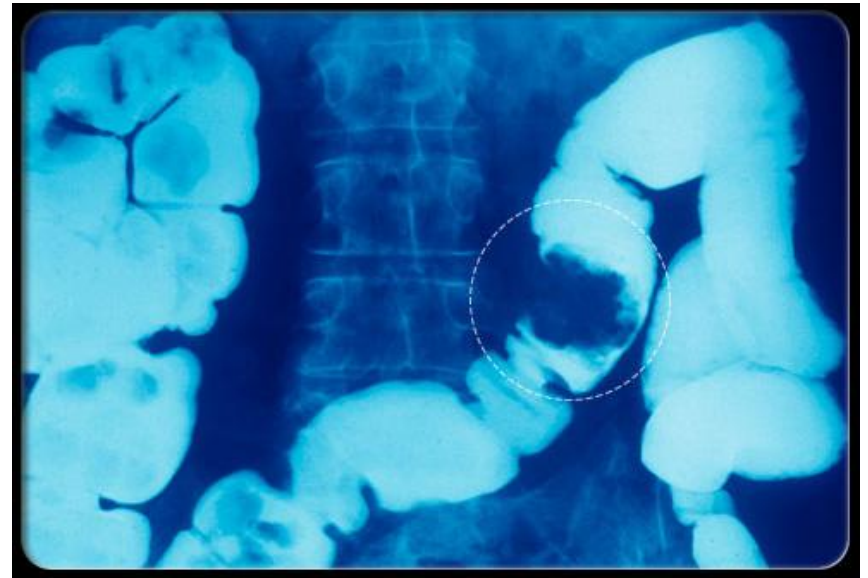
- **Inflammatory Bowel Disease:**

Primarily ulcerative colitis (UC) and Crohn's disease (CD). These are chronic conditions of uncertain etiology, characterized by recurrent episodes of abdominal pain, often with diarrhea.

*Result from an abnormal local **immune response** against the **normal flora** of the gut, and probably against some **self antigens**, in genetically susceptible individuals.*

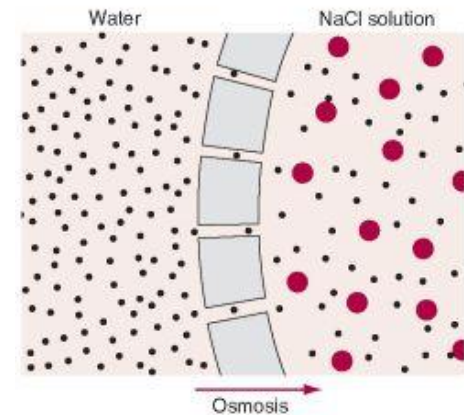
***Crohn's disease** may affect any portion of the gastrointestinal tract from esophagus to anus but most often involves the ileum; about half of cases exhibit noncaseating granulomatous inflammation.*

***Ulcerative colitis** is a nongranulomatous disease limited to the colon.*



C. Osmotic

- Excess amount of poorly absorbed substances that exert osmotic effect → water is drawn into the bowels → diarrhea
- Stool output is usually not massive
- Fasting improves the condition (if patient stops consuming poorly absorbed substance)
- Stool osmotic gap is high (> 125 mOsm/kg)



Can be the result of

- Malabsorption in which the nutrients are left in the lumen to pull in water e.g. lactose intolerance (resulting from a deficiency in the brush border enzyme lactase)
- Osmotic laxatives (Magnesium salts, which are contained in milk of magnesia and many antacids)

D. Motility-Related

- Caused by the rapid movement of food through the intestines (hypermotility)
- Irritable bowel syndrome (IBS) – a motor disorder that causes abdominal pain and altered bowel habits with diarrhea predominating

Deranged Motility

- Decreased intestinal retention time
 - Surgical reduction of gut length
 - Neural dysfunction, including irritable bowel syndrome
 - Hyperthyroidism
- Decreased motility (increased intestinal retention time)
 - Surgical creation of a "blind" intestinal loop
 - Bacterial overgrowth in the small intestine

Water and nutrients are not retained in intestines long enough to be efficiently absorbed

Disorders in motility accelerate transit time → decrease absorption → diarrhea, even if the absorptive process was proceeding properly.

Summary

| | Mechanism | Diagnostic Features | Associated Conditions |
|------------------|---|--|---|
| Secretory | ↑ in active secretion | <ul style="list-style-type: none"> • High stool output • No response to fasting • Normal stool osmotic gap | <ul style="list-style-type: none"> • Non-inflammatory infection; bacterial toxin (E. coli, cholera) • Endocrine tumors |
| Osmotic | Excess amount of poorly absorbed substances that exert osmotic effect & draw water into lumen | <ul style="list-style-type: none"> • Stool output is not massive • Improves w/fasting • Stool osmotic gap is high | <ul style="list-style-type: none"> • Malabsorption • Osmotic laxatives |
| Exudative | Outpouring of blood, protein, or mucus from an inflamed or ulcerated mucosa | <ul style="list-style-type: none"> • Blood & pus in stool (leukocytes) • No response to fasting | <ul style="list-style-type: none"> • Inflammatory bowel disease • Invasive (inflammatory) infections |
| Motility-related | Rapid movement of food through the intestines (hypermotility) | | <ul style="list-style-type: none"> • Irritable bowel syndrome • Hyperthyroidism |

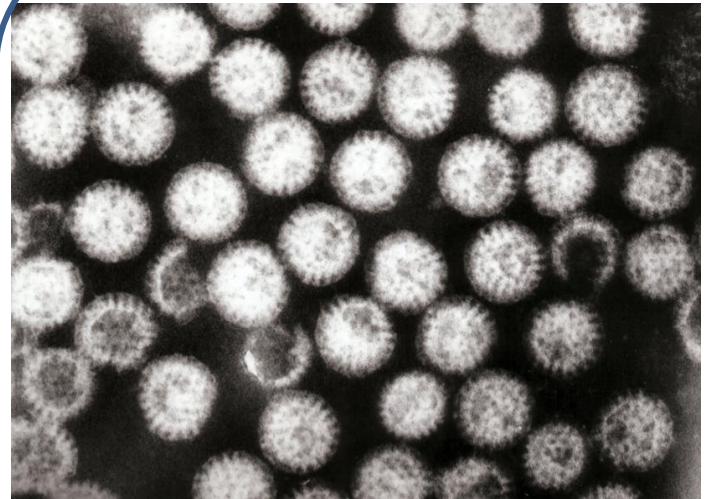
Acute Diarrhea

Acute Diarrhea

- A sudden severe attack of diarrhea, lasting less than 14 days (< 2 week)
- Causes :
 - I. Approximately 80% of acute diarrheas are due to infections (viruses, bacteria, helminthes & protozoa).
 - II. Non-infectious:
 - secretory (e.g.cholera & e.coli)
 - Drugs with chemical irritants.
 - III. Food poisoning
- And Others....

Viral gastroenteritis

Viral infection of the stomach and the small intestine, is the most common cause of acute diarrhea worldwide



Rotavirus: the cause of nearly 40% of hospitalizations from diarrhea in children under 5

Antibiotic-Associated Diarrheas

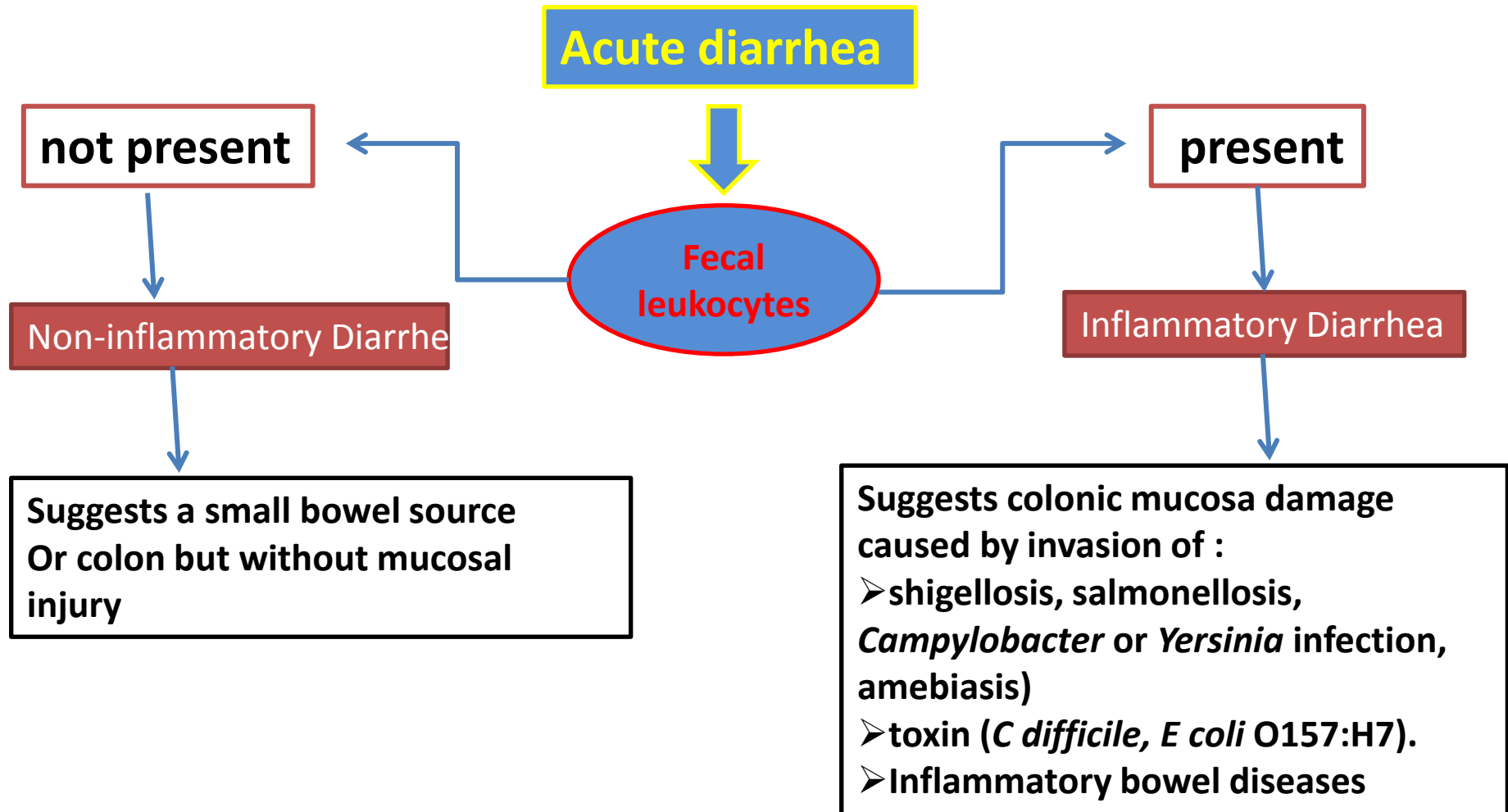
Diarrhea occurs in 20% of patients receiving broad spectrum antibiotics; about 20% of these diarrheas are:

due to *Clostridium difficile*

Broad-spectrum antibiotic: refers to an antibiotic with activity against a wide range of disease-causing bacteria. It also means that it acts against both Gram-positive and Gram-negative bacteria.

Clostridium difficile : Bacteria that are normally present in the large intestine, can cause a serious illness called pseudomembranous colitis in people taking antibiotics, and can sometimes trigger reactive arthritis.

Tests useful in the evaluation of diarrhea



Chronic Diarrhea

Chronic Diarrhea

- Diarrhea is considered to be chronic when the symptoms persist for 3 to 4 weeks in children or adults and 4 weeks in infants
- There are four **major causes** of chronic diarrhea:
 - presence of hyperosmotic luminal contents (osmotic),
 - increased intestinal secretory processes (secretory),
 - inflammatory conditions,
 - infectious processes

Chronic Diarrhea: Causes

1. Hyperosmotic diarrhea

- Lactase deficiency & other **malabsorption** syndrome
- Laxative abuse

2. Secretory diarrhea

- Failure to absorb bile salts
- Chronic laxative abuse
- **Endocrine conditions:**
 - Carcinoid syndrome
 - Zollinger-Ellison syndrome

Carcinoid syndrome refers to the array of symptoms that occur secondary to carcinoid tumors. The syndrome includes flushing, diarrhea and to a lesser extent, heart failure and bronchoconstriction. It is caused by endogenous secretion of mainly serotonin.

3. Inflammatory bowel disease

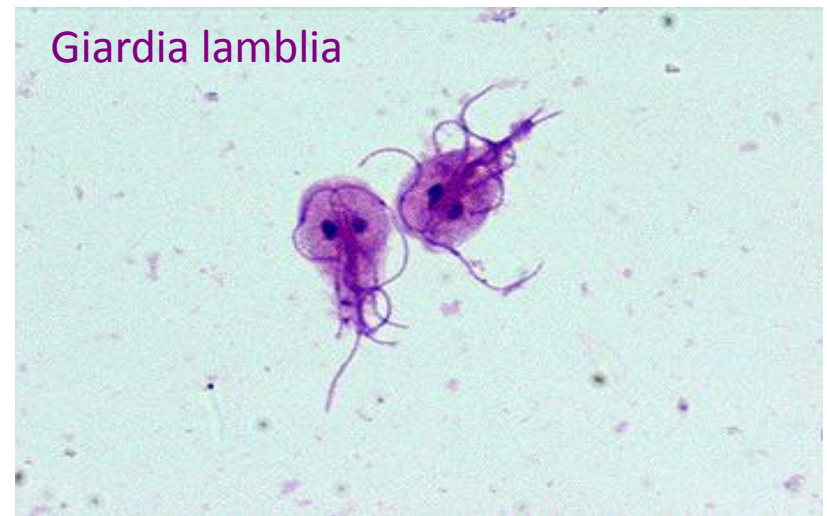
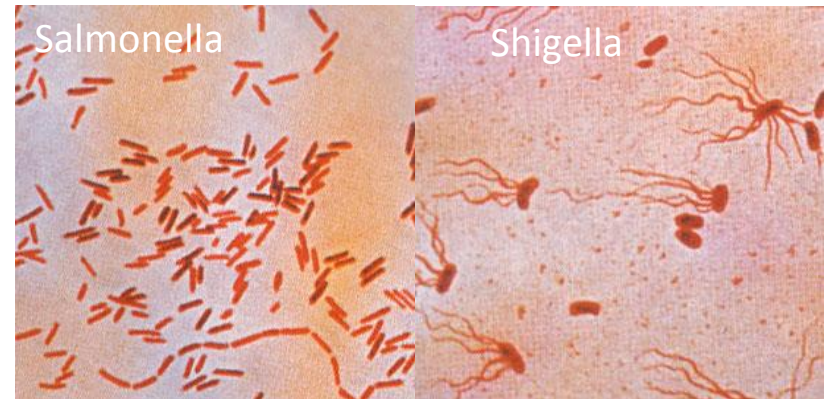
- Crohn disease
- Ulcerative colitis

4. Motility-related: Irritable bowel syndrome, hyperthyroidism, carcinoid syndrome

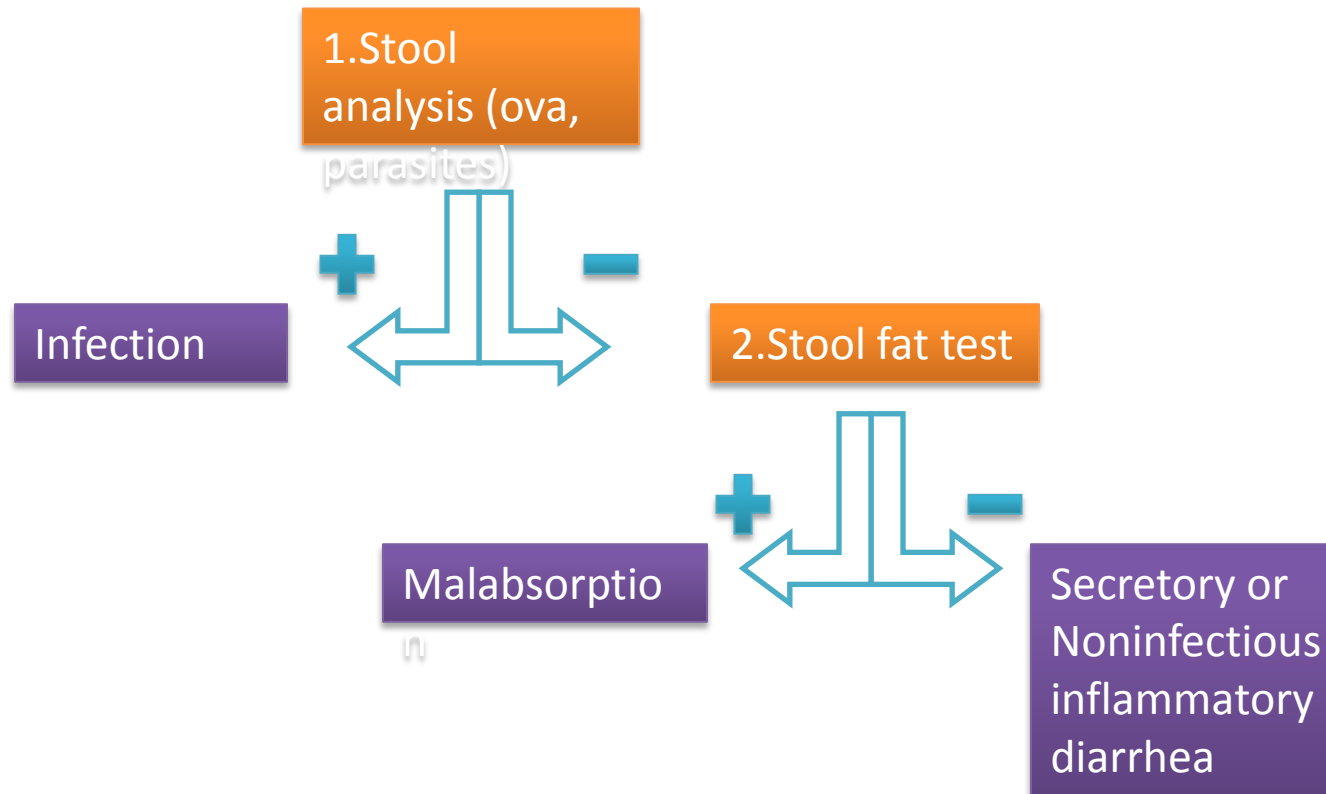
Chronic Diarrhea: Causes

- Infectious disease:
Shigellosis, salmonellosis, giardiasis
- **Post-infectious.** Following acute viral, bacterial or parasitic infections (e.g. post-infectious irritable bowel syndrome)

Immunocompromised persons are particularly susceptible to infectious organisms that can cause acute & chronic diarrhea e.g. AIDS patients



Chronic Diarrhea: Diagnosis



Complications

- Fluid loss → Dehydration
- Electrolyte loss → Electrolyte imbalances

Na⁺ (hyponatremia) → nausea and vomiting, headache, confusion, fatigue, appetite loss, restlessness and irritability, muscle weakness, spasms, or cramps, seizures, and decreased consciousness or coma

K⁺ (hypokalemia) → Hyperpolarization of membrane (cells become less excitable) but heart muscle hyper-excitability → arrhythmias

- NaHCO₃ (sodium bicarbonate) → Metabolic acidosis

Metabolic acidosis is a primary decrease in serum HCO₃⁻ concentration.

Symptoms: headache, nausea & vomiting, abdominal pain, chest pain, confusion, ↓ visual acuity, weight loss, muscle weakness & bone pain.

In severe acidemia: hypotension, seizures, arrhythmias and eventually coma

- Malnutrition (due to malabsorption)