SLOs

List examples of normal microbiota for each part of the gastrointestinal tract

Describe the events that lead to dental caries and periodontal disease

List the causative agents, suspect foods, signs and symptoms, and treatments for staphylococcal food poisoning, shigellosis, salmonellosis, typhoid fever, cholera, gastroenteritis, and peptic ulcer disease

Differentiate between hepatitis A, hepatitis B, hepatitis C

List the causative agents, mode of transmission, and symptoms of viral gastroenteritis

List the causative agent, modes of transmission, symptoms, and treatment for giardiasis

List the causative agents, modes of transmission, symptoms, and treatments for tapeworms, pinworm, and ascariasis
Intro and Normal Microbiota

- Diseases of the digestive system are the 2\textsuperscript{nd} most common illnesses in the US.
- Diseases of the digestive system usually result from the ingestion of microorganisms or their toxins in food and water.
- Fecal–oral transmission can be interrupted by
  - proper disposal of sewage
  - disinfection of drinking water
  - proper food preparation and storage
- >700 bacterial species in mouth
- Stomach and small intestine have few resident microbes
- Up to 40\% of fecal mass is microbial cells
- Bacteria in large intestine assist in degrading food and synthesizing vitamins. They also competitively inhibit pathogens, chemically alter medications, and produce carcinogens.
Dental Caries (Tooth Decay)

- *S. mutans* is 1° causative agent
- Cariogenic **plaque** binds to receptors on tooth pellicle
- Sucrose → glucose + fructose
  - Glucose polymerization → dextran
  - Fructose fermentation → lactic acid → cavity formation
- Starch, mannitol, xylitol, etc. are not used by cariogenic bacteria
- **Dental Calculus or Tartar** → old calcified plaque
- Control: fluoride and restricting dietary sucrose
Periodontal Disease

- **Gingivitis:** Inflammation of gums. Due to inflammatory response to a variety of bacteria growing on gums.

- **Gingivitis can progress to periodontitis**

- Chronic periodontitis can cause bone destruction and tooth loss in older people.

- Acute necrotizing ulcerative gingivitis (ANUG) – Trench mouth
The Stages of Tooth Decay

1. Healthy tooth with plaque
2. Decay in enamel
3. Advanced decay
4. Decay in dentin
5. Decay in pulp

The Stages of Periodontal Disease

1. Healthy gingivae
2. Gingivitis
3. Periodontal pockets
4. Periodontitis
Infection is caused by the growth of a pathogen in the intestines.
- Incubation times range from 12 hours to 2 weeks. Symptoms of infection generally include a fever.

Intoxication due to ingestion of preformed bacterial toxins.
- Symptoms appear 1–48 hours after ingestion of the toxin. Fever is not usually a symptom of intoxication.

Infections and intoxications cause diarrhea and dysentery (some gastroenteritis)

Usually treated with fluid and electrolyte replacement.
Staphylococcal Food Poisoning

- **Staphylococcus aureus** – inoculated into foods during preparation
- 2nd most reported food borne disease
- Heat resistant exotoxin acts as enterotoxin – boiling for 30 mins not sufficient to denature the exotoxin!
- Incubation period 1 – 6 hours; rapid recovery
- Contaminated meats (ham!), fish, potato salad, custards, etc.
- Mode of transmission: Human reservoir (nose); skin abscesses
Events in Staphylococcal Food Poisoning

1. Food containing protein is cooked (bacteria usually killed).

2. Then food is contaminated by worker with staphylococci on hands (competing bacteria have been eliminated).

3. Food is left at room temperature. Organisms incubate in food (temperature abuse) long enough to form and release toxins. (Reheating will eliminate staphylococci but not the toxins.)

4. Food containing toxins is eaten.

5. In 1–6 hours, staphylococcal intoxication occurs.
Bacterial Infections

- Longer incubation periods than intoxication (2 days to 2 weeks)

- **Shigellosis** (Bacillary Dysentery)
  - Toxin. Severe diarrhea or dysentery; 20,000 – 30,000 cases /year in US

- **Salmonellosis** (*Salmonella enterica*) - Gastroenteritis
  - Most reported of foodborne diseases in US

- **Typhoid Fever** (*Salmonella typhi*)
  - Only in humans (carriers); enteroinvasive → blood; Symptoms last 2–3 weeks, antibiotics

- **Cholera** (*Vibrio cholerae*)
  - Primarily third world problem. Toxin. Severe diarrhea (rice water stool), extreme dehydration → Antibiotics plus ORS or iv fluids
Oral (ORS) or i.v. rehydration reduces mortality rate from ~70% to < 1%
(additional: tetracycline)
Traveler’s diarrhea may be caused by

- **Enterotoxigenic** strains (ETEC) → present like mild form of cholera
- **Enteroinvasive** strains (EIEC) → Shigella like dysentery
- Generally self-limiting, ORS but no chemotherapy.

**Enterohemorrhagic** strains produce Shiga toxins (STEC) that cause inflammation and bleeding of the colon, including hemorrhagic colitis and hemolytic uremic syndrome (HUS). *E.g.: E. coli* O157:H7
Clostridium difficile–associated diarrhea

- *C. difficile* growth following antibiotic therapy
- Exotoxin production
- From mild diarrhea to life threatening colitis
- Millions of cases per year
- Nosocomial disease, associated with hospitalized patients and nursing home residents
Helicobacter pylori Gastritis

- Inflammatory response to bacteria $\Rightarrow$ Peptic ulcer disease (gastric and duodenal ulcers)
- 30 - 50% of people in US infected – only ~ 15% develop ulcers. (Blood type O more susceptible)
- Bacteria produces urease (urea $\rightarrow$ ammonia) – neutralizes stomach acid
- Antibiotic treatment is effective
<table>
<thead>
<tr>
<th>Viral Disease</th>
<th>Transmission</th>
<th>Causative Agent</th>
<th>Chronic Liver Disease?</th>
<th>Vaccine?</th>
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<tr>
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<td>Fecal-oral</td>
<td>Picornaviridae</td>
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<td>Filoviridae</td>
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<td>Deltaviridae</td>
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<td>HBV vaccine</td>
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<td>Hepatitis E</td>
<td>Fecal-oral</td>
<td>Caliciviridae</td>
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</tbody>
</table>
Viral Gastroenteritis

- **Rotavirus:**
  - 3 million cases annually
  - Main diarrheal illness of infants and children
  - 1-2 day incubation; 1 week illness

- **Norovirus:**
  - 50% of U.S. adults have antibodies
  - 1-2 day incubation; 1-3 day illness
  - Treated with rehydration
Protozoan GI Diseases

- **Giardiasis** – caused by *Giardia lamblia*
- Drinking feces contaminated water (camping, swimming)
- Type of traveler’s diarrhea
- Symptoms: malaise, nausea, flatulence, weakness, and abdominal cramps that persist for weeks.
- Diagnosis is based on identification of the protozoa in the small intestine.
- ~ 7% of population healthy carriers
HELMINTHIC DISEASES OF THE DIGESTIVE SYSTEM

Percentage of world population infected

- **Trichinella**: 1.0%
- **Flukes (liver, lung)**: 1.5%
- **Tapeworms**: 3.0%
- **Schistosomes**: 6.0%
- **Enterobius**: 10%
- **Hookworms**: 21%
- **Ascaris**: 30%

Number of people infected (100 millions)
Tapeworms

- contracted by consumption of undercooked beef, pork, or fish containing encysted larvae
- Scolex attaches to the intestinal mucosa of humans (definitive host) → matures into adult tapeworm
- Eggs shed in feces and must be ingested by an intermediate host
- Adult tapeworms may be undiagnosed in a human
- Diagnosis based on observation of proglottids and eggs in feces.
- *Dipylidium caninum* vs. *Echinococcus granulosus* (hydatid disease)
Tapeworm segments break releasing eggs, which are eaten by grazing flea larvae. The flea larvae pupate, and the common tapeworm (Dipylidium caninum) will then infest the dog again.
Pinworm Disease / Enterobiasis

- *Enterobius vermicularis*, up to 10 mm long
- Most common worm infection in US (30% of children, 16% of adults infected)
- Live in human rectum. While infected person sleeps, female pinworms leave intestines through anus and deposit eggs on surrounding skin.
- Diagnosis with cellophane tape (scotch-tape test) first thing in the morning.
- Self limiting, but treatment of all family members recommended.

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Diagnosing Pinworm Disease

Do test immediately after waking up. Several samples might need to be examined. Since scratching of the anal area is common, samples taken from under the fingernails may also contain eggs.

**Fig 17.9**

A. Clear plastic tape is pulled back over the end of the slide to expose the gummed surface.

B. The tape, still attached to the slide, is looped over a wood pinworm paddle.

C. The gummed surface of the tape is touched several times to the anal region.

D. The tape is replaced on the slide.

E. The slide is pulled down with the paddle. It is then examined under a microscope for eggs.
Pinworm (*Enterobius vermicularis*) in sigmoid colon
Ascariasis

- *Ascaris lumbricoides* up to 20 cm long
- Lives in human intestines
- After pinworm 2nd most common worm infection in US. (Most prevalent in tropics and subtropics)
- ~85% infections are asymptomatic, however “general failure to thrive” as in many intestinal parasites.
- Transmitted by ingesting *Ascaris* eggs