Viral and Bacterial Diseases

Part 1 –
Skin, Respiratory, and Alimentary Infections
Bacterial Diseases of Skin

- **Staphylococcus aureus**
  - folliculitis – inflammation of a hair follicle,
  - Boils (furuncles) – single localized inflammation,
  - carbuncles – series of boils – draining pus,
  - scalded skin syndrome – skin peels off the body as if it had second degree burns – caused by a toxin,
  - MRSA – Methicillin Resistant Staphylococcus Aureus

- **Streptococcus pyogenes**
  - Impetigo – blisters that weep plasma and form golden colored crusts
Scalded skin syndrome and Impetigo

Figure 22.4-5
Bacterial Skin Infections

- **Rickettsia Rickettsii**
  - Rocky Mountain Spotted fever
    - transmitted by tick
    - faint spots cover extremities - spreads to rest of body -
    - becomes hemorrhagic due to blood vessel damage

- **Borelia burgdorferi**
  - Lyme Disease
    - transmitted by tick
    - “bulls-eye” rash – ECM (erythema chronicum migrans – red persisting expanding rash)
Rocky mountain spotted fever

Figure 22.8

*Dermacentor andersoni* – wood tick
Figure 22.9: *Rickettsia rickettsii*
Reported cases of Rock Mountain spotted fever

Figure 22.10
Lyme disease

Figure 22.12 – 22.14
Reported cases of Lyme disease
Viral Skin Infections

- **Varicella-Zoster**
  - Chicken Pox-Shingles (zoster) –
    - Chicken Pox - raised red bumps all over the body –
    - Shingles – raised vesicles starting along trigeminal nerves
    - Very contagious
    - Varicella vaccine

- **Rubeola –**
  - Measles –
    - fine red rash starts on forehead and spreads to rest of body –
    - Koplick spots in mouth – look like red grains of sand at base of tongue
    - MMR vaccine
      - 400,000 cases in 60’s in US – now less than 100/year

- **Rubella -**
  - German Measles -
    - R in TORCH (congenital diseases) and MMR vaccine
    - similar rash to measles – no Koplick spots however.
Chickenpox

Shingles

Figure 22.17

Figure 22.18
Measles (rubeola)

Figure 22.20

Koplick Spots

Figure 22.21
Electron micrograph of Varicella – zoster virus

Figure 22.19
German measles (rubella)

Figure 22.23
Reported cases of German measles

Figure 22.24
Viral Skin Infections

- Erythema infectiosum
  - “Slapped Cheek” or “Fifth’s” disease
  - red rash on face

- Exanthem subitum
  - Roseola
  - high fever (105°F) and seizures
  - followed by red rash on chest and abdomen

- HPV – Human Papilloma Virus
  - causes common warts
  - benign bumps of out of control growth in each spot.
Wart virus - papillomaviruses
Bacterial –
Upper Respiratory Infections

- **Streptococcus pyogenes**
  - “Strep Throat” (pharyngitis) – beefy red, raw, throat with white pustules – fever over 101°F.

- **Corynebacterium diphtheriae**
  - Diphtheria – formation of whitish-gray pseudomembrane on throat and mucous membrane – powerful toxin (since it is an enzyme – can be re-used)

- **Haemophilus influenzae** –
  - pink-eye - conjunctivitis

- **Streptococcus pneumoniae**
  - sinus infections and ear-aches
Streptococcus pyogenes –

Figure 23.2
Complications – Rheumatic heart disease

Figure 23.4
Corynebacterium diphtheriae

Figure 23.5
Otitis media

Figure 23.7
Viral Upper Respiratory Infections

- **Common cold** - Rhinovirus (a naked RNA virus - very small) - scratchy throat, nasal discharge, malaise, headache, cough

- **Adenoviral Pharyngitis** - Adenovirus (a naked DNA virus with spikes) - presents with fever (unlike cold), very sore throat, severe cough, swollen lymph nodes on neck, pus on tonsils and throat, and conjunctivitis.
Rhinovirus

Figure 23.8
Bacterial – Pneumonia Infections

- *Streptococcus pneumoniae* – encapsulated gram +; secondary, 1-3 days, severe, vaccine available
- *Klebsiella pneumoniae* - gram -; opportunistic, 1-3 days, less severe, no vaccine
- *Mycoplasma pneumoniae* – no cell wall; primary, 2-3 weeks, less severe, no vaccine
Streptococcus pneumoniae

Figure 23.9
Chest x-ray of pneumococcal pneumonia

Figure 23.10
Mycoplasma pneumoniae

Figure 23.12

M. pneumoniae
Cilia
Attachment site
Ciliated respiratory epithelium
0.5 μm
Klebsiella pneumoniae

Figure 23.11
Bacterial-Other Lower Respiratory Infections

- *Bordetella pertussis*- Whooping Cough - persistent staccato cough followed by “whoop” to get air
- *Mycobacterium tuberculosis* – TB – Acid fast bacteria, forms plaques on lungs (seen by X-Rays)
- *Legionella pneumophila* – Legionaire’s disease, Pontiac Fever – Transmitted by aerosolized water droplets – cooling tanks for AC systems
Bordetella pertussis

Figure 23.13
Mycobacterium tuberculosis

Figure 23.17
Tuberculosis lesion
Tuberculin test
*Legionella pneumophila* – fluorescent stain

Figure 23.20
Influenza

- can be deadly –
- antigenic drift – changes in Hemagglutinin and Neuramidase spikes yearly;
- antigenic shift – major changes when animal flu virus co-infects someone and a segment of RNA genome is swapped.
- Symptoms: Fever, muscle aches, lack of energy, headache, sore throat, nasal congestion, cough.
Antigenic shift
RSV

➤ Respiratory Syncytial Virus
  • affects children mostly –
  • Cells of lungs fuse to form a giant “Syncia” cell – decreases gas transport-
  • Symptoms include runny nose, cough, fever, wheezing, difficulty breathing, and a dusky color (due to less oxygen intake).
A cold for all seasons...
HPS

- Hantavirus Pulmonary Syndrome – aka – Sin Nombre virus (no-name virus)
  - affected 4 corners area of SW United States in 1993
  - transmitted by mouse droppings.
  - Symptoms: fever, muscle aches, vomiting, diarrhea, cough, shortness of breath, shock. 40% mortality rate.
Cases of Hanta virus

Total Cases (N = 289 in 31 States)

Figure 23.23
Bacterial –
Upper Alimentary Infections

- **Streptococcus mutans** - Dental caries (tooth decay) - requires sugar, acidic environment and tooth to cause the decay

- **Treponema, Fusobacterium, Prevotella** - Trench mouth - abrupt onset, fever, bleeding, painful gums, and foul odor.

- **Helicobactera pylori** - stomach ulcers - bacteria produces an alkaline environment to survive in gastric juices (very acidic environment)
Scanning electron micrograph - dental plaque

Figure 24.3
Periodontal disease

Figure 24.5
Trench mouth

Figure 24.6
**Helicobacter pylori**

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Figure 24.7

Diagram of Helicobacter pylori with labels:
- Cell wall
- Cytoplasmic membrane
- Sheath
- Flagella
- Urease
- Urea
- Ammonia

Chemical reaction:

\[
\text{Urea} + \text{Water} \rightarrow \text{Carbon Dioxide} + 2\text{Ammonia}
\]
Gastric ulcer formation

Figure 24.8
Viral - Upper Alimentary Infections

- Herpes Simplex I – Cold Sores
- Mumps – swelling of the parotid gland – MMR vaccine
Herpes simplex I – cold sores

Figure 24.9

- Epithelial cells
- Cell nuclei
- Multinucleated cell
- Intranuclear inclusion body
- Epithelial cell
- Neutrophils
Figure 24.10
Reported cases of mumps

Figure 24.11

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Bacterial – Lower Alimentary Infection

- *Vibrio cholerae* – Cholera – contaminated water - huge loss of water due to changes in electrolytes caused by the cholera toxin – typically 20 L of water a lost each day - bacteria adhere tightly to intestines

- *Campylobacter jejuni* – Food poisoning – from fowl or unpasteurized milk. – diarrhea and vomiting with severe abdominal cramping
Scanning electron micrograph of *Vibrio choeræae*

Figure 24.12
Scanning electron micrograph of *Campylobacter jejuni*
Salmonella

- *Salmonella enterica* Typhi – Typhoid Fever – (5 “F’s” of transmission - food, flies, feces, fingers, fomites) food handlers that don’t wash hands – high fever, delirium, abscesses, septicemia, shock, but no diarrhea.

- *Salmonella enterica* Typhimurium – Salmonellosis – transmitted by products with raw eggs (cookie dough) – also transmitted by pets such as turtles, iguanas, baby chickens, and ducks. – most common symptom - diarrhea
Bacterial-
Lower Alimentary Infections

- **Shigella** – Shigellosis – Bacterial Dysentery – other symptoms: headache, vomiting, fever, stiff neck, convulsions, and joint pain – spread by oral-fecal route – humans are the only source – transmitted by fecally contaminated food or water.

- **Escherichia** – Most are normal flora, but several groups are pathogenic –
  - Enterotoxigenic (ETEC),
  - Enteroinvasive (EIEC),
  - Enteropathogenic (EPEC), and
  - Enterohemorrhagic (EHEC).
Pathogenesis of shigellosis

(1) Shigellas are taken up by M cells and transported beneath the epithelium. Macrophages take up shigellas, die and release the bacteria.

(2) The bacteria enter the inferior and lateral aspects of the epithelial cells by inducing endocytosis. The endosomes are quickly lysed, leaving the shigellas free in the cytoplasm.

(3) Actin filaments quickly form a tail, pushing the shigellas into the next cell.

(4) Shigellas multiply in the cytoplasm, and the infection extends to the next cell.

(5) Infected cells die and slough off. Intense response of acute inflammatory cells (neutrophils), bleeding and abscess formation.
Mechanisms of Pathogenesis for Enterobacteriaceae

- **Attachment** – must attach so they are not swept away
- **Toxin Production** – Toxins will either 1) increase secretion of water and electrolytes or 2) destroy cells by stopping protein synthesis.
- **Cell Invasion** – Activates endocytosis and avoids lysozyme in order to multiply within the cell
- **Loss of Microvilli** – Substances enter the host cell and rearrange the actin to form “tails” in order to move throughout the cytoplasm.
Viral Lower Alimentary Infections

- Hepatitis A – Inflammation of the liver – fatigue, fever, loss of appetite, right-sided abdominal pain, dark colored urine – clay colored feces, and jaundice - fast food restaurants that do not have good hygiene among cooks - vaccine available

- Rotavirus – vomiting and slight fever, followed by profuse watery diarrhea - contaminated water source – oral-fecal route – common among children – most children have built up an immunity by age 5 – vaccine was on market for short time – pulled off the market in 1998.

- Norwalk virus - Cruise ship disease – contaminated shellfish -
Cases of hepatitis A

Figure 24.18
Transmission electron micrograph of rotavirus
Electron micrograph of Norwalk virus
## Comparison of Hepatitis Infections

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
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<tr>
<td>Transmission</td>
<td>Food</td>
<td>Blood-STD</td>
<td>Transfusion</td>
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<tr>
<td>Type of Virus</td>
<td>Picornavirus - RNA</td>
<td>Hepadnavirus - DNA</td>
<td>Flaviviridae - RNA</td>
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<tr>
<td>Severity</td>
<td>Mild</td>
<td>Severe</td>
<td>Severe</td>
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<tr>
<td>Frequency</td>
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<td>Second most common</td>
<td>Least common - increasing</td>
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<tr>
<td>Vaccine Available?</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Hepatitis B virus

(a) Complete infectious virion

(b) Viral envelope particles containing HBsAg

Figure 24.19