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Identification of Infectious Diseases

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Long-Term Care Certification in Infection Prevention (LTC-CIP) Preparation Series

Sources

- Content of this module was informed and used with permission from the Association for Professionals in Infection Control and Epidemiology resources:
  - APIC LTC-CIP™ Learning System
  - APIC Text Online

Association for Professionals in Infection Control and Epidemiology (APIC). APIC LTC-CIPTM learning system, book 1. Washington, DC: APIC; 2023.

Association for Professionals in Infection Control and Epidemiology (APIC). APIC text online. Washington, DC: APIC; 2023 [cited 2024 Feb 14]. Available from: https://text.apic.org/

Exam Content

1. Long-Term Care Settings (15 items)
2. Management and Communication of the Infection Prevention Program (16 items)
3. **Identification of Infectious Diseases (18 items)**
4. Surveillance and Epidemiologic Investigation (24 items)
5. Prevention and Control of Infectious and Communicable Diseases (24 items)
6. Environment of Care (18 items)
7. Cleaning, Disinfection, Sterilization of Medical Devices and Equipment (15 items)
8. Antimicrobial Stewardship (11 items)
9. Employee/Occupational Health (9 items)

Learning Objectives

In this review session, the main topics that will be covered are:

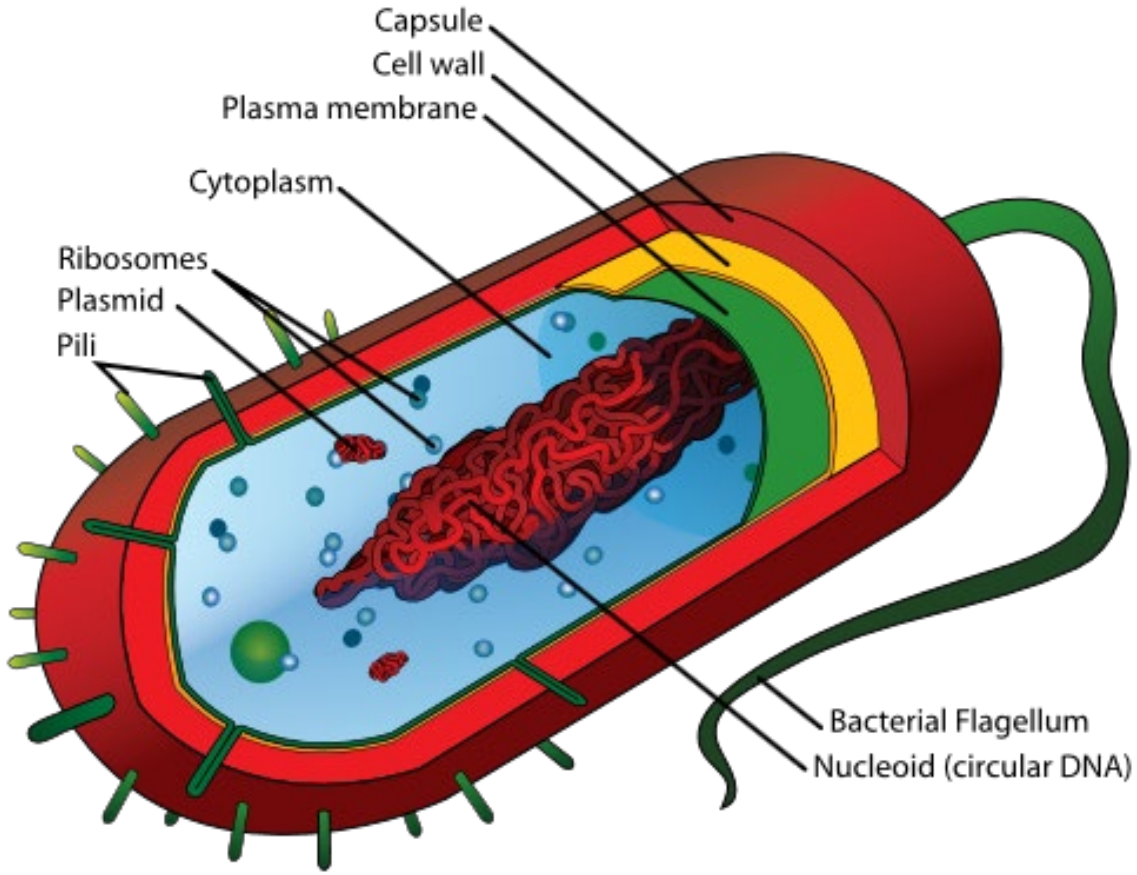
1. Basic microbiology, including epidemiologically significant organisms
2. Clinical signs, symptoms, and risk factors of infectious diseases
3. Appropriate practices for specimen collection, transportation, handling, and storage
4. Interpretation of relevant diagnostic, radiologic, procedural, and laboratory reports to support the diagnosis of infections

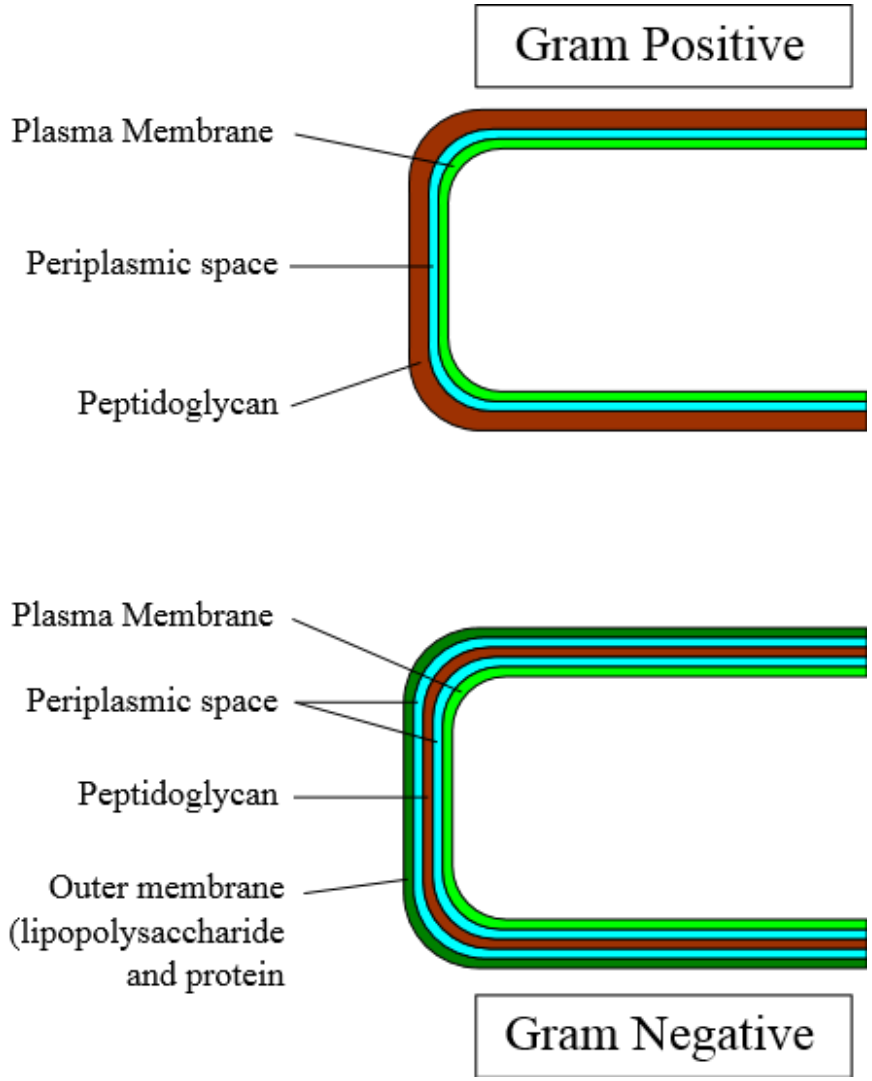
Basic Microbiology

Microbiology

- Bacteriology – study of bacteria
  - *E.g., Clostridioides difficile*, *Staphylococcus aureus*, *Escherichia coli*, *Mycobacterium tuberculosis*, *Salmonella* sp., *Listeria* sp.
- Virology – study of viruses
  - *E.g.,* Influenza, Norovirus, Hepatitis (A,B,C,D,E), Measles, Human Immunodeficiency Virus (HIV), Ebola virus
- Mycology – study of fungi
  - *E.g., Candida* sp., *Aspergillus* sp., *Pneumocystis* sp., *Trichophyton* sp.
- Parasitology – study of parasites
  - *E.g.,* Scabies, *Giardia* sp., *Trichomonas* sp., *Toxoplasma* sp., malaria, helminthes (worms)

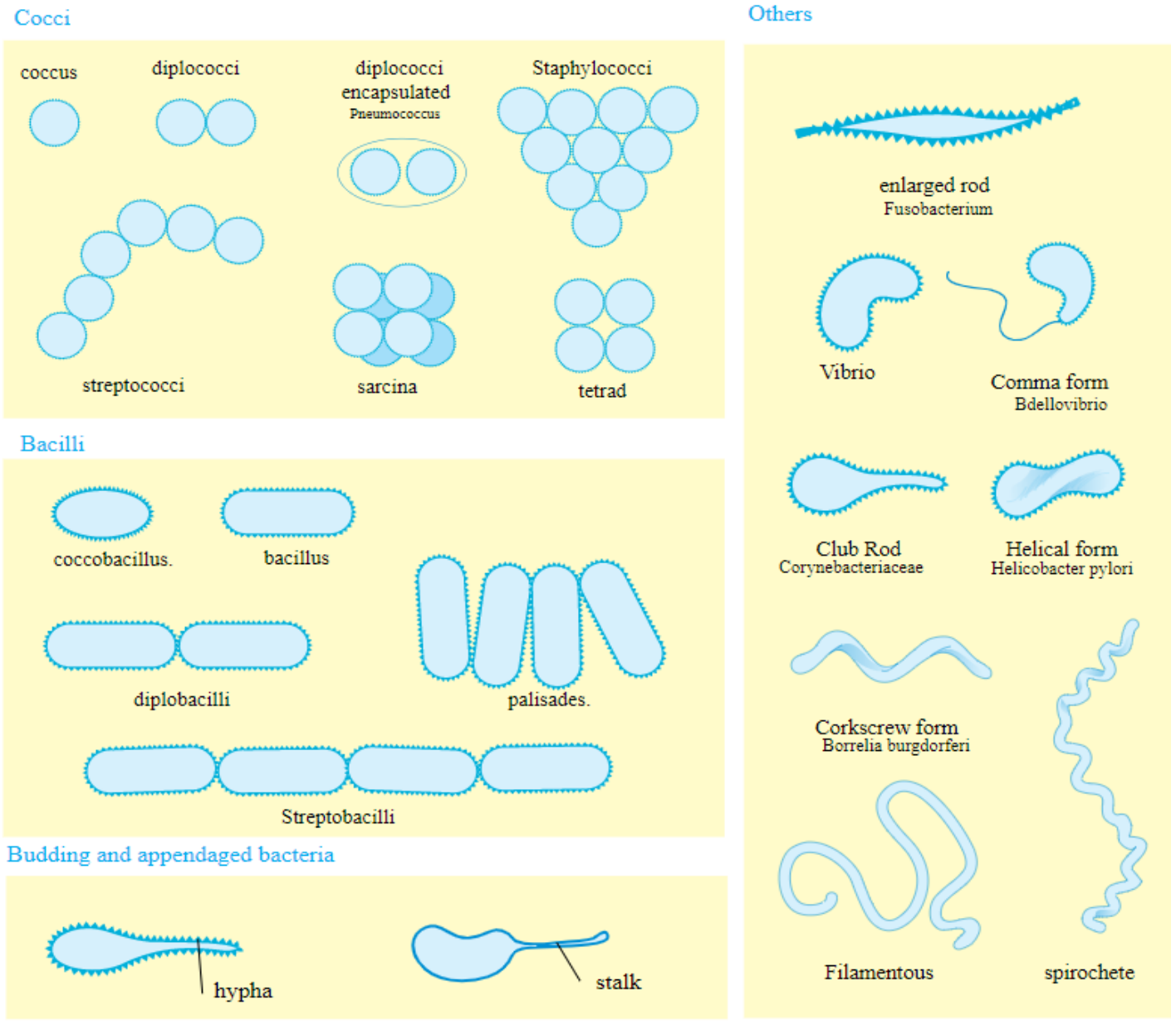
Bacterial Structure



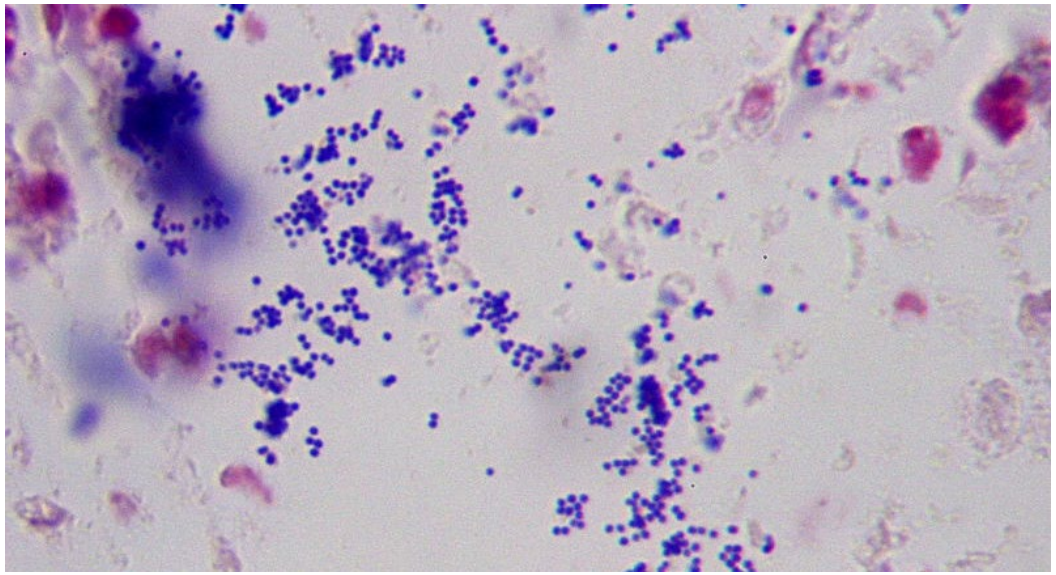


Bacterial Morphology

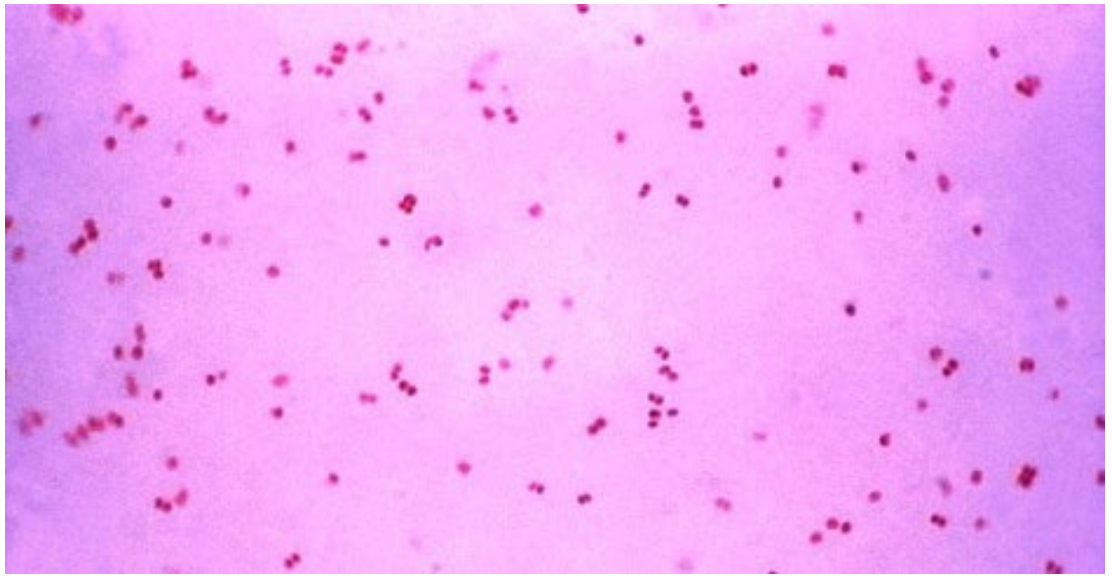
- Bacteria Shape
  - Coccus (cocci)
  - Bacillus (bacilli, rod)
  - Spirochetes
  - Cocco-bacilli
  - Diplococci
- Organization
  - Clusters, chains, pairs



Gram Stain



Gram positive bacteria Staphylococcus aureus



Gram negative bacteria Neisseria gonorrhoeae

Gram positive organisms have a thicker peptidoglycan layer (think of a thick sponge) and will retain the crystal violet stain which results in purple colour

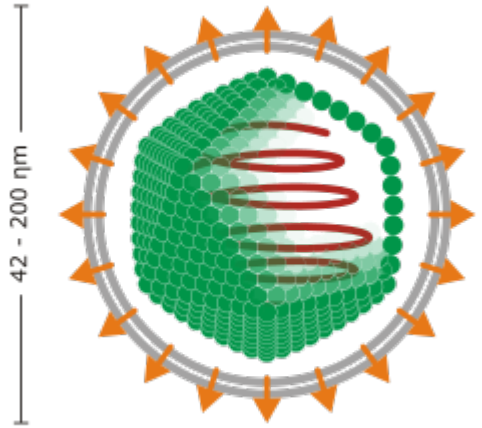
Gram negative organisms have a thinner peptidoglycan layer and the crystal violet stain will wash away and result in a pink colour

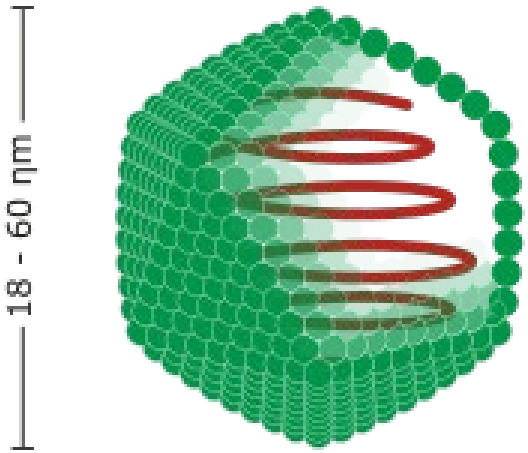
Morphology of Microorganisms – Examples and Disease Condition

Morphology	Example Organisms	Disease condition
Gram-positive cocci in clusters	Staphylococcus aureus Methicillin-Resistant S. aureus (MRSA)	Skin and soft tissue infections, pneumonia, blood, bone and joint infections, food poisoning, toxic shock syndrome, necrotizing fascitis
Gram-positive cocci in chains	Streptococcus (Group A Strep)	Skin and soft tissue infections, Strep throat, Acute Rheumatic Fever, Invasive Group A Strep infections (iGAS)
Gram-positive rod (bacilli) diphtheroid	Corynebacterium spp	Diptheria
Gram-positive rod endospores	Bacillus, Clostridioides difficile Clostridum botulinum Clostridium tetani	C.difficile infection (CDI); Tetanus, Botulism, skin and tissue necrosis.
Gram-positive rod filamentous/branching	Nocardia, actinomyces	Actinomycosis and Nocardiosis
Gram negative diplococci	Neiserria meningitidis	Meningococcal disease(Meningitis)
Gram-negative rod	E coli, Klebsiella pneumoniae	Pneumonia, Urinary tract infection (UTI), Intestinal infections
Fungal hyphae septate	Aspergillus	Aspergillosis

Viruses – Things to Know

- Require living cell for reproduction
- RNA or DNA viruses
- Enveloped
  - Lipid membrane surrounding the viral nucleocapsid
  - Protein capsid makes them easy to kill
  - Example: Influenza virus
- Non-enveloped
  - Proteins covering around the viral genome make them difficult to kill
  - Example: Norovirus

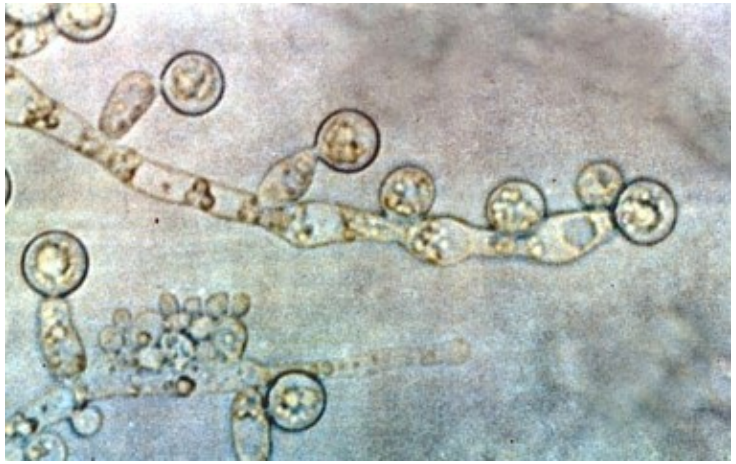




Fungi

- Yeasts and molds are important to know in clinical settings
- Consider *Aspergillus* sp. when you do construction or renovation
- Immunocompromised people often infected by *Candida albicans*
- *Candida auris* is an emerging fungal pathogen causing invasive disease. *C. auris* is the first Candida species to be classified as multidrug-resistant

Aspergillus sp.



Candida albicans

Parasites (1/3)

A) Arthropods – lice, mites, fleas

- Spread person to person via direct or indirect contact
- Scabies
- Pediculosis (Head lice) is common in kids
- Myiasis is an infestation of maggots in humans
- Bed Bugs (*Cimex Lectularius*)

Head Louse

Bed Bug

Parasites (2/3)

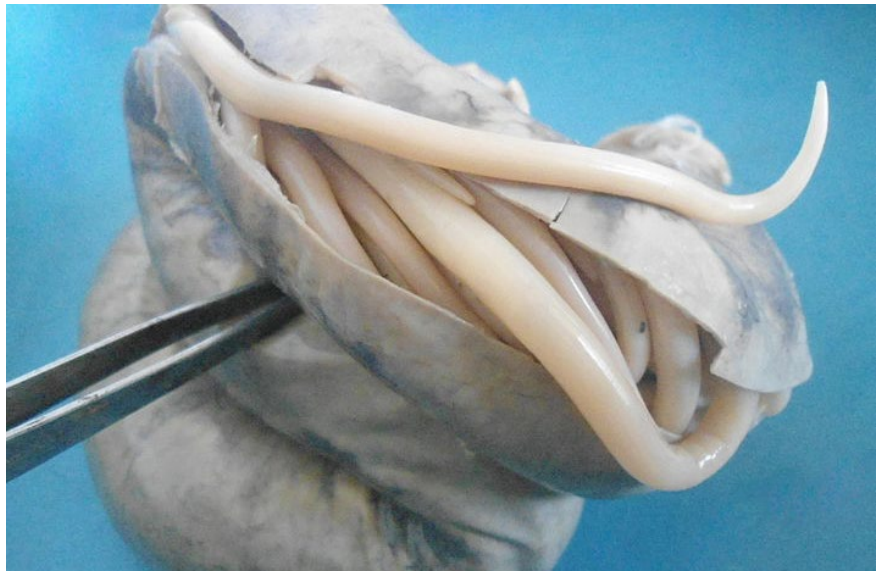
B) Protozoa – a single-celled amoebae, flagellates, ciliates and tissue-dwelling organism

- Malaria, Leishmaniasis: mosquito transmitted infection usually imported from tropical countries
- Giardiasis, Amebiasis: causes gastrointestinal disease (diarrhea) transmitted by fecal-oral route
- Trichomoniasis: sexually transmitted infection
- Cryptosporidiosis: one of the common causes of waterborne diseases in North America
- Toxoplasmosis: concern during pregnancy and when immunocompromised. Cats/cat faeces are the reservoir

Parasites (3/3)

C) Helminthes

- Typically called parasitic worms living in the human organism
- Pinworms and ascaris are roundworms with fecal-oral route of transmission rarely found in North America
- Lymphatic filariasis, onchocerciasis, Guinea worm disease – are most common helminthiasis caused by worms in tropical countries



Risk Factors for Infection Transmission

Factors that Influence Transmissibility of an Organism

- Virulence: the ability to grow and multiply
- Infectivity: the ability to enter tissues
- Pathogenicity: the ability to cause disease
- Duration of exposure: the length of time the person is exposed to the organism
- Size of inoculum: the number of organisms needed to cause disease
- Population immunity: is the community a naïve population to a new or evolving agent?

Mechanisms of Transmission

- Ability of the organism to survive in the external environment (i.e., ability of *C. difficile* to revert to spore state that is resistant to drying and chemical agents)
- Transmit to a new host by insect vectors (e.g., West Nile virus), survival on environments (e.g., Respiratory Syncytial virus (RSV)) and motility of bacteria (e.g., *E.coli*)
- Successful attachment and proliferation (e.g., via biofilms, virus coats, encapsulation)
- Evasion of immune response (e.g., rigid cell wall, alter surface antigens)
- Presence of exotoxins (e.g., Group A Strep, *Clostridium botulinum*, *Pseudomonas*)

Host Response to Infectious Agents

The host response to infection consists of:

- Cellular Immune Response
    - Part of the innate immune response.
    - Includes response from T-lympohocytes and macrophages
- Humoral Immune Response
    - Adaptive immune response, consist largely of B cells
    - Includes antibodies found in bloodstream, oral secretions, tears, intestinal contents, etc., produced in response to antigens. Antibodies are specific to the antigen.
    - Organs such as the thymus gland, spleen and the bone marrow help provide the host with specific immunity to an infectious agent.

Types of Antibodies (1/2)

- Immunoglobulin (Ig) M (IgM)
  - First antibody to be produced; First line of defense against infection
  - Found in break milk and mucosal surfaces
  - Short lived immunity, generally only present up to 6 months after exposure
- IgG
  - IgG antibodies start to develop after IgM antibodies
  - Levels gradually rise in the blood and do not disappear
  - Presence of IgG indicates that immunity to a particular or specific antigen has developed
  - IgG antibodies cross the human placenta and provide temporary immunity for the fetus/neonate

Types of Antibodies (2/2)

- IgA
  - Antibody formed in mucous membrane
  - Present in saliva, breast, milk, tears
  - These antibodies protect body surfaces that are exposed to outside foreign substances
- IgE
  - Allergy-inducing antibody found in lungs, skin and mucous membranes
  - Stimulates release of histamines and inflammatory substances
  - Found on mucous membranes of those with seasonal allergies

Factors Affecting the Immune System

- Bone marrow transplant
- Autoimmune disorders
- Chemotherapy
- Aging
- Corticosteroid use
- Alcohol or drug dependency
- Splenectomy
- Spinal cord injury
- Immunization

Discussion/Knowledge Check

Epidemiologically Significant Organisms

Tuberculosis (TB)

- TB enters through the lungs and from there can also move to other parts of the body through the blood
- Causes pulmonary tuberculosis TB, laryngeal tuberculosis, or extra pulmonary TB such as in the kidney, spine and brain
- Transmitted via airborne route from a person with pulmonary or laryngeal TB disease
- Tests to Screen/ Detect TB
  - Mantoux tuberculin skin test (TST) – See Occupational Health Presentation for more details.
  - Acid-Fast Bacilli (AFB) smear – faster turnaround time for results usually within a day
  - Chest X-ray – consolidation, hilar lymphadenopathy, fibrosis, military opacities
  - Culture – longer turn around time as MTB are slow growing bacteria
  - Blood test – Quantiferon TB Gold in-tube (GFT-GIT)
    - You may have heard this referred to as an Interferon-Gamma Release Assay (IGRA)

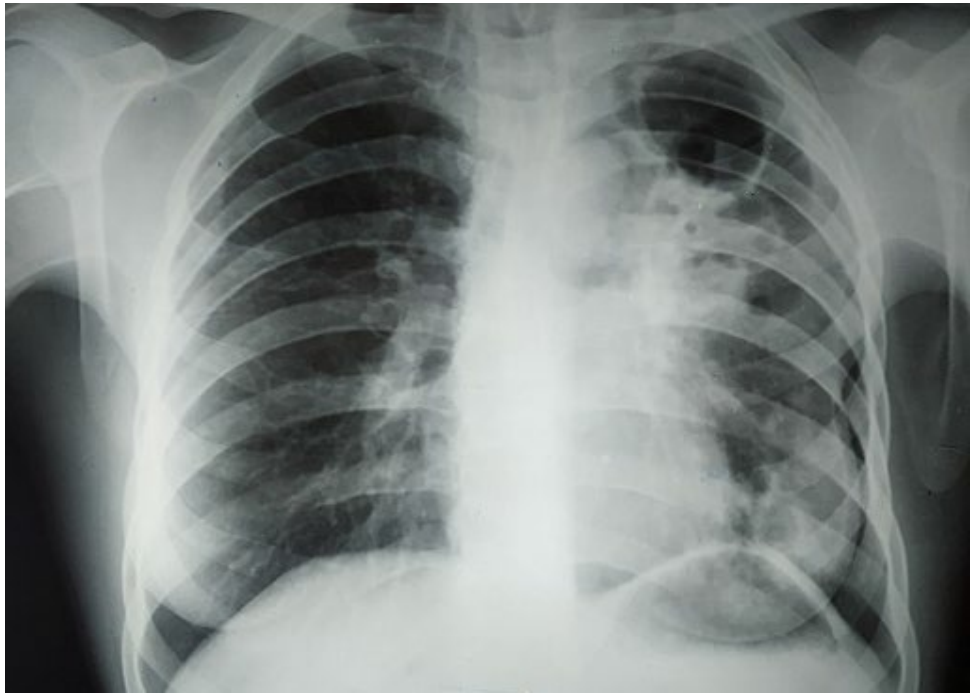
Symptoms of TB

- Classic symptoms of pulmonary TB disease:
  - Chronic cough of at least 2-3 weeks' duration. This cough is initially dry but after several weeks to months will become productive
  - Fever and night sweats are common but may be absent in the very young and the elderly
  - Hemoptysis, anorexia, weight loss, chest pain and other symptoms are generally manifestations of more advanced disease

Tuberculosis – Chest Radiography

Typical Findings:

- Position:
  - Infiltrates in the apical-posterior segments of upper lobes or superior segment of lower lobes
- Volume loss:
  - Resulting from the destructive and fibrotic nature of TB
- Cavitation:
  - Seen at a later stage
  - Occurs from a vigorous immune response
  - Often is not seen in immunocompromised individuals



Latent and Active TB

- Two TB related conditions:
  - **Latent TB infection:**
    - Bacteria is alive but inactive in the body
    - People with latent TB infection do not have signs and symptoms and cannot spread TB to others
    - About 5 to 10% of infected persons who do not receive treatment for latent TB infection will develop TB disease at some time in their lives.
  - **Active TB infection:**
    - *Mycobacterium tuberculosis* (MTB) is actively multiplying in the body usually in the lungs
      - Pulmonary TB is much more likely to be infectious compared to non-pulmonary TB of other solid organs (e.g., kidney TB infection)
    - Presents as weakness, weight loss, fever, loss of appetite, night sweats, cough and coughing up blood.
    - People with active TB disease can spread the bacteria to others

Risk Factors for TB

- Close contacts of a person with infectious TB disease
- Persons who have immigrated from areas of the world with high rates of TB
- Children less than 5 years of age who have a positive TB test
- Groups with high rates of TB transmission, such as persons experiencing homelessness, persons who injection drug users, and persons with HIV infection
- Working or residing with people who are at high risk for TB in facilities or institutions such as hospitals, homeless shelters, correctional facilities, long term care homes, and residential homes for those with HIV
- Medical conditions that weaken the immune system (e.g. HIV, substance abuse, organ transplant, corticosteroid treatment, diabetes, Crohn's disease)

Staphylococcus spp

- *Example: Staphylococcus aureus*
- Gram positive cocci in clusters
- Normal flora of the skin, anterior nares, nasopharynx and peri-anal area
- Common cause of health care-associated infections including skin and soft tissue infections, pneumonia, bone infection (osteomyelitis), surgical site infections (SSIs), necrotizing fasciitis, sepsis
- MRSA is *S. aureus* that is resistant to some antibiotic treatment.
- It can be spread from person to person through contaminated hands, surfaces or medical equipment
- Common in hospitals and health care settings

Streptococcus spp

- Example: *Streptococcus pneumoniae*
- Gram positive cocci in chains or pairs
- *Streptococcus pneumoniae* colonizes the nasopharynx
- Transmitted through direct person to person contact, hand to mouth contact, foodborne, waterborne, via fomites
- Causes: pharyngitis, scarlet fever, skin infections, pneumonia and invasive infections such as necrotizing fasciitis, sepsis, meningitis, bone and joint infection

Enterococcus spp

- *Enterococcus faecium*, *Enterococcus faecalis*
- Can also be as a multidrug resistant organism - vancomycin resistant enterococci (VRE)
- Gram positive cocci in pairs or chains
- Transmitted through direct or indirect contact through hands of health care providers, surfaces and contaminated equipment
- Causes bacterial endocarditis, urinary tract infection and SSIs

Clostridioides sp (formerly *Clostridium* sp)

- *Clostridioides difficile (C. difficile*) is a spore-former and is related to *Clostridium botulinum, Clostridium tetani, and Clostridium perfringens.*
- Gram positive bacilli (rod)
- *C. difficile* is commonly acquired in hospitals and causes gastrointestinal infections, pseudomembranous colitis.
- *C. botulinum* causes botulism through contaminated food, infection of an open wound or ingestion of spores that form toxins.
- *C. tetani is* commonly found in soil, dust and feces enters the body through broken skin, cuts, animal bites or burns, causing tetanus.
- *C. perfringens* is one of the most common cause of food poisoning

Escherichia coli

- Gram negative rod found in the environment, food and intestines of people and animals
- Causes urinary tract infections, diarrhea, sepsis
- Transmitted via contact, ingestion, foodborne
- *E.coli* can produce enzymes called extended spectrum beta lactamases (ESBL) that can destroy commonly used antibiotics

Multi-drug Resistant Gram Negative Organisms

- Carbapenemase producing *Enterobacteriaceae* (CPE) or Carbapenem-Resistant *Enterobacteriaceae* (CRE)
  - Includes *Klebsiella* sp., *Acinetobacter* sp., *Pseudomonas aeruginosa, E.coli, etc.*
- Exposure to travel and health care are risk factors for acquiring CPE or CRE via colonized individuals and environmental reservoirs such as sinks, shower drains or improperly processed endoscopes
- Transmission is via direct and indirect contact
- CPE/CRE can continue to colonize individuals for prolonged periods of time

Legionella pneumophila

- Causes mild self limiting flu-like illness called Pontiac fever and Legionnaires' disease which presents as pneumonia
- Found in water systems, air conditioning systems, water heads, humidifiers, respiratory therapy equipment, whirlpools, potting mixes and compost
- Transmitted via aspiration, direct inhalation or aerosolization from devices
- Can cause of community acquired and healthcare-associated pneumonia
- Risk factors include advanced age, smoking, alcohol abuse, and chronic pulmonary disease and immunosuppression.
- Prevention include proper water distribution system and heating, ventilation and air conditioning (HVAC) management plan.
- Urine antigen test (UAT) is the most frequently used for detection
  - Other tests included, PCR and culture of respiratory specimens

Respiratory Syncytial Virus (RSV) (1/2)

- One of the leading causes of respiratory illness in infants, young children, and the elderly
- Transmission is through direct or indirect contact via droplets
- Community outbreaks of RSV infections usually occur during late fall, winter, and early spring

  Clinical syndromes in adults may begin as mild respiratory tract infection which can include rhinorrhea, pharyngitis, cough, headache, fatigue, and fever – progression to lower respiratory tract disease may occur

Respiratory Syncytial Virus (2/2)

- Incubation period is two to eight days
  - Illness lasting less than five days but some may progress to lung infection or pneumonia
- Adults at highest risk for severe RSV infection include:
  - Older adults, especially those 65 years and older
  - Adults with chronic heart or lung disease
  - Adults with weakened immune systems
- Treatment is supportive
  - Antiviral medication is not routinely recommended

Discussion/Knowledge Check

Vaccine Preventable Diseases

Tetanus and Diptheria

- Tetanus
  - Caused by *C. tetani* spores of the bacterium and by muscle spasms, beginning in the jaw, and then progress to the rest of the body
  - Mode of Transmission: Direct contact with *C. tetani* spores from soil/environment
- Diptheria
  - Caused by toxin-producing strains of *Corynebacterium diphtheria.*
  - The hallmark of respiratory diphtheria is a pseudomembrane which covers mucous lining of the tonsils, pharynx, larynx, or nares and can extend into the trachea
  - Mode of Transmission: Droplet

Pertussis

- Caused by *Bordetella pertussis*
- Catarrhal stage (1-2 weeks) followed by paroxysmal stage and can last up to 2 months
  - Highly communicable, acute, infectious respiratory disease
  - Increasing rates with the highest occurring among young infants and adolescents.
  - Incubation of 6-21 days (average 7-10)
  - The classic symptoms of pertussis include whoop, vomiting, apnea, and cyanosis immediately after a paroxysm of coughing
- Mode of Transmission: Droplet

Varicella (1/2)

- **Varicella-zoster virus (VZV) – chicken pox**
  - Vesicular rash often associated with prodromal malaise, pharyngitis, rhinitis, and abdominal pain
  - Incubation 10-21 days
  - Antivirals for children with medical problems
  - Rare with current vaccine use
  - Vaccine for children, eligible healthcare personnel, day care workers, college students, prisoners, military recruits, non-pregnant women of child-bearing age, and international travelers without previous infection
  - Mode of Transmission: airborne and contact

Varicella (2/2)

- **Herpes zoster – shingles**
  - VZV virus stays in the body after the initial infection. The virus can reactivate later in life and cause shingles
  - Individuals who have never had chicken pox can get VZV from someone with shingles, however, shingles is less transmissible than chicken pox
  - It is transmitted via direct contact with fluid from rash
  - Causes pain and vesicular eruption
  - Vaccine is highly recommended for people >60 years old

Polio

- Disabling and life-threatening disease caused by the poliovirus,
  - Usually mild or no symptoms, but may lead to paralysis or death in some cases
  - eradicated in Canada but travel related cases may occur
- Vaccine recommended for all health care workers (HCWs) who have not received a primary series of poliomyelitis vaccine should receive a primary series of inactivated poliomyelitis vaccine
- Vaccination schedule: 3 doses of 0.5 mL subcutaneously, first two doses separated by 4-8 week apart, third dose 6-12 months after second dose
- Contraindications: safety not determined in pregnancy; anaphylactic reaction after streptomycin or neomycin
- Mode of Transmission: Contact

Measles (1/3)

- Highly contagious febrile illness with accompanying rash
- Characteristic prodrome of respiratory tract symptoms (cough, coryza, and conjunctivitis), followed by a febrile rash (scalp, face and neck initially and continuing downward – erythematous, macular, or maculopapular eruption) and a recovery period that includes a persistent cough
- Complications include: acute otitis media (superinfection with usual bacterial pathogens), bronchopneumonia (measles giant cell pneumonia and secondary bacterial pneumonia), laryngotracheobronchitis (croup), generalized adenopathy, splenomegaly, and encephalitis

Measles (2/3)

- Leading cause of death among young children globally
- Incubation is about 8-12 days, with contagiousness from one to two days before symptom onset
- The live vaccine significantly reduced measles in nations with high vaccine coverage – cannot give to pregnant women, altered immunity and those who recently received blood products or immunoglobulin

Measles (3/3)

- Treatment: supportive care
- Criteria to determine immune status of individuals:
  - Lab evidence of immunity
  - Documentation of age appropriate vaccination with a live measles virus containing vaccine
  - Lab confirmation of disease. Physician diagnosed history of measles is no longer considered an acceptable criterion of evidence of immunity
  - Most persons born before 1957 were infected naturally and should be considered immune
- Mode of transmission: Airborne
- Contacts should be placed in Airborne isolation from days 5-21 day after exposure or until 4 days after the onset of rash

Influenza

- Vaccine is primary preventative mechanism
- Precautions: Droplet and Contact precautions, hand hygiene and respiratory etiquette
- Typically infectious 24 hours before the onset of symptoms.
- Infectious period typically considered to be 1 day before symptom onset to seven days after
- Complications – viral pneumonia, bacterial co-infection
- Treatment - supportive and anti-viral therapy (oseltamivir and zanamivir) for high risk populations

SARS-CoV-2 (COVID-19)

- Transmitted most frequently and easily at short range through exposure to respiratory particles, range in size from large droplets to smaller aerosols that can be inhaled or deposited on mucous membranes
- Infection can also occur by touching mucous membranes with soiled hands contaminated with virus
- Recommended PPE: fit-tested, seal-checked N95 respirator (or equivalent or greater protection), eye protection, gown, and gloves. Other appropriate PPE includes a well-fitted surgical/procedure (medical) mask, or non-fit tested respirator, eye protection, gown and gloves for direct care of patients with suspect or confirmed COVID-19
- Fit tested N95 respirators (or equivalent or greater protection) should be used when aerosol-generating medical procedures (AGMPs) are performed or anticipated

Blood Borne Pathogens

HIV/AIDS (1/2)

- Compromised immune system (reduction of CD4 cells) – Acquired Immune Deficiency Syndrome (AIDS) occurs when immune system is so damaged that that the person develops opportunistic infections and cancers.
  - Normal CD4 cells = 500 to 1,400 cells/mm^3
  - AIDS = <200 cells/mm^3
- US data indicates three quarters of cases are sexually transmitted.
- Treatment with anti-retrovirals has improved survival – reduces viral load to improve immune function and decrease risk of transmission.
- Virus cannot survive long outside the human body

HIV/AIDS (2/2)

- Mode of Transmission: parenteral, broken skin, or mucous membrane contact with contaminated blood or body fluids
- Saliva, tears, urine, and sweat not considered infectious
- Risk factors: unprotected sex, injection drug use
  - Those who engage in these practices should get tested at least once a year

Viral Hepatitis

- Five hepatotropic viruses, A, B, C, D, and E are responsible for viral hepatitis
- Clinical syndrome consisting of malaise, elevated transaminases, inflammatory infiltrate within the liver, hepatocyte injury, and death
- Hepatitis A (HAV) and Hepatitis E (HEV) usually self-limiting (fecal-oral), with the others potentially chronic, life-long diseases (blood-borne)
- IPAC precautions: Standard/Routine Practices

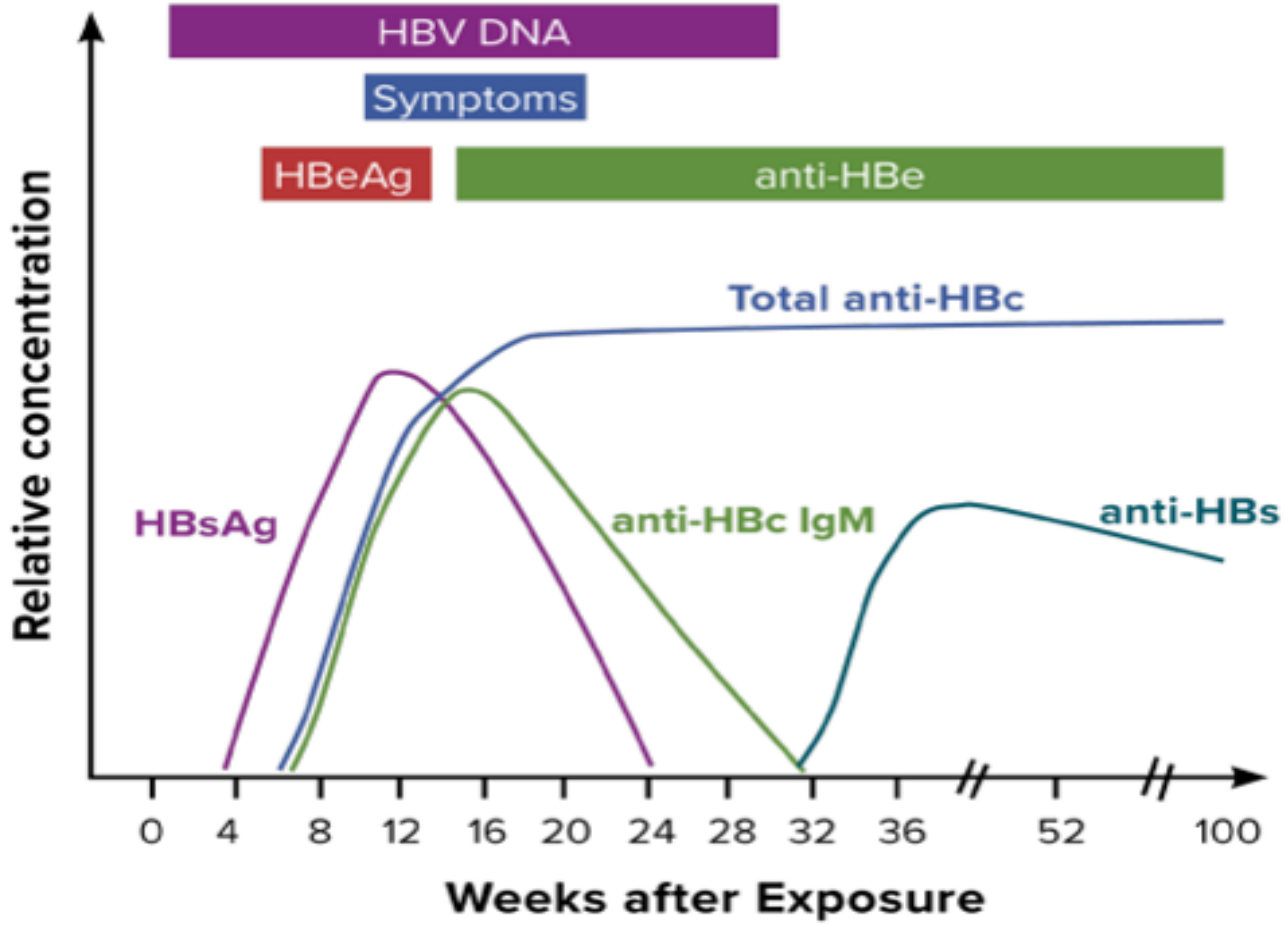
HAV

- HAV risk factors: intimate personal contact, poor hygiene, unsanitary conditions, contaminated water, milk, or food (especially raw shellfish), childcare exposure, IV drug use, travel to an endemic area, chronic institutionalization, men who have sex with men (MSM), and occupation (e.g., sewage worker, pediatric nurse)
- Rates have declined dramatically since introduction of vaccine.
- HAV treatment: supportive

Hepatitis B (HBV)

- Mode of Transmission: blood or blood products, sexual contact, or perinatal exposure of an infant.
- Incubation: 30-180 days
- Rates have declined dramatically since vaccination introduced
- Post-exposure prophylaxis: HBIG is indicated for persons not already immune to HBV
- Treatment: supportive for acute infection

Typical Serologic Course of Acute Hepatitis B to Recovery



Hepatitis Virus C (HVC)

- Incubation: 15 and 160 days
- HCV transmission: blood injection (injecting drug users), organ transplantation, or transfusion of HCV-infected blood or blood products
- Treatment: pegylated interferon plus ribavirin
- No vaccine or post-exposure immunoglobulin

For the Exam – What to Review?

- Most common infections to review:
  - MRSA, VRE, TB, HAV, HBV, HCV, HIV, *C. difficile*, Creutzfeldt-Jakob Disease, scabies, diphtheria, chickenpox, varicella, influenza, measles, mumps, rubella, meningitis (bacterial vs. viral), Lyme disease, bioterrorism agents (anthrax, plaque, botulism)
  - Make note of incubation periods, symptoms, lab testing, mode of transmission for each disease

Discussion/Knowledge Check

Specimen Collection, Transportation, Handling and Storage

Laboratory Diagnostic Tests

- Determine the presence of an infectious agent (e.g., Gram stain)
- Detection of immune response (antigen- antibody reaction) e.g. Hep B surface antibody
- Detection of the presence of an infectious agent through Polymerase chain reaction (PCR) (e.g., Influenza virus, COVID-19)
- Accuracy of the laboratory test is an important factor and can be described by two terms:
  - Sensitivity – ability of a test to detect all true cases of the disease
  - Specificity – ability of a test to correctly identify a negative result when the disease is absent

Examples of Common Tests in Healthcare Settings (1/2)

Test Name	Use & Results	Example of Specimen
Gram stain	Direct examination of the clinical specimen. Identifies cell shape and arrangement. Reported as gram negative or gram positive.	Blood, urine, sputum, cerebrospinal fluid, swabs from throat, nasal, wound etc.
Serology, Immunology or Antibody test	Indirect method of identifying infection. A positive antibody test may indicate a present or past infection.	Blood
Antigen test	Direct method of testing for presence of infectious agents. Helpful in early diagnosis when cultures are not yet available.	Blood, nasal-pharyngeal swab
Polymerase Chain Reaction (PCR) or Nucleic Acid Amplification (NAAT)	A small amount of genetic material in the sample is copied multiple times known as amplification. Detects the DNA or RNA of a pathogen. Can detect early stages of the disease.	Oral/ nasal swab, nasal-pharyngeal swab, throat swab, saliva, blood, mucus or tissue
Urinalysis	Assess color, clarity, presence of proteins, glucose, blood, ketones, white blood cells, bacteria or yeast. Assess health of the urinary tract.	Urine
White blood Cell (WBC) count	Assess either total number or components of the white blood cells. May indicate various types of infection.	Blood

Examples of Common Tests in Healthcare Settings (2/2)

Test Name	Use & Results	Example of Specimen
Culture	Use to grow bacteria and yeast(fungi). Can result to findings of polymicrobial growth (more than one type of bacteria) or pure culture (ingle bacteria).	Blood, tissue, urine
Acid Fast Stain	Rapid screen for Acid fast bacilli like Mycobacterium tuberculosis. Reported as no AFB seen, few, 1+, 2+ etc.	Sputum, abscess contents, blood, body fluids(pleural, pericardia, peritoneal fluids etc.), bone, bone marrow, bronchial washing, Broncho-alveolar lavage, corneal scrapings, tissue, wound, cerebrospinal fluid (CSF), gastric lavage etc.
Chest- X-ray	Imaging of the chest showing potential fractures, conditions and infectious of the lungs. Useful in diagnosis of tuberculosis and pneumonia.	
Antibiotic Sensitivity testing	Done to determine appropriate antibiotic therapy with some bacteria require specialized testing. Examples of test: Kirby-Bauer Disc Diffusion Susceptibility Test, Automated Antibiotic Susceptibility Testing Standards for testing set by Clinical and Laboratory Standards Institute (CLSI). Results are reported as sensitive, resistant or intermediate.	

Specimen Collection for Antibiotic Resistant Organisms

MRSA	VRE	C. auris	CPE	ESBL
Swabs from skin lesions, wounds, incisions, ulcers or exit sites of indwelling devices. Swab from the anterior nares and perianal area or groin area.	Stool OR Rectal swab	Nasal swab plus a combined bilateral axillary and groin swab and other sites as indicated (i.e., wound, urine, exit site). Inclusion of additional swabs from other sites (e.g., perirectal or stool, throat) may increase the yield of testing.	Stool OR Rectal swab AND, if indicated Urine, Wounds, Endotracheal suction (critical care) Exit sites (critical care)	Stool OR Rectal swab AND, if indicated Urine

Specimen Collection – Urine

- Sample collected in sterile collection container
- Catheter urine should have very little contamination if properly collected (from port in tubing not drainage bag)
- Mid-stream (clean catch) urine often contaminated with fecal, vaginal and urethral flora
- Urine may become colonized and always grow bacteria even without symptoms (asymptomatic bacteruria)
- After a short time, all catheter urine will contain bacteria

Specimen Collection – Stool

- Should be collected in a manner that prevents contamination from urine and water
- Only put a small amount in container: about the size of a loonie or until fluid level is raised to line on container
- Do not overfill container
- Make sure appropriate transport media is used for tests required
- Specimens for *Clostridium difficile* must be liquid stool Type 6-7 (takes the shape of the container)

Specimen Collection – Labeling

- Specimen labeling is one of the common laboratory errors
  - Write date and exact time specimen was taken
  - What specimen is collected (swab, stool, urine)
  - Portion or part of the specimen (mid-stream urine, catheter urine)
  - Relevant clinical information (diarrhea, vomiting, frequency)
- Follow the laboratory guidance on specimen storage and transport

Specimen Collection – Transportation/Storage

- In general, all specimens should be collected aseptically (clean), placed in appropriate container, and transported to the lab as soon as collected
- If not possible to transport immediately, refrigerate (if appropriate) as soon as possible. Don’t place in the staff/resident food refrigerator
- Collect specimen where infectious agent is most likely found (e.g. anterior nares for MRSA) and at the optimum time (e.g., early morning sputum for acid fast bacilli)
- Obtain specimens prior to giving antibiotics whenever possible.
- Spinal fluid, genital, eye or internal ear specimens should not be refrigerated

Discussion/Knowledge Check

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