HSS1100[C] - Microbiology and Immunology

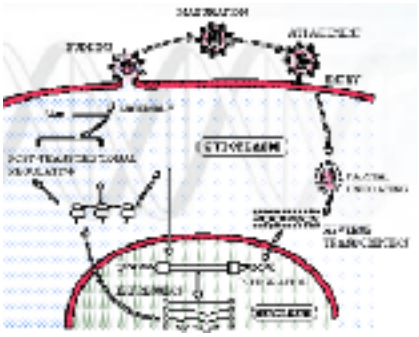
Lecture 1 - General Principles of Microbiology

micro = small bio = life logy = study (of) or science

Immunology = study of our protection from foreign macromolecules or invading organisms and our responses to them

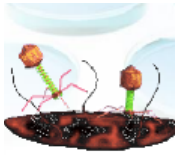
<u>Different classes of organisms</u>

- Viruses / chlamydia (grow only in living cells)
- Mycoplasma (grow on non-living media)
- Bacteria (no separate nucleus; unicellular)
- Parasites
- Small (microscopic)
    - 1-2 microns (1 mm = 1000 microns)
    - Address them by their proper names !!! - (i.e., not “germs”, “bugs”)
    - Listeria monocytogenes
        - Species is the second name
        - The genus capitalized species undercase



<u>What are they made of?</u>

- Viruses



    - Nucleic acid (either RNA or DNA…never both!)
    - Surrounded by protein shell (capsid)
    - Attach, inject nucleic acid (penetration), highjack synthetic processes inside cells to make more viruses, package, get out while going is good…
- Bacteria
    - Rigid cell wall to keep things in place
    - Genetic material – circular chromosome
    - No nucleus (nucleoid) - Both DNA and RNA
    - Binary fission

  Some bacteria do not have a rigid cell wall and are more fragile (i.e., Mycoplasmas)
- Eukaryotes
    - Unicellular and multicellular animals and plants
    - Genetic material is organized into a nucleus
- Are all bacteria bad?
    - biotechnology, spoilage of foods, bioremediation, functional foods, etc…
- Can we live without bacteria? - No , they help with digestion - breaking down food LOOK BELOW

<u>“Normal” flora…the good guys (produced after birth)</u>

- Resident (GI Tract and skin) versus Transient (sometimes)
- GI-tract: colon is inhabited by anaerobes and coliforms
- Skin: mostly coagulase negative staphylococci
- Where should there be NO bacteria?
    - in the CNS, Heart, Cardiovascular system, bacteria in genitals in men - may cause urinary infection. if so they are transient. Female genitals - should have bacteria to maintain pH and temperature
- What can they do for us?
    - protection from invasive (bad) bacteria
    - metabolism (vitamin K), immune stimulation

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What protects us from the bad guys?

- Mechanical barriers
    - skin (most Important mechanical barrier), saliva, mucous, tears, hairs, etc.
- Other helpers include
    - antibodies
    - complement
    - immune cells (T-cells, NK cells, macrophages)
    - immune system (cell mediated; humoural)

How do the bacteria enter?

- Adherence
- Toxin production (destroys some of our defenses)
- Opportunism
- Compromised host
    - Can become compromised if stressed, has a lack of sleep, vitamin deficiency, heredity etc

Bacteraemia - bacteria in the blood
Anemia - involves blood
Bacteraemia is a type of septicaemia (blood poisoning)
Colonize - activity do something to colonize and break through barriers
Contamination - example direct deposit inside person, no need to colonize or do work because already ready

Microbial disease

- Interaction between microorganisms and the host (us) is continuous battle
    - They need to enter-live-multiply
- In order to enter, they need to colonize (establish and multiply) in/on body
- Clinical disease = easy to recognize - result when damage occurs to host [contamination = deposition without multiplication]
- Sub-clinical infection = hard to diagnose (no symptoms)

How do we measure how dangerous a bacteria/virus/parasite is?

- Pathogenicity = ability to produce disease
- Virulence = relative capacity to cause damage (i.e., the degree of pathogenicity)
- Opportunistic = do not normally cause disease but can do so when defense mechanism(s) breached or compromised (organism that usually does not cause problems unless not in the right spot)

Pathogenesis of infectious diseases

- A pathogenic microorganism enters your body…two things happen:
    1. Microorganism (invader) tries to multiply / invade and cause disease (2° event)
    2. Host tries to prevent #1
- Whether the invader wins or not is dependent on several factors
- Transmission:
    - 2 MAJOR WAYS —> inhalation, ingestion - break in protective barrier, direct deposit
    - pathogenicity
    - invasiveness (adherence, persistence, avoidance of immune system)
    - toxigenicity (ability to make toxins) “help bacteria”

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How does a pathogen adhere to us?

- A bacteria needs to adhere, evade and invade the host
- Tools used to achieve these huge objectives:
    - surface structures (pili, fimbriae)
    - capsules
    - enzymes

Toxinogenicity

- Toxins are substances (usually proteins) secreted by bacteria with the hope to cause damage
- Two classes:
    - Exotoxins
        - excreted/secrete by living cells (exo=exit)
        - specific affinities
        - thermolabile - destroyed/deactivated by heat
        - Organism will make it release and go to another area of the body
        - Very potent - sensitive to heat
    - Endotoxins
        - Endo - inside
        - Produces from a live bacteria
        - liberated when cell wall disintegrates (bacteria dies inside)
        - Does not have a specific affinity
        - causes fever, malaise - discomfort, shock
        - thermostable - NOT heat sensitive
        - less potent than exotoxins - resistant to heat

Review

Flora - bacteria produced after birth

Pathogen - a bacterium, virus, or other microorganism that can cause disease.

Answer these questions…

Us vs them What do they need to do What to they have What can we do

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Lecture 2 - What is Immunity?

Immunity = the protection against infectious disease conferred either by the immune response generated by immunization or previous infection or by other nonimmunologic factors…a.k.a. body's ability to resist infection

2 types of immunity

- Non-specific (innate), (front line of defence) stuff we are born with that we don't have to actively think about when we encounter it
- Specific (adaptive, acquired) - you have to do something because the natural front line of defence is not able to address the issue

Innate Immunity

- Skin (Front line of defence)
    - What characteristics of the skin make it an effective mechanical barrier ?
        - Acidic
        - Selectively permeable
        - Secretes stuff
        - Sebaceous gland
        - Covers body
        - Dry
- Mucous membranes (mechanical)
        - Cilia in respiratory tract
        - Lysozyomes, pH
- Iron-binding proteins
        - Some bacteria require iron for growth
        - Transferrin, lactoferrin
- Phagocytosis (cell eats something solid)
        - PMNs, monocytes and macrophages (white blood cells that act as a general vacuum cleaner)
- Complement
        - A set of circulating proteins in the blood
        - What can they do?

            1. Able to bind antibodies, making whatever it is attached to very attractive to your immune system - opsonization
            2. On certain bacteria they can recognize the sugars of a bacteria, they form a membrane attacked complex (pore) and the insides of the bacteria will be released

Specific Immunity

- Humoral and Cell-Mediated (CMI)
- What is the difference between innate immunity and adaptive immunity?
    - Innate: protects against ANY invader, does not discriminate
    - Adaptive: directed against one type of invader, dependant on past exposure specific , why we have vaccines

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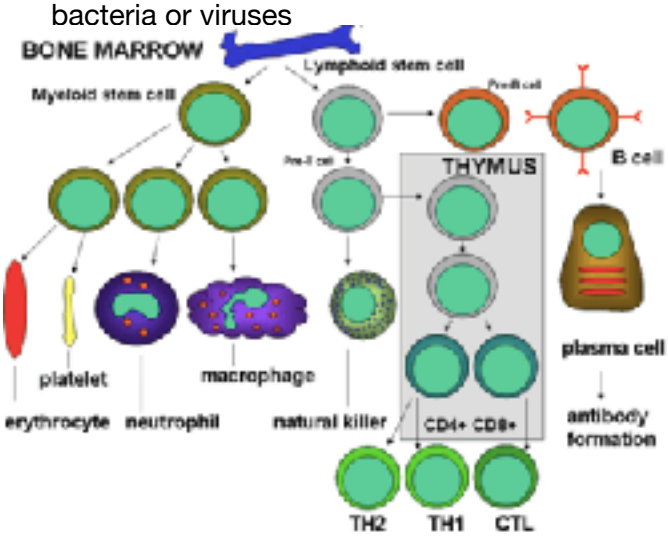
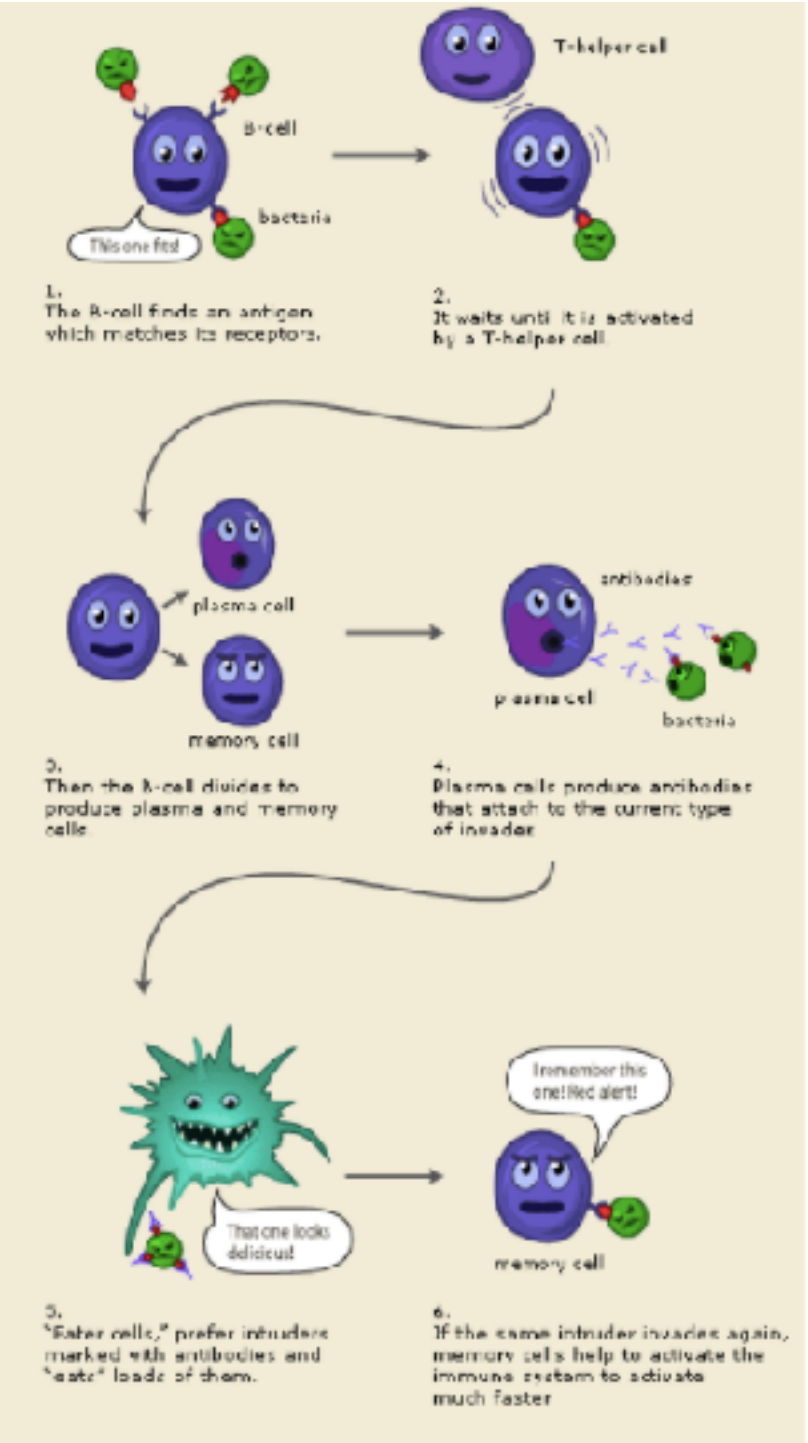
Where do immune cells come from?

- Immune cells - Lymphocytes (T-cells, B-cells and NK cells), neutrophils, and monocytes/ macrophages - all types of white blood cells
- T cells are one of two primary types of lymphocytes—B cells being the second type —that determine the specificity of immune response to antigens (foreign substances) in the body.

- B cells make antibodies to specific antigens
- T helper 2 cells bind to B cell and inform it to make antibodies, other extracellular parasites, humoral
- T helper 1 - turns on cell mediated immunity, regulate response, intracellular parasites such as bacteria or viruses





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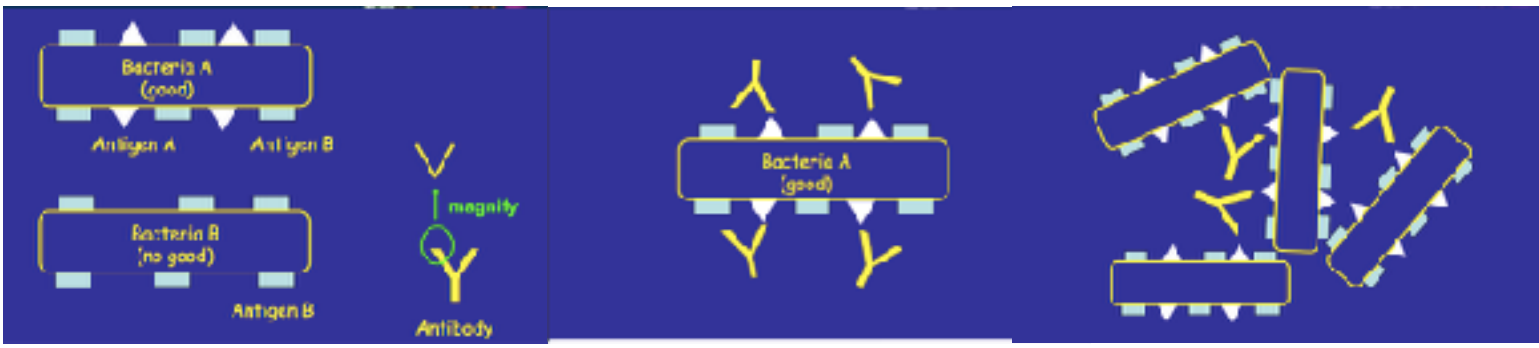
Humoral Immunity

Humoral - antibodies found in clear liquid on top of spinned blood

- Circulating antibodies
- Antibody: protein that binds specifically to a substance (its antigen)
    - Igs or immunoglobulins
    - Produced by B-lymphocytes upon stimulation from antigen presenting T-cells
    - Recognize toxins, capsules, some viral proteins
    - Need help from t helper 2 cell
- Antigen (protein that combines to antigen) - a toxin or other foreign substance that induces an immune response in the body, especially the production of antibodies.
        - "non-self"
        - Protein, glycoprotein, lipoprotein, polysaccharide
        - Preferably unique to the pathogen in order to make a targeted response
        - What structures could be "antigenic" in a bacteria? Virus? - things that can change, ex glasses and contacts

Antibody binding: How does it occur?

clumping - glutamate , bind antibody

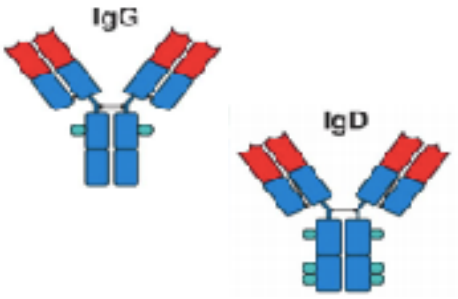


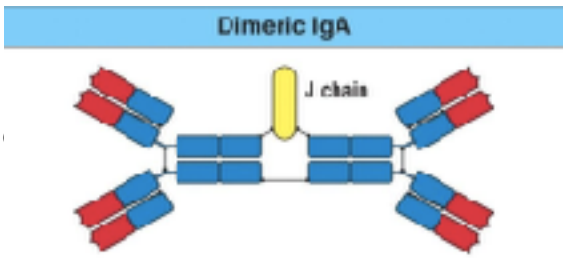
Immunoglobulins (Igs) a.k.a. Antibodies

- Antibody: Ig produced in response to stimulation by an antigen and reacting specifically with it.
- Distinguish "non-self" from "self"
- Constant and variable region
    - Constant region - compliment binds to constant region
    - Variable region is responsible for antigen recognition - top parts of the y

Classes of Igs - immunoglobins ?

- 5 classes: IgG, IgA, IgM, IgE, IgD
- IgG
    - Host defence
    - Crosses placenta and protects newborn
- IgD – Role is unknown
- IgA
    - Host defense
    - Found in secretions
        - Tears, saliva, milk, respiratory, GI and genitourinary tract
    - Dimer
    - 2 Y shaped molecules stuck together





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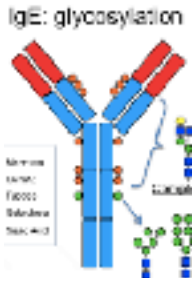
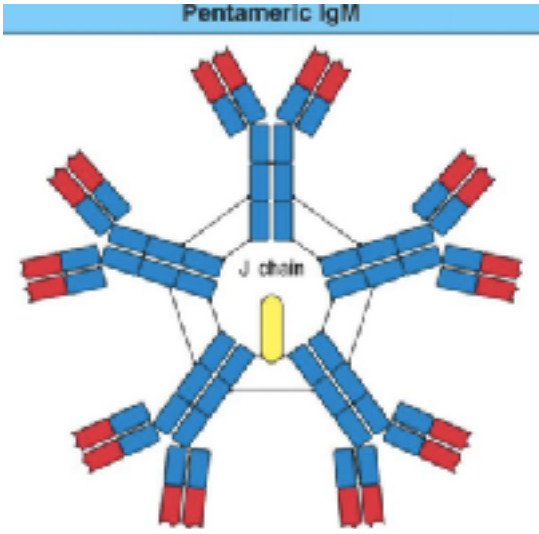
- IgM
    - Host defense
    - Early immune response
    - Pentamer
    - 5 Y shaped molecules
    - First antibody you make
- IgE
    - Hypersensitivity (allergies)
        - immune system recognizes thing and makes too much ige to make mast cells which make histamines then u need to get antihistamenes
    - Defends against parasites

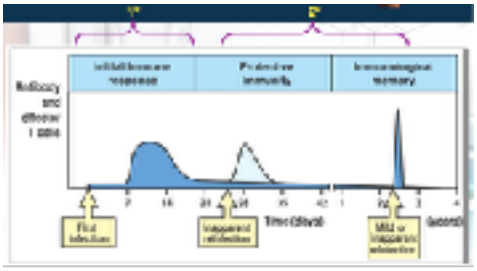




<u>Primary and Secondary Immune Responses</u>

1o Primary Response

- Ab production triggered on first antigen introduction
- Latent period of several days
- Circulating antibody detectable after 5-10 days
- Antibody in serum is maximum at ~21 days, then drops to low levels
- the first time ur immune system sees an antigen, takes a bit of time before we can detect thats bad

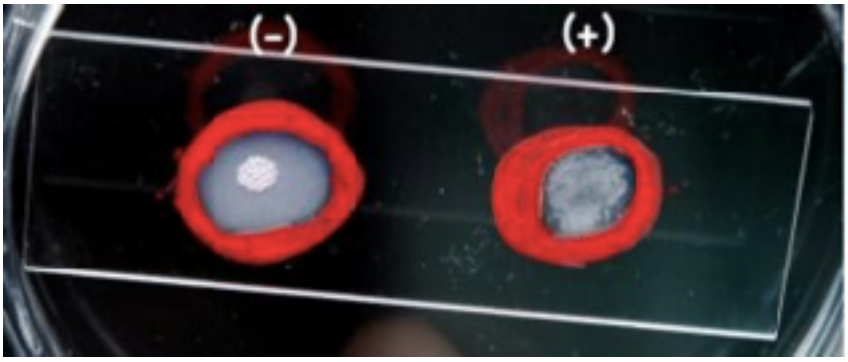


2o Secondary Response

- Basis for Immunizations
- Occurs when Ab is introduced 2nd, 3rd,4th ...time
- Lag, rapid Ab increase (2-3 days), slow decrease
- Booster injections to maximize Ab levels
- Why we immunize and vaccine people
- Your body destroys after it detects the virus the first time and now recognizes it, the amount of antibodies produced stays constant
- Ex tetanus shot, to maximize the toxin is recognized as bad

<u>Antibody Detection</u>

- Serological Reaction
    - Detects presence of antibodies in serum sample – Antigen and antibody interact; agglutination
    - Look for clapping / glutanation to occur - that the the of infection u have ^(if take humours samples)
    - Antibody titration
    - Detect unknown microorganisms using known antisera



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How does ur body know whether to activate hormonal or cell mediated immunity based on the antigen it sees?

- Antigen presenting cells
    - it will prepare for presentation,
    - After presented will know whether helper cells are th 1 or the2
    - take it and process it to the correct antigen cell
    - eventually turn on t helper 2
    - T helper 1 train them to be powerful against a specific response

Pathogens taken in by macrophage (type of antigen) then present it t helper will recognize and pathogen is then activated

<u>Cell - Mediated Immunity</u>

- T-cells NOT antibodies
    - Helper, suppressive, cytotoxic (killer) generated from memory T-cells
- Exposure to antigen induces response from trained T- cells
- Essential for defense against intracellular organisms, parasites, tumors and other foreign cells (i.e., transplants, grafts)
- Immune-suppressive medication for transplant recipients
- t helper 1 - Help control the response, disease enters, process it and respond

<u>Disorders of Immunity</u>

1. Allergy and Hypersensitivity
    - OVER-reaction to antigens in absence of true infection
    - Can be fatal.....ANAPHYLAXIS
2. Auto-immune diseases
    - Immune system reacts to its own “self” antigens
    - “auto-antibodies”
    - Immune system overactivity and body attacks itself
    - Type I diabetes, MS, rheumatoid arthritis, lupus
3. Immunodeficiency states
    - Inability to produce antibodies and/or disfunctional CMI
    - Congenital or acquired, disease, AIDS
    - Prevent your body from fighting infections and diseases
4. Graft rejection
    - NORMAL immune reaction to “non-self”
    - Control by immune-suppressive medication
    - Ex. Organ transplant should have the most similar antigens

<u>Immunization</u>

- Passive Immunization
    - administration of pre-formed antibody against a specific microbial agent
    - IgG animal origin: short lived, risk of hypersensitivity reaction
    - IgG human origin: short lived, no risk of reaction
    - *Gamma globulin (IgG)*: pooled from large grouped of blood donors and has antibodies to many common infections
    - *Hyperimmune globulins (IgG)*: specific for a particular microbe
    - Take antibodies, give them to someone

- Active Immunization
    - Stimulates immune system by administration of antigen
    - LONGERLASTING
    - Better , asks immune system to turn on B cell and make memory cell

<u>How to introduce vaccines</u>

    - Live-attenuated vaccine
        - Sub-clinical or mild illness mimicking the disease
        - Local (IgA) and humoral (IgG) immunity
        - Rapid immunity development
        - Serious illness in immuno-compromised individual
        - Beat up the pathogen until an no longer kill, then injected in people
    - Killed vaccines, sub-unit vaccines and toxoids
        - Antigens without infectivity
        - May require boosters
        - Adjuvant with toxoids(-part of a toxin, (ex part of tetanus))
        - Polysaccharide vaccines can be conjugated to protein (see conjugate vaccines)
    - Recombinant vaccines
        - DNA recombinant technology
        - Attenuates microorganism
        - Hep B vaccine
        - take antigen that is unique and remove the genes and put genes into person
    - Adsorbed vaccines
        - Vaccine mixed with inorganic salt for slower adsorption and longer- lasting immunity
        - Tetanus, diptheria
        - To cause antigen to stay in circulation in body longer and show it to the t helper 2 to make things
        - Injected inter muscular - lymphodes?
    - Conjugate vaccines
        - Designed for poorly antigenic microorganisms
        - Conjugate antigen of interest to immunogenic, non-toxic protein – Haemophilus influenzae type b
    - Combined vaccines
        - For ease of administration
    - Combined Active-Passive Immunization
        - Immediate protection after possible exposure to microbe
        - Hyperimmune Igs and vaccine injected at DIFFERENT sites
        - Tetanus, Rabies, Hep B
    - Long/short term
        - Preformed antibodies - short term
        - Preformed antibodies and vaccine - make primary and secondary response longer term
        - Do not present in the same needle, will attack each other
    - Common misconceptions of diseases
        - Weakens immune system
        - Get autism
        - Allergic reaction to vaccine

Antibiotic Resistance

- The first antibiotic (?)
  - discovered in 1929 by Sir Alexander Fleming
  - Made of mold, left petri dishes and found out the mold had healing properties
- World War II
  - penicillin used to treat staphylococci and streptococci (1946)
- Resistance to penicillin recognized almost immediately
  - 80% of all strains of Staphylococcus aureus
  - Streptococcus pyogenes (Group A strep) still treated with penicillin
  - Interestingly, penicillin has never been effective against Gm-negatives (Salmonella, Shigella, Bordetella pertussis, Yersinia pestis, Pseudomonas) – why? ⍰
- Late 1940s and early 1950s

Antibiotic therapy

- Effective chemotherapy depends on selective toxicity
  - good against pathogen, does not affect host...
- Exploit pathogen processes not seen in humans
  - cell wall, metabolism, etc.
- Knowledge of likely microorganism is crucial…
  - site
  - organism
  - allergy to host?
- Other considerations…
  - route of administration - orally, IV, creams
- Monitoring therapy
- Adverse effects
  - GI-tract, skin, haemopoietic system, renal system, liver

Acquired Resistance

- Three major mechanisms of resistance

1. Alteration in drug target
   - ex antibiotic against something , change something and then the antibiotic can't do anything to it anymore
2. Production of inactivating enzymes
   - ex. Penicillin doesn't work anymore, it was able to produce enzyme against enzyme
3. Decreased uptake of antibiotic
   - Membrane can become less permeable, produce eflux protien (pumps antibiotics out)

Antibiotic Resistance PT2

- Resistance occurs when a susceptible microorganism is no longer inhibited by an antibiotic agent
- Many reasons why this can happen ^ The three major mechanisms can happen these 2 ways
  - intrinsic- characteristics of microorganism vis-à-vis
    - antibiotic's mechanism of action (inherent or "natural")
  - acquired - new or added (driven by two genetic processes in bacteria...mutation and selection (vertical evolution); and exchange of genetic material (horizontal evolution)

The chromosome: role in antibiotic resistance

- Mutations lead to
    - Change it site of antibiotic target (but protein for bacterial still works fine!)
- Regulatory genes
    - turn on alternative path
    - turn on efflux mechanisms
- Change cell permeability - cause cell wall to be less permeable

Post - antibiotic era: is it possible?

- With current overuse of antibiotics, we are forcing bacteria to change (evolve) in order to survive
- How is this achieved/helped by us?

Decreasing antimicrobial resistance?

- Withhold antibiotics
    - self-limited viral infections (i.e., the “common cold”)
- Use narrowest spectrum antimicrobial agents
- Base decision about broadness of empiric antibiotic coverage on severity of illness
    - clinically stable and not at risk for significant morbidity...may be appropriate to wait culture results and MIC testing

Review

- US versus THEM
- Barriers to overcome…getting over shyness
    - Routes…
    - Skin, mechanical, complement, phagocytosis, inane immunity, vaccination
    - Humoral and cell mediated immunity
        - Humoral - key players - B cells, antibodies, T helper 2 cells, APC
        - Cell mediated response- key players - WBC to be trained, or cells infected to commit suicide T helper 1
    - Virulence, pathogenicity, toxinogenicity (endo/exotoxins)
    - Antibiotic resistance (alteration / inactivation / decreased uptake)
- Problems with US … sometimes due to them
    - disorders of the immune system
    - allergies, autoimmune disease, immunodeficiency, graft projection
    - immunization strategies (passive, active)
- Put preservatives in vaccines because it lowers the cost

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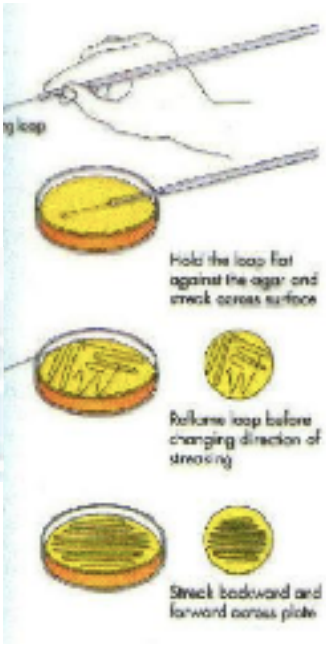
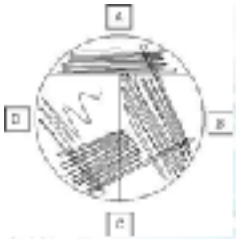
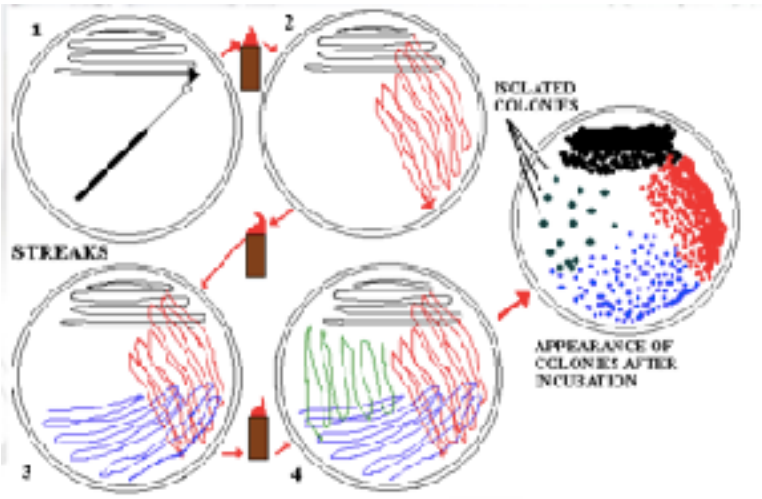
Lecture 3 - General principles of diagnostic microbiology

- Isolation of pure culture from specimen
    - why?
        - To see if there are other things in the immune system
        - To confirm what is causing the illness
        - Ex Study salmonella and see if it can be treated properly
- Culture media
    - why?
    - what?
    - who?
- Inoculation methods
    - streak, spread, or pour



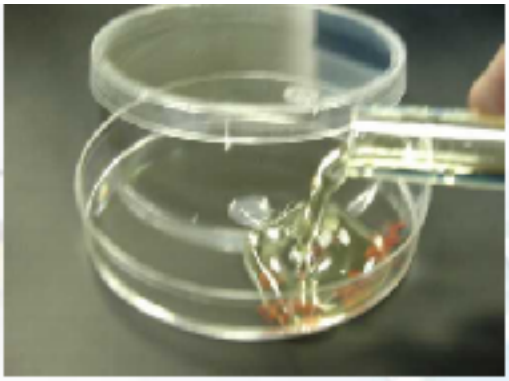


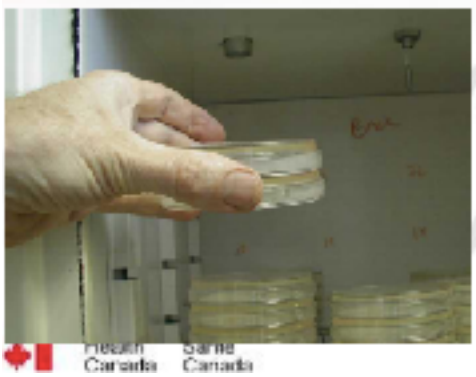
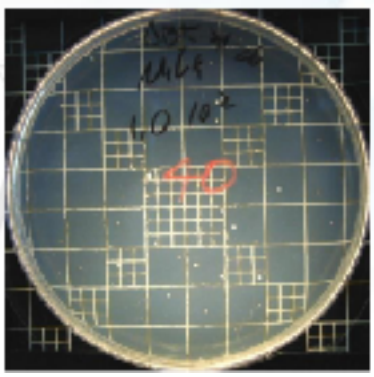
Streaking a plate for isolated colonies



- The rod is sterilized and spread out again and again to dissemble the different bacteria present in the sample
- Colonies at the surface of the plate
- Used today
- Isolate something

Pour plates

- Bacteria grow inside agar
- Used for enumeration of bacteria
    - CFS + hot agar,
    - Not used today
    - Have to dig around to get colonies

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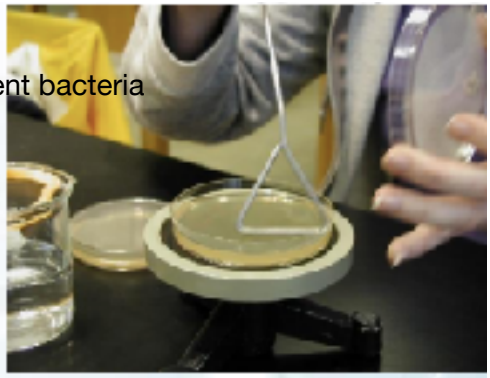
Spread plates

- Useful to know how many different bacteria (when you want to count)
- Dilute and spread out



Preservation of Cultures

- pure cultures of bacteria are stored:
- freeze-dried (lyophilized)
- frozen at -80C

lyophilizer

Ultra-low freezer

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Preservation of pure cultures

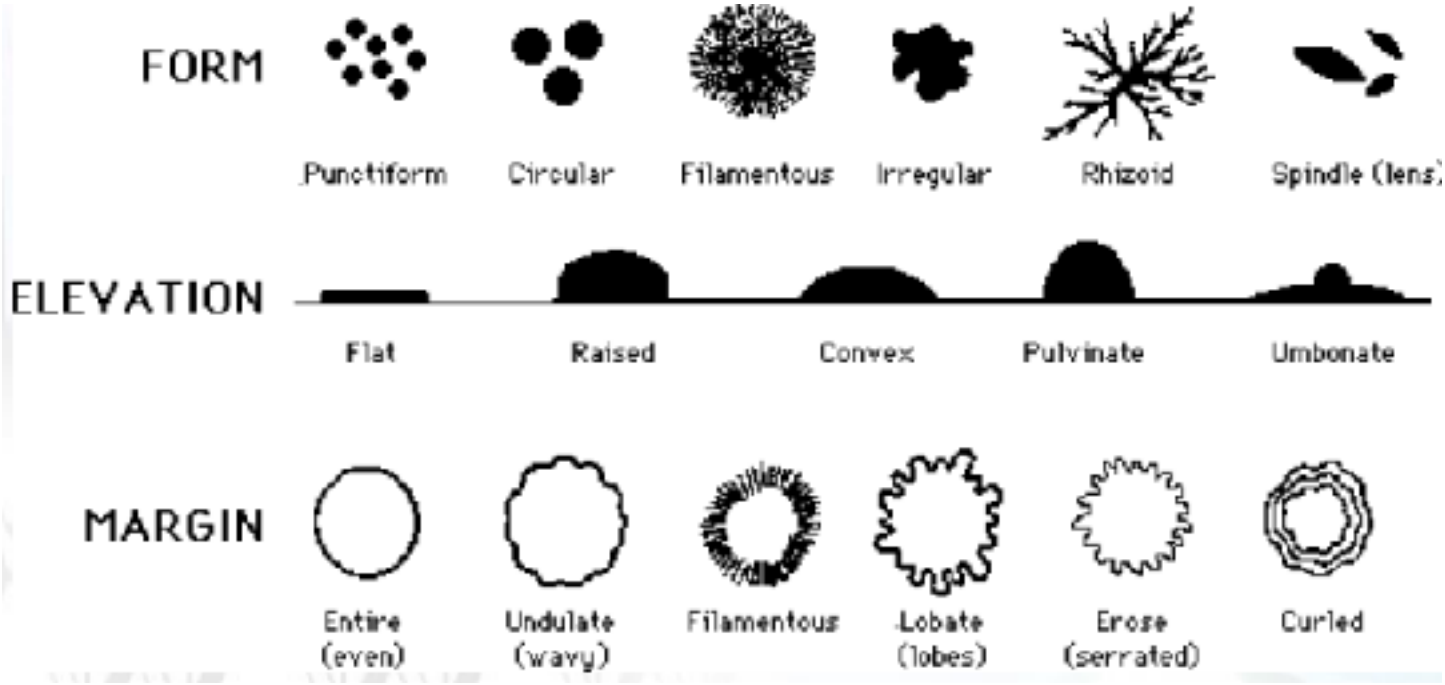
- Why would we want to keep a “copy” of a bacteria we isolated from a patient? Useful for comparing and contrasting current and stored sicknesses
- Short term versus long-term
    - Liquid nitrogen (-195oC)
    - freezers
    - lyophilization (freeze-drying) (stay at room temperature)

Identification

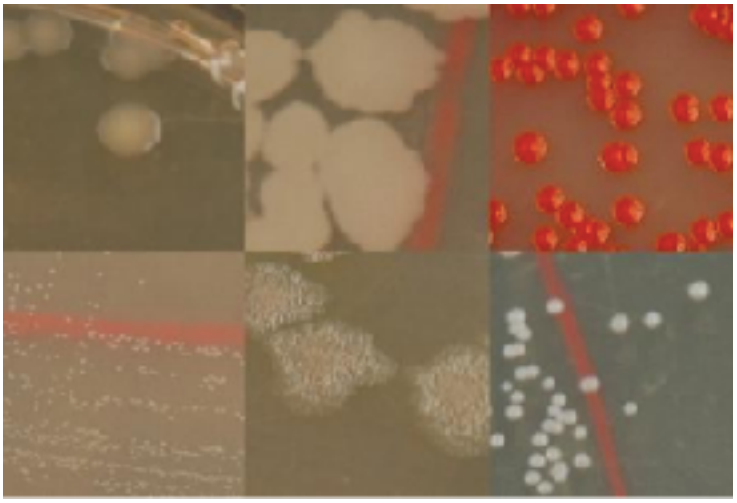
- Now that you have a pure culture…
    - colony morphology
    - cellular morphology
- The microscope is your friend
    - resolving power (resolution) = ability to distinguish two closely located objects as separate, distinct entities
    - Laser microscopy - laser from the bottom with light

Colonial morphology

dont need to know for exam



Examples of colonial morphologies



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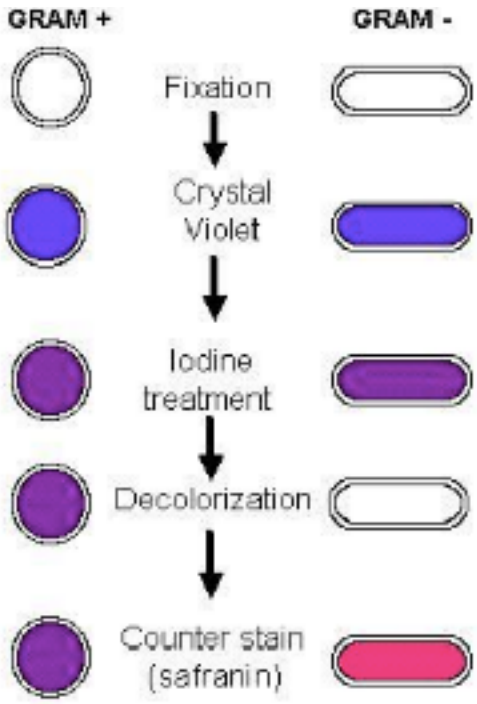
Identification - Staining Techniques

- Generally, three steps:
    1. Make a smear - glass slide, take colony and smear it
    2. Fix dried smear by heat - pass heat (go over bunsen burner) this denatures protein and fixes it to the slide
    3. Stain with desired dye

Simple vs. Differential staining

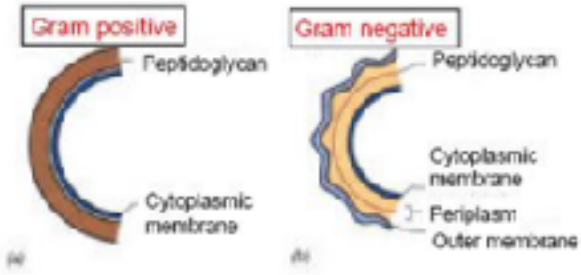
- Simple stain
    - single dye normally used
    - all organisms same colour
    - size, shape, number, arrangement, etc.
- Differential stain
    - two or more dyes
    - differences between microorganisms or parts of cells
    - acid fast, Gram

The Gram Stain (Hans Christian Gram)



Do smear, heat fix it then …
1. Flood slide with crystal (or gentian) violet. (Wash with running tap water)
2. Flood with Gram's iodine. (Wash with water). (iodine will bind with crystal violet and attach really well to bacteria)
3. Carefully decolorize with 95% ethanol. (Wash with water). This third step is the most critical and also the one most affected by technical variations in timing and reagents.
4. Flood with safranin (pink color). (Wash with water). Air dry, or blot with absorbent paper

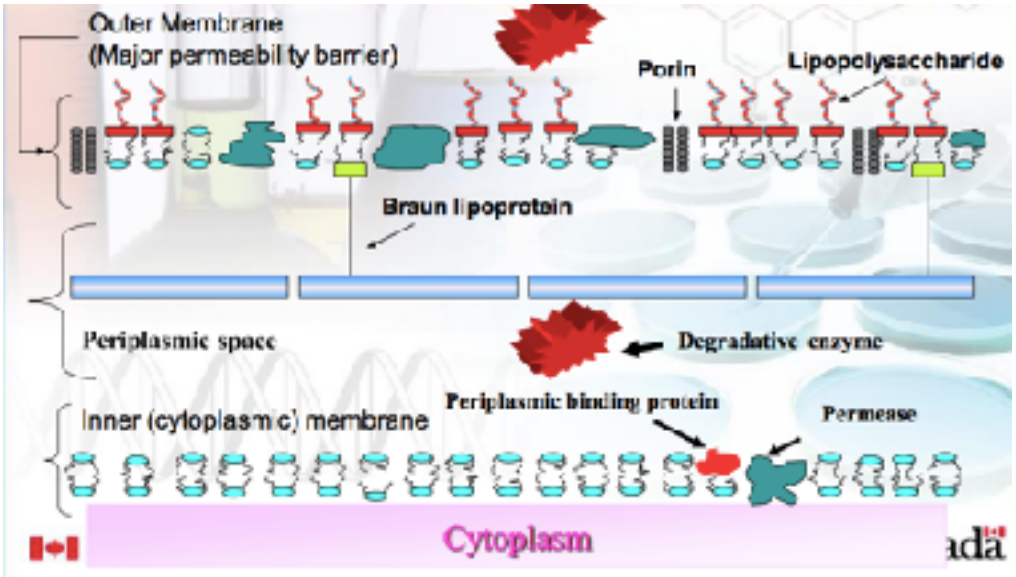
Gram negative - lose ability to wash away



Cell wall is the key!

- Essential for cell growth and division
- Shape of bacteria related to peptidoglycan layer
- Peptidoglycan in Gram negative usually thinner than Gram positive'
- Thicker Gram positive picks up more purple dye, pink stain sticks to the periplasm, of both but shows through the G- to be pink

Gram Negative Cell Envelope



What type of bacteria has endotoxins?
Gram negative

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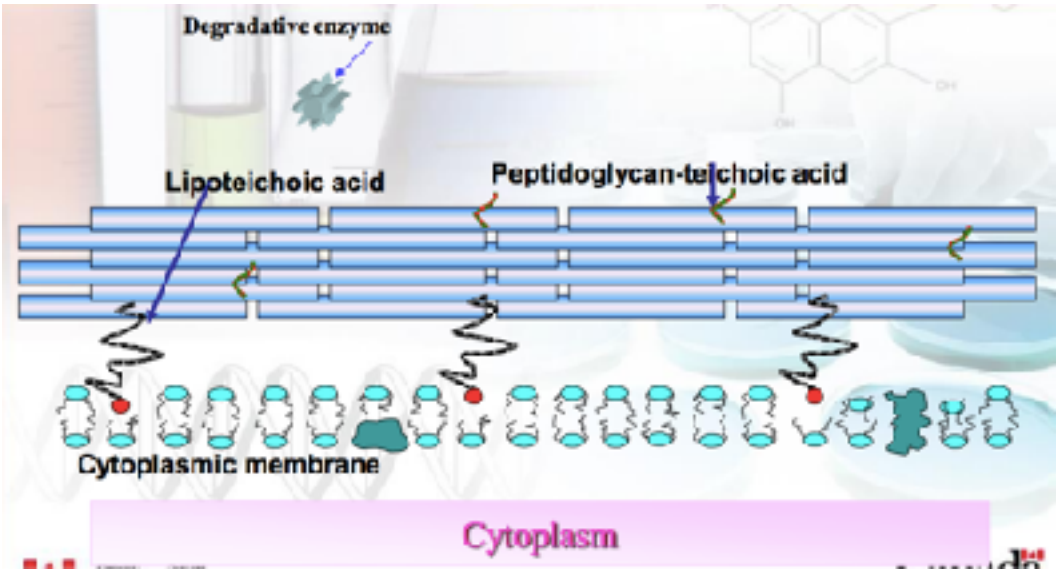
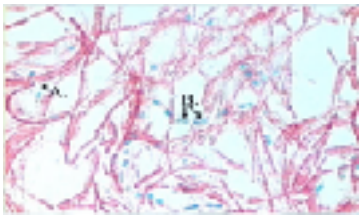
Gram Positive Cell Envelope

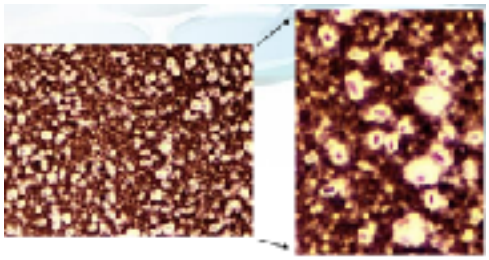
No secondary cell wall
Very thick layer, a lot stays after ethanol therefore it is purple
No liberation of endotoxins

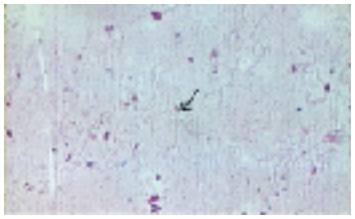


Other Stains

- Endospore
- Capsule
- Flagella

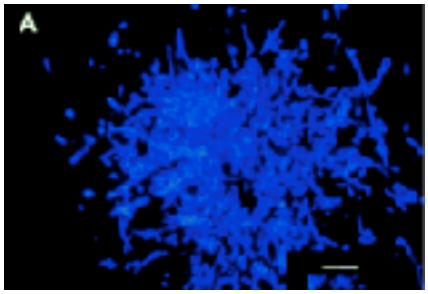






Fluorescence microscopy

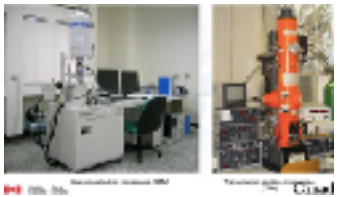
- dye fluoresces at specific wavelength
- antibodies tagged with dyes are common (immunofluorescence microscopy)
- White light that flashes, under slide with antibody



- A section of the liver of a leukemic patient who had succumbed to culture-proven C. albicans mycosis. (staining done with Blankophor) —>

Electron microscopy

- Electron beam (instead of light)
- More expensive
- Million times magnification possible (0.003 µm)
    - TEM - transmission (stain with heavy metals)
        - Slice bacteria, organ, tissue,
    - SEM (3-D image of cell surface)
        - Scan a 3D way to see



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- Electron micrographs
    - example of maple leaf products (listeria)

So what's the bottom line?

- Morphology helps to classify and identify
    - Gram stain
- Gives clues to how they behave in environment
    - capsules, endospores

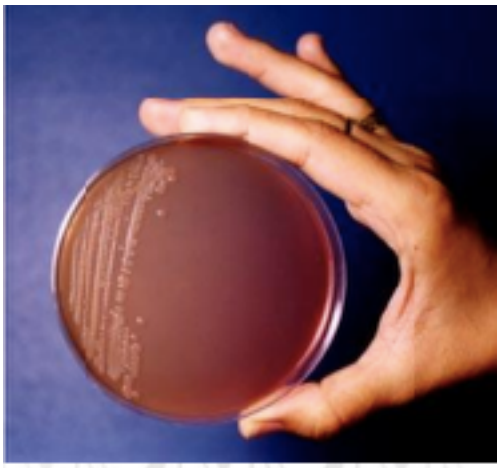
Characteristics of bacteria

- Small (0.75 – 1.25 µm in diameter/width)
- Higher surface area / volume ratio
    - higher metabolism
    - faster growth
    - replication rate (~20 minutes)

Shapes and sizes of bacteria

- NOT ON EXAM Bacteria are usually arranged in specific patterns:
    - single cells (spiral and/or rod shaped)
    - diplococci (pairs) – single plane
    - chain (divide in one plane and remain attached)
    - tetrads (cocci dividing at right angle to first plane of division)
    - division in three planes (grapelike clusters)
    - cubical packet of 8 cells (sarcinae)

With what do we grow bacteria ?



Salmonella typhimurium

Gram Negative: growth

Lactose Fermentation: negative (colorless colonies)

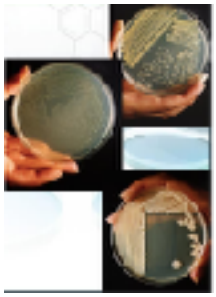
Escherichia coli

Gram Negative: growth

Lactose Fermentation: positive (pink colonies)

Definitions…. :)

- Chemically defined – exact composition known , every ingredient inside can be controlled
- Chemically undefined – some components can't be controlled (beef extract, blood (amount of RBC inside), etc.)
- If solid (versus liquid) growth – 1.5% agar used



- Enrichment media – increase # of specific bacteria in sample by favouring growth of interested species (what are ideal conditions)
- Tissue culture media – for cultivating viruses, derived of plant or animal cells

General media requirements

- Bacteria – requirements vary
- Yeasts – high sugar and lower pH
- Anaerobes – must remove oxygen

Selective, differential and S/D media

- Selective media – enhance growth of one bacterial species or suppression of another (allowing one type of bacteria to grow)
- Differential media – differentiate bacteria based on their nutritional requirements and phenotypic characteristics (can grow together but can tell them apart)
- Selective / Differential media – very useful in clinical labs (e.g., MacConkey agar)

MacConkey – S/D media (Bile salts, crystal violet inhibit Gram +ves)

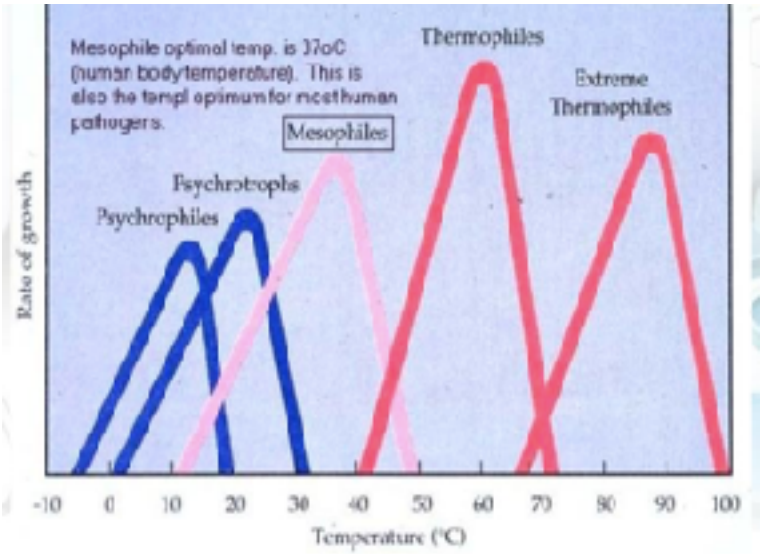
Selective things that inhibit gram positives

— the same figures of how we grow bacteria —

Level 4 pathogen - most dangerous ones,

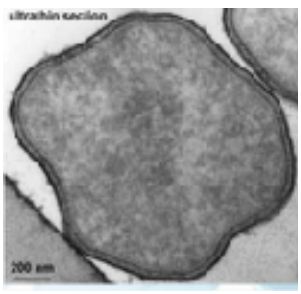
Temperature

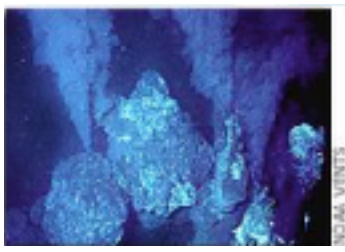
- Psychrophiles
  - grow best at temperatures 15-20oC
  - Bacteria that can grow at refrigeration
  - Listeria! on exam
- Psychotrophs
  - 0 - 30oC
- Mesophiles
  - grow best at temperatures 25-40oC
  - most bacteria belong here
- Thermophiles
  - grow best at temperatures 40-85oC



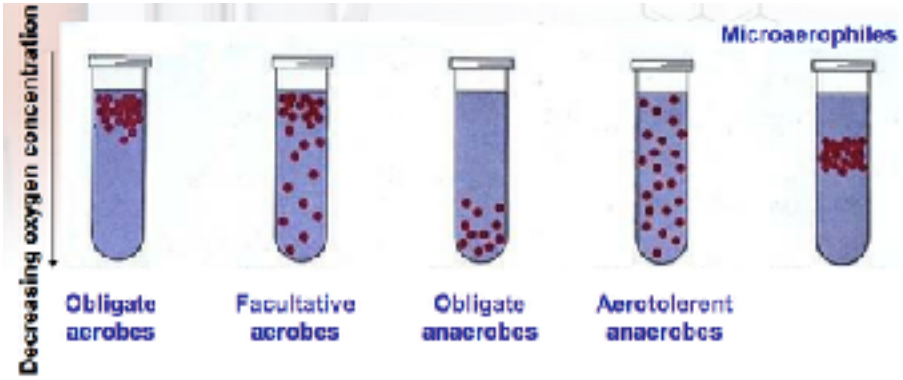
Extreme Thermophiles

- Pyrolobus fumarii
- “fire lobe of the chimney”
- Lobed shape
- Discovered in the walls of a deep sea hydrothermal vent
- Grows between 30 and 113C
  - 106C is optimal





Oxygen requirements



Obligate - needs oxygen, only works with it
Facultative - does well in oxygen
Obligate - oxygen is bad
Aerotolerent - Best with no oxygen but still okay
Microaeophiles - Very specific and defined oxygen requirements, too little and too much is bad

Growth of anaerobic bacteria

Anaerobic jar

Coy anaerobe chamber

pH and Water requirements

- Optimal pH varies from bacteria to bacteria
- Intracellular pH must be ~7.5
- Growth observed at pH values of 4-9 (optimum 6-8)
- Water (light) can be important for certain microorganisms
- Osmotic pressure (hypertonic, hypotonic, isotonic)

Review

Direct ELISA or Indirect ELISA
Direct - detects an antigen
Antibody -positive binds , negative doesn't
Wash
Add another antibody, and enzyme?
Add substrate for enzyme
Colourless molecule gets eaten by enzyme - none fore negative
More colour the more HIV - none for negative sometimes doesn't show, could be too early or too into your body

Indirect ELISA - detects antibody
Take HIV
Add patient serum sample
Antibody is washed away - negative , antibody will stick to the HIV
Another antibody binds with a coloured enzyme and measures the colour

EX. Pregnancy test - is a direct because It is detecting the antigen, - HCG
EX. Drug test - direct, detecting the steroid antigen

Review

- US vs THEM
    - What do “they” need to do?
    - What do “they” have?
    - What can “we” do?
- Colonisation, contamination, pathogenicity, opportunistic, virulence, capsule, pili, toxins (endo/exo)
- Normal flora can sometimes cause infection/kill you
- Barriers to overcome - getting over the shyness
    - Routes of entry
    - Innate versus adaptive immunity
        - Mechanical, complement, phagocytosis = innate immunity
            - Complement = a set of circulating proteins in the blood
                - Can recognize gram - sugars and destroys it
                - Can bind bottom part of y
        - Humoral (t - helper 1) and cell mediated (t - helper 2) immunity — antigen presenting cell is what decides if its humoral or cell mediated
            - Celled needed to make antibodies, activate macrophages
            - Classes of immunoglobulins
            - Primary and Secondary immune response

- Example: a mother breastfeeding is — passive immunization
- Antibiotic resistance
    - Alteration/inactivation/decreased uptake)
- Problems with US … sometimes due to THEM:
    - Disorders of the immune system
        - Allergy, auto-immune, immunodeficiency states, graft rejection
    - Immunization strategies, (passive, active)

Last class

- *Streak (isolating)* versus *pour* versus *spread* (counting) method for plating
- Types of media available
- Requirements for growth (pH, Temp, salt, etc.)
- Simple versus differential stain
- Gram stain (based on cell wall)
    - Crystal violet
    - Iodine
    - Decolonize with EtOH - gram negatives clear
    - Counterstain with “pink stain”

    - Gram positives don't have another cell wall so no endotoxins
    - Gram negatives do have endotoxins
- Temperature, Oxygen requirements
- ELISA (enzyme - linked immunosorbent assay)
        - Direct
        - Indirect

Flu - respiratory virus

Cannot have the stoma

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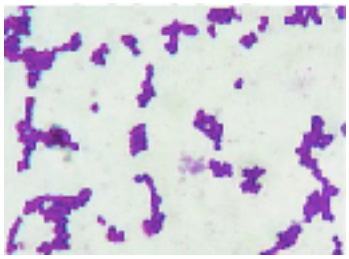
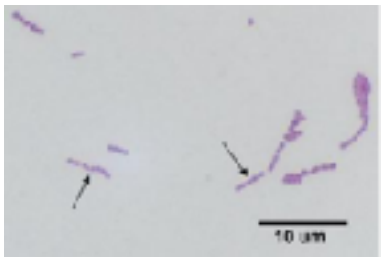
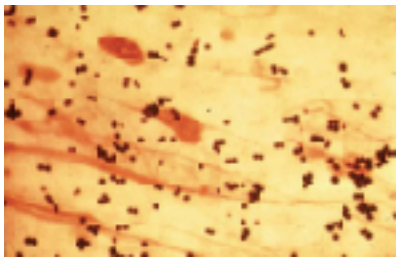
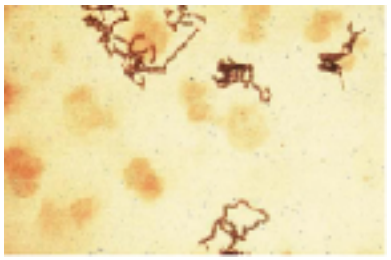
Lecture 4 - Gram-positive and negative cocci

Gram Positive Cocci

Cocci - means circle

Staphylococcus aureus

- “Staphule” means grape in Greek
- Often hang our in “grape” like structures
- Exotoxins are quite the problem: (exotoxins because - staph is gram positive)
    - Cytotoxins - kill or do something to your cells
    - Haemolysins - goes after hemoglobin
    - Enterotoxin (A-E, G-I) - exotoxin that acts on your gastro intestinal tract, they are super antigens
    - Exfoliative toxins (ETA, ETB) - cause the skin to fluff off
    - Toxic shock syndrome toxin 1 (used to be exotoxin C and enterotoxin F)
- Enzymes:
    - Coagulase (coagulation of fibrin)
        - made by almost all pathogenic staphylococci
        - used in laboratory test to differentiate from S. epidermidis, S. capitis and S. saprophyticus (dont need to memorize these names).
    - Beta-lactamase (penicillinase)
        - destroys penicillin
- Many S. aureus strains are found in normal population (~15%)
- Carried in anterior nares, axilla, perineum and hands
- Problem:
    - 85-90% of strains isolated in hospital are penicillin resistant!!!
    - Localized purulent infections (pustules - serious pimples, boils - hair follicles get affected, styes - sebaceous glands in eye affects, conjunctivitis - white part of the eye effected aka pink eye, otitis- ear infection, etc.)
    - Pneumonia, osteomyelitis, (infection of bone/bone marrow) septicaemia, endocarditis
    - Food poisoning , toxic shock syndrome, scalded skin syndrome - as a result of producing exfoliative toxins
- Important cause of hospital acquired nosocomial infections from stitch abcesses, infected wounds, or generalized infections
- Preventative measures include
    - Aseptic technique in ER and OR, wound precaution
    - Education of health personnel
    - Handwashing!

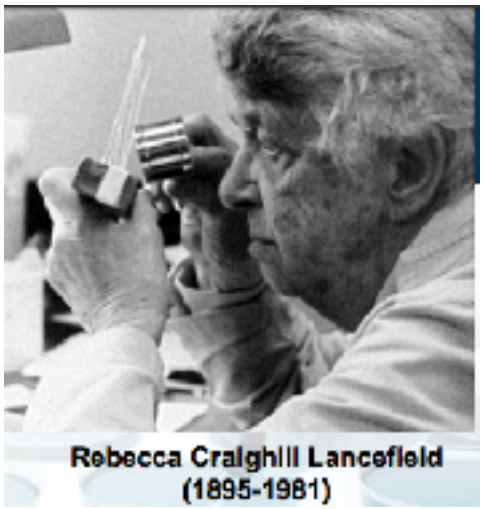
Toxic Shock Syndrome

TSS described in 1978 in Denver to describe illness in 3 boys and 4 girls aged 8-17 years
Rely tampons - made tampons for the whole cycle
- when u leave it to long - staph can be able to grow and produce exotoxins

Staphylococcus epidermidis

- Part of normal skin/mucous membrane flora
- Non-pathogenic, except in compromised patients where can cause post-operative infections (brain, open heart, endocarditis, shunt infections)
- Considered an opportunistic pathogen - when staph goes somewhere its not supposed to (not the outside)

Streptococci


Rebecca Craighill Lancefield
(1895-1981)

- Arranged in pairs or forming chains
- "streptos" - Greek word for twisted (beads on a string)
- subdivided into "groups" based on
    - haemolytic properties (alpha, beta)
    - carboydrate C antigen (Lancefield classification)
    - M-protein
    - divides beta-haemolytic
    - mostly group A

Beta hemolysis - RBC completely destroyed
Alpha hemolysis - RBC partially destroyed
Gama hemolysis - does nothing to RBC

Streptococcus pyogenes

- Group A, beta-hemolytic, S. pyogenes causes:
    - acute tonsillitis (strept throat) – can lead to rheumatic heart disease
    - impetigo, cellulitis, etc. (skin infections)
    - fever and septicaemia
- Caused by toxins (exotoxins)
    - streptolysins (O and S)
        - neutrophils and macrophages
    - streptococcal pyrogenic exotoxins (Spes)
        - scarlet fever rash - red or white tongue
- Enzymes
    - hyaluronidase (helps spreading of bacteria)
        - Acts on hyalorinin - found in connective tissue
    - Virtually all are penicillin G sensitive (vs. S. aureus)!!!
    - Education of health personnel
    - Aseptic obstetric procedures (puerperal fever - aka - doctors plague)
        - Women exposed to bacteria from doctors hands (they didn't wash them back in the day) - and would often die
        - Women started to give birth at home and puerperal fever decreased
    - Early detection and treatment

Flesh-eating disease … aka Necrotizing fasciitis

- Streptococcus pyogenes culprit (strep throat)
    - Group A strep - can lead to dramatic heart disease
- Does not actually “eat” anything
- Exotoxin is responsible for damage
- Research indicates that
    - hijacking human plasminogen from blood, attach to surface and activate it into protease…good for spreading…
    - bacteriophage (virus that effects only a bacteria) has gene encoding for enzyme allowing bacteria to escape entrapment and killing by neutrophils (white blood cells)
- If infected by a bacteria - leads to scarlet disease

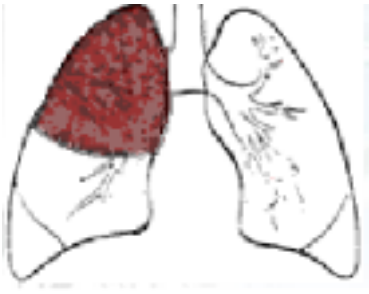
Streptococcus agalactiae

- Group B
- Found in vagina of healthy women (can cause neonatal infections)
    - early septicaemia
        - respiratory distress or shock at birth
        - high fatality rate (serious)
    - delayed meningitic form
        - 1-12 weeks post-partum
        - Sequelae
- Can infect the baby - death, abnormalities, growth development, meningitis

Other Streptococci

- Streptococcus faecalis
    - Group D, aka Enterococcus
    - Part of normal flora of GI-tract
    - Prey on compromised individuals
- Viridens streptococci
    - Found in oral cavity of health individuals
    - Can cause endocarditis in individuals with damaged heart valves

Streptococcus pneumoniae



- Also known as pneumococcus (seen as diplococci)
- Respiratory problems - affects part of your lung
- Polysaccharide capsule has antiphagocytic properties
    - ~90 distinct capsular serotypes
- Found in naso-pharynx of healthy individuals
- Can cause
    - lobar pneumonia
    - meningitis
- Prevention strategies (elderly, alcoholics, crowded living, vaccination….. any condition that affects your immune system)

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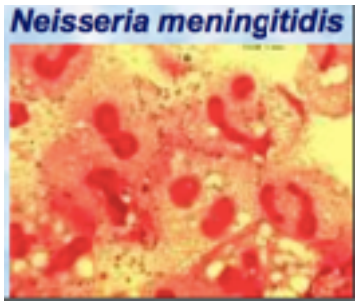
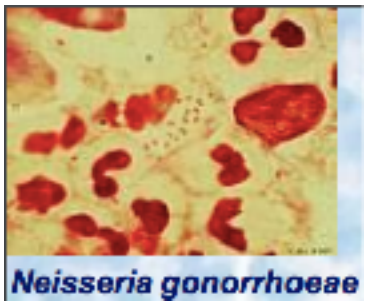
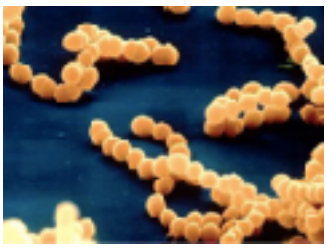
Gram Negative Cocci





Neisseria Meningtidis



- Gram negative diplococci
    - What else is dilococci?
        - Streptococcus pneumoniae
- Laboratory isolation using chocolate agar, 5-10% CO2 , 37 C
    - use selective media (i.e., Thayer-Martin) when isolating from nasopharynx
    - Selective because has things that inhibits gram positive
    - Differential because - allows us to see if gram neg or positive inhibit lactose
- Frequently found in the naso-pharynx of healthy individuals
- Antiphagocytic polysaccharide capsule
    - 13 different serogroups
    - A, B, C, X, Y and W135 most prevalent
- Carriers can occasionally develop infection or pass organism to nonimmune individuals who develop infection
- Only infects humans!!!
    - usually children or those living in crowded living quarters
    - occasional epidemics
- Infection can result in
        - Meningitis - infection or swelling of the meninges
        - Septicaemia (starts as skin rash)
        - Waterhouse-Friderichsen Syndrome (complication of septicaemia…most severe form of septicaemia by N. meningitidis)

Waterhouse-Friderichsen Syndrome

- First described in 1894 by Arthur Francis Voelcker (1861-1946)
- Then in 1901 by the British dermatologist Ernest Gordon Graham Little (1867-1950).
- It was first reported as an entity by Waterhouse in 1911, and the subject was comprehensively reviewed in 1918 by the Danish paediatrician Carl Friderichsen
- So it was called Waterhouse-Friderichsen syndrome…

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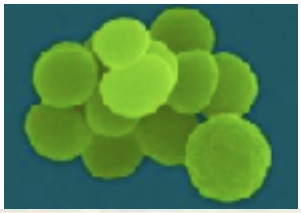
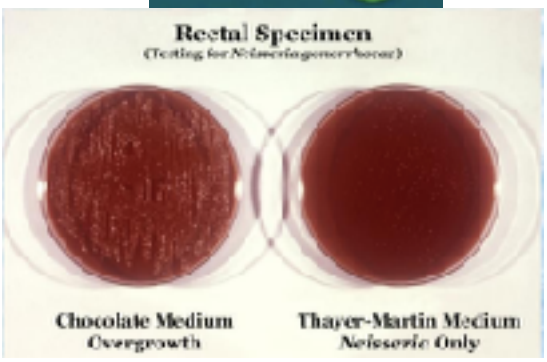
Prevention and Treatment

- Penicillin is primary antibiotic used
- Vaccination is recommended for children (11-12 years), teenagers and college/university students living in dormitories
    - Conjugated vaccine for serogroups A, C, Y and W135
    - Now have meningococcus vaccine for infants at 2-5 months (serogroup C)

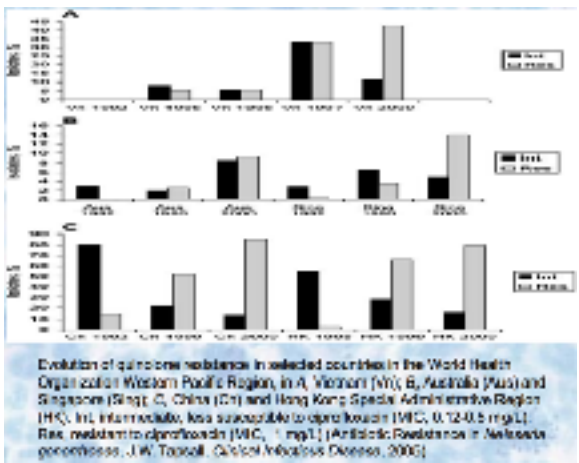


Neisseria gonorrhoeae

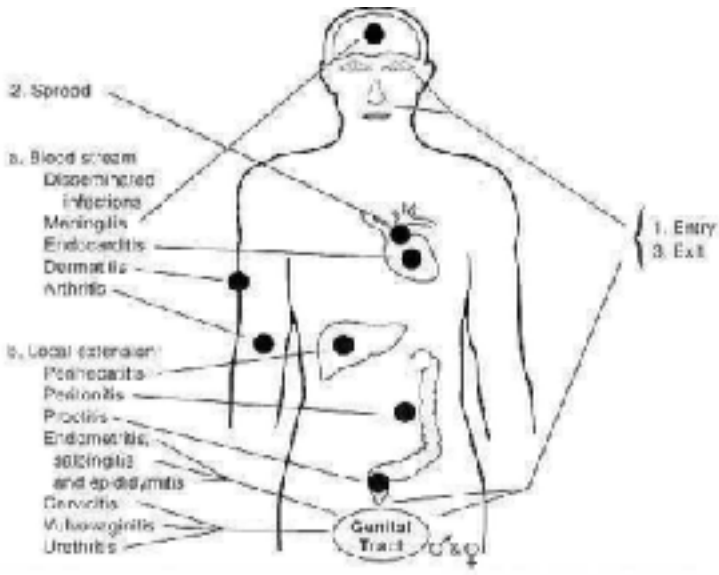
- Gram negative diplococci, 0.6-1µm in diameter
- In a clinical lab, grow on Thayer-Martin plates, in damp environment with CO2 •
    - VERY sensitive to drying and changes in temperature
- Causative agent of STD gonorrhea
- In US, it is the second highest reported STD, after chlamydia
    - >350,000 cases/year reported in the US (2001)
    - Number of cases is now decreasing every year
- Clinical gonorrhea
    - MEN: causes acute infection of urethra (90-95%)
    - WOMEN: 50% are ASYMPTOMATIC!!!
        - More things can go wrong with women then men
        - Cervicitis
        - If untreated can cause PID, sterility



- Disseminated Gonococcal Infection (DGI)
    - 1-3% cases, usually women
    - Fever, skin infection, arthritis
- Neonatal infections
    - Rare, but newborns can acquire infection from mother during birth
    - Causes gonococcal ophthalmia neonatorum (acute purulent conjunctivitis)
        - Put antibacterial eye drops in a newborn
- Diagnosis
    - MEN: use microscopy to directly observe swabs of urethral discharge
    - WOMEN: culture is necessary from endocervical, urethral and anal swabs Urethral smear with intracelllar G-ve diplococci
- Prevention and Treatment
    - Penicillin resistance is emerging (South-East Asia, West Africa, Canada and US)
    - Treat using ceftriaxone, cefixime, ciprofloxacin or ofloxacin combined with doxycycline/ azithromycin
    - Resistance to ciproflaoxacin (quinolones) emerging
    - SIMULTANEOUS treatment of partners is ESSENTI
    - No vaccine available



Evolution of quinolone resistance in selected countries in the World Health Organization Western Pacific Region, in A, Vietnam (Vn); B, Australia (Aus) and Singapore (Sing); C, China (Ch) and Hong Kong Special Administrative Region (HK). Int, intermediate, less susceptible to ciprofloxacin (MIC, 0.12-0.5 mg/L); Res, resistant to ciprofloxacin (MIC, ≥1 mg/L). (Antibiotic Resistance in Neisseria gonorrhoeae. J.W. Tapsall. Clinical Infectious Diseases. 2005)



HSS1100[C] - Microbiology and Immunology

Review/midterm examples

A feature used for lab diagnosis of streptococci is - they are usually arranged in pairs or chains

Which of the following is an example of specific immunity against infection - Isis by killer t cells

The lacefeild groups are used to distinguish what - antigens of streptococci

S epidermis is most commonly associated with boils, pimples, pneumonia and arthritis - False

An endotoxin - the toxic portion of the LPS

endotoxin is liberated when the something dies

A microorganism that can only grow in the complete absence of free oxygen is an - obligate anaerobe

Compare

- endo/exo
- humoral vs cell mediated
- active and passive immunization

HSS1100[C] - Microbiology and Immunology

Lecture 5 - Gram positive bacilli

Review

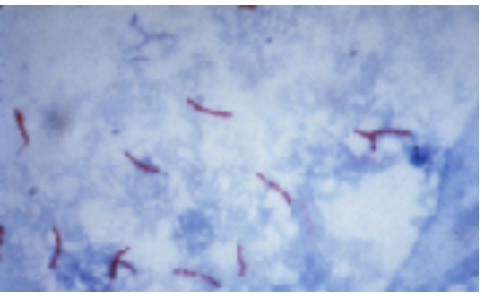
- Gram positive bacilli
  - Two spore formers
  - Two non-spore formers
  - When bacteria is in a spore state, it cannot grow and divide
- Sporeformers:
  - Bacillus species
  - Overuse of antibiotics - C deficyll
  - Tetni - tetanus , has to be a break in the skin for the spore to get inside
- non-spore formers
- Gram positives
  - Listeria - likes colder temperatures
  - Corynebacterium - exotoxin, goes into the blood stream
- non spore formers (gram negative)
- Gram - bacilli (enterics… salmonella, e.coli (hamburger disease and more), enterobacter (old people with strokes, infants, infant power formula??), shigella, vibrio, campylobacter (diahhrea)
- EMB (eosine-methylenee-nlue) and MacConkey agars
  - Includes stuff that doesn't let gram positive grow

- Remember the "non" - enteric (haemophilus influenzae, Legionella (not person to person (shower heads etc)), Bordetella, Helicobacter)

HSS1100[C] - Microbiology and Immunology

Lecture 6 - Mycobacteria

- Causative agents of tuberculosis and leprosy
- Very thick waxy coat as part of its cell wall (very lipid rich)
  - —> NO Gram stain because ^
  - —> Resistant to disinfectants
- Acid-fast bacilli —> Resist decolorisation
- Use Ziehl-Neelsen staining technique



Ziehl-Neelsen Staining Technique (just example)

1. Ziehl-Neelsen carbol fuchsin to the slide for five minutes while applying heat.
2. Follow with a gentle wash with water to cool the slide.
3. Acid alcohol is now added to decolorize the slide.
4. Wash the slide in water again and counterstain with methylene blue for 1-2 minutes

Mycobacterium tuberculosis

- Chronic slow-progressing pulmonary infection; transmission by aerosol droplets
- Obligate aerobe, facultative intracellular parasite (respiratory)
- 4-6 WEEKS to see colonies on a plate
  - Lowenstein-Jensen medium
  - Very slow growing
  - Use microscopy of sputum smears as first line of diagnosis
- Leading cause of death world-wide form a single infection (Bacteriology, Kenneth Todar, 2005)
- Affects 1.7billion/year • Declining in US
- Infection develops in stages

Primary Tuberculosis

Aerosol inhalation

↓

Bacteria multiplication in alveoli

Macrophage ingestion of bacilli and formation of 1o (primary) complex (most of the time ends here) can spread to not be a lung thing

Foci of infection in lungs (may be spread to kidneys, bones, meninges)

- app. 6 weeks

CMI is fully active, infection is stopped (majority of cases)

Some bacilli survive, reactivation several years later

Positive tuberculin test

Mycobacterium tuberculosis

- Post-primary tuberculosis
  - Late reactivation of lesions in lungs, kidneys, bones etc
  - 5% of cases; higher in patients with AIDS
  - Chronic infection

Immunity in Tuberculosis

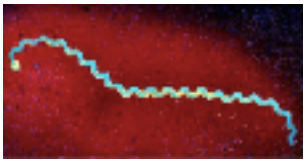
- Cell mediated immunity is most important (T-cells)
- Mantoux test
  - Tuberculin solution (antigen that is for tuberculosis) is injected INTRADERMALLY, wait 48-72 hrs, check for induration (size of the bump), red doesn't mean anything
  - Record diameter of induration
    - >10mm POSITIVE - might just be EXPOSED
    - 5-9 mm Doubtful, maybe cross reaction with other Mycobacteria
    - <4mm NEGATIVE
    - **A positive test does not necessarily mean there is currently an active infection**
      - If the keep putting the antigen in why didn't u get it, —> How they prick ur skin, just under

Atypical Mycobacteria

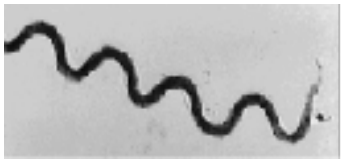
- Occasionally isolated from patients with chronic pulmonary disease
  - indistinguishable from TB
  - M. kansassi, M. avium, M. intracellulare
  - Higher resistance to anti-TB drugs
  - Give "doubtful" Mantoux test (5-9 mm)
- M. marinum: skin infections
- M. fortuitum: soft tissue abscesses
- All these infections are most typically seen in the immune-compromised

Mycobacterium leprae

- Causes leprosy
- 2 kinds
  - Tuberculoid leprosy: visible nerve enlargement, few erythmatous plaques, few bacilli in infected tissues, but many lymphocytes and granulomas; low infectivity
  - Lepromatous leprosy: no visible nerve enlargement, many erythromatous nodules, many bacilli in infected tissue; high infectivity
- Rarely found in developed countries



Spirochetes



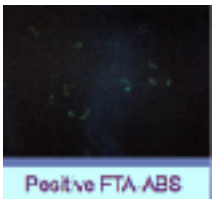
Treponema pallidum

- Causes syphilis
- Gram negative, helical bacteria
- Unculturable in vivo
- Use dark field microscopy (light is prevented, the object you are looking for looks white) (because its very small) ; almost invisible under Gram stain, Geimsa stain and Ziehl-Neelsen

Syphilis

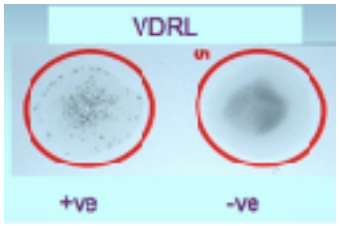
- Happens in stages
- Primary syphilis
  - Appearance of chancre 3-4 weeks after infection
  - Fluid from lesion/ulcer contains bacteria seen under dark-field microscopy

- Secondary syphilis
  - 6 weeks after appearance of chancre
  - Generalized or local rash
  - Mucosal lesions with many treponemes
  - Spontaneous remission may occur after 1 or 2 phase
- Latent syphilis
  - No symptoms of infection
  - Non -transmittable after 4 years
  - BUT congenital infection may occur
- Late syphilis
  - Obliterative endarteritis (arteries fill up)
  - Can involve skin, mucosae, nervous system, cardiovascular system and tissues



Serology Testing

- Non-treponemal tests (VDRL, RPR, Wassermann)
  - Non-specific: use cardiolipin as antigen, put it on a slide, spin and test
  - Screening
  - Positive in early stages
- Treponemal tests
  - Specific: Use treponemal extracts (if positive from non specific test)
  - FTA-ABS: Flourescent Treponemal Antibody Absorption
  - MHA-TP: Microhemagglutination of T.pallidum
  - Used to confirm positive VDRL



Borrelia burgdorferi

- Lyme disease
- Tick bites
- Affects skin, joints, nervous system and heart
- Common in US, rare in Canada (the tick lees and likes the US more)
- Use serology for diagnosis (ELISA)
  - organism is very difficult to see under microscope
  - difficult to culture
  - Serology does not give +ve result in first 2-4 weeks of infection

Lyme disease

- Usually has a Bulls eye rash
- Treatment
  - Doxycycline, amoxicillin, cefuroxime for early disease
  - For neurological and musculoskeletal manifestations, undergo prolonged treatment
- Prevention • Avoid ticks and wear protective clothing in woods (long sleeves and pants)
  - Vaccine available: ospA antigen of organism

Chlamydiae

- Obligate (have to be inside your cells, they cannot make their own ATP) intracellular energy parasites; cocci
  - Can NOT make their own ATP or other energy intermediates
  - Can NOT be grown on artificial media
- Life cycle has 2 forms:
  - Elementary body (300-400 nm)
    - Infectious form

- No growth or replication
- While passing on to another person
- Reticulate body (800-1000 nm)
  - Replication and growth
  - Changes to grow and divide

Chlamydia trachomatis

- STD chlamydia, associated with ghonnerea (probably going to be treated for both)
- Most common STD in Canada and US
- Males: urethritis
- Females: cervicitis
- Many patients are asymptomatic and untreated

Limited diagnostic tools

Untreated male: prostatitis,epididymitis

Untreated female: PID, tubal infertility, ectopic pregnancy, chronic pelvic pain

- 2 biovars: Trachoma and LGV - Dont really need to know
- Trachoma:15 serovars; LGV: 4 serovars - Dont really need to know
- Other infections
  - Trachoma: chronic ocular infection; leading cause of blindness in Middle East, North Africa and South East Asia
  - Conjunctivitis in newborns perinatal transmission
  - Lymphogranuloma venereum: STD from some serotypes of C. trachomatis; endemic in tropical and subtropical countries

Other Chlamydiae

- CHLAMYDIA PNEUMONIAE
  - Respiratory tract infections, mild pneumonia
  - Usually sub-clinical infections
- CHLAMYDIA PSITTACI
  - Bird pathogen
  - Can transmit to humans
  - Pneumonia or endocarditis
  - Can cause problems to our hearts

Mycoplasmas

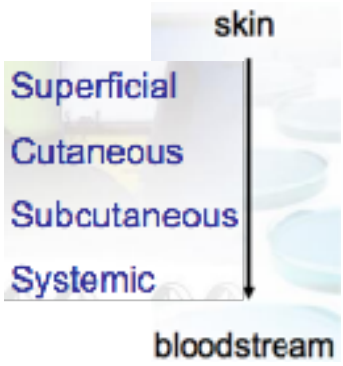
- Smallest free-living bacterium (100-300 nm)
- Saprophytes, part of normal flora of oropharynx and genital tract of humans and animals
- Lack true cell wall
- Some species are pathogenic

- MYCOPLASMA PNEUMONIAE
  - PRIMARY cause of atypical pneumonia (walking pneumonia)
  - More common in younger individuals (15-35 years)
  - RARELY complications lead to meningoencephalitis, myocarditis
  - Diagnosis is usually clinical, no lab confirmation

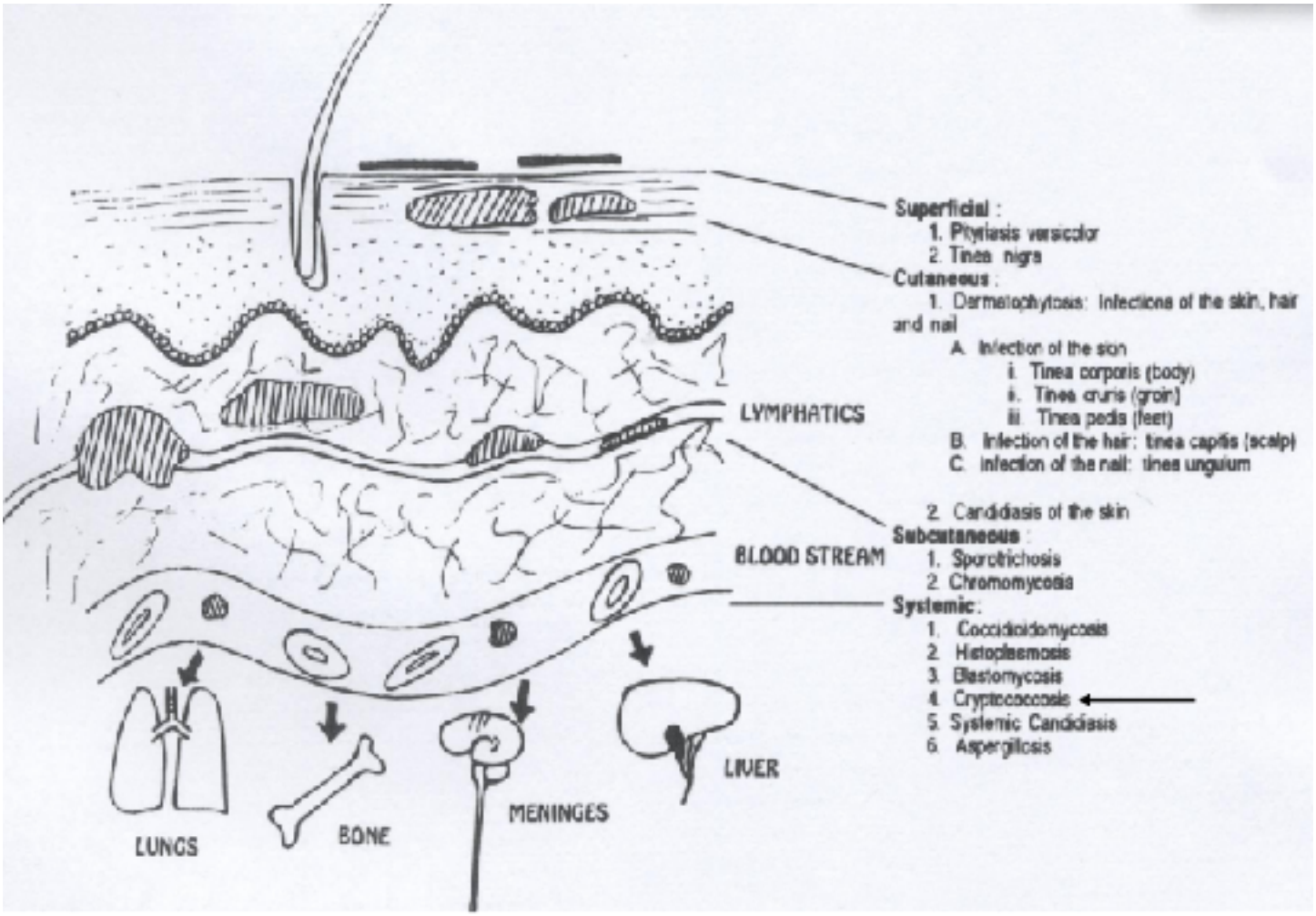
- Treatment: erythromycin or tetracycline

- GENITAL MYCOPLASMA (MYCOPLASMA HOMINIS, UREAPLASMA UREALYTICUM)
  - Part of normal genital flora
  - Rate of colonization increases with number of sexual partners
  - May cause urethritis, epididymitis, pelvic inflammatory disease and postpartum fever
  - ?? Infertility and premature birth ??

Levels (depth) of infection by fungal pathogens



Should know the levels (below)



Aspergillus flavus
Mycotoxin produced = axflatoxin
problem in wheat farmers, can cause disease, grain foods
Athletes foot - you can use vaporub, make sure your feet are dry at all times

Lecture 7 - Cryptosporidium parvum

Parasitism

- Intimate and obligatory symbiotic relationship between two organisms of different species
- Parasite - lives somewhere else
- Parasite is metabolically and physiologically dependent on host
- Short term (mosquito) or permanent (tapeworm)
- Very common way of life (50% of animal species)
- “True parasites” include protozoans (single-celled), helminths (worms), and arthropods (ectoparasites)
- Host: organism which is the home and/or food source for parasite
- Intermediate host: secondary home, like condo in Florida for winter months
- Vector: how parasite gets from host to host

“Success” of parasites defined in terms of:

- prevalence in hosts
- number of host species available
- geographic range
- number of offspring
- available routes of transmission - 2 major (respiratory and ingestion)
  - Factors that help: climate …

Modes of transmission

- person to person (faecal-oral route)
- Water
- Food
- Zoonotic
- Insect vectors
- blood/organ transplant
- Congenital
- Penetration through skin
- Sexual contact

Protazoen parasites

Giardia lamblia (syn. G. duodenalis, G. intestinalis)

HISTORY

• first described by Leeuwenhoek in 1681: “…I have sometimes also seen animalcules a-moving very prettily, their belly which was flatlike, furnisht with sundry little paws…”

- Demonstrated to be a true pathogen in the early 1900’s
- *Most frequently identified intestinal parasite worldwide*

Symptoms – G. lamblia

• Most infections are asymptomatic (carriers)

• acute giardiasis: diarrhea, weight loss, abdominal discomfort, nausea, vomiting

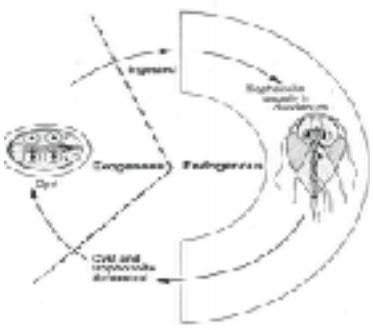
• *retardation of growth and development in young children (failure to thrive) - unique to G.lamblia*

Prevalence - G. lamblia

- most common protozoan infection of intestinal tract worldwide
- 2-5% in industrialized world and 20-30% in developing world;
- prevalence rises through infancy and childhood and declines in adolescence (related to faecal-oral route of transmission)

• Other high risk groups include travelers and immunocompromised

Life cycle – G. lamblia



- excystation
- trophozoites in small intestine
- longitudinal binary fission
- encystation
- cysts shed with faeces

Different antigens in the forms (which antigen to vaccinate?)

Food and water borne ^

Diagnosis – G. lamblia

MICROSCOPY (stool exam)

• cysts concentrated by flotation and identified using bright-field microscopy

• immunofluorecence microscopy using fluorochrome-conjugated mAb's that bind to cyst wall

Immunological Testing

• you can use florescence microscopy

• do not use a light, use a laser (emits a light we can see)

• detection of Giardia-specific antigens in faeces (eg. Direct ELISA)

Treatment

• If nothing in stool, sometimes did "string test" - swallow think tape the string to your cheek, pull it out the next morning

• If you wanted to do an indirect ELISA - takes 10 to 12 days to make antibodies "when did you start showing symptoms? Is he or she having a primary or secondary immune response?"

Treatment– G. lamblia (DNM)

Nitroimidazole derivatives

- metronidazole and tinidazole are the drugs of choice; 2 g (single dose) daily for 3 days NB. drug resistance to metronidazole and furazolidone has been described

Control - Water Treatment

• resistance to chlorination

• fewer outbreaks in municipalities using water filtration

• ozone / UV light promising

• EPA method 1623

Control – G. lamblia

PUBLIC HEALTH EDUCATION

• increase awareness of person-to-person transmission; improve hygienic practices (e.g., daycares)

• food-borne infections (food handlers, wash produce)

• backpackers drinking raw surface water are at risk (portable filters, boil water)

• Advice to travelers (avoid tap water, peeled fruits)

Trichomonas vaginalis

• Possibly the most common sexually transmitted disease worldwide (200 million cases)

• Transmitted through mucous membrane contact (no resistant cyst stage.. that is no enviromental phase)

Trichomonas vaginalis - Symptoms

- 40-50% asymptomatic carriage
- Vaginitis (trichomoniasis) with itching, foul-smelling, sometimes frothy discharge
- May increase susceptibility to cervical cancer and HIV infection
- Infection during pregnancy may result in premature delivery and low birth weight
- Males usually asymptomatic; occasionally urethritis, prostatitis

Trichomonas vaginalis - Diagnosis

Microscopy (wet mounts) to identify trichomonads in vaginal or urethral discharge
Vary greatly in size (10-30μm)

Trichomonas vaginalis - Treatment

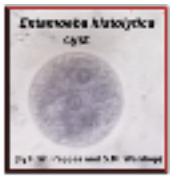
- metronidazole and tinidazole are drugs of choice
- To avoid re-infection, testing and treatment of partners is important

Entamoeba histolytica

- Common in developing tropical countries
- Transmitted through faecal-oral route (person to person), contaminated water, raw produce, food handlers, flies
- Largely related to poor sanitation and hygiene

Entamoeba histolytica - Symptoms

- Typical infections of the large intestine may be asymptomatic, or may result in diarrhea and constipation
- amoebic dysentery in some patients (bloody/mucoid diarrhea)
- May spread through the blood to produce liver, lung or brain abscesses



Entamoeba histolytica - Diagnosis

- Microscopic identification of trophozoites (18-30μm) or cysts in faeces or in lesions

Entamoeba histolytica - Treatment

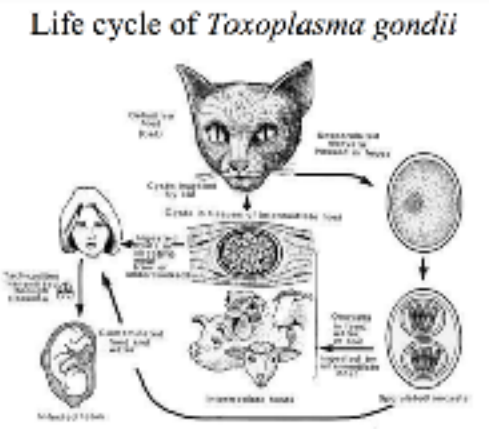
- Luminal amoebicides (such as paromomycin, diloxanide furoate and iodoquinol) act on organisms in the intestinal lumen
- For symptomatic intestinal disease, or extraintestinal infections (e.g., liver abscess), the drugs of choice are metronidazole or tinidazole, immediately followed by treatment with luminal amoebicides

Entamoeba histolytica - Control

- Public health education
- Improved sanitation and water treatment
- Wash fruits and vegetables - if endemic problem, do NOT use tap water as it contains this organism

Toxoplasma gondii

- Recognized as a human pathogen in early 1900's
- Very high seroprevalence in humans worldwide
- Large number of mammals and birds act as intermediate hosts • cats are the only definitive hosts (shed oocysts)
- Cat is good host
- Also found in Raw meats, - cat can bring those from outside



Toxoplasma gondii - Transmission

1. Ingestion of sporulated oocysts (10-12 μm) - contaminated soil/sand - contaminated fruits and vegetables - waterborne outbreaks (Victoria, B.C., 1995)
2. Ingestion of tissue cysts - raw or poorly cooked meat
3. Congenital infection of fetus - infection acquired during pregnancy (most severe if acquired in first trimester)

Symptoms of toxoplasmosis

1. Immunocompetent host 90% asymptomatic, lymphadenopathy, headaches, muscle aches, fever, malaise
2. Immunocompromised host encephalitis, myocarditis, pneumonia (AIDS-defining disease)
3. Congenital infection hepatosplenomegaly, mental retardation, retinochoroiditis, hydrocephalus

Treatment of toxoplasmosis

- Diagnosis based on serological assays
- Immunocompetent patients normally don't require treatment unless symptoms become severe or chronic
- Immunocompromised patients require prompt treatment with a combination of pyrimethamine and sulfadiazine
- Congenital infections: – Mother/fetus can be treated to reduce incidence and severity of fetal infection – Infected newborns can also be treated to minimize sequelae
- Usually Direct ELISA

Precautions

Cats should not be fed raw meat
Should be prevented from catching prey
Considerations during pregnancy

Plasmodium spp. (malaria) - Transmission

- Anopheline mosquitoes (vectors)
- Blood transfusion / shared needles
- Congenital infection
- "Airport malaria"
- Blood transfusion, mother to infant, bite, mosquitoes are able to board airplanes, employees - higher risk of airport malaria

Symptoms of Malaria

- *Spiking* fever and chills
- Flu-like symptoms (myalgias, headaches, abdominal pain, malaise)
- Severe symptoms (P. falciparum) seizures, coma, renal failure, respiratory failure
- Can take unto 8 days to several months for parasite to multiply in liver

Diagnosis of malaria

- Malaria is in the blood cells
- You can do blood smears
- Two people immune - sickle cell anemia, African descent (missing 2 antigens on their red blood cells, the parasite has a harder time getting inside and living in the host)

Malaria prophylaxis and treatments

- Chloroquine and mefloquine are drugs of choice for prevention and treatment
- drug resistance is a serious problem - the parasite itself, as well as the mosquito

Control of Malaria

- Largely a man-made disease (clearing of forests, building of irrigation canals)
- Eradication or control of mosquitoes (resistance to insecticides)
- Protection against mosquito bites
  - Avoid rural areas at night
  - Long-sleeved shirts/long pants
  - Insect repellent
  - Bed netting

Cryptosporidium spp.

- recognized as human pathogen (1976)
- reported in humans worldwide
- The most common symptom of cryptosporidiosis is watery diarrhea; other symptoms include dehydration, weight loss, abdominal pain, fever, nausea, vomiting
- chronic, debilitating, and potentially life-threatening symptoms in immunocompromised
- No drug treatment available! - no vaccine, not many medications that are useful

Life cycle – Cryptosporidium

- complex life cycle including both sexual and asexual phases (oocysts 4-6 μ)
- obligate intracellular protozoan which infects the intestinal epithelial cells of the host (typically in small intestine)

Transmission - Cryptosporidium

WATER

- numerically the most important mode of transmission (contaminated drinking water)
- recently numerous outbreaks associated with water parks/pools

Transmission - C. parvum

PERSON-TO-PERSON

- ingestion of oocysts due to poor hygiene (e.g., day cares, institutionalized patients)

AUTOINFECTION

- thin-walled oocysts are released into the lumen and cause autoinfection
- responsible for chronic and life-threatening disease in immunocompromised

Transmission - C. parvum

ZOONOTIC

- cattle serve as important reservoir hosts
- calves with diarrhea can excrete up to 10^10 oocysts/day
- environmental contamination; veterinary personnel and animal handlers at increased risk (petting zoo visitors)

Diagnosis - C. parvum MICROSCOPY

- oocyst shedding intermittent; multiple stools examined
- concentration methods can be used when low oocyst shedding
- wet-mounts or permanent stains are used (acid-fast)
- Fluorescein-labelled IgG mAb is used in immunofluorescence microscopy
- You can get anti-bodies that are specific
- Parasites (much bigger then bacteria)

Control - Water Treatment

- Watershed management
- Flocculation / Sand filtration
- Resistance to chlorination
- Ozone, UV light
- Water testing (EPA method 1623)

Control - C. parvum

PUBLIC HEALTH EDUCATION

- in endemic areas, avoid drinking tap water/ice cubes, raw fruits and vegetables unless you can peel them
- immunocompromised patients should consider bottled water
- exposure to temperatures above 60°C and below -20°C will kill oocysts
- because crypto is spread person-to-person, handwashing helps prevent infection
- precautions are required when caring for patients with crypto diarrhea; lack of effective disinfectants against oocysts (nosocomial infections)

Cyclospora cayetanensis

- Identified as a coccidian protozoan parasite and named in 1993
- Cases reported in North, Central, South America, Caribbean, S.E. Asia, Europe, UK, India, Africa
- Endemic countries include Nepal, Haiti, Peru, and Guatemala

Cyclosporiasis - Symptoms

- Low infectious dose
- Incubation period approximately 1 week

* *Profuse and prolonged diarrhea*
* Abdominal pain, nausea, vomiting, fatigue, fever, loss of appetite
* Effectively treated with bactrim (trimethoprim-sulfamethoxazole)

Cyclosporiasis - Diagnosis

- microscopic examination of wet mount stool for oocysts (brightfield, differential interference contrast, autofluorescence)
- Autofluorescence on its own
- staining methods (e.g. acid-fast)

Cyclosporiasis - Transmission

- Person-to-person transmission unlikely
- Zoonotic transmission unlikely
- Most earlier outbreaks were waterborne
- 90-99% of cases in U.S. are foodborne • Numerous foodborne outbreaks in recent years

Contamination of Foods

- Direct contamination
  - infected pickers, sorters, inspectors, or other food handlers (poor hygiene, sporulation)
- Indirect contamination
  - contaminated water used for irrigation, mixing pesticides, washing equipment, washing hands - hard to wash berries

Protozoa (uniccellular)

- Guardians
- Trichomonas vaginalis - assymptomatic, most common STI in the world
- Entamoeba histolytica - bloody and mucoid dherria, from water - endemic problem
- Toxoplasma gondii - cats - definitive host, improperly cooked meat, - stay away from cats
- Plasmodium spp. - definitive cause of malaria, in tropical areas bigger population of mosquitoes,
- Cryptosporidium spp. - no vaccine, very little treatment
- Cyclospora

Metazoen Multicellular

- Easier to deal with because they are bigger

Enterobius vermicularis (pinworm)

- Prevalent world wide
- Highest incidence in school-age children
- Up to 50% of children in North America
- More of a nuisance than a health problem (not really an illness)
- Eggs ingested (faecal-oral route)

Pinworm - Symptoms

- Mild infection of caecum/colon
- May cause itching (pruritus ani) leading to disturbed sleep, irritability
- Scratch behind, face, and eat, reinfecting themselves
- Scratching may cause secondary infections
  - itchyness very “diagnostic” characteristic

Pinworm – Diagnosis/Treatment

- Scotch-tape test of perianal area
  - tape between buttcheeks, take off the tape, and put under microscope
- Microscopic identification of eggs; adult female worms may also be present (8-13mm)
- Drug of choice is pyrantel pamoate

Pinworm - Control

- Personal hygiene education for children (wash hands)
- Discourage scratching, nail biting
- Frequent bathing; regular change of underclothing, pajamas, and bedding

Trichinella spp.

- Small roundworm found worldwide in many carnivorous and omnivorous animals, including humans
- Transmitted through ingestion of larvae in raw or poorly cooked meat
- Survives as adult in small intestine; as larvae encysted in striated muscle

Trichinella spiralis (domestic form)

- humans, swine, rats (responsible for endemicity)
- horses! (probably fed animal products as supplement)

T. spiralis adult female

T. spiralis adult m

Trichinella nativa (sylvatic or wild form)

- humans, bears, wild boar, wolf, fox, walrus, etc.

Trichinellosis - Symptoms

- Symptoms dependent upon phase of life cycle
- When larvae excyst in small intestine - diarrhea, abdominal pain, vomiting
- When next generation of larvae migrate into muscle tissues - facial edema, conjunctivitis, fever, myalgias

- Occasional life-threatening manifestations include myocarditis, *central nervous system* involvement, and pneumonitis

Trichinellosis - Treatment

- Thiabendazole effective against intestinal phase
- Mebendazole and albendazole have some effect on tissue phases
- Steroids may be used to reduce inflammation

Trichinellosis - Control

- Rodent control
- Avoid garbage feeding to livestock
- Inspection programs (trichinoscopy, digestion, ELISA)
- Cooking /freezing (T. nativa very resistent to freezing)
- No vaccine
- Direct ELISA - anytime looking for an antigen (Indirect - to look for antibodies)

Ascaris lumbricoides (MOST COMMON)

- Very large intestinal nematode (adult females 20 to 35 cm; adult male 15 to 30 cm) little longer
- High prevalence worldwide (especially warmer regions); most common human helminth infection (over 1 billion cases)

Ascaris lumbricoides - Transmission

- After shedding with the faeces, eggs mature and become infective after several days
- Transmitted through ingestion of eggs in soil, fruits/veg, or water
- Associated with poor sanitation

Ascaris lumbricoides - Symptoms

- Asymptomatic or vague abdominal discomfort
- Vomiting and/or obstruction may occur
- As the worms get bigger, they can cause obstruction - even when treated, need to get rid of whatever is stuck

Ascaris lumbricoides – Diagnosis and Treatment

- Stool examination (microscopy) for the presence of eggs
- Mebendazole, albendazole or pyrantel pamoate
- Surgery may be required to clear worm bolus

Anisakis simplex (whale worm or herring worm)

- Anisakiasis first reported in the Netherlands in the 1950's
- Highly prevalent in Japan (>1000 cases per year)
- Still quite rare in North America
- most cases arise from home-prepared sushi, sashimi, and ceviche - frozen first to get rid of this

Anisakis simplex - hosts

- Definitive hosts - dolphins, porpoises, whales
- First intermediate hosts - marine crustaceans
- Second intermediate hosts - salmon, mackerel, cod, herring, tuna, squid
- NB. Humans are “accidental” or “dead-end” hosts only (once inside cannot leave, ^ we eat all of these)

Anisakiasis

Symptoms

- A. simplex often invasive (penetrates mucosa)
- abdominal pain, nausea, vomiting

Diagnosis / Treatment

• diagnosis difficult – no eggs in stool
• endoscopic and radiologic examinations may be useful
• symptoms often mistaken for appendicitis; exploratory surgery may reveal larvae which are then removed
• drug treatment is not effective

Anisakiasis - Control

• inspection of fillets at processing plant
• candling on a light table will reveal larvae
• cooking / freezing very effective

Diphyllobothrium spp. (Broad fish tapeworm)

• large tapeworm (10 m long)
• Adult tapeworm inhabits the small intestine of humans and other fish-eating mammals
• Larval stages in freshwater fishes (e.g. pike, trout, perch, whitefish, salmon) which act as intermediate hosts
• Transmitted through the consumption of raw or poorly cooked freshwater fish containing infective larvae

Diphyllobothrium spp. - Symptoms

• Most cases are asymptomatic
• Abdominal pain, dizziness, fatigue, vomiting, diarrhea/constipation
• Vitamin B12 deficiency with pernicious anemia

Diphyllobothrium spp. – Diagnosis and Treatment

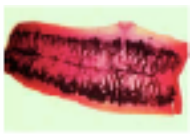
• Stool examination for eggs (microscopy) or proglottids (segments)
• Anthelmintic drugs effective (Praziquantel)

Taenia spp.

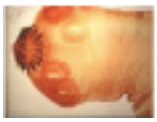
• Large tapeworms (up to 20 m in length)
• Adult stage only found in humans
• Transmitted through ingestion of larvae in raw or poorly cooked meat

Taenia saginata – beef tapeworm


scolex


Gravid proglottid

Taenia solium – pork tapeworm



Taenia spp.

Symptoms (adult tapeworm)
- mild abdominal complaints

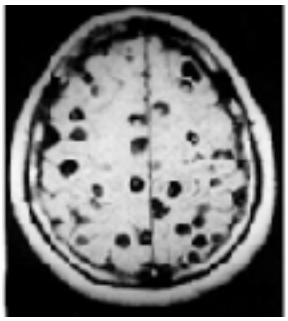
Diagnosis
- Eggs or proglottids in stool
- Serological techniques

Treatment
- Anthelmintic drugs (Praziquantel)
- surgery

T. solium neurocysticercosis

• Infection with larval stage following ingestion of T. solium eggs (humans act as the intermediate host)
• Larvae migrate and develop in brain
• intracranial hypertension, hydrocephalus, convulsive seizures

> black dots are larvae


MRI of patient with neurocysticercosis

Control – Taenia spp.

- Both species are rare in Canada
- Routine inspections in Canada by CFIA
- Cooking meat readily kills larvae
- In endemic countries - sanitation; prevent access of pigs to human faeces

Schistosoma spp. (Blood flukes)

- Worldwide, 200-300 million cases
- Free-swimming larvae in fresh water penetrate skin and develop in blood vessels surrounding intestine or bladder
- Three main species: S. haematobium, S. japonicum, and S. mansoni

Symptoms of schistosomiasis

- rare except in heavily infected individuals
- Rash, itchiness from penetrating larvae (swimmers itch)
- fever, lymphadenopathy, hepatosplenomegaly

Diagnosis of schistosomiasis

- Microscopic examination for eggs in faeces or urine
- Treated with praziquantel

Schistosomiasis - Control

- Eliminate habitat for snails which act as intermediate hosts (e.g. drainage channels)
- Spraying with molluscicides
- Improved sanitation
- Avoid contact with fresh water in endemic areas

TAPEWORM DIET - alternative

- not tapeworms (taenia), but whipworm (trichuris)
  - usually dies within 2 weeks inside us
  - human versus pig whipworm
- hookworms also looked at…
- chrohn's disease, irritable bowel, allergic and autoimmune

Schistosomiasis - Is the second most socioeconomically devastating disease after

HSS1100[C] - Microbiology and Immunology

Should be able to associate parasite with at least one mode of
Key features to think about
• How do we get parasites?

Cold sore - virus
No cure/vaccine.. 1in 5 people affected each year

Canker sore

Lyme disease
Spirochete
Carried by lodes tick (deer tick)

What causes ringworm
Tine corpris

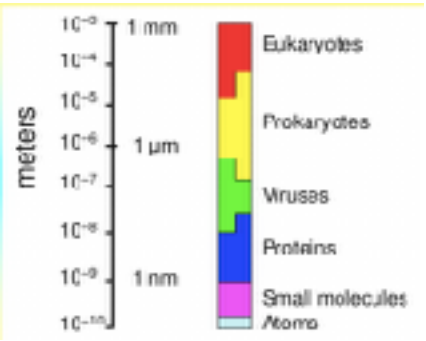
Bullseye rash - raised red, itchy and painful

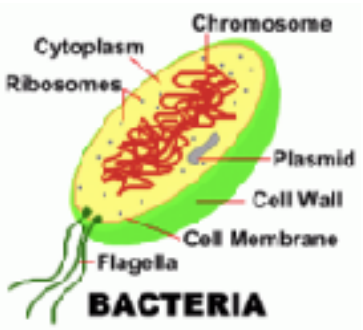
HSS1100[C] - Microbiology and Immunology

Lecture 8 - Viruses

General Characteristics

- Require LIVING cells for growth and replication (cell cultures, embryonated eggs, living animals/plants)
- Need cell culture in order to grow
- Have DNA or RNA…NEVER both!
- Multiply by separate synthesis of nucleic acid and protein, combine to form virus particles
- Size varies from 10 nm-300 nm

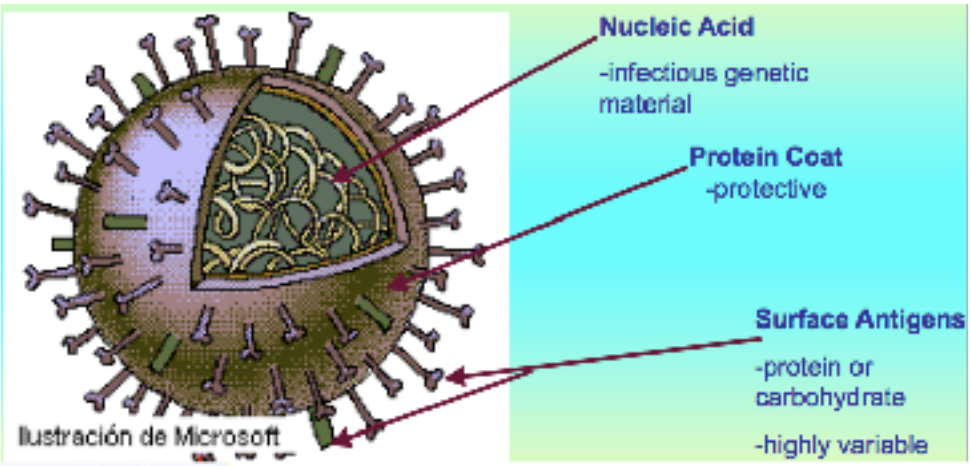




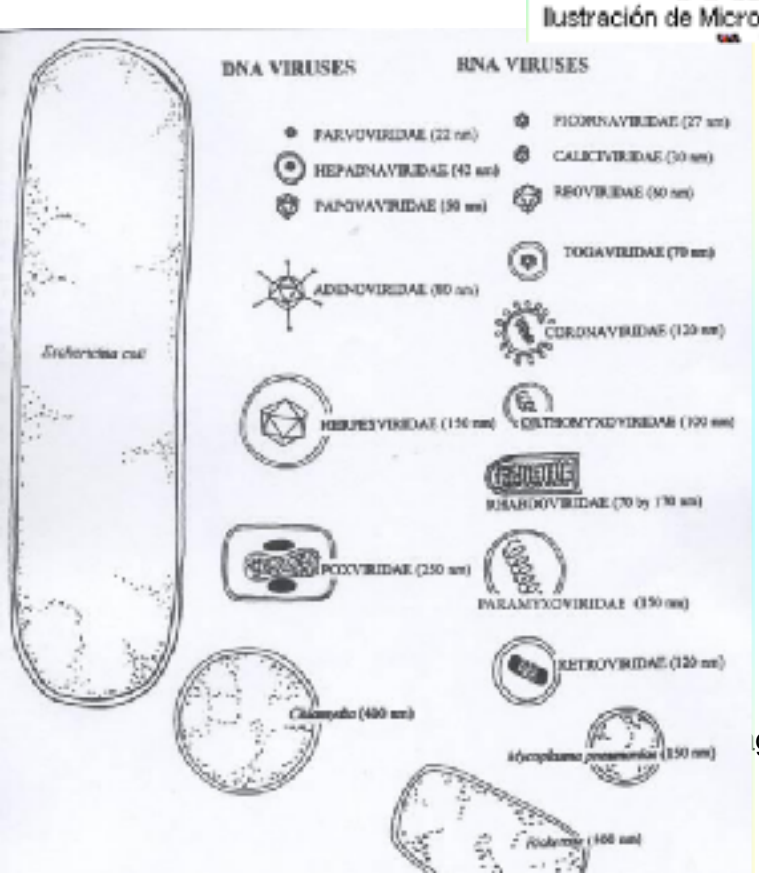
What are viruses made of?

Nucleic acid covered by coat
^ protein (most the time called caspid

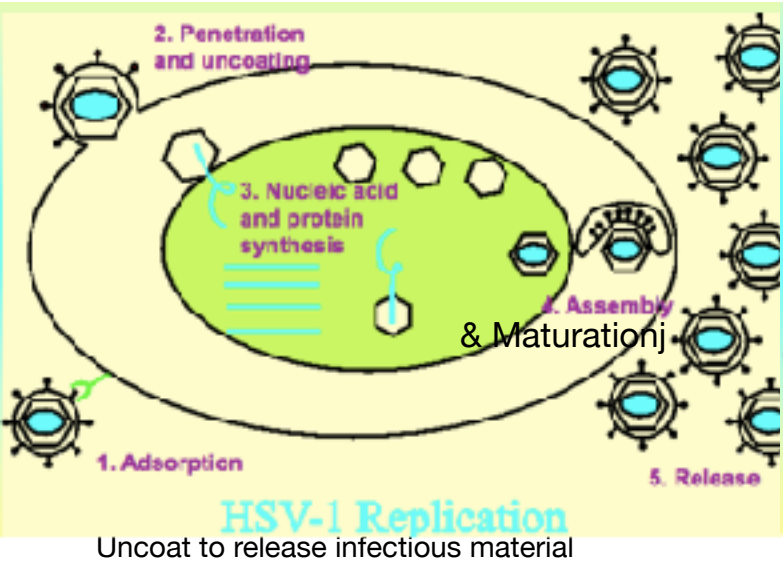
Basic components —>



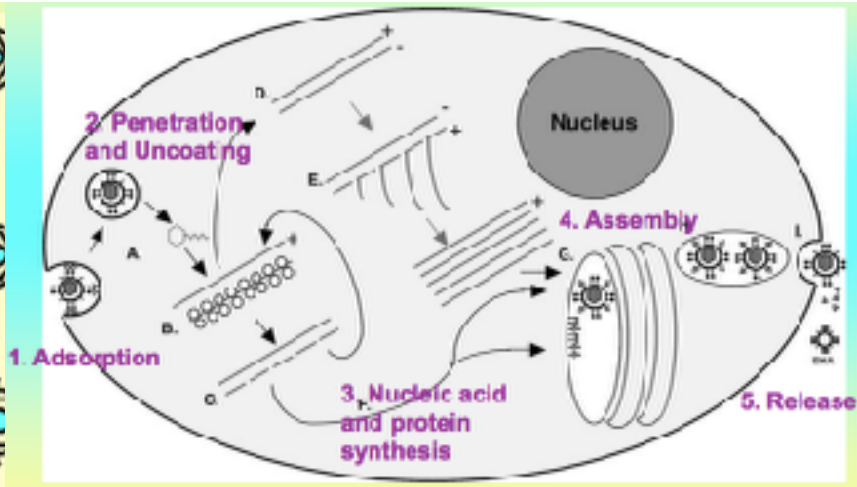
Common cold is good example



Replication



HSV-1 Replication



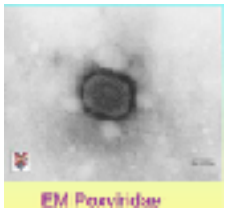
West Nile Virus Replication

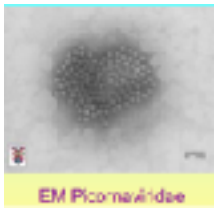
Uncoat to release infectious material
Nucleied acid - make more
Assembley and maturation
Release

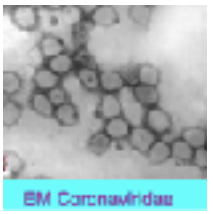
How do we detect viral infections?

1. Detect the virus itself!
   Direct Elisa - look for specific antigen
2. Detect the immune response…antibodies against the virus!

Viral Diagnosis

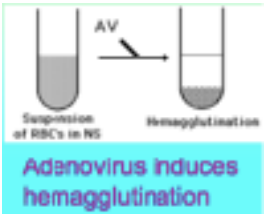

EM Poxviridae


EM Picornaviridae

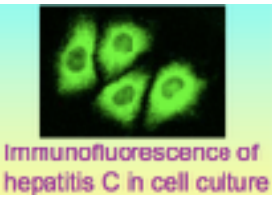

EM Coronaviridae

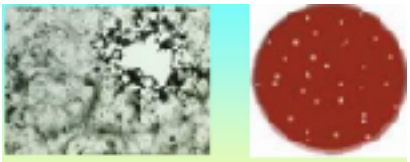
- A. Detection in clinical specimens
  - 1. Visualisation by Electron microscopy

- A. Detection in clinical specimens
  - 2. Cell culture (cytopathic effects, hemagglutination, immunofluorescence)
  - Takes advantage of the 2 ways the virus leaves the cell
  - Release can happen in 2 ways
    - Blow up
    - Cell can stay intact and pump out virus parts



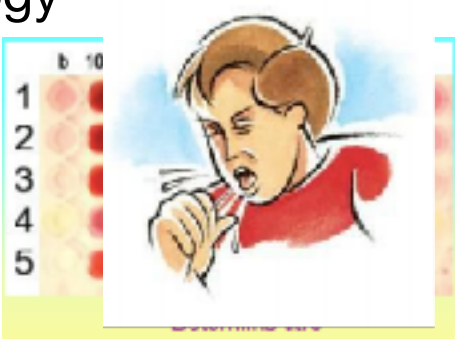
Adenovirus induces hemagglutination


Immunofluorescence of hepatitis C in cell culture


Cytopathic effect of herpes simplex virus

White is called plaques - the amount of viruses in the culture (per ml of blood or whatever u measure)

Adenovirus - clumps red blood cells



- B. Detection of patient's immune responses
  - Antibody detection, presence or absence (ELISA)
    - IMMUNITY TEST (do you have the antibodies)
  - Rise in antibody titre or high antibody titre
    - DIAGNOSTIC TEST (how much antibodies you make)

What types of viruses will we learn about?

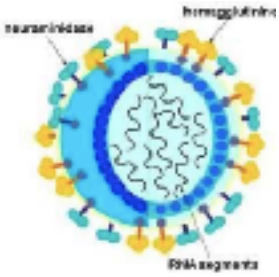
1. Viruses of the breathing
2. Enteric viruses
3. Viruses of diarrhea
4. Viruses of the rashes

Respiratory Viruses

- Respiratory disease

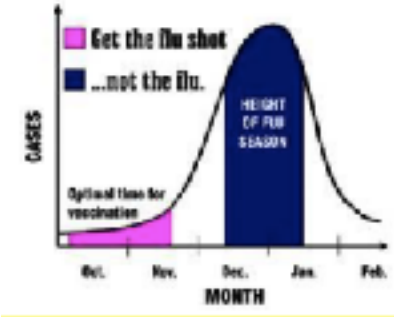
* Different families
  1. Influenza viruses
  2. Parainfluenza viruses
  3. Respiratory syncytial viruses
  4. Rhinoviruses
  5. Adenoviruses
  6. Echoviruses, coxsackie viruses, herpes viruses (occasional respiratory tract infection)

Influenza Viruses (flu)



- Influenza virus type A: major epidemics
- Influenza virus type B: milder disease
- Produce haemagglutinin (diagnostic)
- Frequent recombination
  = High antigenic variability
  = Pandemics
- surface antigens change all the time - thats why we vaccinate every year

Influenza Viruses



- Clinical:
  – fever, variable respiratory symptoms
  – Infants and elderly more susceptible
- Diagnosis:
  – Throat washings, naso-pharyngeal aspirate inoculated into cell culture
    - lung cell culture is used
- Serum:
  – Paired sera (acute and convalescent stage)
- Prevention:
  – Annual vaccination especially for high risk groups

You CANNOT get the flu from the flu shot … because the vaccine is dead
Stomach flu does NOT exist
People are closer to others indoors in the winter - why you get the flu
Feed a cold and flu - drink a lot of water and eat

Herbal treatments are not effective - placebo effect is strong

NA and HA serology:
• H1n1
- Spanish flu (blames the Spanish for the flu … spain was never in the war)
• H5n1
- Bird flu, pathogen that can cross species barrier

Worldwide influenza pandemic The WHO Pandemic response and planning is a direct reflection of disease SPREAD and not of disease SEVERITY

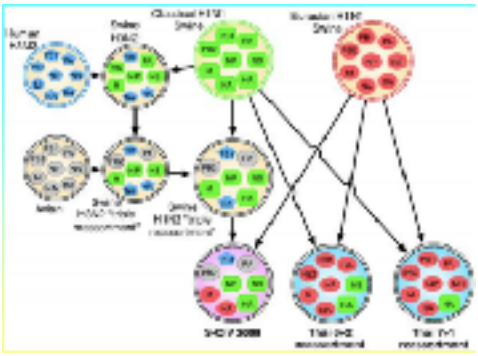
25 April 2009 : Pandemic phase 3. Surveillance for flu should be intensified
27 April 2009 Pandemic phase 4. The likelihood of a pandemic has increased
29 April 2009 : Pandemic phase 5. Countries activate pandemic plans
11 June 2009 : Pandemic phase 6.

What about disease severity?

- Greater disease burden in <25 yrs than in >65 yrs
  – Unusual for seasonal flu
- Certain groups have risk of complications
  – Pregnant women, asthma, diabetes, immune suppression, heart disease, kidney disease
  – Same as for seasonal flu

What does the virus look like?

- Has been termed “swine” flu
- Influenza genome has 8 segments
- 2009 H1N1 segments
  – 3 from classical swine
  – 2 from Asian swine
  – 2 from avian
  – 1 from human - from 8 fragments one has to be human



H1N1 2009 vaccine

- Vaccination is major effort of PHAC to fight pandemic flu
- Canada has a dedicated vaccine manufacturer
- Adjuvanted vs. unadjuvanted vaccine
  – Why adjuvant?
    - To reduce the amount of vaccine protein per dose
    - I dont need as much antigen, can make more vaccine, and its cheaper
  – Why new adjuvant?
    - Existing adjuvants have never worked well for flu shots
  – Why controversial?
    - Little data on adjuvant in children, pregnant women
    - New adjuvant had not been used in other vaccines

Parainfluenza viruses

• Infants and young children
• Respiratory infection that could have serious complications
• Croup (barking cough, high pitch sound on inhalation)

HSS1100[C] - Microbiology and Immunology

- Bronchiolitis, bronchopneumonia
- No vaccine

Respiratory syncytial virus

- Major respiratory pathogen for children < 2years - RSV
- Pneumonia and bronchiolitis; occasionally fatal
- Epidemics
- No vaccine
- Antiviral (antibiotic): Ribavizine

Rhinovirus (cold)

- Common colds
- > 100 serotypes; no cross-immunity
- Repeated infections
- Surface antigens change all the time

Difference between flu
- headache
- fatigue
- flu

Flu vs. Colds: A Guide to Symptoms

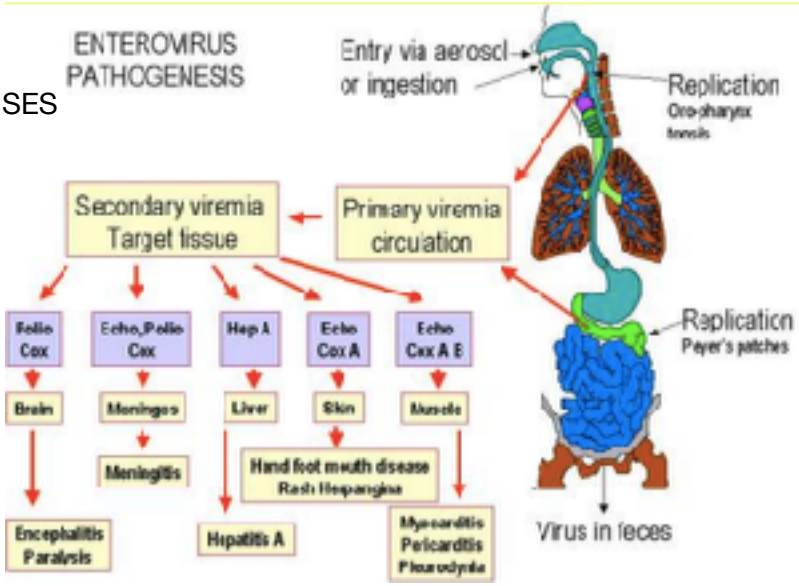
Questions	Flu	Cold
Was your child's onset of illness ...	sudden?	slow?
Does your child have a ...	high fever?	no (or mild) fever?
Is your child's exhaustion level ...	severe?	mild?
Is your child's head ...	achy?	headache-free?
Is your child's appetite ...	decreased?	normal?
Are your child's muscles ...	achy?	fine?
		no chills?

Symptoms	Cold	Flu
Fever	Rare	Usual; high (100°F to 102°F; occasionally higher, especially in young children); lasts 3 to 4 days
Headache	Rare	Common
General Aches, Pains	Slight	Usual; often severe
Fatigue, Weakness	Sometimes	Usual; can last up to 2 to 3 weeks
Extreme Exhaustion	Never	Usual; at the beginning of the illness
Stuffy Nose	Common	Sometimes
Sneezing	Usual	Sometimes
Sore Throat	Common	Sometimes
Chest Discomfort, Cough	Mild to moderate; hacking cough	Common; can become severe
Treatment	Antihistamines Decongestant Nonsteroidal anti-inflammatory medicines	Antiviral medicines—see your doctor
Prevention	Wash your hands often Avoid close contact with anyone with a cold	Annual vaccination; antiviral medicines—see your doctor
Complications	Sinus congestion Middle ear infection Asthma	Bronchitis, pneumonia; can be life threatening

Adenovirus (resp virus)

- Pharyngitis and conjunctivitis; pneumonia in young children
- Children most commonly infected
- Asymptomatic infection common
- *Vaccines used in army*

ENTERIC VIRUSES



- Enterovirus = Enteric virus
- Infect intestinal / lymphoid cells
- Poliovirus, coxsackievirus, echovirus
- Multiply in GI tract, but RARELY cause gastroenteritis
- Infection via respiratory or GI tract
- Spread to other target organs in body
- 95% inapparent infection, 4-5% minor illness, 1% serious illness

Poliovirus

- Humans are the ONLY natural host
- Types 1, 2 and 3
- Causes poliomyelitis *(central nervous system disease)*
  - Highly infectious, invades the host nervous system and can cause total paralysis in as little as a few hours
- Global Polio Eradication Initiative
  - Launched in 1988 by WHO, goal was to eliminate poliovirus in the same manner as smallpox was eliminated
  - Since 1988, number of cases has decreased by ~99% (from > 350,000 cases in 1988 to 1997 cases in 2005)
  - Currently polio is only found in parts of Africa and South Asia (Nigeria, India, Pakistan, Afghanistan)

Poliovirus Diagnosis

- Isolation from stool samples (up to 5-6 weeks after infection), CSF and pericardial fluid
- Serology: acute and convalescent phases

* Some people are asymptomatic carriers. Carriers with inapparent infection are able to spread the disease to susceptible individuals*

Polio Prevention

- VACCINATION

– Salk vaccine (Jonas Salk)
  - Killed/inactivated vaccine; does not produce local immunity in GI of host (IgA); Virus can still colonize host GI tract and SPREAD to the community!!!
  - used for immunocompromised (can protect the patient but not others)

– Sabin vaccine (most common; Albert Sabin)
  - Live attenuated; host will produce IgA and IgG, so is protected against intestinal colonization and virus can NOT replicate and spread (patient protected and stops replication)
  - Oral administration

Coxsackieviruses

- Groups A and B —>
- Seasonal variation
- Diagnosis by stool sample and paired sera (same as polio) —>
- NO VACCINE

	Group A	Group B
Minor Respiratory Illness		√
Aseptic Meningitis	√	√
Herpangina and hand-foot-and-mouth disease	√	
Pleurodynia, pericarditis and myocarditis		√

Echoviruses (dont study)

- Several types
- Enteric Cytopathogenic Human Orphan viruses —>
- Minor respiratory illness
- Aseptic meningitis
- Same diagnosis as coxsackie and polioviruses
- NO VACCINE

Viruses of Diarrhea

- ROTAVIRUS
  - – Epidemics in infants (6 months-2yrs); mainly in winter
  - - Usually under 18
  - – Replication in small intestine
  - – Acute gastroenteritis vomiting, diarrhea, fever
  - – Highly infectious!!!

Rotavirus

- Diagnosis
  - – EM or immunological testing of virus from stool samples (within 3 days)
- Epidemiology
  - – Short incubation (2-3days)
  - – Fecal-oral route, aerosols (explosive diarrhea), fomites
  - – Outbreaks in daycare centres, children's hospitals
- Prevention
  - – Rapid diagnosis and isolation of patient
  - – Proper handwashing
  - – To vaccinate or not to vaccinate?

Norovirus

- Outbreaks of gastroenteritis in older children and adults
- Survives really well on intimate objects
- Diagnosis: first exclude bacterial cause, then can be differentiated from bacterial gastroenteritis
- Epidemiology: VERY CONTAGIOUS; survives well on objects/environment
  - – Fecal-oral route; food-borne outbreaks
- Prevention: no vaccine; handwashing and isolation of infected individuals

Viruses Causing Rashes

- Common epidemiological features of viruses causing rashes:
  - – Humans are the only reservoir
  - – Highly contagious!

Viruses Causing Rashes

• Measles
• Rubella (German measles)
• Varicella (chickenpox)
• Herpes simplex (HSV)
• Papilloma virus

Measles

• One of the highest infectivity rates
• Clinical: rash first appears behind ears, forehead and nostrils then spreads to whole body; BLOTCHY appearance - eventually turns brown
• Lifelong immunity after natural infection
• Complications: secondary bacterial infections, e.g., bronchopneumonia
    – Encephalitis (rare)
    – Exacerbation of TB and leukemia

Measles cont.

• Diagnosis:
    – Serological
    – Confirmation of Suspected Case:
        • IgM Ab in single blood specimen against measles OR a rising IgG Ab titer against measles in paired blood
    – Immune status
        • Circulating measles specific Ab IgG
• Prevention
    – Immunoglobulin: can suppress disease if given within 5 days of contact with virus
    – Live attenuated vaccine: very effective, widely used. Administer after 12 months of age
        • MMR (measles mumps rubella)

Rubella

(German Measles; 3-day measles (rash lasts about 3 days))

• *VERY dangerous for non-immune pregnant women*
    birth defects
• Largest danger is in first trimester
    – 50% chance of damage to the fetus if non-immune mother is infected between 0-4 weeks
• Birth defects:
    – General: abortion, death of newborn
    – Localized:
        cataracts (infection during 6th week)
        deafness (infection during 9th week)
        heart defects (infection during 5th-10th week)
        Other: low birth weight, cleft palate, mental deficiency

Rubella cont.

• Clinical: similar to measles but milder; lifelong immunity
• Epidemiology and Immunity: pre-vaccine era, seen in school children during winter in spring, outbreaks every 7-10 years, lead to life-long immunity
    – Now most cases (60%) are seen in those 15 years and older

Rubella cont.

• Lab Diagnosis:
  – Suspected cases: detection of rubella specific IgM or rising Ab titer in paired sera
  – Immunity status: detection of circulating Rubella Ab (IgG)
• Prevention of congenital rubella:
  – Check immune status of women of childbearing age
  – Diagnosis in hospitals
  – Rubella serology screening of men and women starting work in hospitals
  – Vaccination of non-immune
  – Isolation of rubella cases in hospitals
• Vaccination-live attenuated vaccine
  – Do NOT give vaccine to women who are already pregnant!

Varicella

• Chickenpox: Varicella Zoster Virus (VZV)
• Clinical: childhood febrile illness with characteristic rash
  – Successive crops of fresh vesicles appear within 3- 4 days of onset
  – In non-immune adults, occasional pneumonia, may be fatal
• Herpes Zoster (Shingles)
  – LIMITED rash, along trajectory of ONE nerve
  – Late recurrence of latent VZV (chicken pox) infection
• Diagnosis: ID of virus particles in pustules by EM or immuno methods, followed by cell culture
• Prevention: vaccine; detection of susceptible persons by serological methods

Herpes Simplex Virus (HSV)

• Widespread
• Become LATENT after initial infection; lesions reappear periodically
• High percentage of inapparent infections
• Epidemiology:
  – *HSV1: “cold sores” oral and ocular lesions; transmitted via oral and respiratory secretions*
  – *HSV2: “herpes genitalis” associated with genital tract; infected females can transmit to the newborn* •

Diagnosis: ID of virus particles by EM or immuno methods; cell cultures; Serology NOT useful

HSV cont.

• Clinical forms (other than cold sores):
  – Genital infections: recurrent in both sexes
  – Herpetic encephalitis: RARE (see CNS viruses)
  – Neonatal Herpes: acquired during birth from asymptomatic mother; difficult to prevent; can result in death or severe sequelae (see CNS viruses)
  – Herpetic Whitlow: affects fingers, occupational hazard of health care workers; nosocomial infections in neonates
  – Corneal and Conjunctival Infection: can cause ulceration of cornea and blindness
• Treatment and Prevention: antivirals; C-section for symptomatic mothers; Vaccines coming soon

Papilloma Viruses (family of viruses)

- Cause different types of warts
  - Common warts on hands and feet
  - Genital warts: sexual transmission, asymptomatic carriers
  - Some types associated with cancer: cervix, vulva, penis
- Diagnosis: immuno techniques and DNA hybridization techniques; no cell cultures available
- Prevention: Vaccine now available (Gardasil)

Next week… 1. Viruses of the glands 2. Viruses of the liver 3. Viruses of the brain 4. Viruses of the immune system…aka…HIV

Never give aspirin to a child who has chicken pox - you can get reye syndrome
Agression - fever etc,
Always treat like its a virus

Tb - how to we get it, resp and ingestion

What types of viruses?

1. Viruses of breathing,
    1. Influenza (hard to make vaccine, annual flu shot) (different kinds),
    2. Para influx (croup)
    3. RSV (<2years)
    4. Rhino (common cold
    5. Adeno (army people need vaccine)
2. Enteric
        1. what is bizarre and unique about them
        2. poliovirus (salk versus sabin vaccine)
        3. Coxsackie (don't need to know diff between type a and type b, causes devils grip, hand foot and mouth disease)
        4. Echo (just to know there enteric)
3. Viruses of diarrhea
        1. Rota virus (6m - 2y)
        2. Norovirus (older children - adutls)
4. Viruses of the rashes
        humans only reservoir, highly contagious
        measles (extremely contagious, rash starts behind the ears, look for spots in mouth ___ name) VS German measles
        varicella (chicken pox, shingles)
        HSV (type 1 versus type 2)
        papilloma virus

Review

1. What is viral life cycle
    1. Adsorption, penetration to release genetic material, nucleic acid and protein synthesis, assembly and maturation
2. How do we detect them
        1. Direct detection (em, cell culture Hema, Elisa) (immunofloresence?)
        2.inderect detection (patient immune response)
            - immunity test (famous yes/no to antibody)
            - diagnostic test (how much, or titre)

What happens when vaccine. Clumps?

Lecture 9 - Viruses PART TWO

Viruses Causing Glandular Enlargement

• MUMPS
  – Childhood disease; *bilateral inflammation of parotid glands*; many inapparent infections, swollen appearance, (outbreak, in uni, around st patty, why not on spring break ? Stored better)
  – Complications: meningitis, orchitis (can lead to sterility), ovaritis
  – Epidemiology: spread by salivary and respiratory secretions; incubation 18-21 days
  – Prevention: MMR vaccine (live, attenuated)

Infectious Mononucleosis (Epstein-Barr Virus)

• Belongs to Herpes virus family
• Mild disease; children and young adults; can be prolonged and debilitating
• Transmission by saliva (kissing disease)
• Symptoms: lymphadenopathy, fever, sore throat, atypical lymphocytes, enlargement of liver and spleen LYMPH NODES
• Latent virus
  – Chronic disease (rare) or asymptomatic shedding (common) for lifetime of host
• Diagnosis: blood picture (in atypical lymphocytes) Monospot Test (detects RBC agglutination (if u make antibodies against ebv, then I can measure that, u can use a horses rbc and see it clump) Presence of EBV antigens
• NO VACCINE

Cytomegalovirus (CMV)

• Herpes family, infection usually asymptomatic and latent BUT dangerous for
  – Pregnant women: neonatal infection with jaundice, enlarged liver and spleen, mental retardation and motor disorders
  – *Transplant patients:* disseminated infection can cause transplant rejection
    positive liver and - person infects them, negative person and + liver = rejection
  – AIDS and other immunocompromised patients: frequent infection, GI tract ulceration and retinitis
• Diagnosis:
  – Isolation of virus from urine, blood, organ biopsies (slow process, but accurate)
  – CMV antigen detection, DNA hybridization and PCR in leucocytes much faster
  – Serology screening for donors and recipients before transplant
• Treatment: antivirals
• Prevention (immunocompromised):
  – Match CMV immune status between donor and recipient in transplants
  – Preventative administration of antivirals
  – Universal precautions to prevent transmission
  – NO VACCINE

Hepatitis Viruses

• Hepatitis = Inflammation of the liver
  – Malaise, fatigue, nausea, loss of appetite and jaundice
• Hep A, B most common and well characterized
  – Hep C, E, G less common
• *Other viruses and bacteria can cause hepatitis as a complication of infection*
• Diagnosis: serological

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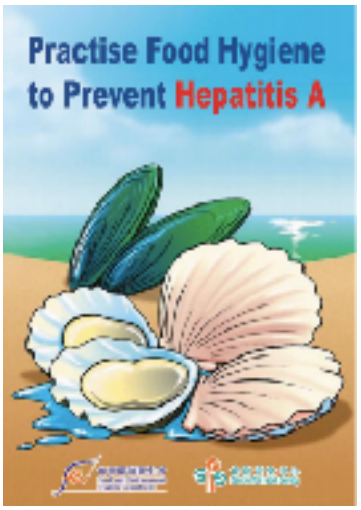
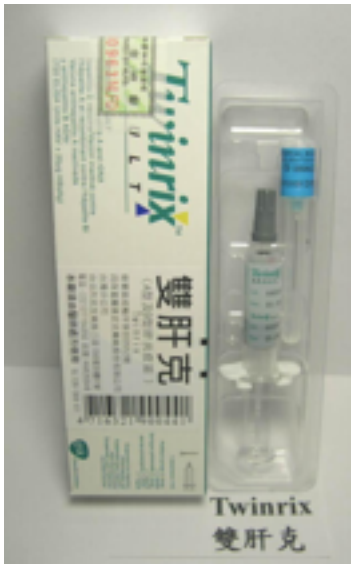
Need to know - is it blood or food borne????? And the usual . . .

Hepatitis A



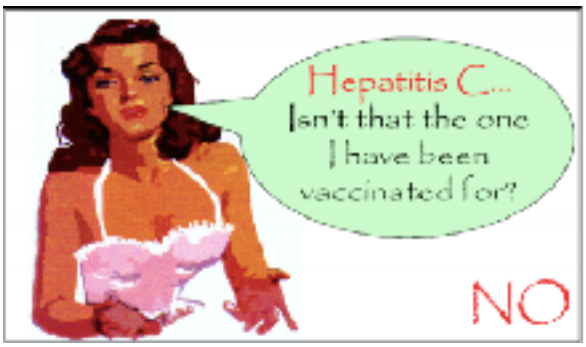
- Mainly children and young adults
- Sporadic cases and small epidemics
- Epidemiology:
  - Transmission by *fecal-oral r*oute
  - Incubation 15-50 days
  - Stools infectious 2-3 weeks before onset
  - Mild or inapparent infection in children
  - No chronic hepatitis
  - Life-long immunity
- Diagnosis:
  - Suspected clinical cases: detection of IgM
  - Immunity: detection of IgG (before travel)
- Prevention:
  - Vaccine for high risk populations
  - Commercial γ-globulin for prevention after exposure
- the blessness of Canada makes it less likely to get as a kid, but more as an adult when vacationing

Hepatitis B



- Sporadic cases; all ages
- Epidemiology:
  - Contaminated *blood*/blood products; saliva, urine, semen
  - Avg. incubation 90 days
  - Infective serum 30-60 days before onset of symptoms
  - Carriers
  - in liver?
- Clinical
  - More severe than HepA
  - Chronic hepatitis and chronic carrier-state
- Diagnosis:
  - Blood test for HepB surface antigen (HBsAg)
  - Antibodies are produced several months after onset of symptoms
- Used as markers of infection and immunity
- Prevention
  - Universal precautions for blood and body fluids
  - Proper handling of needles
  - Screening
  - Vaccination
  - HepB immunglobulins after exposure
  - HepB carriers
  - trinrix - good for hep A and B (3 needles 2 are boosters?)

Hepatitis C



- Epidemiology:
  - Blood and sexual transmission
  - Initially mild disease but can cause chronic hepatitis
- Diagnosis:
  - Serological
- Prevention:
  - Same as HepB
  - Treatment/cure?
    - Epclusa (sofosbuvir-velpatasvir) :) (expensive $$, need to be at a certain stage)

Hepatitis Delta Agent

- Epidemiology:
  - Blood and sexual transmission
  - "*Viroid*"-relies on HepB presence for replication in cells , needs hep B or doesn't cause problems
  - Increases severity of HepB infection
- Diagnosis:
  - Serological
- Prevention:
  - Vaccination against HepB

Hepatitis E

- Transmission via fecal-oral route
- Incubation 15-50 days
- Symptoms similar to HepA BUT 20% mortality in *pregnant women*
- Endemic in India, Pakistan, Nepal, Burma, North Africa and Mexico

Hepatitis G (NOT INCLUDED)

- Epidemiology:
  - Blood and sexual transmission
  - Incubation 14-180 days
  - Initially mild and no jaundice, can cause chronic hepatitis
- Diagnosis:
  - Detection of viral DNA by PCR or other molecular methods
- Prevention:
  - NO VACCINE

Yellow Fever Virus

- Haemorrhagic fever with hepatitis
- Endemic in Africa, South America and Caribbean
- Mortality rates as high as 50%
- *Transmitted by mosquito (the Aedes species)*
- Travellers to endemic countries receive live attenuated vaccine

"I appreciate what you've done for science ... now drop the bonus request, or I'll swat you."

Viruses affecting the CNS

- Clinical Manifestations
  - Aseptic meningitis (all cause aseptic meningitis)
  - Encephalitis
  - Meningo-encephalitis
  - Poliomyelitis
  - Slow progressive, persistant infections
- General Diagnosis *Always first exclude possibility of bacterial or fungal infection*
  - Lumbar puncture X4
    - look for clarity, bacterial culture, check whats inside (protein, sugar, etc)
  - Other specimens
    - Blood, urine, aspirates,
    - throat swabs
    - stools, sera

CNS Viruses with a Human Resevoir

- Usually an extension of a primary infection in another part of the body
  - *Mumps*-aseptic meningitis in children
  - *Enteroviruses*-aseptic meningitis in infants and children
  - *HSV1*-RARE cause of herpetic encephalitis in young adults
  - *HSV 1 or 2*-RARE cause of meningo-encephalitis in neonate or young adult
  - *Vaccination* for mumps, measles and polio (entero)

CNS Viruses with an Animal Reservoir

- RARE: Humans are accidental or dead-end hosts

– Arbovirus:
  - over 200 different types
  - Tropical rainforest areas
  - Encephalitis
  - Eg. *West Nile* - main animal (dead crow)

– *Rabies virus*
  - Fatal, acute encephalitis
  - Infects mammals, transmitted via saliva
  - Long incubation (30-60 days)
  - Combined active and passive immunization
  - Prevention by vaccination of wildlife and pets
  - 2 major phobias - terrified of water and air

HIV and AIDS

- Severe immunosuppressive condition; often fatal; predisposition to opportunistic infections and cancers
- *HIV causes depletion in helper T-cells* (you cannot turn on cell mediated or humeral immunity) making the host very susceptible to other infections
- Frequent antigenic changes

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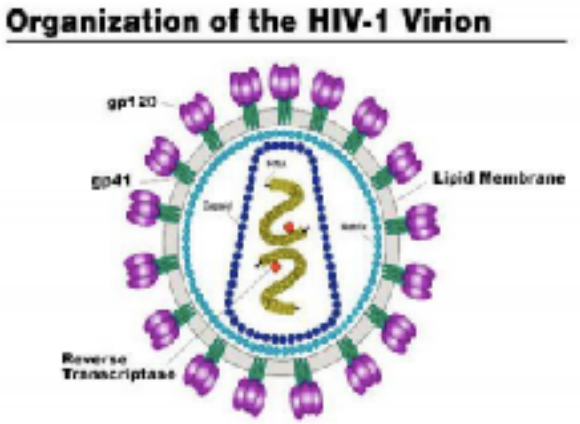
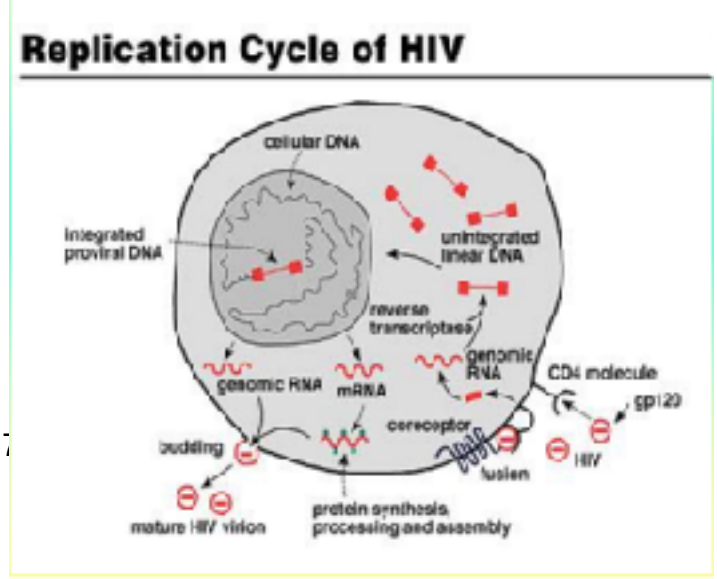
HIV

• Inactivation
  – Virus often protected by living inside cells, protect it from disinfecting action
• Transmission
  – Sexual, blood/blood products, congenital, organ transplants, sperm donation
  – Lengthy asymptomatic period increases spread of disease
• Pathogenesis
  – Virus is cytocidal to helper T4 cells *(macrophages/Th/CD4)*
  – AIDS develops from decreasing immune status
• Clinical
  – Incubation 6 months-several yrs
  – AIDS-related Complex disease, progress to AIDS
  – Terminal stage patients develop dementias, other neurological problems, many opportunistic infections
  - it will integrate into ur genome, over time t-helper goes down
• Lab Diagnosis
  – Serology based; seropositivity can take months to occur
  – Isolation of virus from blood, plasma, semen, cervical, vaginal secretions
• Prevention
  – Universal precautions for healthcare personnel
  – Screen blood, organ and semen donors
  – Heat inactivation of plasma for haemophilia patients
  – Sexual education
  – Education of drug users
  – Testing pregnant women at risk
  – *NO VACCINE yet, but is a key focus of current research*
• Treatment
  – MANY forms of treatment
  – Most effective is cocktail of treatments
• HAART
  – Protease inhibitor (stops viral maturation)
  – Reverse transcriptase (stops viral replication)
  – Bad side-effects
  – Expensive
  – Treatment and Prevention in developing countries very difficult



Why is it hard to get a vaccine?
- volunteers
- More important, person that doesn't have t-helper, how Do you vaccinate



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Review

Measles - rash behind ears, high infectivity, 20 year high

Type 2 diabetes - better to find out from the flora u have

Antibiotics tied to type 1 diabetes and obesity

- 3 courses of antibiotics in first 2 years of life
- cesarean delivers (microbes from skin vs birth canal) - 22% more likely obese as adults

Distortion in gut microbe

Lecture 10 - Hospital-acquired Infections...aka... Nosocomials

Introduction

- A hospital-acquired infection is an infection which was not present (or incubating) at the time of admission
- Common in up to 25% of patients administered to hospital
- Most common infections?
  - urinary tract
  - respiratory
  - wound
  - skin
  - soft tissue
  - septicaemia

Preventable versus Non-preventable?

- Preventable = medical or nursing or surgical mishaps
  - bad hand washing, leaving stuff inside patient, coughing all over…
- Non-preventable = stuff you can't control
  - immunodeficient patient, surgeries where organs are seriously damaged, gunshot / stabbing to GI-tract

Where do these things come from?

- Sources for hospital-acquired infections include
  - environment
  - person-2-person (endogenous (you can contaminate yourself) versus exogenous (somebody else))
  - food supply
  - air supply
  - fomites (an inanimate vector)
  - vector (biological or living entity that spreads disease)
  - water supply

Obvious problems…

- Anything can break the skin barrier is a risk to get a nosocomial infection
- While a hospital is supposed to help, medical activities can cause problems
  - intravenous access
  - urinary catheters
  - surgeries
- Three factors play a role in the transmission of a nosocomial infection

Nosocomial infections: THE CHAIN OF INFECTION (EXAM)

1. Source
   location where microorganisms replicate and disseminate (what is the organism)
2. Route of infection
   way by which microorganisms leave source to get to host (us) (how? food, air, etc)
3. Host
   how susceptible are you? Age? Immune status? Etc… (what makes u pre exposed)

Control over nosocomials

• Chain of infection (source to host) *must* be prevented or avoided
• Hospital infection control plans are in place to
    - render source non-infectious
    - prevent microorganisms from leaving source
    - interfere with dissemination routes
    - prevent microorganisms from entering host
• The most efficient step is the *identification* and *detection of the source of infection*

Control over nosocomials

1. Source
    • what can we do? pest control
2. Route
    • what can be done? sterilize, disinfect
3. Host
    • what should you do? vaccine

Hospital infection control team

- Everyone involved!!!
- Activities include, but are not limited to
    - ? *good clinical practices* (separation of infected/non-infected patients)
    - ? *wound and enteric isolation* (toilet facilities, basins)
    - ? *respiratory isolation* (facemasks, SARS)
    - ? *strict isolation* (enclosed isolation units, air systems)
    - ? *protective isolation* (patients highly susceptible to infection)
    - ? *typing* (serology, phage, molecular)

Universal Precaution

- Infection control techniques recommended following the AIDS outbreak in the 1980's
- Every patient is treated as if they are infected and therefore precautions are taken to minimize risk
- Universal precautions are good hygiene habits, such as hand washing and the use of gloves and other barriers, correct sharps handling, and aseptic techniques.
- Additional precautions are used in addition to universal precautions:
    - Prion diseases (e.g., Creutzfeldt-Jakob disease)
    - Diseases with air-borne transmission (e.g., tuberculosis)
    - Diseases with droplet transmission (e.g., mumps, rubella, influenza, pertussis)
    - Transmission by direct or indirect contact with dried skin (e.g., colonisation with MRSA) or contaminated surfaces
- Universal precautions are recommended not only for doctors, nurses and patients, but for health care support workers. Some support workers, most notably laundry and housekeeping staff, may be required to come into contact with patients or bodily fluids.

Did you notice that, —> universal precaution **NOT =** isolation of patient

Infection control in communities

- Social and environmental factors
- Health education
- Food safety
- Vector control
- Immunization (immunoglobulins, vaccination)
- Chemoprophylaxis (e.g., rifampicin/ciprofloxacin for meningococcal contacts)
- Outbreak investigations
- National and international agencies

Cleaning, Sterilization and Disinfection

- What do we mean by clean?
  - your room?
  - wash your hands?
  - apply some ethanol-based liquid and rub hands until dry?
  - You have to LOOK clean ^^^
- How clean is clean?
  - removal of soil and dirt visible to the naked eye?
- There are physical and chemical exist to achieve our objectives
- Physical (three approaches currently used):
  - heat
    - dry (150-200ºC) ok
    - moist (pasteurization, boiling, autoclaving, microwaves) good
    - incineration (1000ºC!) best
  - radiation
    - gamma
    - ultraviolet

1. Physical
   - filtration (used for a liquid)
2. Chemical

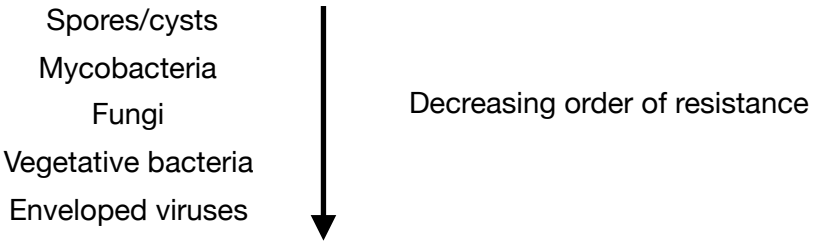
What affects a particular disinfectant?

• In order for a disinfectant to be effective, the following must be thought about…

- concentration of germicide?
- what is the target?
- what is the contact time?
- what is the temperature that I should use product at?
- load? Organic? Inorganic?
- miscellaneous factors…

Who is strongest against disinfectants?

• Interestingly, the resistance against a disinfectant is not necessarily related to how dangerous a microorganism is



To rub or not to rub … that is the question!

• Antiseptics

- used to inactivate and remove flora (transient, resident) from hands prior to surgical procedures
- used to inactivate transient and resident flora from site of operation
- used for treatment and/or prevention of infection on skin surfaces or mucous membranes

• Hand rubs

- removes transient flora only
- usually contains 60-70% ethanol…plus emollient(s)

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Review

Do alcohol-based rubs work against Clostrdium difficile? - no because in spore, yes if theres no spore

^^^ clean protein (peanuts) from hands? - no

Should you by it with emollients? - yes because it prevents dryness of hands

Triclosan

Cytoplasmic and membrane targets

Binds to enzyme involved in fatty acid synthesis

humans to NOT have this enzyme

Resistance to triclosan

Mutations in FabI …

2 best ways to ensure proper hand hygiene

Something interactive

Put a mirror on top of the sanitizer

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Microbiology - ology , bio ,
Microscopes - talked about
Bright field - regular,
Dark field - specimen looks light background is dark , spiroces (one causes lyme disease one causes…)
Phase contrast
Fluorescent - antibody is taged and has a compound and will emit a colour when hit with a laser
Is antibody bound to target and is there
Electron (200,00x normal vision)
Scanning electron - flash a beam of electron and get a 3d thing

Diagnosing an infection
A culture is needed to identify the microbe causing the infection
Potentially infection material like urine, pus, food, water, is collected and put on a culture plate,
…

Bacteriology - the study of bacteria
Some are motile, and stationary
Some like O2 some don't
- aerobic
- ana
- m

Identification of bacteria
Morphology
Gram stain - method of staining to get to 2 groups
Gram + - thick cell wall, purple
Gram - - thin, pink
Antibiotic resistance
Antimicrobial agent,
Antibiotic resistant bacteria

Virology - the study of viruses
Viruses are
Microscopic parasites, with nucleic acid for (either dna or rna)

Antigens and antibodies
Antigen - anything that can illicit a immune resonse - 3 kinds ?

Can also cause a cell mediated immune response
Antibodies - specialized protienthat is produced
Antigen - antibody complex

5 steps of virus reproduction
Adsorbtion
Penetration
Pro nucleic acid and protien synthesis
Assembly and matration
Release

Rhinovirus - common cold, lots of antigen variation, no cross immunity
Influenza - respiratory virus, some major some minor outbreaks, h and n, we get vaccinated every year
West-nile virus - grows in mustiqos, water, food, dead crows. Central Nervous System virus (also rabies)
Rabies - other central nervous system one
HIV - depletion of t helper cells over time, t helper 2 (no antibody production) no cell mediated or humeral responses,
Norovirus - causes dihdehar, no vaccine, 18 and above , 17 lower rotavirus and theres. Vaccine
Hep a - effects liver, food borne, lifelong immunity, hep a as an adult has worse symptoms, should get the vaccine young
Hep b - blood borne, need to have the right amount of antibodies for protected immunity
Hep c - blood borne, no vaccine, but there is a treatment
Hep d - need hep b to control , cannot replicate without hep b
Hep e - food borne, particularly dangeours for pregnant women
Yellow fever - liver, transmitted my mosquito
Varicllа - zoster virus - chicken pox, can come out as an adult and cause shingles
Poliovirus - causes polio, problems in CNS, enteric virus (grow and replicate in the stomach but cause problems elsewhere), Salk vaccine (immunocompromised) dead also u are contagious, sabin (localized immunity, virus can no longer grow)
Rubeola Virus - causes measles, starts behind ears, things in mouth
Rubella - German measels - problem for pregnant women
Mumps virus - causes mumps, glandular - perotic glands, theres a vaccine
Clostridium botulinum - gram positive negative, anaerobic or not, etc
Most common parasite, proto - uni - metazoan - worms
Salmonella - 2 types, one that causes enteric fever (lymph nodes)
E. coli o157:h7 - o antigens, traveling diehrewre, hamburger disease, kidney failure in young people

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Listeria - crosses the 3 protective barriers (what are they)

Shigella -

Gram + cocci

Staphlococcus (aureus vs epidermis)

Streptococcus (progenies vs agalactiae vs pneumonia)

Gram - cocci

Neisseria (gonorrhoere vs meningitids)

Gram positive bacilli

Spore forming

- bacillis (anthracis vs cereus)
- clostridium (botulinum vs tetani vs difficile vs perfringens

Non spore forming

- listeria
- corynebactiurrum

Other

Mycobacteria (tb vs leprosy)

Treponema - syphoilis, dark field microscopy

Borrelia

Clamidya (trachomatics, vspsittacci vs pneumonia)

Mycoplasma

Hand hygiene - best way to control the nano bugs

Multiple choice, short answer, most from mid 2 onward,