

Chapter 14 Epidemiology

Epidemiology – the study of disease.

Look at relationship between organism that's causing the problem and the host. In some cases, the organism doesn't cause a problem, but they live in a "sort of" harmony with the host.

Pathogenic – causes disease.

Pathogens – organisms that cause the disease.

Not all organisms are pathogens.

Some are normal flora—ex. E. Coli (intestines)

Opportunist – take advantage. Example is candida. (Vaginal yeast infection). When take antibiotics, kills off normal flora, and candida take advantage and grows.

Infected: Example HIV. Does not mean you have the disease.

Etiology of disease – is the cause of the disease.

Sterile sites – places in our bodies that do not have organisms, do not have normal flora.

- Lungs / organs. Do not have normal flora. Those people who smoke tend to damage cilia that protect passageways.
- Bladder / urine. Even one colony can be significant.
- Blood
- CSF – Cerebral Spinal Fluid
- Pleural
- Synovial – joint fluid
- Lymph
- Uterus / placenta – fetus
- Bone marrow
- Amniotic fluid

Normal Flora

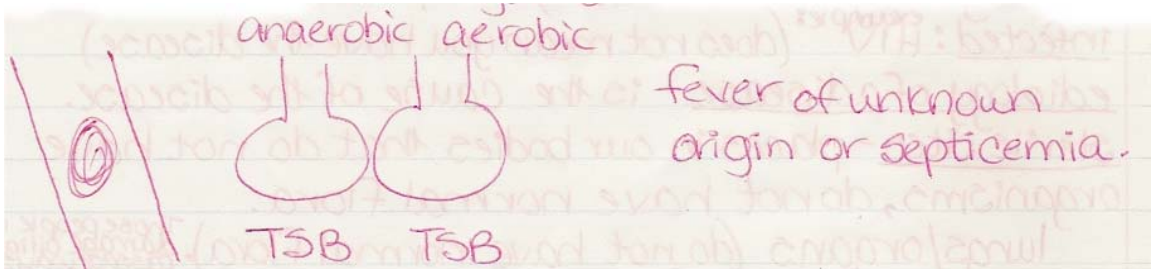
Skin

- Staphylococcus sp. And Streptococcus sp. Gram +
- Corynebacterium sp. Will contaminate specimens unless you use aseptic techniques.
- Fungus / yeast : pH of skin is 5-6, good medium for fungus that prefers a lower pH.
- Propionibacterium acnes (anaerobic organism)
Metabolizes sebum. Lives very deep in the crevasse of your skin. It tends to like the oil sebum. Responsible for acne. Produced propionic acid.

H_2O_2 -----→ $H_2O + O_2$

→ skin cells have catalase (which breaks down hydrogen peroxide to water and oxygen).

When using anti-acne medicine you are causing breakdown of hydrogen peroxide which releases oxygen which kills Propionibacterium (an anaerobe). Important clinical organism, not in terms of causing disease but for contaminating specimens, particularly blood cultures. When you draw a blood culture from a patient's arm:



Important to not only clean patient's arm with betadine to cleanse the area. Starting from middle and moving outward. Let area dry. Should clean tips of bottles. As your cleaning area, you are removing the surface flora (like Staph, Strep & Coryne) but Propionibacterium lives very deep in the skin that you may not be killing. Propionibacterium can get in here.

Immunocompromised (different levels):

- Immune deficiency disease (Rheumatoid arthritis, autoimmunity like Lupus).
- AIDS
- Chemo / radiation therapy
- Burn patients
- Infants / elderly
- Pregnant
- Nutritionally deficient (anorexic)
- Alcoholism
- Transplant receivers
- Drug abusers
- Unusual employment (asbestos worker for 20 years)

These contribute to shifts in normal flora and rise in opportunistic organisms. Need to know what is normal flora and what isn't.

Upper Respiratory, skin & mucous membranes.

- Eyes
- Throat /trachea
- Ears
- Nose
- Gums (anaerobes – deep in gum lines) OK EVERYONE TOOK THIS CLASS BEFORE WAS IN HYGIENE LOL!!!

Normal flora: Staph + Strep + Corynebacterium

Haemophilus sp. (influenzae) is not always present, but when it is, usually in small amounts. Can cause meningitis (#1 cause in infants under 3). Can cause pink eye. Ear infections (normally middle). Carried by a lot of people as normal flora.

Neisseria sp. (N. meningitidis – can cause meningitis) gonorrhea – not the species that is normal flora.

Enteric – lower intestines, rectum, colon. E. Coli & “friends”, members in this family (Gram negative bacilli). Staph + Strep + Corynebacterium sp. E. Coli is a facultative anaerobe. Can also find anaerobes such as Clostridium sp. (C. difficile – produces a toxin) is a spore former, can also produce a toxin. Anaerobes in mouth can lead to serious types of gingivitis. Yeast in intestines (tends to survive) Pseudomonas sp. (can survive because of porins). Would be found in our intestines because pseudomonas is found in soil, WATER (most drink everyday).

Genital region

Yeast – vagina

Lactobacillus, Staph + Strep + Corynebacterium, Gram – rods / anaerobes.

>+ 100,000 colonies / ml. of E. Coli – urinary tract infection.

>+ 100,000 colonies / ml of Lactobacillus is good.

Symbiosis – the living together of two different organisms.

Opportunist – those that can be potentially pathogenic. Such as Clostridium. Normally carry, can potentially be dangerous. *You can carry Haemophilus, doesn't bother you, but if you work in a nursery in a hospital and sneeze all over the infants, you've got a dangerous situation which can cause meningitis.

Koch's postulates. Grow the organism in suitable hosts, an animal, re-isolate it, it causes the disease. It can not be appropriate for every type of disease. An example of why is some do not grow on media. Legionnaires disease, cannot grow HIV in vitro.

Symptoms (subjective) – what the patient feels

Vs.

Signs (objective – measurable) fever of 105°.

Syndrome – collection of symptoms and signs. It may or may not have it's etiology defined. (sick people on cruise ship all get sick with same symptoms and signs).

Contagious

Communicable – can be passed from person to person, passed along (meningitis)

Vs.

Non-communicable – not passed, tetanus, botulism.

Contagious -- not only communicable, but easily spread.

Epidemic – chicken pox, flu. Very acute, highly contagious, very easily spread. A lot of people are involved in a short period of time.

Endemic – common cold, malaria, yellow fever (viral disease carried by mosquitos), always present in a population.

Pandemic – HIV / AIDS, tuberculosis, smallpox (not around anymore, has been eradicated). (WORLDWIDE).

Morbidity (# of people who get sick)

Vs.

Mortality (# of people who die)

MMWR – Morbidity and Mortality weekly report, published by the CDC (Centers for Disease control) located in Atlanta, Georgia. Monitor US epidemiology statistics.

WHO – World health organization. Monitors disease worldwide.

Acute – very quick onset, very quick recovery (flu, common cold).

Subacute – subacute bacterial endocarditis (SBE), not long term, but not quick. People with heart murmurs take antibiotics before dental work, prophylaxis to prevent this.

Chronic – lasts a long time. TB, syphilis, parasitic infections.

Latent -- HIV—means it comes on but takes a long time for the symptoms to show. Ex. Hepatitis, syphilis, and herpes.

Subclinical – means often asymptomatic (or symptoms that you can not put your fingers on). Examples: CFS – chronic fatigue syndrome, meningitis (esp. viral meningitis), Chlamydia (can leave men sterile by the time man does get symptoms).

Localized (ex. Ear infection)

Vs.

Systemic (bacteremia when bacteria gets into blood, septicemia). Aggressive therapy is needed here.

Primary – HIV. Many primary can lead to secondary.

Vs.

Secondary – pneumonia, TB, meningitis, secondary can be opportunistic. Usually secondary is the one that kills patient.

Viral – leads to secondary bacterial infections. Ex. Pneumonia, ear infections. Strep throat due to streptococcus (which is primary infection) leads to secondary like rheumatic fever or glomerulonephritis (kidney infections).

Reservoir – continual sources of microbes / microorganisms. Humans, dogs, hospital, garbage cans are reservoirs.

Zoonoses – from animals, disease like rabies.

Prevention

- Wash hands
- Keep fingers from face

3 types of transmission

1. Contact transmission
Direct – person to person (sexual, kissing) Example: STD
indirect – fomite. Example: doorknob, fork, inanimate object. Carrier of organisms. Examples: Hepatitis A, chicken pox (doorknob). Some are transmitted through portals of entry which makes it different on how you are going to get it. (athletes foot, bare feet).
2. Vector transmission – orthopod / insect. Examples: Malaria, viral encephalitis, yellow fever (worldwide) US: Lyme disease, RMSF (Rocky Mountain Spotted Fever). An anthropod that causes disease-causing organisms to go from one host to another.
3. Vehicle transmission – food / water. Transmission of a pathogen to a large number of people by an inanimate reservoir. Pasteurization dose not kill all fecal organism in milk. Shigella at Round Valley – swimmers get it from water. Due to fecal / oral route. 10% have shigella.

Incubation period

Period of time until you are infected -----> until the time you show symptoms, signs of the disease.

Chicken pox: 7-12 days

Staphylococcal food poisoning: 6-8 hours

Salmonella food poisoning: 24-48 hours

Rabies: 10 days – 1 year (NJ is endemic to rabies)

AIDS: 10 years average (maybe close to 12)

Predisposed factors – anything that makes you more susceptible to a disease: age, race, sex, how you handle stress, lifestyle, socio-economic status, genetics, where you live.

Convalescence – period of healing (can be a carrier during convalescence).

Chapter 15: Pathogenicity

Pathogenicity – disease causing.

Virulent – the degree of pathogenicity of a microorganism.

1. spore formers
2. capsules
3. gram – (porins) Pseudomonas
4. toxins
5. number of organisms

Portals of entry

- Skin, mucous membranes. Break skin or cut. Mucous membranes have capillaries, lesions / rubbing can lead to organisms getting in.
- Orifices. Openings like nose, eyes, mouth and genital regions.
- “Preferred portals”. Neisseria gonorrhoea transmitted by sex, if you swallow gonorrhoea you will not get it, needs to be by its preferred entrance way.
- Injected (parenteral route). Either by accident or on purpose. Vaccine, shots will introduce organisms (like Propionibacterium, Bacillus (not normal flora), yeast and fungus) Sometimes organisms that are encapsulated or have a slime layer stick to certain things that might be in dwelling. Highest incidence of tetanus is from IV drug users that share needles. Tetanus is secondary infections to HIV patients who are also drug users.

Lethal Dose (“LD50”) – how many organisms that plays a role. The lethal dose is the # of pathogens that will kill 50% of the test animal. Call it the LD50. If LD50 is 6, it means that 6 organisms is enough to kill 50 out of 100 guinea pigs. Organisms that are very lethal you don’t need a lot of. Low LD50 -> most lethal, because it does not take much to kill. A measure of how virulent a strain is.

Once organism gets in, next thing is it has to adhere.

Adherence – Those organisms that have (produce) capsules or slime layers that are sticky have an advantage.

- Streptococcus mutans – the organism causes plaque. Capsule hardens. Capsule is made of carbohydrates, and it hardens on your teeth, adheres to your teeth.
- Neisseria sp. (encapsulated). Fimbriae allows it to stick. Little protein hairs that allow it to stick.
- Streptococcus pneumoniae – one of the most deadly organisms around to older people. Has a capsule. Most elderly will get this and die from it.
- Mycobacterium tuberculosis – Has mycolic acid, a very waxy lipid in the cell wall. Can lie dormant for 70 years Mycolic acid very hard to break down. Can destroy your phagocytes.

Cell membranes

Gram – membranes

- LPS, lipid part – Lipid A. Very toxic to host. Causes fever and shock. Gram – have porins, transport things out.

Gram + walls

- Large cell walls – thick peptidoglycan. Protects from osmosis / osmotic shock. Live longer on high sugar areas. Diabetic, gangrene. Gangrene is caused by Clostridium. Live in tissues filled with sugar. Food also.

Enzymes / Toxins – produced by organisms to help make them virulent.

Hemolysins – destroys red blood cells.

Kinases – destroy clots. (staph – scabs)

Coagulase

Exotoxins – Protein toxin released from living, mostly gram positive bacterial cells.

- Exit the cell (they are put out)
- Put out
- Produced by living cells (sent out to infect host)
- Toxic shock syndrome (Staph toxin). Staph on mucous membranes (such as vagina, nose), Staph colonizes tampon or nose packs, start to proliferate.
- Staphylococcal toxin TSST-1 causes toxic shock syndrome.
- LD50 – low, don't need a lot to make you sick
- Toxin is heat-labile (destroyed by heat)
- Usually gram +
- Examples:
 - Neurotoxins – types of exotoxins like botulism, Toxin affects nervous system. Clostridium botulinum (Botulism). Eat it, can die (lose vision, get stiff). Gram +, alive, puts out organism to make you sick. Can be released by antitoxins, but must be quick because it can be fatal.
 - C. tetani – causes tetanus (lockjaw). Gram +, alive, puts out organism to make you sick. Can be released by antitoxins, but must be quick because it can be fatal.

Sometimes they are:

- Cytotoxins – bacterial toxins that kill or alter the functions of host cells. Act on cells and tissues
 - Corynebacterium diphtheriae – (Gram + pleomorphic rod) causes diphtheria (respiratory illness, one of the few pathogens). “pseudo membrane” blocks trachea and you die of suffocation. Anaerobe.
- Enterotoxins – affects intestines. An exotoxin that causes gastroenteritis, such as those produced by Staphylococcus, Vibrio, and Escherichia. Staph food poisoning. Treat to kill Gram + organism. Organism still alive.

Endotoxins – part of the outer portion of the cell wall (Lipid A) of most Gram – bacteria; released on destruction of the cell.

- Produced only after organism is dead.
- Released upon death of microbe. Not put out by living cells.

- LPS Gram – found in out membrane. LPS is only released when cell is destroyed.
- Fever, shock (What LPS causes)
- LD50 – high (You need quite a bit to cause an infection)
- Heat-stable (heat does not destroy it)
- Usually Gram –
- Examples:
 - Salmonella – food poisoning. Supportive treatment, maintain fever, fluids. Endotoxins is making you sick. Cannot treat with antibiotics, because organism is already gone (dead).
 - Neisseria meningitidis – one cause of meningitis. Need to treat or you will die. Susceptible situation.
 - Hemolytic Uremic Syndrome (HUS)
very timely in NJ (remember I took this class in 1997).
Major problem among children.
Kidney failure and a host of other problems due to a strain of E. Coli 0157:H7 (this strain is not in stool). Found in contaminated beef, in contaminated veg. /fruits that have been treated with fertilizers. (comes from infected cows)
Causes complete kidney failure especially in children under 6. Mortality rate of about 60%. Horrible thing to watch
Gram – that also produce exotoxins.
Exception to the rule. Along with Shigella (caused by humans).

Way to avoid E. Coli 0157:H7:

- Stay away from beef, cook it until it is charred.
- Wash veg. and fruits in soap and water
- Wash hands

Prevent Shigella (not normal flora) by:

- Wash hands
- Keep fingers away from mouth

Chapter 14 study guide

These terms were taken from our textbook

Tortora, Gerard J., Funke, Berdell R., Case, Christine L.

Microbiology: An introduction, Fifth edition. Redwood City, CA. The Benjamin/Cummins Publishing Co., Inc., 1995

Pathogen – a disease causing organism.

Etiology – The study of the cause of the disease.

Infectious disease – A disease caused by pathogens.

Normal flora – (Microbiota) Collection of microorganisms that colonize an animal without causing the disease.

Sterile sites – sites free of microorganisms.

Symbiosis – the living together of two different organisms.

Commensalism – a system of interaction in which two organisms live in association and one is benefited while the other is neither benefited nor harmed.

Mutualism – a symbiosis in which both organisms are benefited.

Parasitism – a symbiosis in which one organism (the parasite) exploits another (the host) without providing any benefit in return.

Opportunist organism – An organism that does not ordinarily cause a disease but can become pathogenic under certain circumstances. (Potential pathogenic)

Carrier state – An individual who harbors a pathogen but exhibits no signs of illness.

Koch's postulates – Criteria used to determine the causative agent of infectious diseases.

Symptoms – A change in body function that is felt by a patient as a result of a disease

Signs – Changes due to a disease that a physician can observe and measure.

Syndrome – A specific group of signs and symptoms accompanying a particular disease.

Communicable – Any disease that can be spread from one host to another.

Non-communicable – A disease that is not transmitted from one person to another.

Contagious – A disease that is easily spread from one person to another.

Epidemic – A disease acquired by many people in a given area in a short time.

Endemic – A disease that is constantly present in a certain population.

Pandemic – An epidemic that occurs worldwide.

Morbidity – (1) The incidence of a specific disease. (2) The condition of being diseased.

Mortality – The deaths from a specific notifiable disease.

MMWR – Morbidity and Mortality Weekly Report; weekly publication of the Centers for Disease Control and Prevention containing data on notifiable diseases and topics of special interests.

CDC – Center for Disease Control.

Acute disease – A disease in which symptoms develop rapidly but last for only a short time.

Subacute – A disease with symptoms between acute and chronic.

Chronic – An illness that develops slowly and is likely to continue or recur for long periods.

Latent – A disease characterized by a period of no symptoms when the pathogen is inactive.

Subclinical – An infection that does not cause a noticeable disease.

Localized – (infection) – An infection in which pathogens are limited to a small area of the body.

Localized anaphylaxis – An anaphylaxis-type reaction, such as hay fever, asthma and hives.

Systemic infection – An infection through the body.

Systemic anaphylaxis – Hypersensitivity reaction causing vasodilation (dilation or enlargement of blood vessels) and resulting in shock.

Bacteremia – A condition in which there are bacteria in the blood.

Septicemia – A condition characterized by the multiplication of bacteria in the blood.

Primary infection – An acute infection that causes the initial illness.

Secondary infection – An infection caused by opportunistic pathogen after a primary infection has weakened the host's defenses.

Reservoir – a continual source of infection.

Zoonosis – A disease that occurs primarily in wild and domesticated animals but can be transmitted to humans.

Contact transmission – Spread of disease by direct or indirect contact or via droplets.

Direct – A method of spreading infection from one host to another through some kind of close association of the hosts.

Fomite – A nonliving object that can spread infection.

Droplet infection – The transmission of infection by small liquid droplets carrying microorganisms.

Airborne transmission – The spread of pathogens farther than 1 meter in air from reservoir to susceptible host.

Vehicle transmission – Transmission of a pathogen to a large number of people by an inanimate reservoir.

Vector – (1) An arthropod that carries disease-causing organisms from one host to another. (2) A plasmid or virus used in genetic engineering to insert genes into a cell.

Nosocomial – An infection that develops during the course of a hospital stay and was not present at the time the patient was admitted.

Predisposing factors – Anything that makes the body more susceptible to a disease or alters the cause of a disease.

Incubation period – The time interval between the actual infection and first appearance of any signs or symptoms of disease.

Convalescence – The period of recovery from a disease.