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Kenneth Palmer/Alita Joseph Disease Detectives Notes

Infectious Diseases

"The Biologic and Clinical Basis of Infectious Diseases"
-Youmous-Patersone-Somers

The following information is general information pertaining to the qualities of infectious diseases.

When a disease manifests itself in a host and receives treatment, the host is the one to actually eliminate the disease. The medicine used in treatment is primarily used to avoid additional proliferation of the pathogen and expedite the task of the immune system. (This is not the case with vaccines; they are a preventative measure. However, the vaccine still triggers the immune system and it cannot prevent the disease independently.

If antimicrobial agents are used excessively, a bacterial infection can develop a considerable resistance to the antibiotic. Some professionals believe that staphylococcus (especially MRSA) will soon be resistant to all antimicrobial agents.

A serious concern within the medical community is the affect of treatments on the immune system. For instance, certain catheters, irradiation therapies, immune-suppressive drugs, and corticosteroids have the potential to reduce a host's capacity to manage infection autonomously. While these treatments are very often life saving and vital to a patients well-being, they may well create a very precarious vulnerability to other pestilences. Scientists and doctors consider these risks when they endeavor to treat a patient and attempt to minimize damage to the immune system itself; much research goes into developing treatments that are more innocuous to the host after and during their use.

Zoonotic Diseases

"Zooneses"
-Martin Shakespeare

Zoonotic disease are disease and infection that transmitted from vertebrate animal to/from man. Not all instances of zoonosis fall strictly into these parameters. Malaria is not a zoonotic disease because the mosquito who transfer the disease are simply as vectors (insect modes of transport for disease) and are completely asymptomatic and unaffected by the disease.

It is integral to note that to be zoonotic, a pathogen must span at least two species, one of which implicitly being human kind. In the eyes of epidemiologists, zoonotic threats are minimal if the disease has a difficulty in crossing the boundaries from animal to man. If the disease crosses that threshold with little trouble, the problem is more considerable. If you combine a virulent disease with the capacity to easily make transfers between species (i.e., Yersinia pestis, or the Bubonic Plague) you have a potential disaster.

Often diseases are considered zoonotic if an animal infection greatly increases risk of human infection. For example, the environment may already put an individual at risk for a certain pestilence; however, if an animal contracts this disease and that event causes the risk of human infection to increase, then the disease is zoonotic. This is because the animal serves as an excellent breeding ground for the infection to multiply rapidly and thus increase the rate and plausibility of human infection greatly.

The mode of transmission is essential to the likelihood of an actual human infection. The Bubonic Plague (again!) only requires the transmission of a single bacterium carried by a fleabite and that bacterium is injected directly into the bloodstream.

Often times a fomite (inanimate object that harbors a pathogen) serves to indirectly transfer a zoonotic disease. If an animal that is afflicted with a particular malady comes into contact with an object directly before a human, that object has the potential to serve as a bridge for the pathogen between human and man.

Very often zoonotic infection is transferred via bodily excretions such as feces, urine, tears, blood, or mucus. Ebola is frequently transferred to humankind via the excrement or blood of monkeys and Chlamydiapsittaci is transferred by means of the inhaled particles of dried parrot feces. Pasteurization prevents many serious outbreaks of zoonotic diseases that would otherwise happily utilize produce as a path to a human host.

Zoonoses has a very prevalent impact on human culture and society in the facets of animal welfare, food safety, and Public Health/Hygiene. Halal and kosher disciplines are in part derived from the goal of preventing illnesses that are zoonotic.

Food-borne zoonosis used to be accepted as a risk of day-to-day living; it is now considered to abominable and intolerable. With the extended travel distances of food and the variety of locations of harvest, the task of fighting food-borne zoonosis and disease is very uniquely difficult despite rising standards and expectations. With the responsibility shifted unto the producers and distributors of foods, people often lack knowledge of basic food hygiene.

Certain groups are at a high risk for zoonotic infection: animal handlers, neonates and children, elderly and infirm, agricultural and food industry workers, immunosuppressed or compromised individuals (who are at risk for many diseases!), and pregnant women. Most healthy adults with functional immune systems face little threat of zoonotic infection, even when very infectious inoculum are present.

Zoonoses can have a variety of impacts on society, especially as it pertains to industry. Zoonotic outbreaks can cause a panic that may lead to the departure of staff and the boycott or recall of a company's products. This may lead the company to downplay the threat of a zoonotic disease and in turn exacerbate the

fundamental problem and simultaneously muddle the efforts of a disease detective.

The response of the public ranges from food scares/boycotts/dietary change, to increased legislation, to public/private fear and anxiety, to morbidity and mortality, and to political fallout.

– Zoonotic influenza can manifest itself as a very serious disease that killed more individuals (20,000,000 fatalities) directly after World War I than the war itself.

Birds, pigs, horses, and humans all possess the potential to serve as reservoirs for this virus. Often mutations create subtypes that are particularly pathogenic to one species and not as harmful to others. Influenza is famous for its frequency in mutation and it often changes from year to year in order to find new methods of sustenance and proliferation.

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Prominent Figures

"Doctors and Discoveries"
-John Galbraith Simmons

Hippocrates:

This is the man who is often referred to and considered the founder of Western medicine. Hippocrates determined and emphasized the necessity of developing a diagnosis, prognosis, and method of treatment on the basis of observation as opposed to speculation. He also postulated that the method for ascertaining this information should be shared with the patient in a candid manner.

A rational approach to the perception of life and death and the fashion in which disease affects these facets was necessitated in the *Corpus Hippocraticum* and the Hippocratic *Epidemics.*

Hippocrates was still a man of his time and he certainly granted his approval to many less-than-accurate theories such as the Humoral Theory, or the idea that the body's well-being was a result of the balance of the four humors: blood, bile, phlegm, and black bile. Methods such as the incredulous practice of blood-letting were used to balance these humors to no avail. The humoral was not entirely false, but its premises and ensuing practices were not grounded in facts.

The ***Hippocratic Oath*** is the most powerful and relevant remnant of the Hippocratic influence of medicine, partially because it so completely demonstrates the values and standards set by this man. However, even this piece has many aspects that are extremely outdated and inaccurate. Often times the duties of physician, as outlined in this work, are not based in any documented or factual benefit to either the patient or the scientific community. This seems to be very contrary to Hippocrates' firm rationalism; who would have suspected Hippocrates to be a hypocrite? Concepts discussed in the piece include the prohibition of poisoning for any purpose, allowing or facilitating suicide (this is currently a heavily debated standard and is falling into desuetude), and engaging in sexual conduct with a patient. While many of the mandates of the Oath have been abandoned, the idea of obligations of a physician to a patient remain preeminent.

Louis Pasteur:

Pasteur began his studies in Microbiology on the subject of fermentation. He proved that fermentation (via lactic and butyric acids) was the result of the labors of microscopic organisms. He determined the uniqueness of each microbe and laid the foundation for the modern microbiological technique.

Pasteur developed techniques to immunize against anthrax, cholera, and rabies and he created a technique to sanitize many foods called pasteurization.

Joseph Lister:

Influenced by Pasteur, Lister developed the antiseptic technique; he saw the presence of microbes inf fermentation and wondered if these same organisms caused pus in wounds. The antiseptic technique involved the use of carbolic acid in the operating room to kill microorganisms and reduce sepsis. It worked for the purpose it was intended; however, it also presented a considerable hazard for the doctors and patients because of the toxicity of carbolic acid. With the reduction of sepsis, mortality in the operating room declined the the importance of the role of eliminating microorganisms in a medical environment was emphasized.

The method of sanitation as a preventative measure, instead as a reaction to the the appearance of pus, was introduced as a result of Lister's work.

Robert Koch:

Koch identified the agents responsible for tuberculosis, cholera, typhoid, diphtheria, and other diseases. He used this information to begin the field of classifying bacteria called Bacteriology. He used his studies in Bacteriology and moved to validate the use of gram-stains and to determine the proper and optimal cultivation of bacteria.

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The Immune System and Microbiology

"Microbial and Parasitic Infection"
-BI Duerden – TMS Reid – JM Jewsbury

Most infections I human beings are the result of microorganisms. These microorganisms fall into a few groups: **bacteria, rickettsiae and chlamydiae, viruses, fungi, and protozoa.**

Fungi and protozoa are similar to higher and more complex beings and are eukaryotic while bacteria, rickettsiae, and chlamydiae are prokaryotic because they are simpler in nuclear structure and lack internal nuclear dividing membranes and are prokaryotic.

Viruses are exceedingly simpler and aren't described necessarily as living cells.

{Bacteria are typically unicellular and carry out metabolic processes and possess the capacity to reproduce via binary fission..

Bacteria have a permeable cell wall which is rigid and defines bacterial shape while simultaneously preventing bursting despite high internal osmotic pressure. Mucopeptide composition is responsible fr the rigidity of the cell wall. The level of mucopeptide concentration determines gram-stain. Gram-positive (blue) staining bacteria contain 50-90% mucopeptide while gram-negative (red) staining bacteria contain 5-10% mucopeptide their cell walls. Gram-negatives (red) also have a thicker phospholipid-polysaccharide protein in their cell walls.

The bacterial cytoplasm contains a protoplast surrounded by a cytoplasmic membrane. The cytoplasmic membrane creates mesosomes which conduct specialized metabolic processes, cell wall synthesis, and sporulation (the creation of spores).

The cytoplasm contains many ribosomes (containing RNA) and a chromosome or multiple chromosomes (called a nuclear body). The DNA in the chromosome(s) is in a contorted ring shape and may be accompanied by smaller, disconnected bits of DNA called plasmids.

Many bacteria have flagellum, fimbriae, and pili. They are all helpful in different facets; the flagellum aid movement and are thin and whip-like, the fimbriae aid in the transfer of genetic information, and pili allow the bacteria to adhere to the surface of host cells.

Some bacteria produce spores which are created intracellularly, have thick cell walls, and are durable in adverse conditions. Spores also have vastly reduced metabolic activity. Spores are also only formed by gram-positive (blue) bacilli of the genera Bacillus and Clostridium. The production of spores is always a reaction to very unfavorable conditions.

Bacteria reproduce by means of binary fission in which a cell enlarges, replicates the nuclear ring, and separates (without the polarization of mitosis present in nucleated cells). This eliminates the potential reassortment of chromosomal genes that can occur during mitosis.

The shapes of bacterial cells vary and cause a division in the naming of bacterial cells. The first group is the spherical cocci. Cocci are frequently found in groups of two called diplococci or in chains (if the division is regular and possesses a set orientation) or clusters (if the division is irregular and lacking orientation). The second group is comprised of the rod-like bacilli. Bacilli are found in the shapes of rods, elongated cylinders, club shaped rods and other modified versions of the basic rod shape. The third group, the vibrios **(**or comma bacilli), carry a semblance of the bacilli shape but are curved enough (hence the term "comma" bacilli) that are classified within a different group. The fourth shape is the spirochaetes; these are corkscrew-like spirals. The fifth shape is comprised of actinomycetes and other high bacteria that are thought to mark a group of bacteria that are further along the path of evolution than their differently shaped counterparts. The actinomycetes and higher bacteria in general, however, are still prokaryotes despite their possession of branched filaments, a trait of eukaryotic fungi, and other complexities.

The sixth shape stands out on a few different levels. The primary difference is the array of actual physical shapes by which this groups manifests itself to microbiologists. This group is comprised of mycoplasmas and it is an exception to the rule that bacteria must possess a rigid cell wall; these bacteria are instead essentially comprised of a protoplast which is very much smaller than a regular bacterium and can only survive in roughly isotonic conditions. The mycoplasmas are said to share features of the mutated bacteria called L-forms. These mycoplasmas are still a subject of debate and their classification is, at this point, a moving target.**}**

{Rickettsiae, coxiella burnetti, and chlamydiae are similar to bacteria in that that they both have muramic acid (not to be confused with the aforementioned mucopeptide) in their cell walls, they contain RNA and DNA, they reproduce via binary fission, and they are susceptible to antibacterial agents. However, these organisms very greatly in size with bacteria (they are much smaller, much more like the size of a some virions, or virus particles) and in their method of reproduction which requires a host cell unlike the autonomous reproduction of bacteria.

Of these organisms, Rickettsiae and coxiella are pleomorphic meaning that that they have varied shapes including, but not limited to, cocci, bacilli, and filamented shapes. Chlamydiae, on the other hand, are spherical in shape and develop intraceullarly.

Chlamydiae are manifested initially as elementary bodies and these bodies are phagocytosed (ingested by phagocytes which are organisms that consume waste and harmful organisms within the body) and develop within the phagocytes into mature reticulate bodies. These reticulate bodies reproduce by means of binary fission ad create additional elementary bodies within the host cell (the infested phagocyte). The host cell then bursts and allows new elementary bodies to escape and infect more host cells.

In synopsis, bacteria, rickettsiae, chlamydiae, and coxiella burnetti share qualities of RNA, DNA, well walls, prokaryotic status, and most importantly to many physicians, susceptibility to antibiotics. They have points of contrast in terms of size (bacteria are much larger than the the very small rickettsiae, chlamydiae, and coxiella burnetti) and shape and chlamydiae have their own unique method of intracellular development in which elementary bodies take over a phagocyte, become reticulate, cause the phagocyte to burst and release more elementary bodies that start the process over again. Bacteria are also unique from all of these groups in the respect that they can reproduce without a host cell.**}**

{Viruses are extremely small in comparison to other microorganisms (with some exceptions from the smallest of the rickettsiae, coxiella burnetti, and chlamydiae) and cannot be seen with an ordinary light microscope as a result, unless they form inclusion bodies. These are simply large collection of virions (single virus particles) that make themselves apparent via their considerable numbers of smaller individual organisms.

Viruses lack their own metabolic capacity and thus is is questionable as to whether or not they should be considered living beings. A virus requires a host to even survive and metabolize food while rickettsiae, coxiella burnetti, and chlamydiae can survive without a host; they simply cannot reproduce without one. For this reason, viruses that are capable of invasion and replication are deemed active as opposed to alive and viruses lacking this ability are called inactivated as opposed to deceased or dead. The virus particle is a virion, not a cell; this is because of the multitudinous and considerable points of contrast between viruses (and virions) and their other, more evolved, prokaryotic and eukaryotic counterparts (and their cells).

In their simplest form, presented in poliomyelitis, viruses are extremely basic; they contain only

a nucleic acid core, or the genome, protected by a protein coat called the capsid. The nucleic acid core contains only DNA **OR** RNA, not both, and is protected by the capsid during transmission from the virus to its host.

Viruses, as mentioned, contain a genome to carry their genetic information. However, the genome does **not** carry nucleic acid in both DNA and RNA forms, but instead it carries only one or the other. This is in contrast to other cellular organisms, all of which carry both types of nucleic acid.

In addition, viruses reproduce via replication during which they invade a host cell of a bacterial, plant, or animal host and turn their home into a veritable virus-production unit. This process varies greatly from the typical (i.e., bacteria, chlamydiae, coxiella burnetti, rickettsiae) method of reproduction, binary fission.

As viruses have undergone thorough study in growing detail, systems by which they can be classified have been developed although not with an a complete consensus as to the optimal method in the scientific community. The current characteristics used to classify viruses are as follows:

1. The nature and contents of the nucleic acid are used to determine some qualities, and thus help to classify, of the virus. These contents include DNA or RNA and are used for replication of the virus and make up the genome of the virus.
2. The next quality used for classification in virology is the symmetry of the capsid. The capsids are constructed of smaller units (made up of proteins) called capsomeres. The mutual attractions between the capsomeres determine the shape of the virus itself. Thus when one discusses the symmetry of the capsid it has much to do with the shape of virus (similar to the cocci and bacilli of other pathogenic groups).
3. The third distinguishing factor is the presence of an envelope, a membrane that is composed of lipids, proteins, and carbohydrates and the encloses the nucleocapsid (a term that refers both to the nucleic acid and its protective capsid coat). The envelopes may acquire substance from the host cells that they invade for it is unlikely that the virions produce them independently.
4. The fourth standard for classification is particle size. Whether it is a very small and simple particle, or a somewhat more complex virion that rivals a very small rickettsiae cell, virus size is vital to the differentiation of virus species.

Bacteriophages are small, parasitic agents that feed upon bacteria and cause a “moth-eaten” appearance on bacteria viewed cultivated on solid cultures. Bacteriophages, or phages, are class of virus that prey not just upon bacteria, but on very specific strains of bacteria that correlate very directly with the strain of bacteriophage that feeds upon the bacterium. This specific selectivity to which phages are inclined to adhere is useful for microbiologists in their effort to identify and classify the phages themselves.

Phages have the greatest structural complexity of any virus as a group and most contain DNA (instead of RNA) which serves to reaffirm the idea that bacteriophages possess a higher complexity.

Bacteriophages such as the T Phages of Escherichia *coli* are very complex and use bacteria solely as their host cells. **}**

{Fungi are much larger than bacteria (the largest microorganism group mentioned hitherto), they are eukaryotic, and they owe their rigid consistency to fibrils of chitin encapsulated in protein.

Moulds/filamentous fungi develop filaments (hyphae) that are interwoven to develop a network called mycelium. In other cases the filaments/hyphae are separated by cross-walls (septa) instead of forming mycelium. The yeasts are oval or spherical cells which reproduce via budding, a method of asexual reproduction.

Many pathogenic fungi are dimorphic, meaning they resemble yeast in when they develop in tissue, but contain mycelium in a culture or in soil; some fungi are mycelial despite the medium and some remain yeast-like despite the medium.

{**Protozoa** are considerably more complex than bacteria. They are large, they have unequivocal points of distinction between protoplasm, nucleus, and cytoplasm, and their reproductive methods are varied. Protozoa are eukaryotes who reproduce in a few ways: binary fission, nuclear replication via mitosis, or life cycles that contain both sexual and asexual phases and include the formation of cysts. }

{**Helminths (worms)** are divided into some different groups that affect humans:

The Trematoda (flukes) and the Cestoda (tapeworms) are grouped together to form the Platyhelminthes (flatworms) because they are both flat in shape, symmetrical, and hermaphroditic.

The nematoda (roundworms) are distinct in that they are more tubular (though still symmetrical) and they have a complete digestive system with an oral cavity (mouth) for ingestion and a waste-excreting orifice (anus). Nematodes also have distinctive and entirely separate sexes (they are not hermaphroditic like their counterparts, the flukes and tapeworms).

The Trematoda, or flukes, very frequently in the intestinal tracts or lungs and infrequently in the blood vessels. They have a very simple digestive system, they lay eggs which are excreted y the host, they reproduce asexually and often enter via the mouth of their human hosts.

The schistosomes, the most important trematode (fluke) due to their abundance in human affliction, enters via the skin.

Cestoda, or tapeworms, have no digestive system and they absorb nutrients form the gut of their host, in which they reside, into their external surfaces which are very long to maximize absorption. Tapeworms or cestoda have a scolex, or head (it contains hooks and suckers to attack to the intrestinal wall) and a strobia or body which is tape-like.

Nematodes or roundworms reside within the gut lymphatic vessels, or subcutaneous tissues. They frequently infect a large portion of a population (up to 80% in some places) and they lay large sums of eggs or larvae (some lay eggs and some keep the eggs within themselves until they become larvae and release them upon the advent of a certain stage of maturity). The eggs or larvae are either excreted and mature outside of the host, taken by a blood-sucking insect vector that serves as an intermediate host, or use other invertebrates for transportation and safety during development.

Acquisition and Prevention of Disease

"Sources and Modes of Infection"

-Chapin

Diseases do not typically develop outside of the body and the threat of diseases outside of the body is often exaggerated and isn't particularly preeminent.

In addition, the number of cases that go unrecognized of various diseases (diphtheria, typhoid, etc.) is often equal or greater than the sum of recognized cases of the same disease in a given outbreak. These unrecognized cases are often mild and vary in certain qualities from the more sever cases of the pathogen; however, these cases serve not to endanger the life of the initial host, who only has a mild form of the disease, but instead endangers the peers of the afflicted. This point must be emphasized because the lack of investigation by the physician and the avoidance of a clinical visit by the patient can seriously affect the proliferation rate of disease, sometimes with disastrous consequences. Those with a such a mild case may carelessly spread the disease thinking the worst damage they could cause is to give a small number of people a common cold, or a similarly innocuous pestilence, when they may well be sparking an epidemic.

There are also pure carriers, those who carry the disease but are completely asymptomatic. These individuals may pose more of a threat to the community than the horribly ill and those with a mild case because the pure carriers are much more mobile. Those who are symptomatic are much more likely to remain at home or may at least restrict their activities to some degree while someone who is entirely asymptomatic would have very little reason to do so.

"Control of Virus Diseases"

-Society for General Microbiology

Viruses:

Vaccination does not always fully protect an individual from exposure to a wild virus. Often times the vaccination will reduce the vulnerability of key organs and thus reduce the efficacy of a virus. This reduced efficacy may result in similarly reduced prospects for endemic circulation.

Killed-virus vaccines are very common and are the only vaccines licensed for certain disease. However, attenuated (made impotent) live-virus vaccines have the advantage of acting like the virus and creating immune resistance at the portal of entry. Live-virus vaccines may mutate and consequently cause serious complications, a threat that is often too blatant to ignore. Despite these risks, live-virus vaccinations are majorly successful, especially when compared to the success rate of killed-virus vaccines.

Killed-virus Vaccinations are often used in the presence of a very virulent strain and great care

must be taken to prevent the latent presence of a residual live virulent virus in the vaccines. Also, immunity provided by this type of vaccine can be very brief and may necessitate booster shots.

Attenuated Live-virus Vaccinations behave like the virus, but carry certain risks:

1. There is a risk that the attenuated virus becomes virulent and multiplies. This has been minimally problematic in the past, but monitoring of the patient after vaccination should be required.

2. The storage of live-virus vaccines can be exceedingly difficult in field conditions, but using refrigeration (a very specific method that is highly difficult in some contexts) these cultures can be maintained.

Miscellaneous Information

Encyclopedia of Common Diseases- Staff of Prevention Magazine

- One in every ten Americans suffer from allergies, hay fever and asthma being the most common form of reaction.
- Food allergies can stem from many additives in processed foods.
- Anemia: Lack of iron, epidemic in countries such as India, Vietnam, Bangladesh. Cause of iron deficient anemia: small or little doses of iron mixed with blood loss.
- Most body iron is found in the red blood cells.
- Anemia can cause major fatigue, fast heartbeat during simple exertion.
- Also common: Nervousness, headache, loss of appetite.
- Treatment for anemia consists of iron absorption, consumption of meat, prescription of iron compounds.
- Sickle cell anemia: causes death early on, due to hardened or sickled red blood cells that interrupt circulation, therefore cutting of oxygen. Intake of thiocyanate helps with treatment.
- Accute appendicitis: Symptoms start off as a stomachache, then over time the pain becomes concentrated in the lower right side of the abdomen. The pain is intense, and similar to that of constipation. Noticeably more rigid abdominal pain. Those who are diagnosed are generally under the age of thirty.
- Cystic Fibrosis: Hereditary, common among children because patients rarely make it past adolescence. Symptoms are similar to bronchitis, as well as asthma. Chronic coughing and wheezing is common.
- The mucus in cystic fibrosis patients is generally thicker, which accounts for difficulty in breathing and performing daily tasks.
- Adrenalin: Found in the adrenal glands, squeezes the blood vessels and increases the heart rate and blood pressure.
- Anoxia: Lack of oxygen in part of the heart muscle, caused by limited blood supply from a blood clot.
    - Arrhythmia: Increase in heartbeat

Handbook of Current Health and Medicine by Bryan Bunch

- Cholera- Treatment consists of replacing fluids that are lost due to symptoms, such as diarrhea and vomiting.
- Chronic stress is closely related to ulcers. The stomach releases digestive juices, which irritate the digestive tract lining leading to digestion of the walls of the stomach and causes ulcers.
- Tuberculosis: Occurred in the 19th century. The epidemic slowly died down, during the 20th century) by using technology such as x-rays (screenings). Other tests include skin tests. Red skin meant the person had been or was infected with tuberculosis. The x-ray would show if the infection was active.
- Lyme Disease: Bacterial, spread by tick bites that have to do with the white-tailed deer.
- Rheumatic Fever- Strep infection, attacks the joints and heart. Treated with antibiotics. Sometimes the bacteria invades the brain but doesn't induce permanent damage.
- Scarlet Fever: Rare, from strep, child disease. Symptoms include high fever and a rash. Recovery is normal, but can lead to a kidney infection or rheumatic fever.
- Migraines: Periodic headaches along with blurred vision or nausea.
- Osteoporosis: Weakened and thin bones, associated with the elderly. Can be caused by excess of

thyroid, but main focus on diet and exercise.

Communicable Diseases- Second Edition (African Medical and Research Foundation)

- Largest living organism (tapeworm) can be seen by the naked eye
- Protozoa- Single celled organisms. For example, malaria, parasites.
- Agents: Living organism of disease
- Host: What the agent infects
- If the balance between the triad of the Agent, Host, and Environment is constant, then the number of people getting sick will be consistent.
- Managing disease: Must have prevention, a treatment, and a cure.
- Zoonoses- Animal infections that can spread to humans. Ex. Rabies, plague
- Incubation Period: Time between infection and appearance of symptoms.
- Shorter incubation period results in faster killing of the disease.
- Clinical Infection: Deals with detectable symptoms that allow for treatment
- Subclinical Infections: Not so obvious symptoms
- Reservoir: Animal or place where the organism lives and multiplies
- Route of Transmission: Way in which the organism leaves source and finds new person to infect.
- Mass treatment: High percentage of population are known to have certain disease, and get treated for it.
- Vector Control: Method used is changing the environment so that it is harder for the vector to live. Ex. Draining swamps, and using chemicals.
- Immunization allows for stronger internal defences that the body uses. Ex. Antibodies, killer cells. Very effective in order to control diseases.
- To control disease in a community, the immunization must be given to a large number of people, about eighty percent or higher.
- Those who are malnourished get infections easily, and complications can be worse.
- Contagious diseases- transmitted through direct contact. These diseases occur in clusters. Causes of contagious diseases include populated areas, overcrowding, poor hygiene, and close personal contact.
- Scabies: Symptoms: Sever itching. Can be treated with BBE or Tetmosol. To control, use water and soap regularly.
- The human flea: Also known as Pulex irritans, does not require treatment.
- Malaria: Acute illness caused by protozoa (of the genus Plasmodium). Accompanied by attacks of fever.
- Cell- Unit of life, includes a nucleus, membrane, and protoplasm (substance)
    - Chromosome: Very tiny, rod shaped, carries genes with hereditary characteristics.

Additional Vocabulary Terms

Neutrophils = The most abundant white blood cells that stain a neutral pink hue. These cells are considered the first responders in acute (initial) stage of inflammation and are present in bacterial infections. Part of the innate immune system.

Cowpox/Smallpox and Edward Jenner = The cowpox virus was used as the first vaccine for smallpox and for any disease because both viruses share similar antigens. By exposing an individual to these antigens the immune system could be trained to effectively deal with the antigens of both smallpox and cowpox without subjecting the patient to the risk of smallpox. Cowpox is considerably less virulent and thus could be used as a safe preventative measure against a much more threatening disease.

Innate Immune System = Also known as the non-specific immune system, the innate immune system is the first line of defense in all plant and animal life and responds immediately to pathogens but offers no permanently augmented immunity.

Adaptive Immune System * = Also known as the acquired or specific immune system, the adaptive immune system is no more specific necessarily than the innate immune system in the sense that both assist in developing immunity toward recognized pathogens; yet, the adaptive system creates a potent defense that becomes increasingly effective upon each repeated encounter with a pathogen.

Epidemiology: Epidemiology is the study of the distribution and determinants of health-related states or events, and the application of this study to the control of diseases and other health problems. Various methods can be used to carry out epidemiological investigations: surveillance and descriptive studies can be used to study distribution; analytical studies are used to study determinants.

Analytical epidemiology

statistical analysis of epidemiological data in an attempt to establish relationships between causative factors and incidence of disease.

Descriptive epidemiology

information about the occurrence of a disease, some of it mathematical, but with no attempt to establish relationships between cause and effect.

Experimental epidemiology

prospective population experiments designed to test epidemiological hypotheses, and usually attempt to relate the postulated cause to the observed effect. Trials of new anthelmintics are an example.

Gum-boots epidemiology

see shoe-leather epidemiology (below).

Landscape epidemiology

epidemiology of a disease in relation to the entire ecosystem under study.

Observational epidemiology

based on clinical and field observations, not on experiments.

Shoe-leather epidemiology

epidemiology conducted as a field study. Called also gum-boots epidemiology.

Theoretical epidemiology

the use of mathematical models to explain and examine aspects of epidemiology, e.g. computer simulation models of outbreaks.

***Included in the functions of the adaptive immune system are:**

1. **Somatic hypermutuation**: The process by which adaptive immunity so quickly (hence 'hyper') imprints lymphocytes with antigen receptors and so effectively provides permanent auxiliary to the body's immune system. The process involves a relatively small quantity of genes rapidly producing huge sums of antigen receptors (antibodies??) and doing so irreversibly, so that any new cells produce also contain these adaptations.

2. **Lymphocytes**: These are white blood cells that are intrinsically part of the vertebrate immune system. Lymphocytes can be further divided into large granular natural killer cells, and smaller T and B cells.

3. **B Cells**: These are the cells, the lymphocytes, that directly produce antibodies unlike the T cells. Many B cells remain in an inactive state as memory B cells and respond more quickly over time.

4. **T cells**: These cells share many qualities of the counterparts, the B cells, in that they reproduce and create effector cells and remain as dormant memory T cells; yet, these cells differ in that they do not produce antibodies. They also mature in the thymus (hence 'T') and aid in the development of B cells and the activation of macrophages along with developed resistance to cancers by means of natural killer T cells (not related to other natural killer cells!)

Macrophages = Bearing the title “large eaters,” macrophages serve to consume inactive cells and pathogens, which are digested in a manner which preserves the pathogenic antigens, in the body and work with T cells to allow the body to recognize antigens. Once recognized, the presence of antigens is relayed by T cells to inform B cells of the threat, thus sparking a process of antibody production. This particular process places the macrophages as initial agents battling a disease. The macrophages also

serve, in rare circumstances, to aggressively consume tumor cells and assist T and natural killer cells in their labor.

Pathogen = An agent that causes disease via bacterium, virus, prion, or other microorganism.

Epitope = The part of an antigen that is recognized by the immune system, especially by antibodies.

Paratope = The part of an antibody that recognizes epitopes specifically.

Attack Rate = The proportion of a population affected by a specific condition during a prescribed, usually short, period of time.

Morbidity Rate = The number of cases of a given disease occurring in a specified period per unit of population. The difference between morbidity and attack rate is simply that morbidity refers to # of cases while attack rate refers to a proportional relationship.

Mortality Rate = Death rate; the mortality rate of a disease is the ratio of the number of deaths from a given disease to the total number of cases of that disease.

Case Rate = Refer to definition of morbidity rate.

Reactor = A person sensitive to a particular drug or agent.

Reactor Rate = Percentage of reactors in a tested population.

Autoimmunity = Autoimmunity is the failure of an organism in recognizing its own constituent parts as *self*, which allows an immune response against its own cells and tissues. Any disease that results from such an aberrant immune response is termed an autoimmune-disease. In addition, autoimmune diseases attack the body damaging tissues and causing inflammation.

Septic Shock = In humans, septic shock has a specific definition requiring several conditions to be met for diagnosis. It is the result of a bacterial infection:
•First,SIRS (systemic inflammatory response syndrome) must be diagnosed by finding at least any two of the following:
Tachypnea (high respiratory rate) > 20 breaths per minute, or on blood-gas, a PCO2 less than 32 mmHg signifying hyperventilation.
White blood cell count either significantly low, < 4000 cells/mm³ or elevated > 12000 cells/mm³.
Heart Rate > 90 beats per minute
Temperature/ Fever > 38.5 °C (101.3 °F) or hypothermia < 35.0 °C (95.0 °F)

Second, there must be sepsis and not an alternative form cause of SIRS. Sepsis requires evidence of infection, which may include positive blood culture, signs of pneumonia on chest x-ray, or other radiological or laboratory evidence of infection.

•Third, signs of end-organ dysfunction are required such as renal failure, liver dysfunction, changes in mental status, or elevated serum lactate.

•Finally, septic shock is diagnosed if there is refractory hypotension (low blood pressure that does not respond to treatment). This signifies that intravenous fluid administration alone is insufficient to maintain a patient's blood pressure from becoming hypotensive.

Influenza = Usually referred to as the flu or grippe, influenza is a highly infectious respiratory disease. The disease is caused by certain strains of the influenza virus. When the virus is inhaled, it attacks cells in the upper respiratory tract, causing typical flu symptoms such as fatigue and chills, a hacking cough, and body aches. Influenza victims are also susceptible to potentially life-threatening secondary infections. Although the stomach or intestinal "flu" is commonly blamed for stomach upsets and diarrhea, the influenza virus rarely causes gastrointestinal symptoms. Such symptoms are most likely due to other organisms such as rotavirus, *Salmonella, Shigella*, or *Escherichia* coli.

Prion = Infectious agents caused by a protein in a “misfolded” form (according to a debated hypothesis) and always affecting the brain or other neural tissue (yes!) bringing very frequent fatality. The incubation period of prion diseases is determined by the exponential growth rate of the incorrectly folded proteins. There are relatively few prion diseases presenting a risk to humans, but those few are extremely potent and nearly always fatal. Also, many mammals including humans have species-specific variations of the prion spongiform encephalopathy

Additional Information and Hisory:

John Snow = Widely considered the first epidemiologist, he traced the outbreak of London Cholera to the water supply as opposed to “bad air”. He did so by comparing the mortality rates of customers of two water companies, each with differing levels of sewage contamination.

Robert Koch = Discovers, by means of the inchoate science of bacteriology, that tuberculosis is a product of coughing and sneezing spread in the form of bacteria. His work founded the germ theory to understand infectious diseases.

Alesandre Yersin Kitasato Shibasaburo = Discover the bacteria that causes the plague, Yersin is credited more so hence the scientific name for the pathogen “Yersinia pestis.”

Selman Waksman = Discovers streptomycin, the first antibiotic that effectively reduces the potency of tuberculosis, he earns a Nobel prize for the momentous benefits of his discovery.

Smallpox Eradication of 1979 = The only instance during which an infectious disease was effectively eliminated was celebrated heartily by the World Health Organization.

Lupus (Systemic lupus erythematosus) = An autoimmune disease with a multitude of symptoms, lupus causes the distinctive butterfly rash which often heals from the inside out. The disease is considerably more prevalent in women of non-European descent and often affects various regions of the body. The disease increases in intensity during flares and sees reduction in intensity during remission.

	Disease Yes	Disease No
Exposed (Ate salad)	150 (a)	30 (b)
Unexposed (no salad)	50 (c)	170 (d)

- ***Attack rate* – the rate that a group experienced an outcome or illness= number sick ÷ total in that group (Look for high attack rate in exposed & low rate in unexposed)**

exposed = a ÷ (a+b) = 150 ÷ 180 = 80% unexposed = c ÷ (c + d) = 50 ÷ 220 = 20%

***Relative risk* = [a ÷ (a+b)] / [c ÷ (c+d)] = 80% ÷ 20% = 4**

Ate	Case patients	Controls	Total
Yes	a = 30	b = 36	66
No	c = 10	d = 70	80
Total	40	106	146

***Odds Ratio* =**

Odds of exposure in cases = a/c = a d = 30x70 = 5.8
Odds of exposure in controls b/d b c 36x10

This means that people who ate at Restaurant A were 5.8 times more likely to develop hepatitis A than were people who did not eat there. a = # of case patients exposed b = # of control exposed c = # of case patients unexposed d = # of control unexposed

Name 3 routes of entry into a person's body for environmental micro-organisms or chemicals .

- Respiratory (breathing or through the air)
- Ingestion (food, eating, water or drinking)
- Dermal Contact (skin or skin absorption

Environmental factors that can cause disease could be biological, chemical, or physical. List one of each type. (No credit if you list agents discussed in today's event)
Answers will vary but may include

Biological:

- Bacteria or parasites or viruses (Specific genus/species of specific organism or virus name is acceptable

Chemical:

- Drugs
- Dust
- Skin irritants
- Food additives
- Food contaminants
- Hazardous waste
- Toxic waste
- Pollution

Physical:

- Noise
- Climate
- Weather
- Light

Age-adjusted mortality rate: A mortality rate statistically modified to eliminate the effect of different age distributions in the different populations.

Agent: A factor, such as a microorganism, chemical substance, or form of radiation, whose presence, excessive presence, or (in deficiency diseases) relative absence is essential for the occurrence of a disease.

Age-specific mortality rate: A mortality rate limited to a particular age group. The numerator is the number of deaths in that age group; the denominator is the number of persons in that age group in the population.

Analytic epidemiology: The aspect of epidemiology concerned with the search for health-related causes and effects. Uses comparison groups, which provide baseline data, to quantify the association between exposures and outcomes, and test hypotheses about causal relationships.

Analytic study: A comparative study intended to identify and quantify associations, test hypotheses, and identify causes. Two common types are cohort study and case-control study.

Applied epidemiology: The application or practice of epidemiology to address public health issues.

Association: Statistical relationship between two or more events, characteristics, or other variables.

Attack rate: A variant of an incident rate, applied to a narrowly defined population observed for a limited period of time, such as during an epidemic.

Attributable proportion: A measure of the public health impact of a causative factor; proportion of a disease in a group that is exposed to a particular factor which can be attributed to their exposure to that factor.

Bar chart: A visual display of the size of the different categories of a variable. Each category or value of the variable is represented by a bar.

Bias: Deviation of results or inferences from the truth, or processes leading to such systematic deviation. Any trend in the collection, analysis, interpretation, publication, or review of data that can lead to conclusions that are systematically different from the truth.

Biologic transmission: The indirect vector-borne transmission of an infectious agent in which the agent undergoes biologic changes within the vector before being transmitted to a new host.

Box plot: A visual display that summarizes data using a ``box and whiskers" format to show the minimum and maximum values (ends of the whiskers), interquartile range (length of the box), and median (line through the box).

Carrier: A person or animal without apparent disease who harbors a specific infectious agent and is capable of transmitting the agent to others. The carrier state may occur in an individual with an infection that is inapparent throughout its course (known as asymptomatic carrier), or during the incubation period, convalescence, and postconvalescence of an individual with a clinically recognizable disease. The carrier state may be of short or long duration (transient carrier or chronic carrier).

Case: In epidemiology, a countable instance in the population or study group of a particular disease, health disorder, or condition under investigation. Sometimes, an individual with the particular disease.

Case-control study: A type of observational analytic study. Enrollment into the study is based on presence (``case") or absence (``control") of disease. Characteristics such as previous exposure are then

Compared between cases and controls.

Case definition: A set of standard criteria for deciding whether a person has a particular disease or health-related condition, by specifying clinical criteria and limitations on time, place, and person.

Case-fatality rate: The proportion of persons with a particular condition (cases) who die from that condition. The denominator is the number of incident cases; the numerator is the number of cause-specific deaths among those cases.

Cause of disease: A factor (characteristic, behavior, event, etc.) that directly influences the occurrence of disease. A reduction of the factor in the population should lead to a reduction in the occurrence of disease.

Cause-specific mortality rate: The mortality rate from a specified cause for a population. The numerator is the number of deaths attributed to a specific cause during a specified time interval; the denominator is the size of the population at the midpoint of the time interval.

Census: The enumeration of an entire population, usually with details being recorded on residence, age, sex, occupation, ethnic group, marital status, birth history, and relationship to head of household.

Chain of infection: A process that begins when an agent leaves its reservoir or host through a portal of exit, and is conveyed by some mode of transmission, then enters through an appropriate portal of entry to infect a susceptible host.

Class interval: A span of values of a continuous variable which are grouped into a single category for a frequency distribution of that variable.

Cluster: An aggregation of cases of a disease or other health-related condition, particularly cancer and birth defects, which are closely grouped in time and place. The number of cases may or may not exceed the expected number; frequently the expected number is not known.

Cohort: A well-defined group of people who have had a common experience or exposure, who are then followed up for the incidence of new diseases or events, as in a cohort or prospective study. A group of people born during a particular period or year is called a birth cohort.

Cohort study: A type of observational analytic study. Enrollment into the study is based on exposure characteristics or membership in a group. Disease, death, or other health-related outcomes are then ascertained and compared.

Common source outbreak: An outbreak that results from a group of persons being exposed to a common noxious influence, such as an infectious agent or toxin. If the group is exposed over a relatively brief period of time, so that all cases occur within one incubation period, then the common source outbreak is further classified as a point source outbreak. In some common source outbreaks, persons may be exposed over a period of days, weeks, or longer, with the exposure being either intermittent or continuous.