UNIT 10 - INFECTIOUS DISEASES

Infectious diseases are caused by pathogens. Pathogens can be bacteria, viruses, protoctists, or fungi.

Disease transmission - the transfer of a pathogen from a person infected with that pathogen to an uninfected person

Transmission cycle - the passage of a pathogen from one host to another that is continually repeated as the pathogen infects new hosts

- Endemic - a disease that is always within a population e.g. tuberculosis
- Pandemic - a sudden increase in the number of cases in an entire continent or across the globe e.g. COVID-19
- Epidemic - a sudden increase in the number of people with a disease
- Prevalence - the number of people who have the disease at any one time
- Incidence - the number of people diagnosed over some time

Bacteria and viruses are the main disease-causing pathogens in humans. Even though they both cause disease. They vary in many ways:

- Bacteria are prokaryotic cells and do not have a nucleus – their genetic information is stored in the form of a circular strand of DNA whereas viruses consist of just nucleic acids enclosed in a protein hull, and their genetic material can be either DNA or RNA
- Bacteria do not need a host to survive whereas viruses do
- Viruses are significantly smaller than bacteria

Disease transmission

- Diseases can be infectious or non-infectious. Non-infectious diseases such as sickle cell anemia and lung cancer are not caused by pathogens and cannot spread between organisms.
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DISEASE	PATHOGEN	PATHOGEN NAME	TRANSMISSION	PREVENTION
Cholera	Bacteria	Vibrio cholera	Contaminated water & food	Improved sanitation
Malaria	Protoctist	Plasmodium falciparum Plasmodium vivax Plasmodium malariae Plasmodium ovale	Infected female Anopheles mosquito	Reduce the number of mosquitos (e.g. habitat destruction) & preventing biting (e.g. repellants)
Tuberculosis	Bacteria	Mycobacterium tuberculosis Mycobacterium bovis	Airborne droplets from sneezing/coughing	Using the TB vaccine & quarantining patients
HIV/AIDS	Virus	Human immunodeficiency virus	Exchange of infected bodily fluids e.g. blood or semen	Take HIV medication. Use condoms & clean needles.

Cholera:

- Is transmitted through contaminated water and food that has come into contact with infected fecal matter.
- V. cholera conceals itself in the wall of the intestines (antigenic concealment) and causes symptoms such as diarrhea and "rice water" (which is when the person only passes water as waste instead of urine or feces). This results in severe dehydration, which can be fatal if the person is not treated.

Malaria:

- Is transmitted via the bite of a female Anopheles mosquito.
- Malaria causes symptoms including fever, anemia, headaches, nausea, and an enlarged spleen. Since the pathogen is transmitted via an insect vector, it is extremely difficult to develop a vaccine that can target the pathogen

Tuberculosis:

- Infects phagocytes in the lungs.
- Tuberculosis lies dormant in the cells and when it emerges, it is not destroyed by the immune system as the tubercles are covered with a thick waxy coat.
- When the immune system becomes weakened, the bacteria become active and slowly destroy lung tissue. This is why when a person is suffering from another disease or is under the influence of immunosuppressant drugs, they can often fall ill with TB as well because their immune system has been weakened.

HIV/AIDS:

- HIV causes AIDS (Acquired Immunodeficiency).
- After several weeks, HIV antibodies appear in the blood, thus making a person HIV positive.
- After this period, the symptoms of the disease disappear until the immune system becomes weakened again, leading to AIDS.

Location of diseases

Cholera - mainly in underdeveloped areas in parts of Asia, Africa, and Latin America
Malaria - 80% of the cases are concentrated in Africa (the climate is suitable for a large mosquito population)
Tuberculosis - prevalent among the entire world population
HIV/AIDS - present worldwide, but especially in Sub-Saharan Africa and East Asia

Prevention

Cholera
- Proper sanitation and public sewage treatment - this will prevent any fecal matter, infected or not, from contaminating bodies of water
- Hygiene regulations in crowded areas and in places where food must be handled
- Clean irrigation water free from human waste
- Oral vaccines provide temporary immunity for people traveling to high-risk areas
  - ★ Cholera's method of transmission includes ingestion of infected water and fecal matter due to poor sanitation. By breaking the cycle of transmission, the disease can be prevented.

Malaria
- Malaria is transmitted by an insect vector, so one way to prevent the spread of malaria is to reduce the number of mosquitos. This can be done by:
  - Destroying their habitats by draining marshes and clearing away ground vegetation to prevent mosquitos from breeding
  - Spreading oil on stagnant, dirty water to prevent mosquitos from laying eggs, and to prevent existing mosquito larvae from breathing
- Another way is to avoid being bitten. This can be done by using insect repellent, insect sprays, and mosquito nets.
- Lastly, prophylactic drugs can prevent plasmodium from infecting people. RSTS, S is an injectable vaccine that provides partial protection against malaria for young children.
- Some factors may lead to improvements in the control of malaria, including:
- Modern techniques in genetic technology and drug design
- The development of vaccines targeted against different stages of the parasite's life cycle
- An international will to eradicate malaria, especially from poorer regions

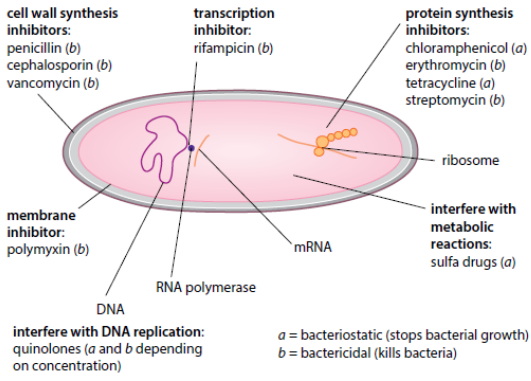
HIV/AIDS
- HIV/AIDS is spread through the exchange of infected bodily fluids, either by sexual means or via injection. Prevention measures include:
  - Spreading awareness about the transmission of the disease
  - Providing clean needles to those addicted to injection drugs (e.g. heroin) to prevent the sharing of needles
  - Blood screening to make sure donors are not HIV+
  - Home testing kits for HIV/AIDS to be made widely available
  - Reducing mother-to-child transmission by using different breast milk

Tuberculosis
- Screen all those that come into contact with an infected person
- Isolate infected people to prevent the spread of the disease
- Positively test cattle for mycobacterium bovis
- Vaccinate the general population to prevent infection as well as the spread of the disease

Antibiotics

Antibiotic - a substance derived from a living organism that is capable of killing or inhibiting the growth of microorganisms

Antibiotics only work against bacteria, not viruses. Antibiotics can work in different ways, as demonstrated in the diagram.



Antibiotic resistance - the ability of bacteria or fungi to grow in the presence of an antibiotic that would normally slow their growth (bacteriostatic) or kill them (bactericidal). Antibiotic resistance is caused by mutation and becomes widespread when antibiotics are overused.

- Some bacteria become resistant via natural selection. Bacteria not killed by the drugs possess a selective advantage – resistance which enables them to survive and reproduce. The allele for resistance is passed onto the offspring, thus creating a resistant strain
- The resistant alleles are found in plasmids, loops of DNA that may have multiple genes coding for multiple resistances
- To prevent antibiotic resistance, hospitals shoulds:
- Isolate patients infected with resistant bacteria to control their spread
- Only administer antibiotics when necessary
- Ensure patients complete the full course of the antibiotic to make sure all the bacteria are killed