

Infectious disease

- Cholera, malaria, tuberculosis (TB) and HIV/AIDS
- Antibiotics

Learning Outcomes

A. Define the term disease and explain the difference between an infectious disease and non-infectious diseases (limited to sickle cell anaemia and lung cancer);

Disease: an abnormal condition affecting an organism, which reduces the effectiveness of the functions of the organism.

Infectious disease: a disease caused by a pathogen that can be transmitted from one host organism to another.

Non-infectious disease: a disease with a cause other than a pathogen, including genetic disorders (such as sickle cell anaemia) and lung cancer (linked to smoking and other environmental factors).

B. Describe the causes of the following diseases: cholera, malaria, TB, HIV/AIDS, smallpox and measles;

Diseases	Causes/ Pathogen
Cholera	Cholera is caused by a bacterium, Vibrio cholera.
Malaria	Plasmodium falciparum, P. vivax, P. ovale, P. malariae
TB	Mycobacterium tuberculosis; mycobacterium bovis
HIV/AIDS	Human immunodeficiency virus
Smallpox	Variola virus
Measles	Virus

C. Explain how cholera, measles, malaria, TB and HIV/AIDS are transmitted;

Diseases	Method of transmission
Cholera	Food-borne, waterborne
Measles	By breathing in tiny droplets that come out of the nose and mouth when someone with measles coughs or sneezes.

Malaria	Insect vector: female Anopheles mosquito
TB	Airborne droplets (m.tuberculosis); via undercooked meat and unpasteurised milk (M.bovis)
HIV/AIDS	In semen and vaginal fluids during sexual intercourse, infected blood or blood products, contaminated hypodermic syringes, mother to fetus across the placenta, at birth, mother to infant in breast milk

D. Discuss the roles of social, economic and biological factors in the prevention and control of cholera, measles, malaria, TB and HIV/AIDS (a detailed study of the life cycle of the malarial parasite is not required);

Preventing Cholera:

Transmission is most likely to occur in the crowded and impoverished conditions, such as refugee camps. Cholera is best controlled by treating sewage effectively, providing a clean water supply and maintaining good hygiene in food preparation. There is no fully effective vaccine for cholera.

Preventing Malaria:

Reducing the population of mosquitoes, for example by removing sources of water in which they can breed, or by releasing large numbers of sterile males, can reduce the transmission of malaria.

Preventing mosquitoes from biting people, for example by sleeping under a mosquito net, or by wearing long-sleeved clothing and insect repellent, can reduce the chances of a mosquito picking up plasmodium from an infected person or passing it to an uninfected person.

Prophylactic drugs (that is, drug that prevent pathogens infecting and breeding in a person) can be taken. However, in many parts of the world plasmodium has evolved resistance to some of these drugs.

Preventing TB:

TB is most prevalent amongst people living in poor accommodation, or whose immune systems are not functioning well, perhaps because of malnutrition or infection with HIV. Increasing standards of living and treating HIV infection can therefore help to reduce the incidence of TB.

Vaccination with the BCG vaccine confers immunity to TB in many people. New vaccines are being developed that it is hoped will be more effective.

Treatment of HIV drug therapy reduces the risk that an HIV – positive person will get TB.

Treatment of TB with antibiotics can often completely cure the disease. However, that is not always the case because:

- There are now many strains of the M. tuberculosis bacterium that have evolved resistance to most of the antibiotics that are used;
- The bacteria reproduce inside body cells, where it is difficult for drugs to reach them;
- The drugs need to be taken over a long time period, which often requires a health worker checking that a person takes their drugs every day.

Preventing HIV/AIDS

All blood to be used in transfusion should be screened to ensure it does not contain HIV.

All hypodermic needles should be sterile and used only once, and disposed of carefully.

A person should avoid sexual activity with anyone whose HIV status they do not know. If everyone had only one partner, HIV could not be transmitted. Condoms, if properly used, can prevent the virus passing from one person to another during intercourse. If a person is diagnosed with HIV, all their sexual contacts should be traced and informed that they may have the virus.

The chances of HIV passing from an HIV – positive mother to her fetus is greatly reduced if the mother is treated with appropriate drugs. These drugs can also greatly increase the length of time between a person becoming infected with HIV and developing symptoms of AIDS, and can significantly prolong life.

HIV infection rates are especially high in sub-Saharan Africa. Many of these people are not able to receive treatment with effective drugs, generally for economic reasons.

Preventing Measles:

Measles is a serious disease, which can cause death, especially in adults and in people who are not in good health, for example because they do not have access to a good diet.

Vaccination is the best defence against measles. The vaccine is highly effective, especially if two doses are given. The people most likely to suffer from measles are therefore those who are malnourished and who live in areas where no vaccination programme is in place.

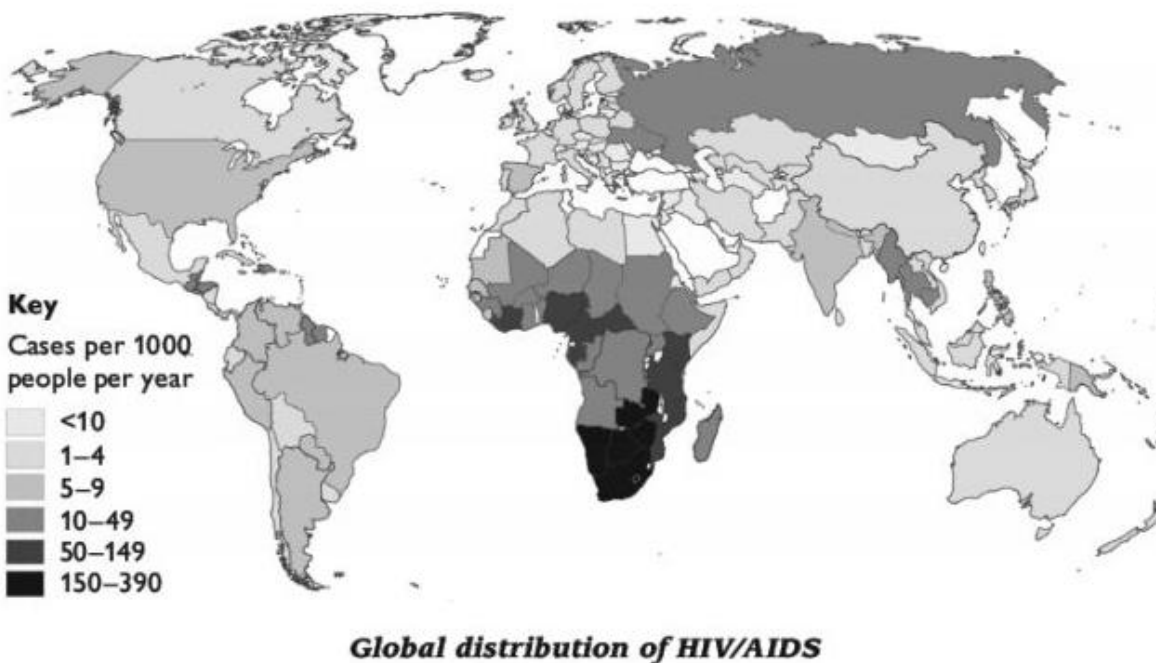
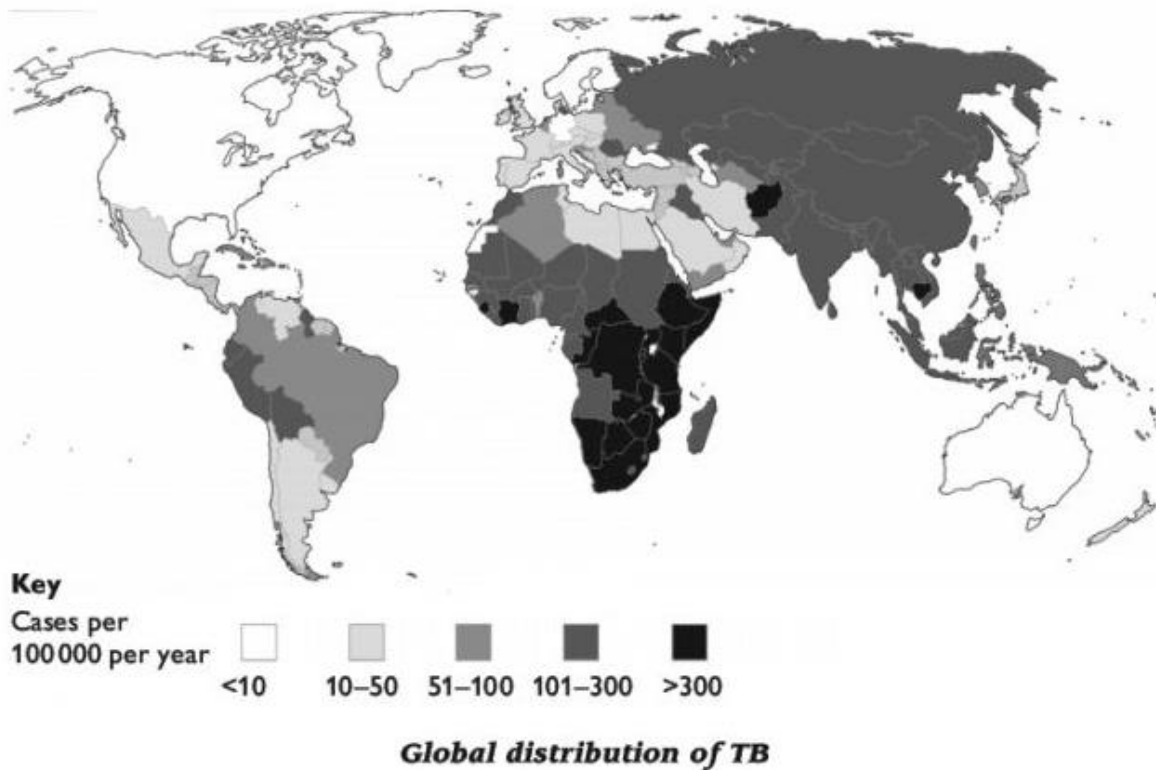
E. Discuss the global patterns of distribution of malaria, TB and HIV/AIDS and assess the importance of these diseases worldwide;

Malaria is found in parts of the world where the *Anopheles* mosquito species that can act as vectors are found. This is mostly in tropical and subtropical regions where humidity is high.



Global distribution of malaria

TB is found in all countries of the world, including developed countries such as the USA and the United Kingdom. However, it is most common in areas where living conditions are poor and crowded, or where large numbers of people have HIV/AIDS.



F. Outline the role of antibiotics in the treatment of infectious diseases;

An antibiotic is a substance that, when taken orally or by injection, kills bacteria but does not harm human cells. Antibiotics are not effectively against viruses. Many antibiotics are

originally derived from fungi, but they can also be obtained from other organisms or synthesised in the laboratory.

Antibiotics act on structure or metabolic pathways that are found in bacteria but not in eukaryotic cells. The correct antibiotic must be chosen for a particular disease. For example:

- **Penicillin** prevents the synthesis of the links between peptidoglycan molecules in bacterial cell walls; when the bacteria take up water by osmosis, the cell wall is not strong enough to prevent them bursting.
- **Rifampicin (rifampin)** inhibits an enzyme required for RNA synthesis in bacteria.
- **Tetracycline** binds to bacterial ribosomes and inhibits protein synthesis.

Exposure to antibiotics exerts strong selection pressure on bacterial populations. Any bacterium that is resistance to the antibiotic – for example, because it synthesises an enzyme that can break down the antibiotic – has a selective advantage and is more likely to survive and reproduce successfully. The offspring will inherit the alleles that confer resistance. A whole population of resistance bacteria can therefore be produced. For this reason, it is important that antibiotics are only used when necessary. A person prescribed antibiotics should complete the course, as this increases the chances of eradicating all the disease – causing bacteria in the body.