



Edexcel GCSE Biology



Your notes

Disease

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Health & Disease



Your notes

Defining Health

- The World Health Organisation (WHO) defines health as '**a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity**'
- This means that health is not just dependent on whether an individual is physically sick or not
 - There are lots of factors that should be considered when assessing the health of an individual which includes mental health as well as the level of social support in place

Communicable & Non-Communicable Disease

Communicable Diseases

- **Communicable** diseases are caused by **microorganisms** called **pathogens** which can **spread** between individuals or individuals and animals
 - E.g. **chickenpox**, a common childhood disease, is caused by a viral pathogen called the varicella-zoster virus whereas **Covid-19** is caused by the SARS-CoV-2 virus

Communicable Diseases Table



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Pathogen type	Disease caused	Pathogen	Method of transmission
Bacterium	Tuberculosis (TB)	M. tuberculosis M. bovis	Direct – airborne droplets
	Bacterial meningitis	N. meningitidis (also caused by H.influenzae, S.pneumoniae and L.monocytogenes)	Direct – airborne droplets
Virus	Influenza	Influenza A, influenza B, influenza C	Direct – airborne droplets
	HIV/AIDS	Human immunodeficiency virus (HIV)	Direct – transfer of body fluids
Protocist	Malaria	P. falciparum (also caused by P.ovale, P.vivax and P.malariae)	Indirect – female mosquitoes
Fungus	Cattle ringworm	T. verrucosum	Direct – contact with infected cattle
	Athlete's foot	E. floccosum, T. rubrum and T. mentagrophytes	Direct – contact with items touched by infected individuals

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Non-Communicable Diseases

- Non-communicable diseases are **not caused by pathogens** and **cannot be passed on** between individuals
 - Their effects on health tend to be **longer-lasting**; examples are **asthma**, **CHD** and most **cancers**
- However, the **risk** of developing non-communicable diseases may be **increased** by certain **factors** (including **diet**, **stress** and **life situations**) as these factors may have a profound effect on both physical and mental health
 - Eating a balanced diet that provides the right amount of energy and nutrients helps maintain good health whereas a **poor diet** can lead to **deficiencies**, **obesity**, **diabetes** and **poor mental health**
 - Constantly being under **stress** can lead to cardiovascular issues (such as high blood pressure, increasing the risk of CHD) and poor mental health
 - Where a person lives and their income can have a profound impact on health – this affects the standard of **healthcare** that is accessible to them (and what they can afford), what food they buy etc.

Risk Factors in Non-Communicable Diseases Table



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Risk factor	Disease risk factor is linked to	Explanation of how risk factor may cause disease
Smoking	Lung disease, lung cancer and cardiovascular disease	Chemicals in cigarette smoke (such as tar and nicotine) damage the alveoli in the lungs and the endothelial lining of the arteries.
Obesity caused by a poor diet	Type 2 diabetes	Excess consumption of sugar as a result of a poor diet reduces the body's sensitivity to insulin
Consuming alcohol	Liver disease and impaired brain function	The breakdown of alcohol by cells of the liver produces substances which can be toxic to liver cells in high concentrations. The neurones of the brain are also damaged by alcohol, reducing brain function.
Exposure to carcinogens	Cancer	Exposure to ionising radiation (eg. X-rays) or certain chemicals can damage DNA in cells leading to uncontrolled cell division, causing cancer
Smoking and consuming alcohol when pregnant	Poor development of foetus (unborn baby)	Carbon monoxide in cigarette smoke reduces the amount of oxygen transported around the mother's body, reducing the oxygen delivered to the foetus. Substances in alcohol can impair the development of the brain in a foetus.



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Susceptibility

- If an individual suffers from one disease, they are likely to be more susceptible to other diseases
- This is because the immune system may be compromised in some way or the different types of disease may interact in ways that negatively affect the health of the individual
 - Defects in the **immune system** mean that an individual is more likely to suffer from **infectious diseases**; individuals infected with HIV eventually end up with reduced numbers of lymphocytes circulating around the body which reduces the ability of the immune system to fight opportunistic infections like pneumonia
 - **Viruses** living in cells can be the trigger for cancers; the HPV virus can infect cells of the cervix in women resulting in cervical cancer developing in some cases, whereas some strains of the hepatitis virus can cause liver cancer
 - **Immune** reactions initially caused by a pathogen can trigger **allergies** such as **skin rashes** and **asthma** – these often develop as a result of an **overactive immune response**
 - **Severe physical ill health** can lead to **depression** and other **mental illness**; both can negatively impact the immune system and lifestyle choices made by the individual, further compounding the effects of poor health



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Pathogens

Types of Pathogen

- **Communicable diseases** are spread by pathogens
- A **pathogen** is any microorganism that **causes disease** in another organism (e.g. in plants or animals)
- Many **microorganisms** are pathogens including:
 - **Bacteria**
 - **Fungi**
 - **Protists (protocists)**
 - **Viruses**
- **Not all species** within these groups (apart from the viruses) are pathogens, as many bacteria, fungi and protists are **harmless** and **do not cause disease**
- However, **all viruses are pathogenic** as they can **only exist** by living inside the living cells of other organisms (or by using these cells to create more viruses)

Pathogenic bacteria

- Pathogenic bacteria do not always infect the hosts of cells, they can remain within body cavities or spaces
- **Toxins** produced by the bacteria also damage cells
- They are small and can **reproduce very quickly**
- Bacterial infections include:
 - *M. tuberculosis* causes **tuberculosis** (TB) in humans
 - *N. meningitidis* causes **bacterial meningitis** in humans
 - *Helicobacter Pylori* causes **stomach ulcers**
 - *V. Cholerae* causes **cholera** in humans

Pathogenic fungi

- Fungal diseases are much more common in plants than animals
- Fungi can be **single-celled** or **multicellular** (with threads of hyphae)
- The **spores** they produce allow them to infect other organisms



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- In plants, fungal diseases tend to be much more serious and can threaten entire crops
- Fungal diseases include:
 - **Cattle ringworm** and **athletes foot** are fungal diseases in animals
 - **Black Sigatoka** is a fungal disease in bananas
 - **Chalara Ash Dieback** is a fungal disease that affects ash trees

Pathogenic protists

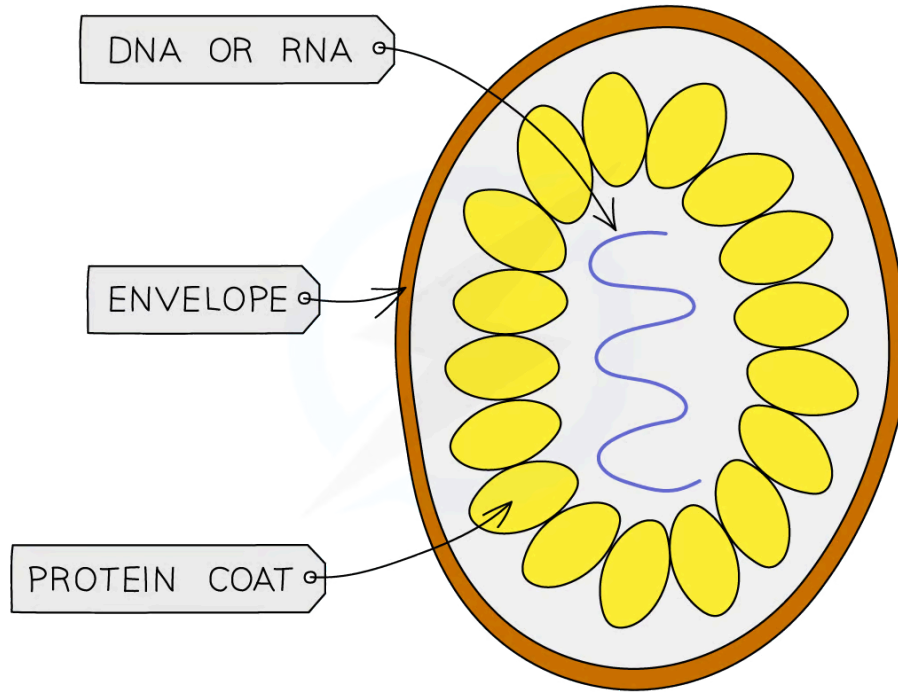
- **Protists** are a diverse group of **eukaryotic** (and usually unicellular) organisms
- They are **parasites** which means they need a **host** in order to survive
- Only a small number of protists are pathogenic, but the diseases they cause are often serious
- Examples of diseases caused by protists are:
 - *Plasmodium falciparum* is a protist that causes severe forms of **malaria** in humans
 - *P. infestans* causes the infamous **potato blight**

The Lifecycle of a Virus

- **Viruses** are not usually included in the classification of living organisms as they are **not considered to be alive**
 - This is due to the fact that viruses **do not carry out the 8 life processes** for themselves
- In fact, the only life process they seem to display is reproduction but even to carry out this process they must **take over a host cell's metabolic pathways** in order to make multiple copies of themselves
- Viruses, which have a wide variety of shapes and sizes, all share the following biological characteristics:
 - They are small particles (**always smaller than bacteria**)
 - They are parasitic and **can only reproduce inside living cells**
 - They infect **every type of living organism**
 - They have **no cellular structure** but have a **protein coat** and contain one type of **nucleic acid**, either **DNA** or **RNA**



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Structure of a typical virus

- Examples of viruses include:
 - **Tobacco mosaic virus (TMV)** causes discolouring of the leaves on tobacco plants by preventing the formation of chloroplasts
 - **HIV virus** causes **AIDS**
 - **Influenza virus** causes the 'flu'
 - **Ebola virus** causes haemorrhagic fever
- When a virus infects a host cell, it can then reproduce using two different pathways, known as:
 - The lytic pathway
 - The lysogenic pathway

The lytic pathway

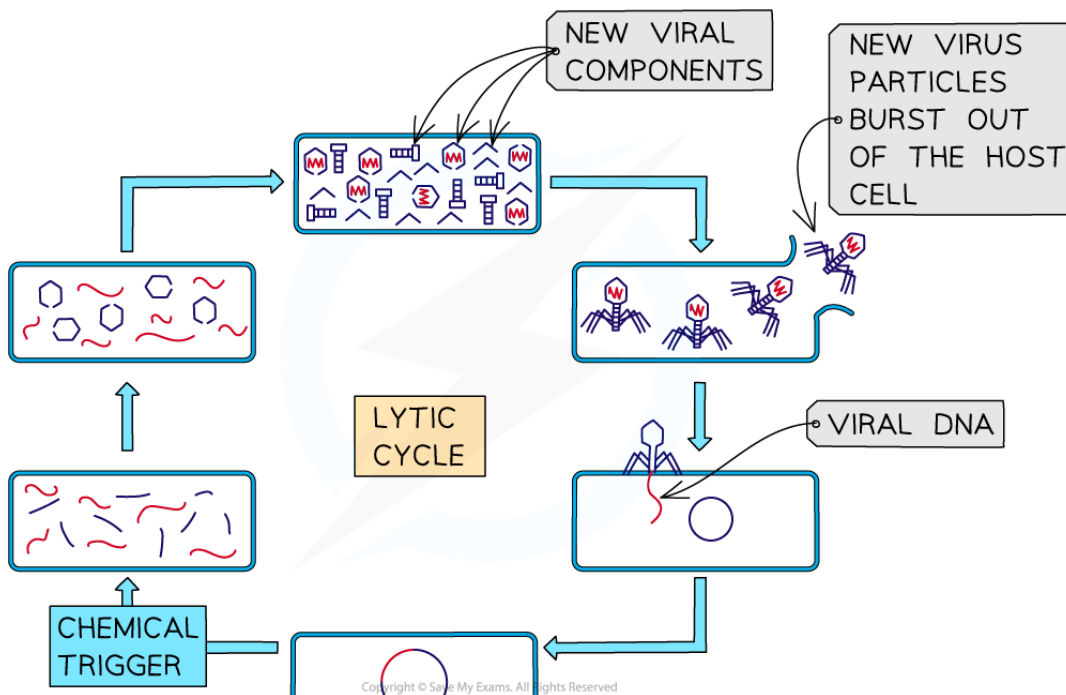


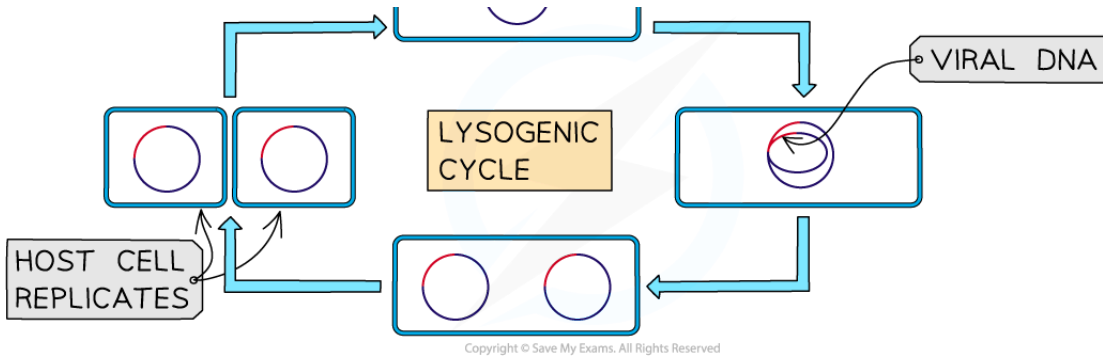
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1. The virus infects the host cell and injects its DNA into the cytoplasm
2. Next, the virus uses proteins and enzymes within the host cell to produce new virus particles
3. Finally, the cell bursts, releasing the virus particles into the host organism to infect more cells

The lysogenic pathway

1. The virus injects its DNA into the host cell and the DNA becomes incorporated into the host DNA
2. As the host cell replicates, the viral DNA replicates also, but no new virus particles are made during this time (the virus is dormant)
3. Changes in the environment (e.g. a chemical trigger) cause the viral DNA to move to the lytic pathway to make new virus particles





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A virus can follow two different pathways after infecting the host cell



Your notes

Common Infections

Common Infections

Infections caused by bacteria

- *Mycobacterium tuberculosis* causes **tuberculosis** (TB) in humans
 - The bacteria infect the lungs, causing a chronic cough and bloody mucus
 - It is a disease often associated with poor hygiene and sanitation
 - *M. bovine* in cows can also transmit to humans to cause TB
- *Vibrio cholerae* causes **Cholera**
 - Bacteria infect the intestines causing diarrhoea, vomiting and leg cramps
 - Cholera can lead to death if not treated quickly
 - It is a disease often associated with poor hygiene and sanitation
- *Helicobacter pylori* causes **stomach ulcers**
 - Infection of the stomach commonly occurring during childhood
 - *H. pylori* infection often gives no symptoms, but can lead to leads to pains in the abdomen, loss of appetite, bloating and nausea
- *Chlamydia trachomatis* causes **chlamydia**
 - This is a sexually transmitted infection
 - There may be no symptoms in some patients, others may have pain when they urinate, unusual discharge or bleeding after sex
 - Chlamydia can cause infertility if left untreated

Infections caused by fungi

- **Chalara Ash Dieback**
 - This fungal infection originated in Asia and affects ash trees of all ages with devastating effects
 - It causes **dark patches on the leaves**, **early leaf loss** and **bark lesions**
 - Spores travel **large distances** in the wind

Infections caused by protists



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- *Plasmodium falciparum* is a protist that causes severe forms of **malaria** in humans
 - The parasite is spread by **mosquitoes**
 - It causes damage to the **blood** and the **liver**
 - Infected individuals experience **fever, chills and fatigue**
 - Malaria can progress with more serious symptoms eventually leading to **death**

Infections caused by viruses

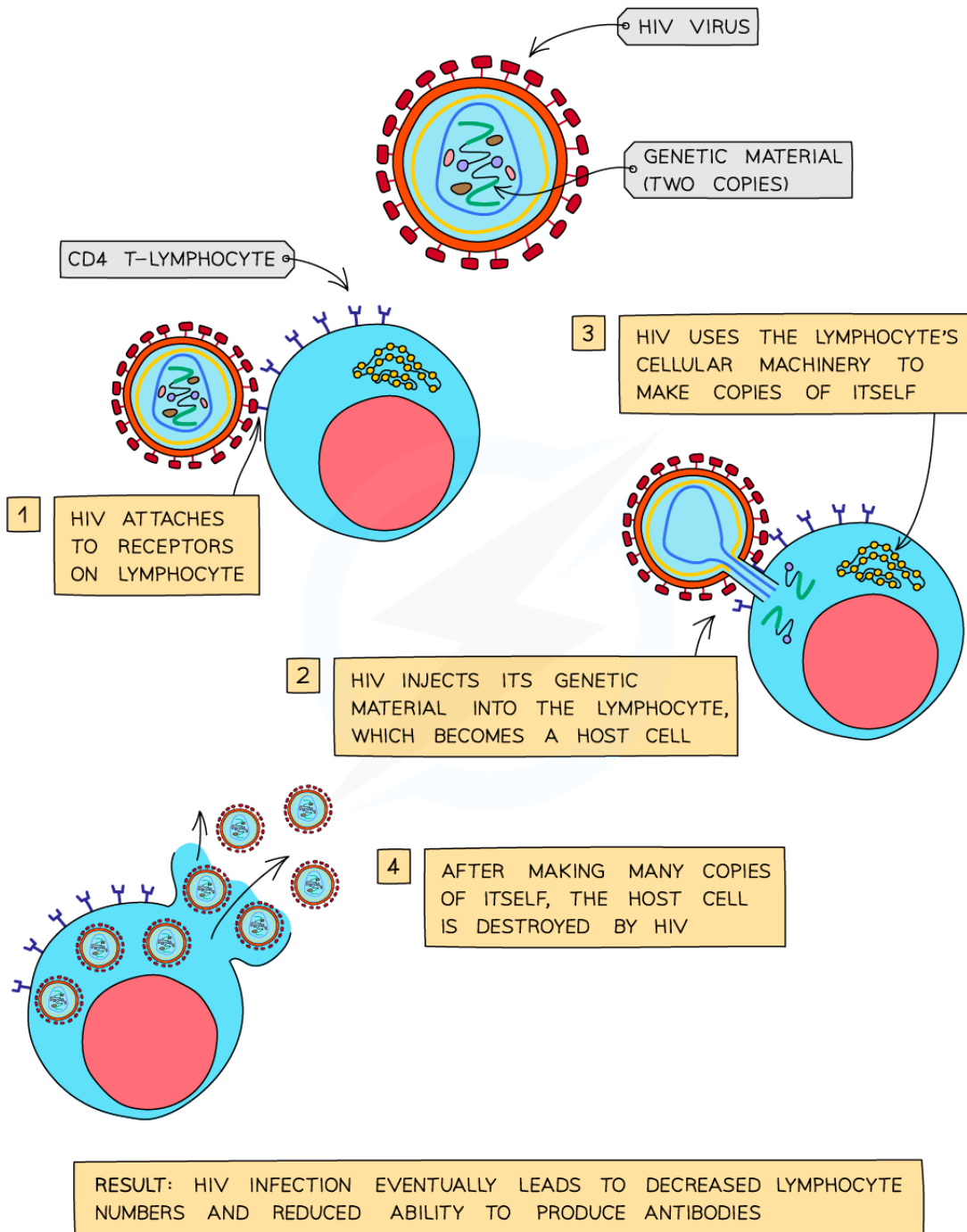
- **Ebola Virus** infects and kills body cells
 - Symptoms are flu-like initially
 - This includes headaches, high temperature, joint and muscle pains
 - Serious cases will also show diarrhoea, sickness, rashes and may lead to haemorrhagic fever (fever and internal bleeding)
- **Human Immunodeficiency Virus (HIV)** **destroys white blood cells** in the immune system
 - Initial symptoms are **flu-like**
 - This includes headaches, high temperature, joint and muscle pains
 - If untreated, the virus **compromises the immune system** leading to the onset of Acquired Immune Deficiency Syndrome (**AIDS**)
 - AIDS is used to refer to several life-threatening illnesses which may result from having a compromised immune system

More about HIV

- The virus infects a certain type of **lymphocyte** of the body's immune system
- Normally lymphocytes **seek out and destroy pathogens** that enter the body, producing antibodies that attach to pathogens, enhancing phagocytic activity
- However, HIV avoids being recognised and destroyed by lymphocytes by repeatedly **changing its protein coat**
- It then infects a certain type of lymphocyte and **uses the cells' machinery to multiply**
- This **reduces the number of lymphocytes** of the immune system, and also **the number of antibodies** that can be made
- This decreases the body's ability to fight off infections, eventually leading to **AIDS (Acquired immunodeficiency)**



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How HIV affects lymphocytes

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The Spread of Common Infections

- Diseases that are caused by pathogens that pass from one host to another are described as **transmissible diseases**
- Transmission can occur through several different mechanisms:
- **Airborne** - droplets travelling in the air (maybe as a result of wind or sneezing/coughing) lead to infection
 - e.g. Colds, influenza, tuberculosis, Chalara ash dieback
 - These types of infection in animals can be prevented by:
 - **Avoiding crowded areas**
 - **Good hygiene** generally
 - **Ventilation** of homes or workspaces
 - These types of infection in plants can be prevented by:
 - **Preventing imports** of trees from countries known to carry the disease
 - **Cutting down** infected trees as soon as possible and replacing with an **alternative species** which is unaffected
- **Waterborne** - pathogens that live in dirty water are transmitted to organisms that come into contact with it
 - e.g. Cholera
 - This can be prevented by **avoiding poor quality water** and making sure that people have access to **clean water**
- **Oral transmission** - pathogens are ingested and transmitted to the host
 - e.g. Stomach ulcers
 - This can be prevented by having access to **clean water** and good **hygiene standards**
- **Body fluids and sexual transmission** - Exchange of saliva, blood or semen can carry pathogens from one host to another
 - e.g. HIV, Chlamydia, Ebola
 - Generally, **body fluid transmission** is prevented by:
 - **Isolating** infected individuals



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- Cleaning and **sterilising** contaminated areas
- **Sexual transmission** of chlamydia and HIV can be reduced by:
 - Wearing **condoms**
 - **Screening** to detect cases and particularly after **unprotected sex**
 - Medications
 - Drug users with HIV should also **avoid sharing needles**
 - **Limiting the number of sexual partners**
 - Raising awareness by **education programmes**
- **Animal vectors** - Animals carry pathogens between hosts
 - e.g. Malaria
 - Animal vectors can be prevented by
 - Using **insect repellent**
 - **Mosquito nets**
 - Preventing the vector from **reproducing**

Transmission of Common Infections Table



Your notes

Disease and pathogen	Symptoms	Mechanism of transmission	Method to prevent/reduce transmission
Tuberculosis (Bacteria – M.Tuberculosis)	Cough, bloody mucus and lung damage	Airborne – through coughing	Avoid crowded areas, maintain good hygiene, ventilate homes and work spaces
Cholera (Bacteria – V.Cholerae)	Diarrhoea, vomiting, leg cramps	Waterborne – in contaminated water sources	Avoid dirty water Improve sanitation Give access to clean water
Stomach Ulcers (Bacteria – H.Pylori)	Can be symptomless, or cause abdominal pains, loss of appetite, bloating and nausea	Oral transmission – consumption	Ensure access to clean water

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Chlamydia (Bacteria – C.Trachomatis)	Can be symptomless, or cause painful urination, discharge and bleeding after sex	Sexually transmitted – in body fluids	Use condoms, Screening after unprotected sex, Limiting sexual partners
Chalara Ash Dieback (Fungus)	Dark patches on leaves, early leaf loss and lesions in bark	Airborne – carried in the wind	Removed infected trees and replace with a different species Restrict or prevent imports of Ash species
Malaria (Protist – P.Falciparum)	Blood and liver damage, fever, chills and fatigue In serious cases, death	Animal borne – carried by mosquitoes	Use insect repellent Mosquito nets Prevent reproduction in mosquitoes

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Ebola (Virus)	Headaches, high temperature, joint and muscle pains, diarrhoea, sickness, rashes, haemorrhagic fever	Body fluids	Isolate infected individuals Sterilise contaminated areas
HIV (Virus)	Headaches, high temperature, joint and muscle pains AIDS associated illness	Sexually transmitted in body fluids	Wear condoms Limit number of sexual partners Avoid sharing needles Screening after potential exposure Education Medication can stop the spread

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Examiner Tips and Tricks

Know the **symptoms** and how the pathogen causing each **disease is spread**. Typically, this topic appears as data analysis questions in the exam where you may be given a graph to analyse and interpret.