Human Health and Disease

Common Diseases in Humans

What is Health?

- Health is the state of complete physical, mental, and social well being.
- Health increases productivity and ensures longevity.

Ways to Ensure Good Health

- Balanced diet
- Personal hygiene
- Exercise
- Awareness about prevention and control of diseases
- Proper waste disposal and control of vectors
- Vaccination

Why do Diseases Occur?

- Genetic reasons – Innate deficiencies and inheritable defects
- Infections
- Sedentary life style – Junk food, consumption of alcohols/drugs, lack of exercise

Pathogenic Diseases

Pathogens are the organisms that enter the human body through various means, then multiply, interfere with normal vital activities and causes harm to the human body. The diseases caused due to these pathogens are called pathogenic diseasese.

Types of Pathogenic Diseases

1. Bacterial Diseases

- **Typhoid**
- Pathogen – *Salmonella typhi*

- Spreads through – Contaminated food and water
- Site of infection – Small intestine
- Symptoms – High fever, stomach pain, headache, loss of appetite, constipation, and intestinal perforations in severe cases
- Confirmatory test – Widal test
- **Pneumonia**
- Pathogens – *Streptococcus pneumoniae* and *Haemophilus influenzae*
- Spreads through – Droplets/aerosols released from infected person, sharing of glasses or utensils
- Site of infection – Alveoli (gets filled with fluid, difficulty in breathing)
- Symptoms – Fever, chills, cough, headache, lips and nails become grey in severe cases

2. Viral Diseases

- **Common cold**
- Pathogen – Rhino viruses
- Site of infection – Nose and respiratory passage
- Spreads through – Droplets released from coughing or sneezing, or contaminated objects
- Symptoms – Nasal congestion and discharge, sore throat, cough, headache, tiredness

- **Dengue**
- Pathogen – Dengue virus (*Flavivirus*, a RNA virus)
- Transmitted by – Mosquitoes (*Aedes aegyptii*)
- Symptoms – fever, headache, muscle and joint pains, and a characteristic skin rash similar to measles.
- **Chikungunya**
- Pathogen – Chikungunya virus (*Alphavirus*, a RNA virus)
- Transmitted by – Mosquitoes (*Aedes aegyptii*)
- Symptoms – fever, headache, muscle and joint pains, fatigue, nausea and vomitting, inflammation of eyes.

3. Protozoan Diseases

- **Malaria**

- Pathogen – *Plasmodium sp*. (*P.vivax, P. falciparum, P. malaria*)
- Vector – Female *Anopheles* mosquito
- Symptoms – High grade fever, chills
- **Amoebiasis**
- Pathogen – *Entamoeba histolytica*
- Vector – Housefly
- Site of infection – Large intestine
- Symptoms – Constipation, abdominal pain, cramps, stools with mucous, and blood clots

4. Fungal Diseases

- **Ringworms**
- Pathogens – Genera *Microsporum*, *Trichophyton*, and *Epidermophyton*
- Spreads through – Towels, clothes, comb (Fungus is acquired from soil)
- Symptoms – Appearance of dry, scaly lesions on various body parts with intense itching

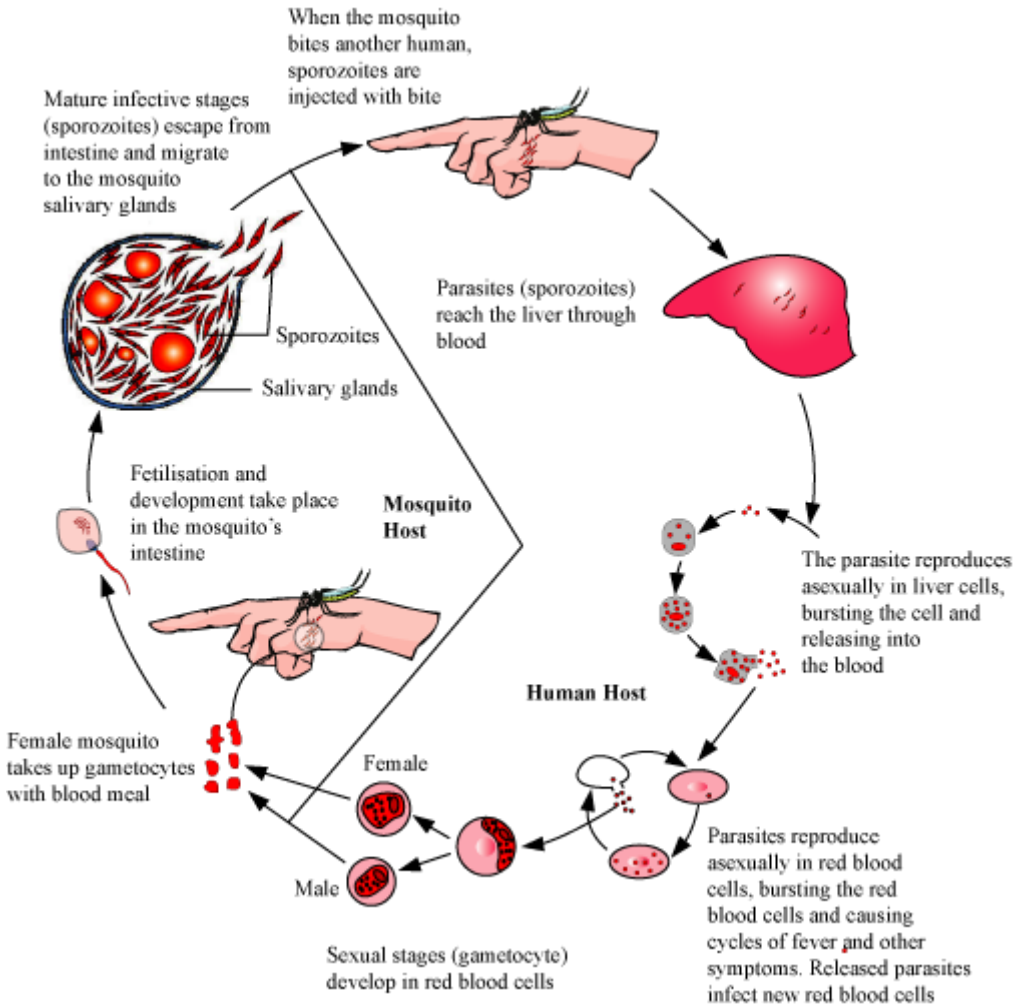
5. Diseases Caused by Worms

- **Ascariasis**
- Pathogen – Round worm, *Ascaris*
- Spreads through – Water, vegetables, fruits contaminated by faeces of infected person
- Symptoms – Internal bleeding, muscular pain, fever, anaemia, blockage of intestinal passage

- **Elephantiasis (filariasis)**
- Pathogen – *Wuchereria* (*W.malayi* and *W.bancrofti*)
- Spreads through – Bite of female mosquito vector
- Symptom – Chronic inflammation of the organs, usually the lymphatic vessels of lower limb

Life Cycle of *Plasmodium*

- *Plasmodium* requires two hosts to complete its life cycle.
- When female *Anopheles* mosquito bites a healthy human being, it releases *Plasmodium*, which lives in its body as sporozoite (infectious form).
- The parasites multiply (asexual reproduction) in the liver cells and finally burst the liver cells. Sporozoites are released in blood.
- Parasites enter RBCs and further multiply (asexual reproduction) here and finally burst RBCs also.
- Bursting of RBCs is accompanied by release of a toxic substance called haemozoin (associated with fever and chills).
- In the RBCs, only sporozoites change into gametocytes (sexual stage). Gametocytes multiply.
- When the diseased person is bitten by a female *Anopheles* mosquito, gametocytes are introduced into the mosquito.
- Gametocytes fertilise and develop inside the intestine of mosquito to form sporozoites.
- Sporozoites are stored in the salivary glands of mosquito and are released into the healthy person who is bitten by this mosquito.



Immunity

What Is Health?

According to WHO, health is defined as the state of complete physical, mental, and social well being.

Health does not merely mean freedom from diseases, but it covers the broader spectrum of the ability to perform all tasks up to one's full strength. It includes a state of psychological well being where a person has positive attitude and motivation.

April 7 is celebrated as the **World Health Day**.

Whenever we think about health, the term 'immune system' comes into our minds. It is the system of our body that keeps us healthy.

Immunity

Immunity is the ability of an organism to resist the attack of pathogens. Several germs enter our body, but all of them do not result in diseases. This is because our immune system fights with the germs.

Immunity is of two types – innate and acquired immunity.

Innate immunity is the inborn or the natural immunity, which an organism has due to its genetic makeup. It is present in an individual from the time of birth. It is non-specific in nature. It consists of four kinds of barriers.

- Physical barriers – Skin and mucus coating of respiratory, gastrointestinal, and urogenital tract prevent entry of microbes into body.
- Physiological barriers – Acid in stomach, saliva in mouth, tears from eyes
- Cellular barriers – Blood has leukocytes such as polymorphic nuclear leukocytes, monocytes, etc. and tissue has macrophages which phagocytose the microbes.
- Cytokine barriers – Special proteins called interferons are secreted by virus-infected cells that prevent the further spread of viral infection.

Acquired immunity is the immunity acquired during the lifetime of an individual. It is acquired, which means that it is produced in response to an encounter with a pathogen based on memory. It is pathogen specific.

- When a pathogen for the first time infects a person, low intensity immune response is generated (primary response).
- When the same pathogen attacks again, intensified immune response in generated, thereby preventing the occurrence of disease (secondary response).
- Acquired immunity involves two types of cells – B-lymphocytes and T- lymphocytes.
- B-lymphocytes – They secrete proteins called **antibodies** in response to pathogens. They generate **humoral immune response** (found in blood).
- T-lymphocytes – They help B-cells to produce antibodies. They generate **cell -mediated immune response**. This response helps the body to differentiate between 'self' and 'non-self' as occurs in case of graft rejection.

Acquired immunity is further of two types – passive and active immunity.

Passive immunity is the acquired immunity that is provided to an individual by injecting the individual with serum containing antibodies from another individual or animal.

In active immunity, resistance is developed by an individual due to a previous infection. This is the reason why a person has a very rare chance of getting a disease again, if he has suffered and survived from it once in his lifetime.

Active immunity	Passive immunity
Body's own cells produce antibodies in response to an infection.	Antibodies from another person or animal are injected into the person.
Person's own immune response has to get activated and produce antibodies. Hence, this takes time.	Ready-made antibodies are injected in the person. Hence, it provides immediate cure.
This is harmless.	This may cause reactions.
It provides long lasting protection.	Its effects are short lived.

Two types of active immunity – Natural and artificial

Natural – Body gets immunity naturally when the person suffers from a disease. During a disease, the person produces antibodies to fight the infection, which remain in the body for a long time to prevent the occurrence of a disease on subsequent exposure to the same microbe. These antibodies are produced by plasma cells of the immune systems.

Artificial – It is imparted by vaccination.

Two types of passive immunity – Natural and artificial

Natural – In this, readymade antibodies from mother reach the foetus through placenta.

Artificial – In this, serum antibodies from horse or other animals are isolated (they are first made stronger by repeatedly injecting the vaccination for the particular disease). These antibodies are injected into the humans to provide them immunity.

The serum containing antibodies against a particular antigen is called **antiserum**. For preparing the antiserum, the following steps are employed.

1. First of all, the disease-causing microbe is cultured and toxin is separated from it.
2. The toxin is injected into the body of the animal in small amount.
3. After some days, stronger dose of toxin is given to the animal.
4. The immune system of the animal works against the toxin and secretes antibodies against it. Now the serum of the animal contains concentrate amount of antibodies against that particular disease.
5. The blood is drawn from the animal and is allowed to coagulate in order to separate the serum.
6. This serum is collected in sterilised bottles.

Local Defence System of the Body

Apart from these defence mechanisms, our body has some local defence systems, which act as the barrier and protect our bodies from local injuries and infections. These systems have some of their own significances, such as:

- They start working against the pathogens the moment they try to enter our body.
- They do not require a previous memory of exposure to a pathogen to work against it.
- They are effective against various potentially infectious agents.

Some of these local defence systems are given in the following table.

Organ	Function
Skin	First line of defence; prevents entry of germs Oil glands and sweat glands destroy the germs.
Nose	Hair present in the nose filters the foreign particles. These particles are thrown out during sneezing.
Eyes	Tear glands secrete tears containing lysozymes. Lysozyme prevents eye infections.

Mouth	Salivary enzymes kill the microbes.
HCl in stomach	Kills the microbes that reach the stomach
WBCs	Kill the microbes that enter the body through cuts and abrasions

Antibodies

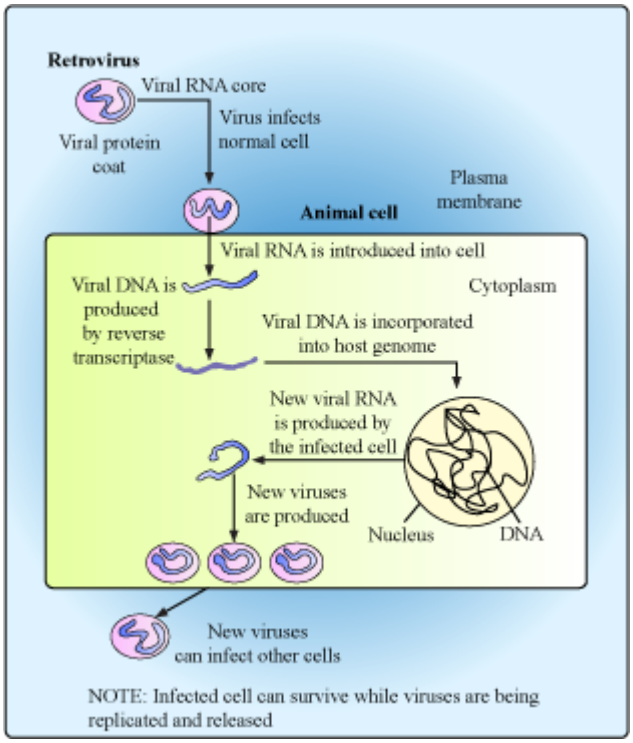
- These are special chemicals made up of proteins that are found in our blood and act against the pathogens entering our body.
- They are secreted by B-lymphocytes on exposure to **antigens.**
- These are highly specific against antigens.
- An antibody can recognise its specific antigen, binds to it, and subsequently destroys and eliminates it from the body.
- Numerous different antibodies, each specific for a different antigen, can be produced by our body.

AIDS & Cancer

AIDS (Acquired Immuno Deficiency Syndrome)

- Caused by HIV (Human Immunodeficiency Virus) [HIV is a retrovirus (RNA virus)]
- **Transmission of HIV occurs through:**
- Sexual contact with infected person
- Sharing infected needles (as in case of intravenous drug abusers)
- Transfusion of contaminated blood
- Infected mother to child through placenta
- Time lag between infection and appearance of symptoms – Few months to many years (5-10 years)
- **How does AIDS infection spread?**
- Virus enters the body of a person and enters macrophages.

- Here, virus replicates (viral RNA reverse transcribes to viral DNA, which gets incorporated into hosts DNA and subsequently new viral particles are produced).



- Macrophages become a virtual HIV factory.
- Thereafter, HIV enters helper T-lymphocytes, replicates, and produces progenies.
- As the progenies are released, they attack other T-lymphocytes.
- Therefore, T-lymphocytes start decreasing in number and immune response of the person becomes weak.
- Even infections which could be overcome easily start aggravating.
- **Diagnosis of AIDS –** By ELISA (Enzyme Linked Immuno Sorbent Assay)
- **Treatment –** No permanent cure; antiretroviral therapies can prolong the life of patient
- **Prevention of AIDS**
- Ensuring use of disposable syringes
- Screeningblood from blood banks

- Advocating safe sex
- NACO (National AIDS Control Organization) and many NGOs are doing a lot to create awareness among people.

Cancer

- The process of development of cancer is called **oncogenic transformation.**
- Normal cells have the property of contact inhibition (stoppage of growth on coming in contact with other cells), but cancer cells lose this property.
- As a result, cancer cells divide continuously to give rise to mass of cells (tumours).

Commonly Abused Drugs

Opioids (Heroin)

- Source: Acetylation of morphine extracted from the latex of poppy plants (*Papaver somniferum*)
- Consumed by: Snorting or injection
- Properties: White, bitter and odourless
- Mode of action: Binds to opioid receptors present in the CNS and GI tract
- Effect: It is a depressant; slows down body functions

Cannabinoids

- Source: Inflorescences of the plant *Cannabis sativa*
- Consumed by: Inhalation or oral ingestion
- Mode of action: Binds to cannabinoid receptors present in the brain
- Effect: Affects the cardiovascular system

Cocaine

- Source: Coca plant *Erythroxylum coca*, found in South America
- Consumed by: Snorting

- Mode of action: Interference with transfer of neurotransmitter, dopamine
- Effect: Stimulates the CNS, producing a sense of euphoria and increased energy; excessive dosages cause hallucination

Drugs Normally Used as Medicines

- Drugs like barbiturates, amphetamines, benzodiazepines, LSD (Lysergic acid diethyl amides) are used as medicines to help patients with mental illness and insomnia.
- Morphine: It is a pain killer which is used for patients who have undergone surgery, but it is also abused.

Nicotine

- Present in tobacco, which is smoked, chewed or snuffed
- Mode of action: Stimulates the adrenal gland to release adrenaline and nor-adrenaline
- Effect: Increases blood pressure and heart rate

Ill Effects of Smoking

- Increased risk of diseases like bronchitis, emphysema, coronary heart disease, gastric ulcer and cancer (throat, lung and urinary bladder)
- Increased carbon monoxide levels in blood, leading to oxygen deficiency

Alcohol / Drug Abuse

Causes of alcohol/ Drug Abuse

- Alcohol / drug abuse normally starts in adolescence (period between 12-18 yrs – transition phase between childhood and adulthood).
- Many adolescents are motivated towards drugs/ alcohol due to curiosity and experimentation.
- Peer pressure, academic stress, unstable family structure further incline youth towards alcohol/ drug abuse.
- Perception of consuming alcohol / drug being cool and progressive and use of alcohol/drug in television, movies, etc. further promote this habit.

Alcohol/ Drug Addiction

- When a person uses alcohol/ drug repeatedly, he becomes addicted.
- Addiction refers to psychological attachment to certain effects such as euphoria and temporary feeling of well-being associated with use of alcohol or drugs.
- In addiction, tolerance level of receptors present in our body increases towards the drug.
- This drives the person to use them even when they are not required or when they tend to harm his health / family life.
- Subsequently, the user runs into a vicious circle of addiction and subsequent dependence.
- Dependence leads to manifestation of withdrawal syndrome on discontinuation of use.
- Withdrawal syndrome – Anxiety, nausea, sweating, shakiness, and sometimes may be lethal

Effects of Alcohol/ Drug Abuse

- Immediate effect – Vandalism, violence, and reckless behaviour
- Drop in academic performance, lack of interest in personal hygiene, rebellious behaviour, and change in eating and sleeping patterns, weight and appetite fluctuations
- Mental, psychological, and financial loss not only to the user, but also to his family
- Those who take drugs intravenously have a high risk of acquiring deadly diseases such as AIDS and hepatitis B.
- Damage to nervous system and liver (cirrhosis)
- Use of anabolic steroids by sports person have adverse effects:
- In females – Increase of masculinity, aggressiveness, depression, abnormal menstrual cycle, facial hair growth, enlargement of clitoris, and deepening of voice
- In males – Acne, aggressiveness, depression, reduction in size of testicles, decreased sperm production, enlargement of prostate gland, breast enlargement, premature baldness
- Ultimately, prolonged use of alcohol/drugs leads to coma and death.

Preventing Alcohol/ Drug Abuse

- It is better to prevent the inclination of an individual towards alcohol/ drugs right from adolescence. Some of the ways of prevention are:
- Avoid peer pressure – Understand the unique personality and capabilities of a child

- Education and counseling – A child must be taught to accept success and failure equally. Especially during adolescence, he must be inclined towards constructive activities such as music, yoga, sports, reading based on his interest.

- Help from parents and peers – This includes proper guidance, advice, and trust to overcome problems such as stress and guilt.

- Identifying danger signals – If any sign of symptom of alcohol / drug abuse is seen in the adolescent by family or friends, then it should not be ignored because prevention is better than cure.

- Seeking medical help – Psychologists and rehabilitation programs surely help an addict. Medical help should be sought to prevent further damage.