

HUMAN HEALTH AND DISEASE

Comprehensive Typed Study Notes & Complete Reference Guide

1. INTRODUCTION & FUNDAMENTALS OF HEALTH

WHO (World Health Organization) Definition of Health:

Health is defined as a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity. Our immune system maintains our health against various diseases.

Factors Affecting Health

There are three main factors that affect human health:

- **Genetic Disorders:** Caused due to abnormalities in genes or chromosomes. They are inherited from parents to offspring and transmitted across generations.
- **Infections:** Caused by pathogens such as bacteria, viruses, protozoans, fungi, and worms.
- **Lifestyle Factors:** Imbalances in daily habits, including eating behavior, type of food, lack of exercise, insufficient body rest, and mental tension.

Benefits of Good Health: A healthy person can perform duties with full capacity. Good health decreases the mortality rate, increases longevity, and brings economic prosperity to society.

Requisitions for Maintaining Good Health

- Balanced diet and adequate nutrition.
- Daily physical exercise, including *Yoga*, which strengthens body and mind.
- Proper vaccination (immunization) of self and family.
- Hygienic disposal of waste and clean surroundings.
- Control of vectors carrying pathogens.

Classification of Human Diseases

Any disease impairs normal functioning of organs, resulting in specific symptoms. Human diseases fall into two major categories:

Category	Definition & Characteristics	Examples
Infectious / Communicable Diseases	Diseases transmitted easily from an infected person to a healthy individual.	Bacterial, Viral, Fungal, and Protozoan diseases (e.g., Typhoid, Common Cold, Malaria).
Non-infectious / Non-communicable Diseases	Diseases that do not transmit from one person to another.	Cancer, Genetic disorders, Deficiency diseases.

2. COMMON HUMAN DISEASES & PATHOGENS

Disease-causing microorganisms (bacteria, viruses, fungi, protozoans, helminths) are called **pathogens** or parasites.

A. Bacterial Diseases

1. Typhoid:

- **Pathogen:** *Salmonella typhi* (Bacterium).
- **Mode of Infection:** Contaminated food and water.
- **Affected Organs:** Stomach and small intestine; can migrate to other body parts via blood.
- **Symptoms:** Sustained high fever (39°C to 40°C), weakness, stomach pain, constipation, headache, loss of appetite. Severe cases cause intestinal perforation and death.
- **Diagnosis:** Confirmed by the **Widal Test**.
- **Classic Medical Case:** Mary Mallon (nicknamed 'Typhoid Mary'), a professional cook and carrier who spread typhoid for years through food.
- **Treatment:** Antibiotics taken as per doctor's advice.

2. Pneumonia:

- **Pathogens:** *Streptococcus pneumoniae* or *Haemophilus influenzae*.
- **Mode of Infection:** Inhaling droplets/aerosols released by an infected person, or sharing utensils.
- **Affected Organ:** Alveoli (air sacs) of lungs, which fill with fluid causing severe breathing problems.
- **Symptoms:** Fever, chills, cough, headache. In severe cases, lips and fingernails turn gray to bluish.
- **Other Common Bacterial Diseases:** Tuberculosis (TB), Diphtheria, Cholera, Plague, Bacterial Dysentery, Tetanus.

B. Viral Diseases

Common Cold:

- **Pathogen:** *Rhinovirus* group.
- **Affected Area:** Nasal epithelium and respiratory passage (does NOT infect lungs).
- **Symptoms:** Nasal congestion, discharge (runny nose), sore throat, cough, headache, fatigue, hoarseness. Lasts 3–7 days.
- **Transmission:** Direct inhalation of droplets from cough/sneeze or contaminated objects (pens, books, keyboards).

C. Protozoan Diseases

1. Malaria:

- **Pathogen:** *Plasmodium* species (*P. vivax*, *P. ovale*, *P. malariae*, and *P. falciparum*).
- **Most Serious Type:** Malignant malaria caused by *Plasmodium falciparum* (can be fatal).

- **Vector / Carrier:** Female *Anopheles* mosquito.
- **Infectious Stage:** *Sporozoites* (stored in mosquito salivary glands).
- **Affected Organs:** Liver cells and Red Blood Cells (RBCs).
- **Symptoms:** High recurring fever with chills every 48–72 hours, severe headache, profuse sweating.

Life Cycle of Plasmodium (Requires Two Hosts):

1. **Human Host (Primary Host):** Mosquito bites human → injects sporozoites into blood → sporozoites reach liver and multiply asexually → attack RBCs → RBCs rupture, releasing a toxic substance called **Haemozoin** (causes recurring high fever & chills) → gametocytes develop in RBCs.
 2. **Mosquito Host (Secondary Host):** Female *Anopheles* bites infected human → takes up gametocytes → fertilization & development occur in mosquito gut → sporozoites form and migrate to salivary glands.
- **Prevention & Control:** Avoid stagnant water; spray kerosene oil on water bodies to destroy larvae; introduce larvicidal fish like *Gambusia*; use mosquito nets and repellents.
 - **Treatment:** Chloroquine tablets; juice/extract from bark of *Cinchona* plant (quinine).

2. Amoebiasis (Amoebic Dysentery):

- **Pathogen:** *Entamoeba histolytica* (Protozoan parasite).
- **Vector:** Housefly (acts as mechanical carrier).
- **Affected Organ:** Large Intestine.
- **Symptoms:** Constipation, abdominal pain, cramps, stools with excess mucous and blood clots.

D. Helminthic Diseases

1. **Ascariasis:** Caused by *Ascaris lumbricoides* (Roundworm). Transmitted via water, vegetables, and fruits contaminated with eggs. Symptoms include internal bleeding, muscular pain, fever, anemia, and intestinal blockage.
2. **Elephantiasis / Filariasis:** Caused by *Wuchereria bancrofti* and *Wuchereria malayi* (Filarial worms). Transmitted by female *Culex* / *Aedes* mosquitoes. Causes chronic inflammation of lymphatic vessels, usually of lower limbs and genital organs.

E. Fungal Diseases

Ringworm: Caused by fungi belonging to genera *Microsporum*, *Trichophyton*, and *Epidermophyton*. Heat and moisture help them grow in skin folds (groin, toes). Symptoms include dry, scaly lesions on skin, nails, and scalp with intense itching.

3. IMMUNITY & IMMUNE SYSTEM

Immunity is the overall ability of the host body to fight against disease-causing organisms with the help of the immune system. Derived from the Latin word '*Immunis*' (meaning 'to make safe'). The study of the immune system is called **Immunology**.

A. Innate Immunity (Non-Specific / Natural)

Innate immunity is non-specific defense present from birth, inherited from parents. It consists of four types of barriers:

1. **Physical Barriers:** Skin (prevents entry of microorganisms) and Mucous coating in respiratory, gastrointestinal, and urogenital tracts.
2. **Physiological Barriers:** Acid in stomach, Saliva in mouth, Tears from eyes (contain lysozyme).
3. **Cellular Barriers:** Phagocytic WBCs such as Polymorpho-nuclear leukocytes (PMNL-neutrophils), Monocytes, and Natural Killer (NK) lymphocytes.
4. **Cytokine Barriers:** Virus-infected cells secrete proteins called **Interferons**, which protect non-infected cells from further viral attack.

B. Acquired Immunity (Specific / Adaptive)

Acquired during lifetime through exposure to pathogens. Characterized by **memory**.

- **Primary Response:** Low-intensity response produced during the first encounter with a pathogen.
- **Secondary (Anamnestic) Response:** Highly intensified response triggered during subsequent encounters with the same pathogen due to memory cells.

Lymphocytes Involved:

- **B-Lymphocytes (B-Cells):** Formed and matured in bone marrow. Produce an army of proteins called **Antibodies** into blood.
- **T-Lymphocytes (T-Cells):** Formed in bone marrow, mature in the **Thymus gland**. Do not secrete antibodies directly, but help B-cells produce them.

Structure & Types of Antibodies

Antibodies are immunoglobulin (Ig) proteins. Each antibody molecule has four peptide chains: two small **Light (L) chains** and two longer **Heavy (H) chains**, represented as **H₂L₂**. The chains are bound by disulfide bonds.

- The variable region at the upper end binds specifically to antigens (**Antigen Binding Site / Fab segment / Paratope**).
- **Five Classes of Antibodies:** IgG, IgM, IgD, IgA, IgE.
 - *IgG*: Crosses placenta to protect foetus.
 - *IgA*: Present in **Colostrum** (yellowish fluid secreted during early lactation) and breast milk.
 - *IgE*: Involved in allergic reactions.

Types of Immune Response

- **Humoral Immune Response:** Antibody-mediated immunity carried out by antibodies circulating in body humors (blood, plasma, lymph).
- **Cell-Mediated Immunity (CMI):** Mediated by T-lymphocytes. Responsible for graft rejection during organ transplantation (distinguishes 'self' vs 'non-self').

Comparison: Active vs. Passive Immunity

Feature / Property	Active Immunity	Passive Immunity
Definition	Developed naturally when body produces antibodies in response to infection or vaccine.	Readymade antibodies are directly introduced into the body.
Action Speed	Slow response, takes time to develop fully.	Rapid and immediate protection.
Duration	Long-lasting (often life-long memory).	Short-lived / temporary protection.
Side Effects	Harmless with minimal side effects.	May cause allergic reactions or side effects.
Example	Immunity gained after recovering from disease or vaccination.	IgA in colostrum; anti-venom injection against snake bite.

Vaccination, Allergies & Auto-Immunity

- **Vaccination & Immunisation:** Introduction of inactivated/weakened pathogens into body to produce antibodies and memory B/T cells. Recombinant DNA technology allows mass production (e.g., Hepatitis-B vaccine from yeast).
- **Allergy:** Exaggerated immune response to environmental antigens (**allergens** like pollen, dust, mites, animal dander). Mediated by **IgE**. Mast cells release **histamine** and **serotonin**. Treated with anti-histamines, adrenaline, and steroids.
- **Auto-Immunity:** Immune system misidentifies self-cells as foreign antigens and attacks own body tissues. Examples: *Rheumatoid Arthritis*, *Insulin-Dependent Type-1 Diabetes*.

Organs of the Immune System

- **Primary Lymphoid Organs:** Bone Marrow and Thymus (where immature lymphocytes differentiate into antigen-sensitive cells). The Thymus is large at birth but shrinks progressively with age.
- **Secondary Lymphoid Organs:** Spleen, Lymph Nodes, Tonsils, Peyer's patches of small intestine, and Appendix. Spleen acts as a blood filter trapping blood-borne microorganisms.
- **MALT (Mucosa-Associated Lymphoid Tissue):** Located within mucosal lining of respiratory, digestive, and urogenital tracts; accounts for ~50% of lymphoid tissue in human body.

4. AIDS AND CANCER

A. AIDS (Acquired Immuno Deficiency Syndrome)

AIDS was first reported in 1981. It is caused by **HIV (Human Immunodeficiency Virus)**, a retrovirus with an RNA genome.

Modes of Transmission:

1. Sexual contact with infected person.
2. Transfusion of contaminated blood/blood products.

3. Sharing infected needles (intravenous drug abusers).
4. From infected mother to child through placenta during pregnancy.

Note: AIDS does NOT spread by shaking hands, hugging, kissing, sharing utensils, toilets, or casual body contact.

Mechanism of HIV Infection: Virus enters **macrophages** → viral RNA replicates via *reverse transcriptase* into viral DNA → viral DNA directs host cell to produce new virus particles (macrophages act as HIV factory) → HIV enters **Helper T-lymphocytes (TH cells)** → replicates and destroys TH cells → progressive reduction in Helper T-cells destroys immune system.

- **Diagnosis:** Confirmed by **ELISA** (Enzyme-Linked Immunosorbent Assay) and Western Blot test.
- **Prevention & Control:** NACO (National AIDS Control Organisation in India), WHO guidelines, using disposable needles, safe blood transfusion, condom usage, avoiding drug abuse.

B. Cancer

Cancer is characterized by uncontrolled cell division and breakdown of regulatory mechanisms like **Contact Inhibition** (normal cells stop dividing upon contacting other cells).

Types of Tumors:

- **Benign Tumors:** Remain confined to original location, enclosed in connective tissue, non-invasive, less harmful.
- **Malignant Tumors:** Cancerous mass of proliferating cells (neoplastic cells) that invade surrounding tissues, enter blood/lymph, and form secondary tumors elsewhere (**Metastasis**).

Causes of Cancer (Carcinogens):

1. *Physical Agents:* Ionizing radiation (X-rays, gamma rays) & Non-ionizing radiation (UV rays).
2. *Chemical Factors:* Tobacco smoke chemicals (major cause of lung cancer).
3. *Biological Factors:* Oncogenic viruses (contain viral oncogenes); activation of cellular proto-oncogenes in normal cells.

Detection & Treatment:

- **Diagnosis:** Biopsy, Histopathological studies, Radiography (X-ray), CT scan, MRI.
- **Treatment:** Combination of Surgery, Radiotherapy, Chemotherapy, and Biological response modifiers (e.g., α -interferon).

5. DRUGS, ALCOHOL, AND TOBACCO ABUSE

Commonly Abused Drug Categories

Category	Plant Source & Active Chemical	Target Organs & Effects
Opioids	Latex of Opium Poppy (<i>Papaver somniferum</i>). Morphine, Heroin ('Smack' / diacetylmorphine).	Binds to opioid receptors in CNS and GI tract. Acts as depressant, slows body functions.
Cannabinoids	Inflorescence/leaves of <i>Cannabis sativa</i> . Produce Marijuana, Hashish, Charas, Ganja.	Binds to cannabinoid receptors in brain. Affects cardiovascular system.
Coca Alkaloids / Cocaine	Erythroxylum coca (native to S. America). Also <i>Atropa belladonna</i> & <i>Datura</i> .	Interferes with dopamine transport in CNS. Potent stimulant, produces euphoria, high doses cause hallucinations.

Tobacco & Smoking

Tobacco contains **Nicotine** (an addictive alkaloid) which stimulates adrenal glands to release adrenaline and nor-adrenaline, increasing blood pressure and heart rate. Smoking increases carbon monoxide (CO) levels in blood, reducing oxygen-carrying capacity. Causes oral cancer, lung cancer, bronchitis, emphysema, and coronary heart disease.

Adolescence, Addiction & Dependence

- **Adolescence (12–18 years):** Vulnerable bridge period between childhood and adulthood driven by curiosity, peer pressure, stress, and desire for adventure.
- **Addiction:** Psychological attachment to effects like euphoria and temporary feeling of well-being.
- **Dependence & Withdrawal Syndrome:** Body's tendency to manifest unpleasant symptoms (anxiety, shakiness, nausea, sweating) if regular drug/alcohol intake is abruptly stopped.

Effects of Anabolic Steroids Abuse

- **In Females:** Masculinisation, aggressiveness, mood swings, depression, abnormal menstrual cycles, excessive facial hair, clitoral enlargement, deepening of voice.
- **In Males:** Acne, aggressiveness, mood swings, reduction of testicle size, decreased sperm production, liver/kidney dysfunction, premature baldness, enlargement of prostate gland.

Prevention and Control Measures

1. Avoid undue peer pressure on youth.
2. Education, counselling, and nurturing creative talents.
3. Seeking help from parents and trusted peers.
4. Looking for danger signs (isolation, dropping grades, fatigue).
5. Seeking professional medical and psychological rehabilitation help.