Human Health and Diseases
Development of concept of Health

- Hippocrates\(^1\) (Greeks) and Indian Ayurveda system of medicine: health as a **state of body and mind** where there was a **balance of certain humors**.

- They thought that persons with ‘**black bile**’ belonged to **hot personality** and would have **fevers**. *This idea was arrived at by pure reflective thought.*

- Discovery of blood circulation by **William Harvey** using experimental method and the demonstration of normal body temperature in persons with black bile using thermometer disproved the ‘**good humor**’ hypothesis of health.

- Later, biology stated that ‘**Mind and mental state can affect our health**’ i.e. mind influences neural system, endocrine system, immune system and that our immune system maintains our health.

\(^1\) Medical practitioner who is regarded as the father of medicine; author of the Hippocratic oath (circa 460-377 BC)
Human Health

- Human health is affected by –
  1. **genetic disorders** – deficiencies with which a child is born and deficiencies/defects which the child inherits from parents from birth;
  2. **infections** and
  3. **life style** including food and water we take, rest and exercise we give to our bodies, habits that we have or lack etc.
How do you define health?

• Health does not simply mean ‘absence of disease’ or ‘physical fitness’.
• Health could be defined as a state of complete physical, mental and social well-being.

Significance of health

• Healthy people are more efficient at work. This increases productivity and brings economic prosperity.
• Health increases longevity of people and reduces infant and maternal mortality.
Diseases

- Malfunctioning of one or more organs or systems of the body leads to disease, characterised by various signs and symptoms.
- Diseases can be broadly grouped into infectious and non-infectious.

- Explain infectious diseases.

<table>
<thead>
<tr>
<th>Infectious/Communicable diseases</th>
<th>Non-infectious/Non-communicable diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diseases which are easily transmitted from one person to another</td>
<td>Diseases which are not easily transmitted from one person to another</td>
</tr>
<tr>
<td>Very common and every one of us suffers from these at sometime or other</td>
<td>Not very common and some people suffers from these at sometime or other</td>
</tr>
<tr>
<td>Example: Common cold</td>
<td>Example; cancer (major cause of death)</td>
</tr>
</tbody>
</table>
Maintaining and achieving good health

• Enlist important things you need to do for maintaining and achieving good health.

• Ways for maintaining and achieving good health;
  ✓ Balanced diet,
  ✓ Personal hygiene,
  ✓ Regular exercise: Practicing yoga to achieve physical and mental health.
  ✓ Awareness about diseases and their effect on different bodily functions,
  ✓ Vaccination (immunisation) against infectious diseases,
  ✓ Proper disposal of wastes,
  ✓ Control of vectors and
  ✓ Maintenance of hygienic food and water resources.
What are pathogens?

**Answer:** Pathogens are *disease causing organisms* belonging to bacteria, viruses, fungi, protozoans, helminths, etc.

All parasites are pathogens as they cause harm to the host by living in (or on) them.

The pathogens can *enter our body* by various means, *multiply* and *interfere with normal vital activities, resulting in morphological and functional damage.*

Pathogens have to adapt to life within the environment of the host. For example, the pathogens that enter the gut must know a way of surviving in the stomach at low pH and resisting the various digestive enzymes.
# Common Human diseases caused by Bacteria

<table>
<thead>
<tr>
<th>Common disease</th>
<th>Causative agent</th>
<th>Symtoms</th>
<th>Mode of transmission</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typhoid</td>
<td><em>Salmonella typhi</em>  (Pathogenic bacterium)</td>
<td>Sustained high fever (39° to 40°C), weakness, stomach pain, constipation, headache and loss of appetite. Intestinal perforation and death may occur in severe cases.</td>
<td><em>Salmonella typhi</em> contaminated food and water enter the small intestine and migrate to other organs through blood.</td>
<td>Typhoid fever could be confirmed by <em>widal test</em>.</td>
</tr>
</tbody>
</table>

Mary Mallon nicknamed *Typhoid Mary*. *She was a cook by profession* and was a typhoid carrier who continued to spread typhoid for several years through the food she prepared.
# Common Human diseases caused by Bacteria

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<tbody>
<tr>
<td><strong>Pneumonia</strong></td>
<td>Bacteria like <em>Streptococcus pneumoniae</em> and <em>Haemophilus influenzae</em></td>
<td>Fever, chills, cough and headache. In severe cases, the lips and finger nails may turn gray to bluish in colour.</td>
<td>Healthy person acquires the infection by inhaling the droplets/aerosols released by an infected person or even by sharing glasses and utensils with an infected person.</td>
</tr>
</tbody>
</table>

Dysentery, plague, diphtheria, etc., are some of the other bacterial diseases in man.
## Common Human diseases caused by Virus

<table>
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<th>Symptoms</th>
<th>Mode of transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common cold</td>
<td>Rhino viruses</td>
<td>Nasal congestion and discharge, sore throat, hoarseness, cough, headache, tiredness,</td>
<td>Droplets resulting from <em>cough</em> or <em>sneezes</em> of an infected person are either inhaled directly or transmitted through contaminated objects such as pens, books, cups, doorknobs, computer keyboard or mouse, etc., and cause infection in a healthy person.</td>
</tr>
<tr>
<td>(One of the <strong>most infectious human ailments</strong> usually last for 3-7 days)</td>
<td>Infected the nose and respiratory passage but not the lungs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Chikungunya is vector-borne diseases. *Aedes mosquitoes* is the vector of Chikungunya.
# Diseases caused by helminths

<table>
<thead>
<tr>
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<th>Causative agent</th>
<th>Symptoms</th>
<th>Mode of transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ascariasis</strong></td>
<td><em>Ascaris (an intestinal parasite)</em></td>
<td>Internal bleeding, muscular pain, fever, anemia and blockage of the intestinal passage</td>
<td>The <strong>eggs of the parasite</strong> are <strong>excreted</strong> along with the faeces of infected persons which contaminate soil, water, plants, etc. A healthy person acquires this infection through contaminated water, vegetables, fruits, etc.</td>
</tr>
</tbody>
</table>

Helminths like *common round worm, Wuchereria* and filarial worm are also pathogenic to man.
<table>
<thead>
<tr>
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<th>Causative agent</th>
<th>Symptoms</th>
<th>Mode of transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elephantiasis or filariasis</td>
<td><em>Wuchereria (the filarial worm)</em> cause a slowly developing chronic inflammation of the organs in which they live for many years, usually the lymphatic vessels of the lower limbs</td>
<td>Genital organs are also often affected, resulting in <strong>gross deformities</strong></td>
<td>The pathogens are transmitted to a healthy person through the <strong>bite</strong> by the female mosquito vectors.</td>
</tr>
</tbody>
</table>
# Diseases caused by fungi

<table>
<thead>
<tr>
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<th>Causative agent</th>
<th>Symtoms</th>
<th>Mode of transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ringworms</strong></td>
<td>Fungi belonging to the genera Microsporum, Trichophyton and Epidermophyton</td>
<td>Appearance of <strong>dry, scaly lesions</strong> on various parts of the body such as skin, nails and Scalp. These lesions are accompanied by <strong>intense itching</strong>.</td>
<td>Ringworms are generally acquired from soil or by using towels, clothes or even the comb of infected individuals.</td>
</tr>
</tbody>
</table>

*One of the most common infectious diseases in man.*
<table>
<thead>
<tr>
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<th>Causative agent</th>
<th>Symptoms</th>
<th>Mode of transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoebiasis (amoebic dysentery)</td>
<td><em>Entamoeba histolytica</em></td>
<td>Constipation, abdominal pain and cramps, stools with excess mucous and blood clots</td>
<td><strong>Houseflies</strong> act as <strong>mechanical carriers</strong> and serve to transmit the parasite from faeces of infected person to food and food products, thereby contaminating them. Drinking water and food contaminated by the faecal matter are the main source of infection</td>
</tr>
<tr>
<td></td>
<td><em>Protozoan parasite in the large intestine of human</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Diseases caused by protozoans

<table>
<thead>
<tr>
<th>Common Disease</th>
<th>Causative agent</th>
<th>Preventive and control measures</th>
<th>Symptoms</th>
<th>Diagnosis test</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>Plasmodium (<em>P. vivax, P. malaria</em> and <em>P. falciparum</em>)&lt;br&gt; <em>P. falciparum</em> causes malignant malaria and can even be fatal</td>
<td></td>
<td><strong>Chill and high fever recurring every three to four days.</strong>&lt;br&gt;<strong>Some people may experience:</strong> <em>Abdomen and muscle pain, fatigue, fever, night sweats, shivering, or sweating, Diarrhoea, nausea, or vomiting fast heart rate, headache, mental confusion,</em></td>
<td>Blood test</td>
<td>Medication</td>
</tr>
</tbody>
</table>
• The malarial parasite requires two hosts viz., **human** and **mosquitoes** to complete its life cycle
• The female *Anopheles mosquito* is the vector (transmitting agent).
Malaria patient (Plasmodium infected person)

Female Anopheles mosquito bites an infected person

Plasmodium enter the mosquito’s body and undergo further development

The parasites multiply within the mosquito to form sporozoites that are stored in their salivary glands.

When these mosquitoes bite a healthy human, the sporozoites are introduced into his/her body.
Plasmodium enters the human body as sporozoites (infectious form) through the bite of infected female Anopheles mosquito.

The parasites initially multiply within the liver cells and then attack the Red Blood Cells (RBCs) resulting in their rupture.

The rupture of RBCs is associated with release of a toxic substance, haemozoin, which is responsible for the chill and high fever recurring every three to four days.
When the mosquito bites another human, sporozoites are injected with bite.

Mature infective stages (sporozoites) escape from intestine and migrate to the mosquito salivary glands.

Sporozoites

Salivary glands

Parasites (sporozoites) reach the liver through blood.

The parasite reproduces asexually in liver cells, bursting the cell and releasing into the blood.

Female mosquito takes up gametocytes with blood meal.

Gametocytes

Female

Male

Sexual stages (gametocytes) develop in red blood cells.

Parasites reproduce asexually in red blood cells, bursting the red blood cells and causing cycles of fever and other symptoms. Released parasites infect new red blood cells.

Fertilisation and development take place in the mosquito’s intestine.

Mosquito Host

Human Host
Prevention and control of many infectious diseases

• Maintenance of personal and public hygiene is very important
• Measures for personal hygiene include
  – keeping the body clean;
  – consumption of clean drinking water, food, vegetables, fruits, etc.
• Public hygiene includes
  – proper disposal of waste and excreta;
  – periodic cleaning and disinfection of water reservoirs, pools, cesspools and tanks and
  – observing standard practices of hygiene in public catering.
• These measures are particularly essential where the infectious agents are transmitted through food and water such as typhoid, amoebiasis and ascariasis.
Prevention and control of many infectious diseases

• Prevention and control measures for air-borne diseases (such as pneumonia and common cold);
  – personal hygiene and public hygiene measures,
  – Avoiding close contact with the infected persons or their belongings.

• Measures to control or eliminate the vectors to prevent diseases (like malaria and filariasis)
  – avoiding stagnation of water in and around residential areas,
  – regular cleaning of household coolers,
  – use of mosquito nets,
  – introducing fishes like Gambusia in ponds that feed on mosquito larvae,
  – spraying of insecticides in ditches, drainage areas and swamps, etc.
  – doors and windows should be provided with wire mesh to prevent the entry of mosquitoes.
Prevention, diagnosis, treatment and eradication of diseases.

Why there is need for advancement in medical science (biological science in the healthcare sector)?

- Vaccines
- Immunisation programmes
- Antibiotics
- Medicines
Why exposures to few of infectious agents result in diseases and not by all the infectious agents?

Answer: Because our body is able to defend itself from most of these foreign agents (with the help of our immune system).
IMMUNITY

Define immunity.

• **Answer:** Immunity is the **overall ability of immune system** of the host to **fight the pathogen**.
Innate Immunity

- Innate immunity is **non-specific type of defence**.
- Innate immunity is **present at the time of birth**.
- It is accomplished by **providing different types of barriers to the entry of the foreign agents into our body**.
- Innate immunity consist of **four types of barriers**.

**Four types of barriers of innate immunity**

- Physical barriers
- Physiological barriers
- Cellular barriers
- Cytokine barriers
Four types of barriers

• **Physical barriers:** Preventing entry of the micro-organisms. *Skin* is the main barrier. *Mucus coating of the epithelium lining* of respiratory, gastrointestinal and urogenital tracts also help in trapping microbes entering our body.

• **Physiological barriers:** Acid in the stomach, saliva in the mouth, tears from eyes—all prevent microbial growth.

• **Cellular barriers:** Certain types of leukocytes (WBC) of our body like polymorpho-nuclear leukocytes (PMNL-**neutrophils**) and **monocytes** and **natural killer cells** (type of lymphocytes) in the blood as well as **macrophages** in tissues can **phagocytose and destroy microbes**.

• **Cytokine barriers:** Virus-infected cells secrete **interferons (antiviral proteins)** which protect non-infected cells from further viral infection.
Acquired Immunity

• Acquired immunity is **developed during lifetime** of an individual.

• Acquired immunity is **pathogen specific**.

• It is characterised by **memory** i.e. *our body when it encounters a pathogen for the first time produces a response called** primary response **which is of low intensity. Subsequent encounter with the same pathogen elicits a highly intensified secondary or anamnestic response*. This is ascribed to the fact that our body appears to have memory of the first encounter.

• **B-lymphocytes** and **T-lymphocytes** carry out primary and secondary immune responses.
Acquired Immunity

• **Antibodies** are the **army of proteins** produced into our blood by **B-lymphocytes** in response to **pathogens** i.e. to **fight with them**.

• The **T-cells** help B cells produce/secrete antibodies.

• Production of different **types of antibodies** like IgA, IgM, IgE, IgD, IgG* etc. in to blood of our body is called as **humoral immune response or antibody mediated response**.

* Types of antibodies can be remembered as: AGED Mother
The T-lymphocytes mediate CMI.
General structure of antibody/immunoglobulin

- Antibody is structurally represented as H2L2
- Each antibody molecule has **four peptide chains**,  
  - two small chains (light chains) and  
  - two longer chains (heavy chains).
Read the first paragraph on page no. 152 on ‘Organ transplantation’
Organ transplantation

- Our body is able to differentiate ‘self’ and ‘non self’ during organ transplantation (True/False)

Can doctors transplant/graft organs like heart, eye, liver or kidney?

Answer: Yes, doctors transplant human organs like heart, eye, liver, kidney donated by suitable donor to enable patient to live a normal life.

Why is it that the organs cannot be taken from just anybody?

OR

Why grafts from just any source - an animal, another primate, or any human beings cannot be made?

Answer: Because the grafts would be rejected sooner or later.

What is it that the doctors check before organ transplantation?

Answer: Doctors check tissue matching, blood group matching are essential before undertaking any graft/transplant

Name the medication that has to take by an patient who received organ transplant.

Answer: Immuno suppressants.

Which acquired immunity is responsible for the graft rejection?

Answer: Cell-mediated immune response
Why mother’s milk is considered very essential for the newborn infant?

• The yellowish fluid colostrum secreted by mother’s mammary gland during the initial days of lactation has abundant antibodies (Ig A) to protect the infant. Such immunity is known as passive immunity.
# Active and Passive Immunity

<table>
<thead>
<tr>
<th>Active Immunity</th>
<th>Passive Immunity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Developed due to exposure of the host to antigens like living or dead microbes or proteins and antibodies</strong> (produced in the host body.)</td>
<td><strong>Developed when ready-made antibodies are directly given</strong> to protect the body against foreign agents.</td>
</tr>
<tr>
<td><strong>Slow and takes time</strong> to give its full effective response.</td>
<td><strong>Much faster immune response</strong> compared to active immunity.</td>
</tr>
<tr>
<td>Induced by injecting the microbes deliberately during <strong>immunisation or infectious organisms</strong> gaining access into body during natural infection</td>
<td>Example:</td>
</tr>
<tr>
<td>1. Colostrum secreted by mother during the initial days of lactation has abundant antibodies (Ig A) to protect the infant.</td>
<td>1. The foetus also receives some <strong>antibodies from their mother, through the placenta</strong> during pregnancy.</td>
</tr>
<tr>
<td>2. The foetus also receives some <strong>antibodies from their mother, through the placenta</strong> during pregnancy.</td>
<td></td>
</tr>
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</table>
Immunisation and vaccination
Principle of immunisation and vaccination

• The principle of immunisation or vaccination is based on the property of ‘memory’ of the immune system.
What is vaccination?

• Vaccination is **introduction of vaccine** into our body.
• Vaccines are prepared **antigenic proteins of pathogen** or **inactivated/weakened pathogen**
• Vaccine stimulates massive **production of antibodies**.
• The vaccines generate **memory – B and T-cells** that recognise the pathogen quickly on subsequent exposure.
• The **antibodies produced** in the body against antigens would **neutralise** the **pathogenic agents** during actual infection.
What is immunisation?

• Immunisation is **administration of preformed antibodies or antitoxins** into our body **for quick immune response** to defense against invaders.

• Examples:
  – Direct injection of **preformed antibodies, or antitoxin** to protect against tetanus.
  – Introduction of preformed antibodies against the snake venom in cases of **snakebites**.

• Direct injection of preformed antibodies or antitoxin is called **passive immunisation**.
What is Recombinant DNA Vaccine?

• Recombinant DNA (rDNA) Vaccines are **antigenic polypeptides of pathogen**

• rDNA vaccines are produced by **genetic engineering/ recombinant DNA technology**.

• rDNA technology vaccines are produced at large scale using bacteria or yeast.

• E.g., **Hepatitis B vaccine** produced from yeast.
Read the section on ‘Allergies’
Allergies

• Allergy is the exaggerated response of the immune system to certain antigens present in the environment.

• Allergens are the substances which induce allergy. For example; mites in dust, pollens, animal dander, etc.

• The antibodies produced to allergens are of Ig E type.

• Symptoms of allergic reactions
  – sneezing,
  – Wheezing,
  – watery eyes,
  – running nose and
  – difficulty in breathing.
Allergies

• Allergy is due to the release of chemicals like histamine and serotonin from the mast cells*.

• For determining the cause of allergy, the patient is exposed to or injected with very small doses of possible allergens, and the reactions studied.

• Drugs like anti-histamine, adrenalin and steroids quickly reduce the symptoms of allergy.

• Modern-day life style has resulted in lowering of immunity and more sensitivity to allergens.

• Many children in metro cities of India suffer from allergies and asthma due to sensitivity to the environment. This could be because of the protected environment provided early in life.

*Mast cell/mastocyte/labrocyte is a type of granulocyte white blood cell derived from the myeloid stem cell that is a part of the immune and neuroimmune systems and contains many granules rich in histamine and heparin.
Auto Immunity

- Auto immunity is memory based acquired immunity evolved in higher vertebrates, based on the ability to differentiate foreign organisms (e.g., pathogens) from self cells or due to genetic reasons.

- While we still do not understand the basis of this, two corollaries of this ability have to be understood.
  1. higher vertebrates can distinguish foreign molecules as well as foreign organisms.
  2. sometimes, due to genetic and other unknown reasons, the body attacks self-cells.

- The damage to the body resulted due to attack by self cells and is called auto-immune disease. For example; Rheumatoid arthritis
Immune System in the Body

• The human immune system consists of lymphoid organs, tissues, cells and soluble molecules like antibodies.

• Importance of immune system;
  – it recognises foreign antigens, responds to these and remembers them.
  – plays an important role in allergic reactions, auto-immune diseases and organ transplantation.
Lymphoid Organs

Primary Organs
- Thymus
- Bone Marrow

Secondary Organs
- Adenoids
- Tonsils
- Lymph nodes
- Spleen
- Peyer’s patches
- Appendix
- Lymph nodes
Lymphoid organs

• Lymphoid organs are the **organs where origin or maturation and proliferation of lymphocytes occur.**

• The primary lymphoid organs are;
  – **bone marrow** and
  – **thymus**

• **Bone marrow and thymus** are the organs where immature lymphocytes differentiate into **antigen-sensitive lymphocytes.**

• After maturation, the lymphocytes migrate to **secondary lymphoid organs.**
**Lymphoid organs**

**Bone Marrow**

- **Bone marrow** is the **main lymphoid organ** where all **blood cells including lymphocytes** are produced.

**Thymus**

- The **thymus** is a **lobed organ located near the heart and beneath the breastbone/sternum**.
- The **thymus** is quite large at the time of birth but keeps **reducing in size** with age and by the time puberty is attained it reduces to a very small size.
- Both **bone-marrow and thymus** provide **micro-environments for the development and maturation of T-lymphocytes**.
THE THYMUS GLAND

**Front view**
- Right lobe
- Left lobe
- Thymus
- Trocheo
- Thymic corpuscle
- Interlobular septum
- Cortex
- Medulla

**Structure**
- Capsule
- Interlobular septum
- Cortex
- Medulla
Secondary lymphoid organs

- Secondary lymphoid organs are;
  - spleen,
  - lymph nodes,
  - tonsils,
  - Peyer’s patches of small intestine and
  - appendix.

- The secondary lymphoid organs provide the sites for interaction of lymphocytes with the antigen, which then proliferate to become effector cells.

*Peyer's patches/aggregated lymphoid nodules (Swiss anatomist Johann Conrad Peyer) are small masses of lymphatic tissue found throughout the ileum region of the small intestine. They form an important part of the immune system by monitoring intestinal bacteria populations and preventing the growth of pathogenic bacteria in the intestines.*
Immune System in the Body

Spleen

• The spleen is a **large bean shaped organ**.
• Spleen **contains lymphocytes and phagocytes**.
• It acts as a **filter of the blood** by trapping **blood-borne microorganisms**.
• Spleen also has a large **reservoir of erythrocytes**.
Lymph node

- The lymph nodes are **small solid structures** located at different points along the lymphatic system.
- Lymph nodes **trap the micro-organisms or other antigens**, which happen to get into the lymph or tissue fluid.
- Antigens trapped in the lymph nodes are responsible for the **activation of lymphocytes** present there and cause the immune response.
Lymphoid tissue

- 50 per cent of the lymphoid tissue in human body are Mucosal associated lymphoid tissue (MALT).
- MALT is the Lymphoid tissue that is located within the lining of the major tracts (respiratory, digestive and urogenital tracts).
Diagrammatic representation of Lymph nodes/glands
LYMPHATIC SYSTEM

- Parotid nodes
- Retroauricular nodes
- Buccal nodes
- Cervical nodes
- Thoracic duct
- Axillary nodes
- Apical axillary nodes
- Lateral group
- Anterior group
- Parasternal nodes
- Cubital nodes
- Intercostal nodes
- Palmar and dorsal plexus
- External iliac nodes
- Internal iliac nodes
- Popliteal nodes
- Plantar and dorsal plexus
- Common iliac nodes
- Superficial inguinal nodes
- Ostoma chyl
- Ostoma chyl
- Ostoma chyl
The Lymph & Immune System

Lymph Nodes of the Neck
Tonsils
Thoracic Duct
Lymph Vessels of the Chest
Lymph Nodes of the Axillary Region
Spleen
Lymph Vessels of the Abdomin
Thymus Gland
Appendix
Lymph Nodes of the Groin
Lymph Nodes Behind the Knee
AIDS (Acquired Immuno Deficiency Syndrome)

• AIDS means deficiency of immune system, acquired during the lifetime of an individual indicating that it is not a congenital disease.
• ‘Syndrome’ means a group of symptoms.
• AIDS was first reported in 1981
• AIDS has spread all over the world and killed >25 million people.
• AIDS is caused by a retrovirus called Human Immuno deficiency Virus (HIV), which have an envelope enclosing the RNA genome.
Structure of HIV
**AIDS (Acquired Immuno Deficiency Syndrome)**

- Transmission of HIV-infection generally occurs by
  - sexual contact with infected person,
  - by transfusion of contaminated blood and blood products,
  - by sharing infected needles as in the case of intravenous drug abusers and
  - from infected mother to her child through placenta.
High risk people (HIV)

• People who are at high risk of getting HIV infection includes –
  – individuals who have multiple sexual partners,
  – drug addicts who take drugs intravenously,
  – Individuals who require repeated blood transfusions and
  – children born to an HIV infected mother.
Time-lag

• **Time-lag** is the period between the *infection* and appearance of AIDS symptoms.

• Time lag may vary from a **few months to many years** (usually 5-10 years).
Prevention of AIDS

As AIDS has no cure, prevention is the best option.

• **Following conscious behaviour patterns** (More often, HIV infection spreads due to conscious behaviour patterns - not something that happens inadvertently, like pneumonia or typhoid).

• **Proper screening and monitoring of blood for transfusion** (Infection in blood transfusion patients, new-borns (from mother) etc., may take place due to **poor monitoring**. The only excuse may be ignorance and it has been rightly said – “don’t die of ignorance”).

• **Educating people** At national level [In India, the National AIDS Control Organisation (NACO) and other non-governmental organisation (NGOs) are doing a lot to educate people about AIDS] and for world wide, **WHO** has started a number of programmes to prevent the spreading of HIV infection.
Physical and psychological well-being of HIV/AIDS infected persons

• HIV/AIDS is **not spread by mere touch or physical contact.**
• HIV/AIDS **spreads only through body fluids.**
• For the **physical and psychological well-being**, HIV/AIDS infected persons should **not be isolated from family and society**.
Life Cycle Of HIV

1. HIV gets into the body of the person
2. HIV enters into macrophages
3. RNA genome of the virus replicates to form viral DNA using reverse transcriptase.
4. Viral DNA gets incorporated into host cell’s DNA
5. Infected cells produce virus particles
6. The macrophages acts like a HIV factory by continuous production of virus
7. Simultaneously, HIV enters into helper T-lymphocytes ($T_h$), replicates and produce progeny viruses.
8. The progeny viruses released in the blood attack other helper T-lymphocytes.
9. This is repeated leading to a progressive decrease in the number of helper T-lymphocytes in the body of the infected person.
Retrovirus

Viral RNA core

Viral protein coat

Virus infects normal cell

Plasma membrane

Animal cell

Viral RNA is introduced into cell

Viral DNA is produced by reverse transcriptase

Cytoplasm

Viral DNA incorporates into host genome

Nucleus

DNA

New viral RNA is produced by the infected cell

New viruses are produced

New viruses can infect other cells

NOTE: Infected cell can survive while viruses are being replicated and released
HIV-AIDS

• During the period of progressive decrease in the number of helper T-lymphocytes in the body, *the patient*
  – **becomes so immuno-deficient** that he/she suffers from various infections.
  – **starts suffering from infections** of *Mycobacterium (bacteria)*, viruses, fungi and even parasites like *Toxoplasma*.
  – **suffers from bouts** of fever, diarrhoea and weight loss.

*Period of illness*
Diagnosis and treatment of AIDS

- A widely used diagnostic test for AIDS is enzyme linked immuno-sorbent assay (ELISA).
- Polymerase chain reaction (PCR) and Western blotting techniques are also used for diagnosis of HIV-AIDS.
- Treatment of AIDS with anti-retroviral drugs is only partially effective.
- Anti-retroviral drugs can only prolong the life of the patient but cannot prevent death, which is inevitable.
Measures/steps taken up to prevent HIV infection by WHO, NACO and NGOs:

✓ Making blood (from blood banks) safe from HIV,
✓ ensuring the use of only disposable needles and syringes in public and private hospitals and clinics,
✓ free distribution of condoms,
✓ controlling drug abuse,
✓ advocating safe sex and
✓ promoting regular check-ups for HIV in susceptible populations, are some such steps taken up.
CANCER

• Cancer is one of the most dreaded diseases of human beings.
• It is a major cause of death all over the globe.
• Some of the research area in cancer biology and medicine are:

  – oncogenic transformation of cells (mechanisms underlying development of cancer),
  – Treatment of cancer and
  – Control of cancer.
### CANCER

<table>
<thead>
<tr>
<th>Normal Cell</th>
<th>Cancer Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell growth and differentiation is highly controlled and regulated</td>
<td>Cancer cells undergo uncontrolled and unregulated growth and differentiation</td>
</tr>
<tr>
<td>Show a property called <strong>contact inhibition</strong>(^*) by virtue of which contact with other cells inhibits their uncontrolled growth.</td>
<td>Cancer cells have <em>lost property of contact inhibition</em>. As a result of this, cancerous cells continue to divide giving rise to masses of cells called tumors.</td>
</tr>
</tbody>
</table>

\(^*\)Contact inhibition is a regulatory mechanism that functions to keep cells growing into a layer one cell thick (a monolayer). If a cell has plenty of available substrate space, it replicates rapidly and moves freely.
CANCER

• Tumors are of two types:
  – benign and
  – malignant.

• Benign tumors normally remain confined to their original location and don’t spread to other parts of the body and cause little damage.

• The malignant tumors are a mass of proliferating cells called neoplastic* or tumor cells.

• Neoplastic cells grow very rapidly, invade and damage the surrounding normal tissues i.e. neoplastic cells starve the normal cells by competing for vital nutrients.

• Neoplastic cells sloughed from malignant tumors reach distant sites through blood, and wherever they get lodged in the body, they start a new tumor there. This property called metastasis.

• Metastasis is the most feared property of malignant tumors.

*New and abnormal growth of tissue
Causes of cancer

- Transformation of normal cells into cancerous neoplastic cells may be induced by carcinogens like
  - Physical agents,
  - chemical agents or
  - biological agents.

- Ionising radiations like X-rays and gamma rays and non-ionizing radiations like UV cause DNA damage leading to neoplastic transformation.

- The chemical carcinogens present in tobacco smoke have been identified as a major cause of lung cancer.

- Cancer causing viruses called oncogenic viruses have genes called viral oncogenes.

- Cellular oncogenes (c-onc) or proto oncogenes have been identified in normal cells which, when activated under certain conditions, could lead to oncogenic transformation of the cells.
Diagnosis of Cancer

- Blood and bone marrow tests
- Histopathological studies
- Imaging techniques
- Immunological techniques
- Techniques of molecular biology
Cancer detection and diagnosis

- Early detection of cancers is essential as it allows the disease to be treated successfully in many cases.
- Cancer detection is based on biopsy and histopathological studies of the tissue and blood and bone marrow tests for increased cell counts in the case of leukemias.
- In biopsy, a piece of the suspected tissue cut into thin sections is stained and examined under microscope (histopathological studies) by a pathologist.
- Imaging techniques like radiography (use of X-rays), CT (computed tomography) and MRI (magnetic resonance imaging) are very useful to detect cancers of the internal organs.
- Computed tomography uses X-rays to generate a three-dimensional image of the internals of an object.
- MRI uses strong magnetic fields and non-ionising radiations to accurately detect pathological and physiological changes in the living tissue.
Causes of cancer

- Antibodies against cancer-specific antigens are also used for detection of certain cancers.
- Techniques of molecular biology can be applied to detect genes in individuals with inherited susceptibility to certain cancers.
- Identification of such genes, which predispose an individual to certain cancers, may be very helpful in prevention of cancers.
- Such individuals may be advised to avoid exposure to particular carcinogens to which they are susceptible (e.g., tobacco smoke in case of lung cancer).
Common approaches for treatment of cancer

- Surgery,
- Chemotherapy
- Radiation therapy and
- Immunotherapy
Treatment of cancer

• The common approaches for treatment of cancer are
  – surgery,
  – radiation therapy and
  – immunotherapy.
Treatment of cancer

• In radiotherapy, tumor cells are irradiated lethally, taking proper care of the normal tissues surrounding the tumor mass.
• Several chemotherapeutic drugs are used to kill cancerous cells.
• Some of these are specific for particular tumors.
• Majority of drugs have side effects like hair loss, anemia, etc.
• Most cancers are treated by combination of surgery, radiotherapy and chemotherapy.
• Tumor cells have been shown to avoid detection and destruction by immune system. Therefore, the patients are given substances called biological response modifiers such as an interferon which activate their immune system and help in destroying the tumor.
Drugs And Alcohol

Questions and Answer
Define drug abuse
• Answer: When drugs are taken for purposes other than medicinal or taken in amounts or frequencies that impairs physical, physiological or psychological functions, it is called drug abuse.

Define alcohol abuse
• Answer: When alcohol is consumed for purposes other than medicinal or taken in amounts or frequencies that impairs physical, physiological or psychological functions, it is called alcohol abuse.
Enlist different categories of drugs;

• Answer: Drugs belong to different categories which are as follows;
  – Opioids
  – Cannabinoids
  – Coca alkaloid and cocaine
  – Hallucinogens
  – Tobacco
Chemical structure of drugs that you should identify

**Figure 8.7** Chemical structure of Morphine

**Figure 8.9** Skeletal structure of cannabinoid molecule
## Opioids

<table>
<thead>
<tr>
<th>Source</th>
<th>Morphine is extracted from the latex of poppy plant (<em>Papaver somniferum</em>). Heroin (smack) is a white, odourless, bitter, crystalline compound. It is obtained by <strong>acetylation of morphine</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of intake</td>
<td>By snorting and injection.</td>
</tr>
<tr>
<td>Mode of action/Organ system affected</td>
<td>They bind to specific opioid receptors in the Central Nervous System (CNS) and gastrointestinal tract.</td>
</tr>
<tr>
<td>Effects</td>
<td>Heroin is a depressant and slows down body functions. Morphine is an effective sedative and painkiller</td>
</tr>
</tbody>
</table>
# Cannabinoids

<table>
<thead>
<tr>
<th>Source</th>
<th>Obtained from inflorescence of the plant <em>Cannabis sativa</em>. Flower tops, leaves and resins of <em>C. sativa</em> in various combinations produce hashish, charas, marijuana and ganja.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mode of intake</strong></td>
<td>By inhalation and oral ingestion.</td>
</tr>
<tr>
<td><strong>Mode of action/Organ system affected</strong></td>
<td>Cannabinoids interact with cannabinoid receptors present in the brain.</td>
</tr>
<tr>
<td><strong>Effects</strong></td>
<td>Effect the cardiovascular system of the body.</td>
</tr>
</tbody>
</table>
## Coca alkaloid and cocaine*

<table>
<thead>
<tr>
<th>Source</th>
<th>Derived from the leaves and young branches of <em>Erythroxylum coca</em> - South American plant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mode of intake</strong></td>
<td>Sniffing and snorting</td>
</tr>
<tr>
<td><strong>Mode of action/Organ system affected</strong></td>
<td>It has a potent stimulating action on central nervous system and interferes with the transport of the neurotransmitter dopamine.</td>
</tr>
<tr>
<td><strong>Effects</strong></td>
<td>It is a strong stimulant and when taken in overdose causes headache, convulsions, hallucinations and death due to cardiovascular or respiratory failure.</td>
</tr>
</tbody>
</table>

*Cocaine is commonly called as coke or crack*
# Hallucinogens

<table>
<thead>
<tr>
<th>Source</th>
<th>Obtained from plants like <em>Atropa belladona</em> and <em>Datura sps</em>. Lysergic acid diethyl amide (LSD) is derived from the fungus <em>Claviceps purperea</em>.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of intake</td>
<td>Taken orally, or ingested</td>
</tr>
<tr>
<td>Mode of action/Organ system affected</td>
<td>These drugs are called psychedelic drugs because of their effect on cerebrum and sense organs.</td>
</tr>
<tr>
<td>Effects</td>
<td>These drugs effect thoughts, feelings and perceptions of an individual. Medically these are given to patients to cope with mental illnesses like depression and insomnia.</td>
</tr>
</tbody>
</table>
Uses and abuse of drugs

• Drugs like barbiturates, amphetamines, benzodiazepines, and lysergic acid diethyl amides (LSD) normally used as medicines to help patients cope with mental illnesses like depression and insomnia.

• Morphine is a very effective sedative and painkiller, and is very useful in patients who have undergone surgery.

• Several plants, fruits and seeds having hallucinogenic properties have been used for hundreds of years in folk-medicine, religious ceremonies and rituals all over the globe.

• Cannabinoids are abused by some sportspersons.
# Tobacco

<table>
<thead>
<tr>
<th>Source</th>
<th>Tobacco plant.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of intake</td>
<td>It is smoked, chewed or used as a snuff.</td>
</tr>
<tr>
<td>Main component of tobacco</td>
<td>It has nicotine, an alkaloid</td>
</tr>
<tr>
<td>Effects, Mode of action/Organ system affected</td>
<td>Nicotine stimulates adrenal gland to release adrenaline and nor-adrenaline into blood circulation, both of which raise blood pressure and increase heart rate. It increases the chances of lung cancer, bronchitis, emphysema, coronary heart diseases, cancer of throat, gastric ulcer, cancer of urinary bladder, etc. Smoking leads to increase in carbon monoxide content of blood and reduces concentration of haem-bound oxygen, as a result of which oxygen deficiency in the body is created. Chewing of tobacco causes oral cancer which becomes fatal in extreme conditions.</td>
</tr>
<tr>
<td>Source</td>
<td>Mode of intake</td>
</tr>
<tr>
<td>--------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>Oral intake</td>
</tr>
</tbody>
</table>
Questions On Drugs And Alcohol

Define addiction

• Answer: The psychological attachment to certain effects such as euphoria [A feeling of great elation (usually exaggerated)] and temporary feeling of well-being, associated with drugs and alcohol is called addiction.

What are the reasons for alcohol abuse in adolescents?

• Answer:
  1. Social pressure.
  2. Curiosity and need for adventure, excitement and experiment.
  3. To escape from stress, depression and frustration.
  4. To overcome hardships of daily life.
  5. Unstable or unsupportive family structure.
Define dependence
• Answer: The tendency of the body to manifest characteristic and unpleasant withdrawal syndrome on abrupt discontinuation of regular dose of drugs/alcohol is called dependence.

What are the Characteristics of withdrawal symptoms?
• Answer:
  1. Anxiety
  2. Shakiness
  3. Nausea
  4. Sweating
  5. Vomiting
  6. Diarrhoea
  7. Insomnia
  8. Muscular and abdominal cramps
  9. Restlessness
Questions On Effects of Drug and Alcohol Abuse

Which organ system is affected by alcohol?

• Answer: Alcohol has an anaesthetic effect on nervous system, affecting cerebrum followed by cerebellum and other parts.

What are the side effects of drugs on females and males?

• Answer:

<table>
<thead>
<tr>
<th>Side effects of drugs on</th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i. Masculinisation,</td>
<td>i. Appearance of acne,</td>
</tr>
<tr>
<td></td>
<td>ii. Aggressiveness,</td>
<td>ii. Aggressiveness,</td>
</tr>
<tr>
<td></td>
<td>iii. Mood swings,</td>
<td>iii. Reduction in size of testicles,</td>
</tr>
<tr>
<td></td>
<td>iv. Depression,</td>
<td>iv. Decreased sperm production,</td>
</tr>
<tr>
<td></td>
<td>v. Abnormal menstrual cycles,</td>
<td>v. Premature baldness,</td>
</tr>
<tr>
<td></td>
<td>vii. Excessive facial and body hair.</td>
<td></td>
</tr>
</tbody>
</table>
Questions On Effects of Drug and Alcohol Abuse

What are the warning signs of drug and alcohol abuse?

• Answer: Warning signs of drug and alcohol abuse are;

  • Drop in academic performance.
  • Absence from school/college.
  • Lack of interest in personal hygiene.
  • Isolation, depression, fatigue, aggressive and rebellious behaviour
  • Deteriorating relationships with family and friends,
  • Fluctuation in weight, etc.
Questions On Effects of Drug and Alcohol Abuse

What are the ill effects of drugs and alcohol?

• Answer: The ill effects of drugs and alcohol can be;
  – Those who take drugs intravenously develop a risk of AIDS and hepatitis-B.
  – Use of alcohol during adolescence may lead to heavy drinking in adulthood.
  – The chronic use of drug and alcohol damages nervous system and liver (cirrhosis) and the alcoholism during pregnancy affects the foetus.

Enumerate the prevention and Control?

• Answer: Prevention and Control measures are;
  – Avoid undue peer pressure.
  – Educating and counselling the problems and stresses to avoid disappointments and failures in life
  – Seeking help from parents and peers.
  – Looking for danger signs to take appropriate measures on time
  – Seeking for professional and medical help whenever required.
Chapter ends here.....