

## HUMAN HEALTH AND DISEASE

### Good Humor Hypothesis

Health, for a long time, was considered as a state of body and mind where there was a balance of certain 'humors'. This is what early Greeks like **Hippocrates (Father of medicine)** as well as **Indian Ayurveda system** of medicine asserted.

- It was thought that persons with '**blackbile**' belonged to hot personality and would have fevers.
- The discovery of blood circulation by William Harvey using experimental method and the demonstration of normal body temperature in persons with blackbile using **thermometer** disproved the 'good humor' hypothesis of health
- health is affected by
  - (i) **genetic disorders** – deficiencies with which a child is born and deficiencies/defects which the child inherits from parents from birth;
  - (ii) **infections**
  - (iii) **life style** including food and water we take, rest and exercise we give to our bodies, habits that we have or lack etc.

### HEALTH

According to **WHO (1948)**-health is a state of complete physical, mental and social well-being. Health also increases longevity of people and reduces infant and maternal mortality.

#### How to achieve Good health

- Balanced diet, personal hygiene and regular exercise are very important to maintain good health
- Yoga has been practised since time immemorial 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

### DISEASE

When the functioning of **one or more** organs or systems of the body is adversely affected, characterised by various signs and symptoms, we called it as disease.

Diseases can be broadly grouped into infectious and non-infectious.

#### 1-Infectious disease

Diseases which are easily transmitted from one person to another are called infectious diseases.

Eg : **AIDS**

#### 2-Non infectious disease

Diseases which are not easily transmitted from one person to another

Eg : **cancer**

### Pathogens

The disease causing organisms are called pathogens.

Eg: bacteria, virus, protozoan, helminthes, fungus

- 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.
- Etiology :The study of the causes of disease

## COMMON DISEASES IN HUMANS

### A) Bacterial disease

It include Typhoid fever, pneumonia, Dysentery, plague, diphtheria, TB, cholera, Leprosy, Whooping cough, gonorrhoea

#### a) Typhoid fever

- **Pathogen** : *Salmonella typhi*
- **Part of the body it infect** : These pathogens generally enter the small intestine through food and water contaminated with them and migrate to other organs through blood.
- **Symptoms** : Sustained high fever (39° to 40°C), weakness, stomach pain, constipation, headache and loss of appetite are some of the common symptoms of this disease. Intestinal perforation and death may occur in severe cases.
- **Spread** : Contaminated food and water
- **Test** : Typhoid fever could be confirmed by Widal test.

**Mary Mallon** : A classic case in medicine, that of Mary Mallon nicknamed Typhoid Mary, is worth mentioning here. She was a cook by profession and was a typhoid carrier who continued to spread typhoid for several years through the food she prepared

#### b) Pneumonia

- **Pathogen** : *Streptococcus pneumonia*  
*Haemophilus influenza*
- **Part of the body it infect** : alveoli (air filled sacs) of the lungs. As a result of the infection, the alveoli get filled with fluid leading to severe problems in respiration.
- **Symptoms** : fever, chills, cough and headache. In severe cases, the lips and finger nails may turn gray to bluish in colour.
- **Spread** : A 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.

Disease	Bacterial Pathogen
Dysentery	<i>Shigella</i>
Plague (Black death)	<i>Yersinia pestis</i>
Diphtheria	<i>Corynebacterium diphtheriae</i>
Leprosy (Hansen's disease)	<i>Mycobacterium leprae</i>

TB (Tuberculosis)	<i>Mycobacterium tuberculosis</i>
Cholera	<i>Vibrio cholera</i>
Whooping cough (Pertusis)	<i>Bordetella pertusis</i>

- DPT vaccine (Triple antigen ) is used against **diphtheria, pertusis and tetanus**
- Tetanus is also called **lock jaw** disease
- World TB day-**24<sup>th</sup> march**
- Anti leprosy day-**30<sup>th</sup> January**
- World's 1<sup>st</sup> anti leprosy vaccine (*Leprovac*) developed by national institute of immunology-New Delhi

### B) Viral disease

It include Common cold, AIDS, Chicken Pox, Small pox, Polio, Rabies, Mumps,

#### a) Common cold

- **Pathogen** : Rhino viruses (It represent one such group of viruses which cause one of the most infectious human ailments – the common cold).
- **Part of the body it infect** : They infect the nose and respiratory passage but not the lungs.
- **Symptoms** : nasal congestion and discharge, sore throat, hoarseness, cough, headache, tiredness, etc., which usually last for 3-7 days.
- **Spread** : Droplets resulting from cough or sneezes 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.



#### b) AIDS (Acquired Immuno Deficiency Syndrome.)

- **Pathogen** : HIV (Human immuno deficiency virus )-HIV was 1<sup>st</sup> isolated by Luc Montagnier
- **Part of the body it infect** : helper T lymphocyte
- **Symptoms** : progressive decrease in the number of helper T lymphocytes. During this period, the person suffers from bouts of **fever, diarrhoea and weight loss**.
- Due to decrease in the number of helper T lymphocytes, the person starts suffering from infections that could have been otherwise overcome such as those due to bacteria

especially **Mycobacterium, viruses, fungi and even parasites like Toxoplasma.**

- The patient becomes so immuno-deficient that he/she is unable to protect himself/herself against these infections.
- There is always a time-lag between the infection and appearance of AIDS symptoms. This period may vary from a few months to many years (**usually 5-10 years**).
- **Spread** : Transmission of HIV-infection  
Generally occurs by
  - (a) sexual contact with infected person,
  - (b) by transfusion of contaminated blood and blood products,
  - (c) by sharing infected needles as in the case of intravenous drug abusers and
  - (d) from infected mother to her child through placenta.

So, people who are at high risk of getting this 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.**

**Test** : ELISA (enzyme linked immune sorbent assay ).

**Confirmatory test is : Western Blot**

- 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 in USA** and in the last twenty-five years or so, it has spread all over the world killing more than 25 million persons.
- HIV/AIDS is not spread by mere touch or physical contact; it spreads only through body fluids. It is, hence, imperative, for the physical and psychological well-being, that the HIV/AIDS infected persons are not isolated from family and society.



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### **Life cycle of HIV**

- HIV is a **retro virus**
- After getting into the body of the person (by endocytosis), the virus enters into macrophages where RNA genome of the virus replicates to form viral DNA with the help of the **enzyme reverse transcriptase (RNA dependent dna polymerase)**

- This viral DNA gets incorporated into host cell's DNA and directs the infected cells to produce virus particles
- The **macrophages** continue to produce virus and in this way acts like a **HIV factory**.
- Simultaneously, HIV enters into helper T-lymphocytes (TH), replicates and produce progeny viruses. The progeny viruses released in the blood attack other helper T-lymphocytes. This is repeated leading to a progressive decrease in the number of helper T lymphocytes in the body of the infected person.
- During this period, the person suffers from bouts of fever, diarrhoea and weight loss.

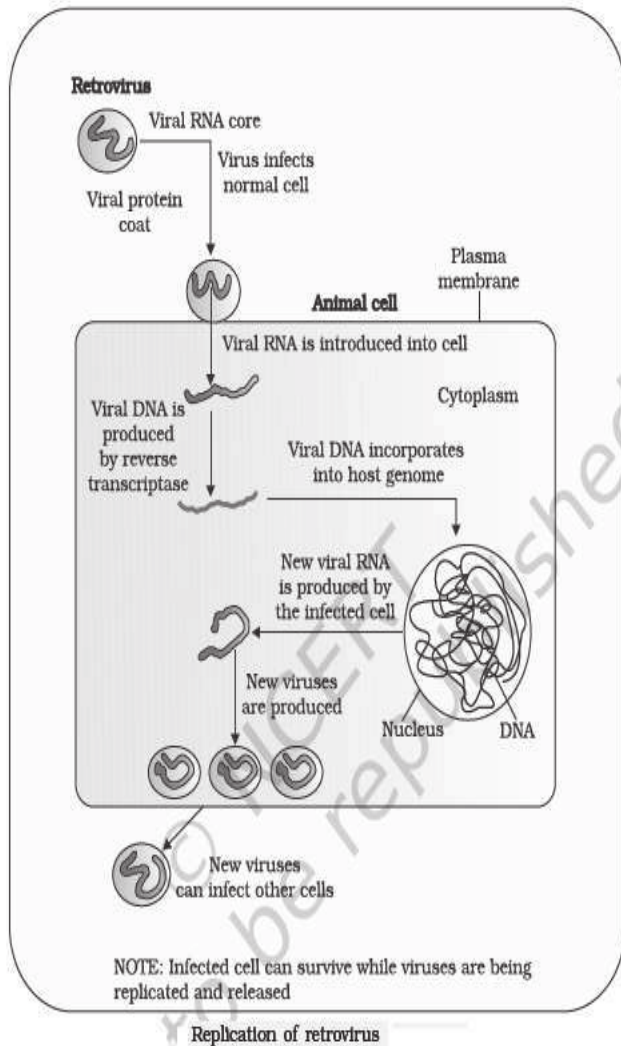
### **Treatment of AIDS** :

Treatment of AIDS with **anti-retroviral drugs** is only partially effective. They can only prolong the life of the patient

### **Prevention of AIDS** :

As AIDS has no cure, prevention is the best option. Moreover, HIV infection, more often, spreads due to conscious behavior patterns and is not something that happens inadvertently, like pneumonia or typhoid. Of course, 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”.

- In our country the **National AIDS Control Organisation (NACO)** and other non-governmental organisation (NGOs) are doing a lot to educate people about AIDS. WHO has started a number of programmes to prevent the spreading of HIV infection.
- 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. but cannot prevent death, which is inevitable.



- AIDS was 1<sup>st</sup> recognized in the USA by Dr. Gottlieb in 1981
- HIV has two copies of single stranded RNA
- World AIDS day 1<sup>st</sup> December
- Small pox is caused by **variola virus**
- Rabies are also called hydrophobia
- Dengue fever is a viral disease spread by *Aedes aegypti*
- National institute of virology-Pune
- Chicken pox is caused by **varicella zoster virus**
- **Mumps** is caused by mumps virus and it infect Parotid gland
- **SCID** (severe combined immune deficiency) results due to one of many genetic defect. One such genetic defect leads to adenosine deaminase deficiency. SCID is characterized by very low number

of circulating lymphocytes. The affected individual die at an early age.

### C)PROTOZOAN DISEASE

It include malaria and amoebiasis

#### a)Malaria

- **Pathogen** : Plasmodium (a tiny protozoan) Different species of Plasmodium (*P. vivax*, *P. malaria* and *P. falciparum*) are responsible for different types of malaria. Of these, malignant malaria caused by *Plasmodium falciparum* is the most serious one and can even be fatal.
- **Part of the body it infect** : Liver, RBC
- **Symptoms** : 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
- **Spread** : the female Anopheles transmitting agent



#### Life cycle of Plasmodium

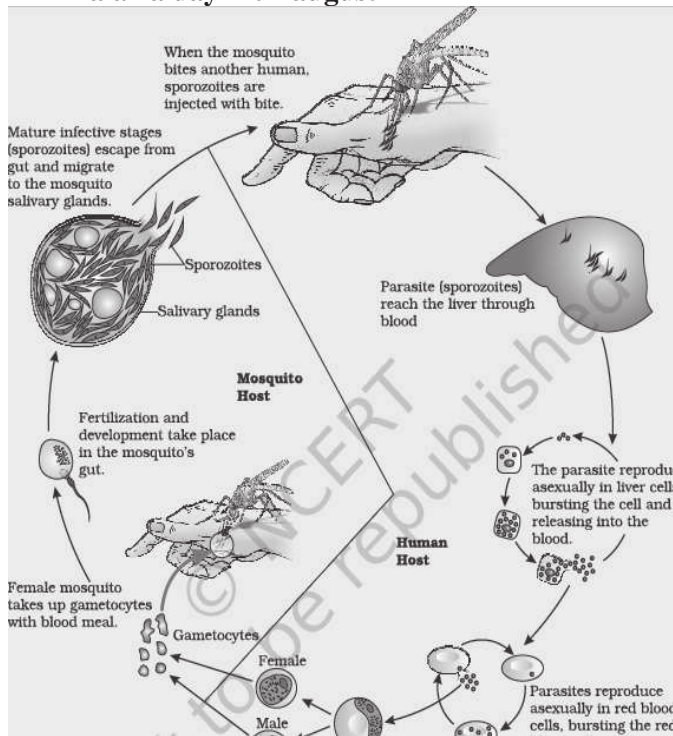
- Plasmodium enters the human body as **sporozoites (infectious form)** through the bite of infected **female Anopheles mosquito**.
- The parasites initially multiply within the liver cells and then attack the red blood cells (RBCs) resulting in their rupture.
- The rupture of RBCs is associated with release of a toxic substance, **haemozoin**, which is responsible for the chill and high fever recurring every three to four days.
- When a female Anopheles mosquito bites an infected person, these parasites enter the mosquito's body and undergo further development. The parasites multiply within them to form sporozoites that are stored in their salivary glands.
- When these mosquitoes bite a human, the sporozoites are introduced into his/ her body, thereby initiating the events mentioned above.
- It is interesting to note that the malarial parasite requires two hosts – human and mosquitoes – to complete its life cycle the female Anopheles mosquito is the vector (transmitting agent) too.
- **Ronald Ross** was an Indian-born British medical doctor who received the Nobel Prize in Medicine in 1902 for his work on malaria . His discovery of the malarial parasite in the gastrointestinal



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tract of mosquito led to the realisation that malaria was transmitted by mosquitoes

- **Malaria day=20<sup>th</sup> august**



- **Part of the body it infect :** Intestine
- **Symptoms :** internal bleeding, muscular pain, fever, anemia and blockage of the intestinal passage.
- **Spread :** The eggs of the parasite are excreted 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



#### b) Filariasis/ elephantiasis

- **Pathogen :** *Wuchereria* (*W. bancrofti* and *W. malayi*),
- **Part of the body it infect :** the lymphatic vessels of the lower limbs . The genital organs are also often affected
- **Symptoms :** the filarial worms cause a slowly developing chronic inflammation of the organs in which they live for many years, usually the lymphatic vessels of the lower limbs and the disease is called elephantiasis or filariasis The genital organs are also often affected, resulting in gross deformities.
- **Spread:** The pathogens are transmitted to a healthy person through the bite by the female mosquito vectors (*Culex*)

#### b) Amoebiasis (amoebic dysentery).

- **Pathogen :** *Entamoeba histolytica*
- **Part of the body it: infect** the large intestine of human
- **Symptoms :** constipation, abdominal pain and cramps, stools with excess mucous and blood clots.
- **Spread :** Houseflies act as mechanical carriers 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
- Kala azar/Leishmaniasis/dum dum fever is a protozoan disease caused by *Leishmania donovani* (It is transmitted by sand fly-*Phlebotomus*)
- Sleeping sickness is a protozoan disease caused by *trypanosoma* (It is transmitted by Tse tse fly-*Glossina*)



#### D) Helminth disease

It include ascariasis and filariasis

##### a) Ascariasis

- **Pathogen :** *Ascaris*, the common round worm

#### E) Fungal disease

##### Ring worms

- **Pathogen :** Many fungi belonging to the genera *Microsporum*, *Trichophyton* and *Epidermophyton* are responsible for ringworms which is one of the most common infectious diseases in man.
- **Part of the body it infect :** skin, nails and scalp
- **Symptoms :** Appearance of dry, scaly lesions on various parts of the body such as skin, nails and scalp are the main symptoms of the disease. These lesions are accompanied by intense itching. Heat and moisture help these fungi to grow, which make them thrive in skin folds such as those in the groin or between the toes.
- **Spread :** Ringworms are generally acquired from soil or by using towels, clothes or even the comb of infected individuals.

## **PREVENTION AND CONTROL OF INFECTIOUS DISEASES**

Maintenance of personal and public hygiene is very important for prevention and control of many infectious diseases

### **Personal hygiene**

Measures for personal hygiene include keeping the body clean; consumption of clean drinking water, food, vegetables, fruits, etc.

### **Public hygiene**

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.

### **For air Borne disease**

In cases of air-borne diseases such as pneumonia and common cold, in addition to the above measures, close contact with the infected persons or their belongings should be avoided

### **For vector borne disease**

For diseases such as malaria and filariasis that are transmitted through insect vectors, the most important measure is to control or eliminate the vectors and their breeding places. This can be achieved By

- 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. Such precautions have become all the more important especially in the light of recent widespread incidences of the vector-borne (Aedes mosquitoes-dengue fever and chikungunya) diseases like dengue and chikungunya in many parts of India.

### **Immunization**

The use of vaccines and immunisation programmes have enabled us to completely eradicate a deadly disease like smallpox. A large number of other infectious diseases like polio, diphtheria, pneumonia and tetanus have been controlled to a large extent by the use of vaccines.

Biotechnology is at the verge of making available newer and safer vaccines. Discovery of antibiotics and various other drugs has also enabled us to effectively treat infectious diseases

## **CANCER**

- Cancer is one of the most dreaded diseases of human beings and is a major cause of death all over the globe.
- More than **a million Indians** suffer from cancer and a large number of them die from it annually
- Our body, cell growth and differentiation is highly controlled and regulated. In cancer cells, there is breakdown of these regulatory mechanisms.
- Normal cells show a property called **contact inhibition** by virtue of which contact with other cells inhibits their uncontrolled growth. Cancer cells appear to have lost this property. As a result of this, cancerous cells just continue to divide giving rise to masses of cells called tumors.
- Tumors are of two types: **benign and malignant.**
- **Benign tumors** normally remain confined to their original location and do not spread to other parts of the body and cause little damage.
- **The malignant tumors**, on the other hand are a mass of proliferating cells called neoplastic or tumor cells. These cells grow very rapidly, invading and damaging the surrounding normal tissues. As these cells actively divide and grow they also starve the normal cells by competing for vital nutrients. Cells sloughed from such tumors reach distant sites through blood, and wherever they get lodged in the body, they start a new tumor there. This property called **metastasis** is the most feared property of malignant tumors.

### **Causes of cancer :**

Transformation of normal cells into cancerous neoplastic cells may be induced by **physical, chemical or biological agents**. These agents are called **carcinogens**.

Eg : **Ionising radiations like X-rays and gamma rays** and

**non-ionizing radiations like UV cause DNA damage leading to neoplastic transformation.**



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- 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.
- Furthermore, several genes called 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.

#### **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 (blood cancer)**
- **In biopsy**, a piece of the suspected tissue cut into thin sections is stained and examined under microscope (histopathological studies) by a pathologist.
- 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.
- **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).

#### **Treatment of cancer :**

- The common approaches for treatment of cancer are **surgery, radiation therapy and immunotherapy**.
- **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  $\alpha$ -interferon which activates their immune system and helps in destroying the tumor.

#### **Extra shots**

- The study of cancer is called **Oncology**
- **Carcinoma= cancer of epithelial Tissue tat cover or line body organs**  
Eg: skin cancer, breast cancer, lung cancer
- **Sarcoma=cancer of connective tissues**  
Eg: bone cancer, muscle tumor
- **Melanoma=Cancer of melanocytes**
- **Leukaemia= cancer of WBC**
- **Lymphoma=Cancer of lymph nodes and spleen**
- **Glioma=Cancer of glial cells of CNS**
- **Oncogenic virus = Herpes Simplex virus (Cause cancer of uterus, cervix in women)**
- A common weed *Catharanthus roseus* is the source of 2 anti cancer drugs, Vincristin and Vinblastin, used in the treatment of Blood cancer





## IMMUNOLOGY

- The overall ability of the host to fight the disease-causing organisms, conferred by the immune system is called immunity. Immunity is of two types:

- Innate immunity and
- Acquired immunity.

### i) Innate immunity/inborn immunity /non specific immunity

- This type of immunity is present at the time of birth. This 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. These are —

#### (a) Physical barriers :

**Skin** on our body is the main barrier which prevents entry of the micro-organisms. **Mucus coating** of the epithelium lining the respiratory, gastrointestinal and urogenital tracts also help in trapping microbes entering our body.

#### (b) Physiological barriers :

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

- Saliva and tear contain antibacterial agent called **Lysozyme**

#### (c) Cellular barriers :

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

- The PMNL especially neutrophils of the blood have the ability to come out of the blood capillaries by amoeboid movement called Diapedesis. It engulf many pathogens

#### (d) Cytokine barriers :

Virus-infected cells secrete proteins called **interferons** which protect non-infected cells from further viral infection.

### ii) Acquired immunity/adaptive immunity/specific immunity

- It is pathogen specific.
- It is characterised by **memory**. This means that 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**.

- Features of acquired immunity
- Specificity**: distinguish specific foreign molecules.
- Diversity**: recognize vast variety of foreign molecules.
- Discrimination between self and nonself**: it is able to recognize and respond to molecules that are foreign or non-self. It will not respond to our own cell or molecules.
- Memory**: after responding to the foreign microbes and elimination, this immune system retains the memory of that encounter (primary immuneresponse). The second encounter with the same microbe evokes a heightened immune response. (Secondary immune response)
- This is ascribed to the fact that our body appears to have memory of the first encounter.

### B-lymphocytes and T lymphocytes

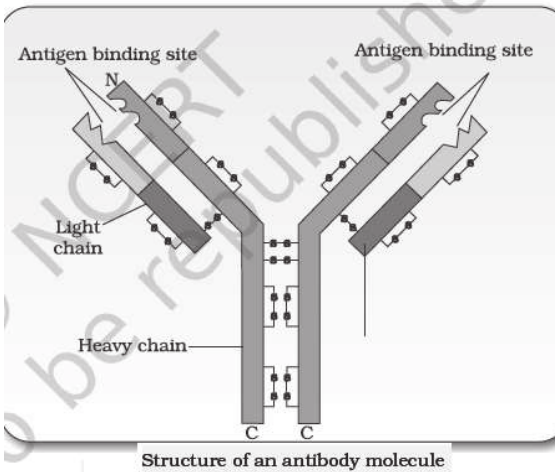
- The primary and secondary immune responses are carried out with the help of two special types of lymphocytes present in our blood, i.e., B-lymphocytes and T lymphocytes.
- Certain cells of bone marrow produce lymphocytes (Haematopoiesis). These cells mature in the bone marrow lymphocytes. The B-lymphocytes produce an army of proteins in response to pathogens into our blood to fight with them. These proteins are called antibodies. The B lymphocytes give rise to plasma cells and memory B cells.
- Some stem cells in the Bone marrow give rise to immature lymphocytes. These lymphocytes migrate via the blood to the thymus, where they mature as T cells. In the thymus, these cells mature as T lymphocytes. The T-cells themselves do not secrete antibodies but help B cells produce them

### Structure of Antibody

Each antibody molecule has **four peptide chains**, two small called **light chains** and two longer called **heavy chains**. Hence, an antibody is represented as **H<sub>2</sub>L<sub>2</sub>**. Different types of antibodies are produced in our body. IgA, IgM, IgE, IgG are some of them







- Both light and Heavy chain contains 2 distinct regions-constant and variable region
- An antibody doesnot usually destroy an antigen directly but targets it for elimination by phagocytes
- IgG=Most abundant Immunoglobulin
- IgM=1<sup>st</sup> Ig produced in a primary response to an antigen
- IgA=contain in the secretions like saliva, colostrums.Tear (Secretory antibody)
- IgE=mediatory in allergic reactions
- IgD=It activate cells to secrete other Ab

### **HUMORAL IMMUNITY & CELL MEDIATED IMMUNITY**

- Immune response by the **B-cells** by production of antibody is called Antibody mediated immune response (AMI) or humoral immune response.
- Immune response by T-cells which detects and destroys the foreign cells and also cancerous cells called cell mediated immune response.(CMI)
- Rejection of organs in transplantation are due to **T-lymphocytes**.
- Tissue matching, blood group matching are essential for organ transplantation.
- Immune-suppressants is required before and after transplantation

### **Types of transplant :**

- **Autograft:** tissue grafter from one part of the body to another part of the same person Eg :Skingrafting
- **Isograft:** A graft between 2 genetically identical individual such as identical twins
- **Allograft:** A tissue grafted from one individual to a genetically different individual of the same species

- **Xenograft :** A graft between individuals of different species such as pig to human

### **Active and Passive Immunity**

#### **Active immunity :**

- When a host is exposed to antigens, which may be in the form of living or dead microbes or other proteins, antibodies are produced in the host body. This type of immunity is called active immunity.
- Active immunity is slow and takes time to give its full effective response.
- Injecting the microbes deliberately during immunisation or infectious organisms gaining access into body during natural infection induce active immunity.

Eg: **Vaccines**



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#### **Vaccines**

- The term vaccine is coined by Louis Pasteur
- 1<sup>st</sup> vaccination was carried out by British Physician Edward Jenner to protect people from small pox
- The principle of immunisation or vaccination is based on the property of '**memory**' of the immune system.
- In vaccination, a preparation of antigenic proteins of pathogen or inactivated/weakened pathogen (vaccine) are introduced into the body. The antibodies produced in the body against these antigens would neutralise the pathogenic agents during actual infection.
- The vaccines also generate memory – B and T-cells that recognize the pathogen quickly on subsequent exposure and overwhelm the invaders with a massive production of antibodies.
- Examples for vaccines

Live BCG vaccine	Tuberculosis
Killed TAB vaccine	Enteric fever
MMR	Rubella,mumps,measles
Salk vaccine	Poliomyelitis
DPT	Diphtheria, Pertusis and tetany

- **Recombinant DNA technology** has allowed the production of antigenic polypeptides of pathogen in bacteria or yeast. Vaccines produced using this approach **allow large scale production** and hence greater availability for immunisation, e.g., **hepatitis B vaccine** produced from yeast

### Passive immunity

- When **ready-made antibodies** are **directly given to protect the** body against foreign agents, it is called passive immunity.
- The yellowish fluid **colostrum** secreted by mother during the initial days of lactation has abundant antibodies (IgA) to protect the infant
- **The foetus** also receives some antibodies (IgG) from their mother, **through the placenta** during pregnancy.
- If a person is infected with some deadly microbes to which quick immune response is required as in tetanus, we need to directly inject the preformed antibodies, or antitoxin (a preparation containing antibodies to the toxin).
- in cases of snakebites, the injection which is given to the patients, contain preformed antibodies (Anti venom ) against the snake venom



### Allergies/Hypersensitivity

- The **exaggerated response** of the immune system to certain antigens present in the environment is called allergy.
- The substances to which such an immune response is produced are called **allergens**.
- examples of allergens are mites in dust, pollens, animal dander, etc.
- The antibodies produced to these are of **IgE type**.
- **Symptoms** of allergic reactions include sneezing, watery eyes, running nose and difficulty in breathing.
- 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.
- The use of 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 – more and more 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.

- A **severe allergic reaction, called anaphylactic shock**, occurs when large amount of histamine are suddenly released by the mast cells

**Eg: bee bite**

### Auto Immunity

- Memory-based acquired immunity evolved in higher vertebrates based on the ability to differentiate foreign organisms (e.g., pathogens) from self cells.
- higher vertebrates can distinguish foreign molecules as well as foreign organisms.
- **due to genetic and other unknown reasons, the body attacks self-cells**. This results in damage to the body and is called auto-immune disease.

Eg: Rheumatoid arthritis

Myasthenia gravis

Graves disease

Hashimoto's disease

### Immune System in the Body

The human immune system consists of **lymphoid organs, tissues, cells and soluble molecules like antibodies**. The immune system also plays an important role in allergic reactions, auto-immune diseases and organ transplantation.

#### Lymphoid organs:

These are the organs where origin and/or maturation and proliferation of lymphocytes occur.

#### The primary lymphoid organs/central lymphoid organ

They are **bone marrow and thymus** where immature lymphocytes differentiate into antigen-sensitive lymphocytes.

**The bone marrow:** it is the main lymphoid organ where all blood cells including lymphocytes are produced.

**The thymus:** it is a lobed organ located near the heart and beneath the breastbone. 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. Hence thymus gland is called juvenile gland.

Both bone-marrow and thymus provide micro-environments for the development and **maturation of T-lymphocytes**

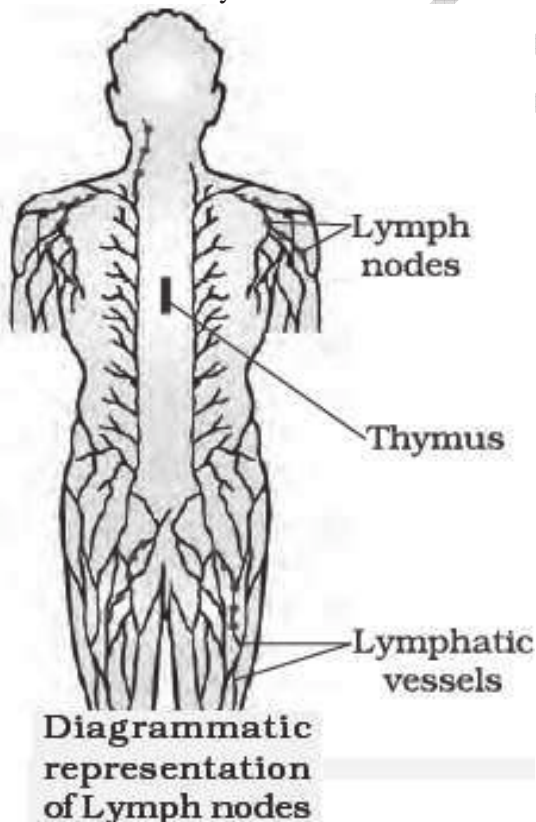
### **Secondary lymphoid organ**

After maturation the lymphocytes migrate to secondary lymphoid organs like **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.

**The spleen:** it\_ is a large beanshaped organ. It mainly 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.

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

- There is lymphoid tissue also located within the lining of the major tracts (respiratory, digestive and urogenital tracts) called mucosa associated lymphoid tissue (MALT). It constitutes about 50 per cent of the lymphoid tissue in human body.





## DRUGS

Surveys and statistics show that use of drugs and alcohol has been on the rise especially among the youth. This is really a cause of concern as it could result in many harmful effects. Proper education and guidance would enable youth to safeguard themselves against these dangerous behaviour patterns and follow healthy lifestyles.

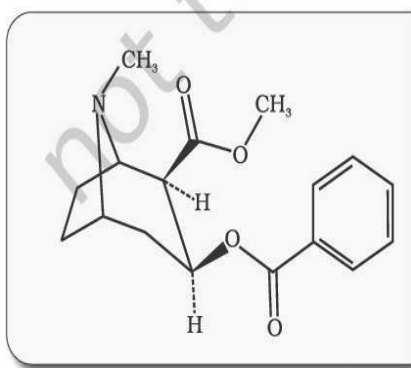
The drugs, which are commonly abused are **opioids, cannabinoids and coca alkaloids**. Majority of these are obtained from **flowering plants**. Some are obtained from **fungi**.

### 1.opioids,

- Opioids are the drugs, which bind to specific opioid receptors present in our central nervous system and gastrointestinal tract.

**Eg 1 :Heroin** commonly called **smack** is chemically **diacetylmorphine** which is a white, odourless, bitter crystalline compound. This is obtained by **acetylation of morphine** which is extracted from the latex of poppy plant *Papaver somniferum*. Generally taken by snorting and injection, heroin is a depressant and slows down body functions.

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



Chemical structure of Morphine

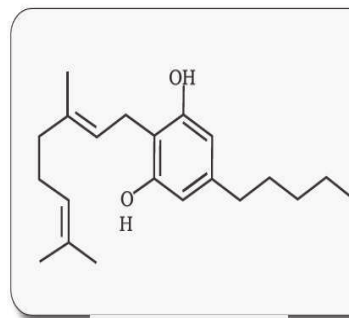


Opium poppy

### 2.Cannabinoids

They are a group of chemicals which interact with cannabinoid receptors present principally in the brain.

Natural cannabinoids are obtained from the inflorescences of the plant *Cannabis sativa*. The flower tops, leaves and the resin of cannabis plant are used in various combinations to produce **marijuana, hashish, charas and ganja**. Generally taken by inhalation and oral ingestion, these are known for their effects on cardiovascular system of the body



Skeletal structure of cannabinoid molecule



Leaves of Cannabis sativa

### 3. Coca alkaloid or cocaine

It is obtained from coca plant *Erythroxylum coca*, native to South America. It interferes with the transport of the neurotransmitter **dopamine**.

- Cocaine, commonly called coke or crack is usually snorted. It has a potent stimulating action on central nervous system, producing a sense of euphoria and increased energy. Excessive dosage of cocaine causes hallucinations.
- Other well-known plants with hallucinogenic properties are Atropa belladonna and Datura. These days cannabinoids are also being abused by some **sports persons**



Flowering branch of Datura

### 4.Other drugs

Drugs like barbiturates, amphetamines, benzodiazepines, and other similar drugs, that are normally used as medicines to help patients cope with mental illnesses like depression and insomnia, are often abused. 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. When these are taken for a purpose other than medicinal use or in amounts/frequency that

impairs one's physical, physiological or psychological functions, it constitutes drug abuse.

### SMOKING

- Tobacco has been used by human beings for more than 400 years. It is smoked, chewed or used as a snuff.
- Tobacco contains a large number of chemical substances including nicotine, an alkaloid.
- Nicotine stimulates adrenal gland to release adrenaline and nor-adrenaline into blood circulation, both of which raise blood pressure and increase heart rate. Smoking is associated with increased incidence of cancers of lung, urinary bladder and throat, bronchitis, emphysema, coronary heart disease, gastric ulcer, etc.
- Tobacco chewing is associated with increased risk of cancer of the oral cavity.
- Smoking increases carbon monoxide (CO) content in blood and reduces the concentration of haem bound oxygen. This causes oxygen deficiency in the body.

### Adolescence and Drug/Alcohol Abuse

- Adolescence means both 'a period' and 'a process' during which a child becomes mature in terms of his/her attitudes and beliefs for effective participation in society.
- The period between **12-18** years of age may be thought of as adolescence period. In other words, adolescence is a bridge **linking childhood and adulthood**.
- Adolescence is accompanied by several biological and behavioural changes. Adolescence, thus is a very vulnerable phase of mental and psychological development of an individual.
- **Curiosity, need for adventure and excitement, and experimentation, constitute common causes, which motivate youngsters towards drug and alcohol use.** A child's natural curiosity motivates him/her to experiment.
- Thus, the first use of drugs or alcohol may be out of curiosity or experimentation, but later the child starts using these to escape facing problems. Of late, stress, from pressures to excel in academics or examinations, has played a significant role in persuading the youngsters to try alcohol and drugs. The perception among youth that it is 'cool' or progressive to smoke, use drugs or alcohol, is also in a way a major cause for youth to start

these habits. Television, movies, newspapers, internet also help to promote this perception. Other factors that have been seen to be associated with drug and alcohol abuse among adolescents are unstable or unsupportive family structures and peer pressure.

### Addiction and Dependence

- Addiction is a psychological attachment to certain effects –such as euphoria and a temporary feeling of well-being –associated with drugs and alcohol.
- These drive people to take them even when these are not needed, or even when their use becomes self-destructive. With repeated use of drugs, the tolerance level of the receptors present in our body increases. Consequently the receptors respond only to higher doses of drugs or alcohol leading to greater intake and addiction. However, it should be clearly borne in mind that use of these drugs even once, can be a fore-runner to addiction.
- Thus, the addictive potential of drugs and alcohol, pull the user into a vicious circle leading to their regular use (abuse) from which he/she may not be able to get out. In the absence of any guidance or counselling, the person gets addicted and becomes dependent on their use.
- Dependence is the tendency of the body to manifest a characteristic and unpleasant withdrawal syndrome if regular dose of drugs/alcohol is abruptly discontinued. This is characterised by anxiety, shakiness, nausea and sweating, which may be relieved when use is resumed again.
- In some cases, withdrawal symptoms can be severe and even life threatening and the person may need medical supervision.
- Dependence leads the patient to ignore all social norms in order to get sufficient funds to satiate his/her needs. These result in many social adjustment problems.

### Effects of Drug/Alcohol

- the reckless behaviour, vandalism and violence.
- Excessive doses of drugs may lead to coma and death due to respiratory failure, heart failure or cerebral hemorrhage.
- A combination of drugs or their intake along with alcohol generally results in overdosing and even deaths.
- The most common warning signs of drug and alcohol abuse among youth include drop in

academic performance, unexplained absence from school/college, lack of interest in personal hygiene, withdrawal, isolation, depression, fatigue, aggressive and rebellious behaviour, deteriorating relationships with family and friends, loss of interest in hobbies, change in sleeping and eating habits, fluctuations

in weight, appetite, etc.

- If an abuser is unable to get money to buy drugs/alcohol he/she may turn to stealing. The adverse effects are just not restricted to the person who is using drugs or alcohol.
- a drug/alcohol addict becomes the cause of mental and financial distress to his/her entire family and friends. Those who take drugs intravenously (direct injection into the vein using a needle and syringe), are much more likely to acquire serious infections like AIDS and Hepatitis B.
- The viruses, which are responsible for these diseases, are transferred from one person to another by sharing of infected needles and syringes. Both AIDS and Hepatitis B infections are chronic infections and ultimately fatal. Both can be transmitted through sexual contact or infected blood.
- The use of alcohol during adolescence may also have long-term effects. It could lead to heavy drinking in adulthood. The chronic use of drugs and alcohol damages nervous system and liver (cirrhosis).
- The use of drugs and alcohol during pregnancy is also known to adversely affect the foetus.
- Another misuse of drugs is what certain sportspersons do to enhance their performance. They (mis)use narcotic analgesics, anabolic steroids, diuretics and certain hormones in sports to increase muscle strength and bulk and to promote aggressiveness and as a result increase athletic performance. The side-effects of the use of anabolic steroids in females include masculinisation (features like males), increased aggressiveness, mood swings, depression, abnormal menstrual cycles, excessive hair growth on the face and body, enlargement of clitoris, deepening of voice.
- In males it includes acne, increased aggressiveness, mood swings, depression, reduction of size of the testicles, decreased sperm production, potential for kidney and

liver dysfunction, breast enlargement, premature baldness, enlargement of the prostate gland. These effects may be permanent with prolonged use. In the adolescent male or female, severe facial and body acne, and premature closure of the growth centres of the long bones may result in stunted growth. Prevention and Control The age-old adage of 'prevention is better than cure' holds true here also.

- It is also true that habits such as smoking, taking drug or alcohol are more likely to be taken up at a young age, more during adolescence. Hence, it is best to identify the situations that may push an adolescent towards use of drugs or alcohol, and to take remedial measures well in time. In this regard, the parents and the teachers have a special responsibility. Parenting that combines with high levels of nurturance and consistent discipline, has been associated with lowered risk of substance (alcohol/drugs/tobacco) abuse.
- Some of the measures mentioned here would be particularly useful for prevention and control of alcohol and drugs abuse among adolescents
- **(i) Avoid undue peer pressure** - Every child has his/her own choice and personality, which should be respected and nurtured. A child should not be pushed unduly to perform beyond his/her threshold limits; be it studies, sports or other activities.
- **(ii) Education and counselling** - Educating and counselling him/ her to face problems and stresses, and to accept disappointments and failures as a part of life. It would also be worthwhile to channelize the child's energy into healthy pursuits like sports, reading, music, yoga and other extracurricular activities.
- **(iii) Seeking help from parents and peers** - Help from parents and peers should be sought immediately so that they can guide appropriately. Help may even be sought from close and trusted friends. Besides getting proper advice to sort out their problems, this would help young to vent their feelings of anxiety and guilt.
- **(iv) Looking for danger signs** - Alert parents and teachers need to look for and identify the danger signs discussed above. Even friends, if they find someone using drugs or alcohol,



Navas cheemadan

should not hesitate to bring this to the notice of parents or teacher in the best interests of the person concerned. Appropriate measures would then be required to diagnose the malady and the underlying causes. This would help in initiating proper remedial steps or treatment.

- **(v) Seeking professional and medical help** -  
A lot of help is available in the form of highly qualified psychologists, psychiatrists, and deaddiction and rehabilitation programmes to help individuals who have unfortunately got in the quagmire of drug/alcohol abuse. With such help, the affected individual with sufficient efforts and will power, can get rid of the problem completely and lead a perfectly normal and healthy life.

