

Aids to Health

Immunity

What Is Health?

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

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

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

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

Immunity

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

Immunity is of two types – innate and acquired immunity.

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

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

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

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

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

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

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

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

Two types of active immunity – Natural and artificial

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

Artificial – It is imparted by vaccination.

Two types of passive immunity – Natural and artificial

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

Artificial – In this, serum antibodies from horse or other animals are isolated (they are first made stronger by repeatedly injecting the vaccination for the particular disease).

These antibodies are injected into the humans to provide them immunity.

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

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

Local Defence System of the Body

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

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

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

Organ	Function
Skin	First line of defence; prevents entry of germs Oil glands and sweat glands destroy the germs.
Nose	Hair present in the nose filters the foreign particles. These particles are thrown out during sneezing.

Eyes	Tear glands secrete tears containing lysozymes. Lysozyme prevents eye infections.
Mouth	Salivary enzymes kill the microbes.
HCl in stomach	Kills the microbes that reach the stomach
WBCs	Kill the microbes that enter the body through cuts and abrasions

Antibodies

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

Means to Fight Infections

Body has natural defence mechanisms to fight infections. The immune system of the body fights most of the germs that enter our bodies and prevent us from falling ill frequently.

Immunisation

It is the process of development of resistance against disease causing pathogens by introducing killed pathogens or their mild forms into the body, so as to induce the production of specific antibodies.

Vaccination

In this, the immune system of the body is made to produce antibodies to encounter with dead virus/bacteria or toxin secreted by the virus/bacteria.

These weakened microbes act as antigens and stimulate the immune system for secreting antibodies.

Edward Jenner was the first one to use vaccination for protection against diseases.

Types of Vaccines

Type of vaccine	Feature
Killed germs	Killed germs are used to stimulate the immune system. E.g. – TAB vaccine for typhoid, salk vaccine for polio
Living weakened germs	E.g. – Measles vaccine, BCG vaccine
Living germs	In this, living and fully virulent germs are used. In small pox vaccine, fully virulent small pox virus is used. It does not cause small pox because a single pustule is present, unlike multiple pustules as in the actual disease.
Toxoids	These are the extracts of toxins secreted by the bacteria, which are made harmless by addition of formalin, but still retain their ability to evoke immune response.

Antiserum

Antiserum, which is the serum containing antibodies against a particular antigen, is also used for fighting infections.

Toxins - Any poisonous substance produced by a living organism (for example, snake venom, sting poisons, poisonous chemicals released by pathogens in body, etc).

Antitoxin - Chemical substance produced inside the body in response to the entry of any toxic substance.

Antivenins - Chemical substances produced inside the body of some animals (like horses), against the snake venom.

External Health Aids

Antiseptic – These are the chemicals that are applied locally to destroy the bacteria. Since they are diluted, they cause no harm to the skin.

E.g. – Lysol, carbolic acid, iodine, etc.

Disinfectants – These are the chemicals that are used to destroy microbes on the floors, surgical instruments, hospitals, toilets, etc. They should never be applied on the skin due to their highly corrosive nature.

Sterilisation – In this process, all the microbes are removed from equipment. Sterilisation can be done by chemicals, heat, or radiations.

Differences between Antiseptics and Disinfectants

Antiseptics	Disinfectants
Mild in nature	Strong in nature
Cause no harm to skin	May cause harm to skin and body
Used in applying on skin	Used in applying on spots and places
Example: Benzoic acid	Example: Phenol

Antibiotics

Antibiotics are the chemical substances produced by a microbe that inhibits or kills other microbes.

Selman Waksman coined the term 'antibiotic' in 1942.

First antibiotic was penicillin (1929).

Penicillin was discovered by chance, when Alexander Fleming was working on the cultures of bacterium *Staphylococcus*.

He observed that growth of a mould *Penicillium notatum* inhibited the growth of *Staphylococcus*. This property of the mould is used till date to get rid of disease-causing bacteria *Staphylococcus*. The commercial production of penicillin is done by *P.chrysogenum*.

Uses of antibiotics

- As medicines to fight against infections
- For treating animal feed to prevent food borne infections
- As food preservatives – especially in meat and fish
- For controlling the growth of plant pathogens

Streptomycin obtained from bacterium *Streptococcus*; ampicillin, sulphonamides (synthetic drugs) are some of the common antibiotics.

Chemotherapy

A kind of treatment that uses chemical substances to cure a disease. Many drugs are now being used by humans to treat a variety of diseases.

- **Sulphonamides** are groups of chemicals that were discovered in the 1930s. They originally were obtained from antimicrobial agents that contain sulfonamide

group. These sulpha drugs are effective against various bacterial diseases. They interfere with the metabolism of bacteria, and thus kill them. Examples include sulphadiazine and sulphanilamide.