



Biochemical pathways: The cells of a living organism are biochemical factories. A large number of processes go on inside a cell. These processes result in the production of energy, chemical compounds, etc., which are needed for various life functions. A large number of chemical reactions are usually involved in these processes. The chain of reactions is called the biochemical pathway for this final product. A chain of reactions occurring inside an organism to produce a compound is called a biochemical pathway. For example, a biochemical pathway inside a cell is used for making pyruvic acid from glucose. That means the pathway consists of a series of reactions that leads to the formation of pyruvic acid. Pyruvic acid is needed for energy production. So, in an organism, if any reaction in this pathway is prevented from taking place, pyruvic acid will not be formed.

Targetting biochemical pathways to fight infectious agents: Scientists study the biochemical pathways of infectious agents to find out which of these can be attacked by a drug. But they have to make sure that the drug does not harm any biochemical process in humans or any other animal to whom the drug is given. Drugs are chemical compounds which targets a particular reaction in a pathway. This prevents the next reaction in the pathway from taking place. In this way, a substance needed by the organism is not allowed to form. This may kill the organism or stop it from multiplying. Based on this principle many drugs have been made to fight organisms like bacteria and fungi.

Antibiotics: Antibiotics are drugs used to cure diseases caused by bacteria. There are different kinds of antibiotics which attack different processes and structures in bacteria to kill them or to stop their growth. Bacteria, as you know, are single-celled organisms. One type of antibiotic stops the production of a compound needed for the growth of the cell wall. This prevents the cell wall from expanding when the other parts of the cell are growing. As a result, the cell bursts, which kills the bacteria. Penicillin, an important antibiotic, works in this way. Antibiotics do not work on viruses because viruses are quite different from bacteria. First, viruses are not made up of cells. Virus as a small particle of some genetic material (DNA or RNA) inside a cover of protein. It does not have cytoplasm and cellular organelles where biochemical reactions occur. To multiply, it enters the cell of a living organism, which becomes its host. As viruses lack cells, biochemical processes which occur in cells are missing in viruses. Since these biochemical processes are the targets of antibiotics, antibiotics do not work on viruses.

Prevention of infectious diseases: Prevention is better than Cure: Although we have antibiotics and other medicines it is difficult to cure many diseases like rabies and AIDS. It is always easier and better to prevent a disease than cure it. Prevention is easier and better because of the following reasons.

1. When we suffer from a disease our body does not function properly.
2. Even after treatment, we may not get well again. For example, an attack of polio can cause paralysis, the loss of control or feeling in some part of the body, usually the legs.
3. Even with proper treatment, we may take some time to recover completely. For example, an infection of tuberculosis requires prolonged treatment and can keep us bedridden for a long time.
4. During an infection our body has a large number of infectious agents multiplying within us. In this state we can be a source of infection and spread it to other people. For example, when infected with influenza or measles we can become the source of infection.

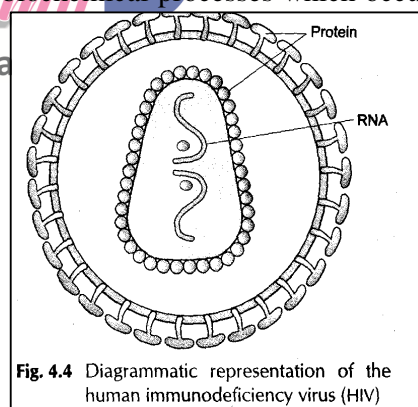


Fig. 4.4 Diagrammatic representation of the human immunodeficiency virus (HIV)



General Prevention of Infectious Diseases: There are some general ways to prevent infectious diseases. These are precautions against exposure to infectious microbes.

1. Safe drinking water: We can prevent exposure to water-borne diseases like typhoid, cholera and hepatitis by providing safe drinking water. The sources of drinking water are usually rivers, ponds or underground sources. Drinking water should be filtered to remove suspended particles and treated (e.g., with chlorine) to kill bacteria.

2. Proper disposal of waste: We can prevent exposure to infectious diseases of the stomach and intestines, which can spread through contaminated food, by ensuring the proper disposal of waste. The waste we generate everyday is the breeding ground for disease-causing microbes. The proper gathering and disposal of waste is, therefore, very important for preventing diseases like cholera and typhoid. Covered garbage cans should be provided at garbage-pick-up places in towns or cities. The collected garbage should be burnt or buried.

3. Control of vectors: We can prevent exposure to vector-borne diseases by controlling the growth and breeding of animals like mosquitoes, flies, cockroaches and rats. Providing clean surroundings will prevent them from breeding and carrying diseases. We should take steps to eliminate vectors like mosquitoes, houseflies and sandflies by spraying insecticides. It would be best to eliminate the sites at which they breed like stagnant water.

4. Having a strong immune system: We have an immune system that defends the body from infectious agents. Immunity is the ability of the body to resist infections. Every day we are exposed to many infectious agents. But we are able to resist them and do not suffer from many diseases all the time. We are protected from diseases because we have an immune system that recognizes any foreign substances or invading disease-causing organisms and destroys it. Our immune system works with the help of the white blood cells, or leucocytes.

When infectious agents enter our body, white blood cells in the blood move to the areas of infection. They isolate, engulf, kill and digest the infectious agents. In this way, they reduce the number of infectious agents in the body and the ill effects that they could have caused if they were allowed to multiply. As a result, there may be no significant effect of the disease. Thus, our immune system provides a general prevention to infectious diseases by killing any invading microbes.

5. Taking a balanced diet: We need a balanced diet for the proper functioning of our immune system. People who eat a balanced, nourishing diet are less prone to falling ill as they have better immunity. Therefore, prevention of infectious diseases also depends many the availability of proper food.

Specific Prevention of Infectious Diseases: Specific prevention is provided by the immune system when it produces some specific molecules called antibodies to fight against specific invading microbes or their products, called antigens. Antibodies are proteins made by the white blood cells, called lymphocytes, in response to any foreign substances, called antigens, in order to detect them, bind with them and destroy them. Antigens are of many types. For each type of antigen, the body produces a corresponding antibody to bind with it and destroy it. The antigen—antibody binding is highly specific. An antibody binds with an antigen to destroy it in the following ways.

1. Specific antibodies bind with the antigens on the microbes making them more likely to be engulfed and destroyed by phagocytes (WBC).
2. Antibodies combine with the antigens toxic chemical to make them harmless.
3. Antibodies bind with antigens to destroy them.
4. Some antibodies bind to the antigens on the microbes and make them stick together so they cannot multiply.

The immune system has a memory of the invading microbes. It recognizes them and fights them later if they invade again. When an infectious agent invades for the first time, the



antibodies are produced slowly. After destroying the antigens, they remain in the body. When there is a second infection, the circulating antibodies recognize the specific antigens and more antibodies are produced much faster this time. When we suffer from a mild form of a disease, our immune system forms antibodies against the invading antigens. At the second infection of that disease, the immune system responds faster to destroy the antigens as there are antibodies that already recognize them. As a result, we do not suffer from the severe form of the disease. For example, if we have had mild chickenpox once, we will not suffer from its severe form later.

Immunization: Immunization is stimulating the body to produce antibodies by artificial means. These antibodies fight against infections later. We can immunized against certain diseases by taking vaccines for them. A vaccine is a preparation of weakened-infectious agents or their products that can be injected or given orally to prevent specific diseases. Vaccines help in the specific prevention of diseases. Today there are many types of vaccines available to prevent infectious diseases. Nowadays, vaccines are available against tetanus, diphtheria, whooping cough, polio, chickenpox, measles, mumps, typhoid, tuberculosis, hepatitis and many other diseases. Many of these vaccines are given to children under the public health programme of childhood immunization.

Pulse polio programme: The pulse polio programme is an immunization drive against polio. Polio is a disease of the muscles and nerves which can cause paralysis. To prevent polio, oral vaccines are given periodically to all children under 5 years of age in our country. This is an effort to eradicate polio, so no child will be infected by the polio virus.

Smallpox vaccine: An immunization programme was carried out earlier to eradicate smallpox. Earlier, in smallpox epidemics people were afraid of going near someone suffering from it. Smallpox was controlled and eradicated with the help of a vaccine. An English physician, Edward Jenner (1749—1823) observed that people who got cowpox, a mild disease, did not suffer from smallpox, a more severe disease. Usually, the girls who milked cows got cowpox, a disease that causes rashes on the hands. Jenner decided to test his observations about cowpox and smallpox. Jenner took some pus with a sterile needle from Jenner took some pus with a sterile needle from the cowpox rashes of an infected girl and injected it into scratches made in the skin of an uninfected boy, who soon got cowpox. After he recovered, Jenner injected the boy's skin with pus from the spots of a person suffering from smallpox. Luckily, the boy did not get smallpox and Jenner's experiment was successful. The modern term 'vaccination' comes from the Latin words 'vacca' which means cow and 'vaccinia' which means cowpox. It tells us how Jenner made the first vaccine against smallpox using the microbes of cowpox, a similar but less severe disease.

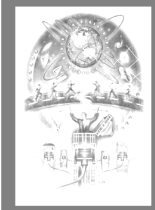
Some infectious diseases:

1. Malaria: this disease is caused by protozoans of the genus Plasmodium (species: vivax, ovale, falciparum, and malaria). These parasites grow and multiply in the liver and the RBCs of man. They also grow in the gut of the female Anopheles mosquito, which is the vector. The protozoans enter our bloodstream when a female mosquito carrying them bites us.

Signs and Symptoms: Malaria is characterized by periodic attacks of shivering followed by high fever. Headache and muscular pains, anaemia and enlarged spleen are other symptoms.

Control: A person suffering from malaria is given quinine, a drug which has been in use since long. It is extracted from the bark of the cinchona tree. A substance called arteether extracted from another plant is also an antimalarial drug.

Prevention: The occurrence of malaria can be prevented in two ways. First, by breaking contact between Anopheles mosquitoes and human beings, and second, by not allowing the mosquitoes to breed. Contact can be broken by using mosquito nets, mosquito repellents, etc. And the breeding of mosquitoes can be prevented by eliminating breeding places and by





killing the eggs, larvae and adults with the help of chemicals or biological agents. Common chemical methods of killing mosquitoes and their larvae have been spraying insecticides (e.g., DDT) in powder or liquid form or as fumes (fumigation), and spraying kerosene over stagnant water.

2. Diarrhoea: The passing of loose stool at frequent intervals is called diarrhoea. It results from the infection or inflammation of the intestine, which can occur due to a variety of reasons. The reasons include protozoan, bacterial or viral infection, food poisoning, alcohol, some drugs and the deficiency of some hormones.

Signs and Symptoms: Diarrhoea is characterized by dehydration and cramps. The skin, tongue, the inner surfaces of the cheeks and nose become dry. The eyes become sunken. The patient may also have fever and pains in the joints.

Control: Patients are advised to rest and take oral rehydration salts (ORS) with water and/or a mild solution of common salt and sugar to prevent dehydration. The ORS as well as salt—sugar solution increases the rate of absorption of water. Drugs that prevent diarrhoea and kill microorganisms responsible for diarrhoea should be taken.

Prevention: Diarrhoea related to contaminated food and water can be prevented by maintaining personal and community hygiene, and by being particular about drinking water and food. Any hormonal deficiency must be treated, and stale food must be avoided.

3. Cholera: This disease is caused by the bacteria Vibrio cholerae. The bacteria infect the small intestine. They enter the human body through contaminated water and food.

Signs and Symptoms: Cholera is characterized by severe, but painless diarrhoea followed by sudden vomiting. This leads to loss of body fluids resulting in dehydration. The loss of body fluids and minerals causes muscular cramps. The eyes are sunken, and the skin becomes cold and wrinkled. If untreated, cholera can cause death.

Control: Dehydration can be prevented by giving the patient a solution of ORS or a solution of salt and sugar. Intravenous administration of normal saline (alkaline solution of 0.9% sodium chloride) is also recommended.

Prevention: Clean drinking water, proper sanitation and vaccination are methods of preventing - the disease.

4. Typhoid: Typhoid is caused by the bacteria Salmonella typhi. They infect the intestine of man. They erode the intestinal wall and enter the blood stream. The infection causes a characteristic fever. S. typhi is found mainly in the faecal matter of an infected person. Housefly and sewage water that drains into drinking-water sources like ponds help spread the bacteria. The bacteria find their way to the human intestine through food contaminated by houseflies and through water from a contaminated source.

Signs and Symptoms: It is accompanied by headache, stomach ache, rash on the body and mental confusion (delirium).

Control: Antibiotics bring down the fever in about two weeks.

Prevention: Proper sewerage system and chlorination of drinking water prevents typhoid. At home, we can drink boiled water. Two types of vaccines are used to prevent typhoid. The typhoid antibacterial (TAB) vaccine is the most effective and protects us from typhoid for about 3 years.

5. Tuberculosis (TB): Generally when we talk about tuberculosis, we mean a lung disease. But this disease can affect other parts of the body too. It is caused by the bacteria Mycobacterium tuberculosis. A person usually gets infected by the TB bacteria. This affects the persons lungs. A person can also get infected by drinking milk from cattle infected by TB. In this case the lymph nodes of the abdomen are affected. A person gets infected by the TB bacteria either by inhaling the bacteria or by drinking infected milk. The bacteria can spread from the lungs or the abdominal lymph nodes to other parts of the body such as bones,



brain, etc.

Signs and Symptoms: The symptoms of TB include mild fever, sweating at night, blood in the sputum, loss of appetite, fatigue and weight loss. The symptoms, however, vary according to the site of the infection. For example, in case of pulmonary TB (lung TB), the patient coughs frequently, bringing up blood with the sputum. There is chest pain and breathlessness. In case of lymph gland TB, there is swelling and tenderness of the lymph glands, particularly in the lower parts of the body.

Control: TB can be controlled by the use of specific antibiotics over a long period of time.

Prevention: The spread of TB can be minimized if people are made aware that spitting indiscriminately is injurious to public health. Children should be immunized with BCG (Bacille Calmette-Guerin) vaccine.

6. Hepatitis: Hepatitis is a disease in which the liver becomes enlarged. The most obvious symptom of this disease is the yellowing of the skin and the whites of the eyes, a condition referred to as jaundice. The yellowing is because of the presence of excessive **bilirubin** (a bile pigment) in the blood. Viral hepatitis is caused by different strains of the hepatitis virus. Hepatitis caused by a virus is named after it. Thus we have, hepatitis A... hepatitis G, named after the strains A, B, C, D, E, F and G. Some of these strains (e.g., hepatitis A) get transmitted through

contaminated food or water. Others (e.g., hepatitis B) get transmitted through blood, semen, saliva and breast milk. A hepatitis patient needs up to 4 weeks to recover. Certain types of hepatitis can cause death.

Signs and Symptoms: The different forms of hepatitis have different symptoms. However, loss of appetite, nausea, mild fever, jaundice (yellowing of the skin) and dark-coloured urine are common.

Control: To give rest to the liver, a hepatitis patient is advised to take **light** food that has high carbohydrate content. Fatty and protein-rich food must not be taken. Also, the patient should take bed rest. An antiviral injection (interferon) controls the disease.

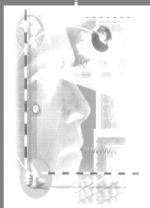
Prevention: Good sanitation prevents the spread of those forms of the disease that spread by food and water contaminated by faeces. Water should be treated (ozonized or treated with UV rays) to kill the virus. It is important that we wash our hands after handling the clothes, utensils, etc., used by the patient. To prevent the forms which are transmitted by body fluids (such as hepatitis B), tested blood should be used for transfusion, and disposable needles and syringes should be used. The hepatitis B vaccine provides immunity against hepatitis B.

7. Influenza: Influenza, or flu as it is commonly known, is caused by certain strains of myxoviruses. These viruses attack the respiratory tract. When an infected person coughs or sneezes, the droplets produced contain the influenza virus. The virus enters a healthy person's body when the person breathes in these infected droplets.

Symptoms: Fever (101°—104°F), shivering, cough, sneezing, weakness, headache and muscular aches are common to influenza caused by all strains of the virus.

Control: There is no specific medicine for influenza. Aspirin, bed rest and plenty of fluids provide relief.

Prevention: One can avoid catching the flu by keeping away from an infected person. Vaccines are available for specific types of influenza, but they are effective only against specific strains of the virus, and that too for a period of about one year. Scientists find it difficult to develop a vaccine that will provide general protection against influenza because of two reasons. First, because it is difficult to produce a vaccine that is effective against all strains of virus causing influenza. Second, because these viruses mutate (change in nature) very rapidly, making a vaccine developed against a particular virus ineffective after a year or two.





8. Rabies: A type of rhabdovirus causes rabies, which is a fatal disease of the central nervous system. The virus is transmitted by animal bite. It grows and reproduces in animals such as dogs, bats, jackals, monkeys, cats and squirrels. An animal affected by the disease is called rabid. When a rabid animal bites a human, the virus enters the person's body. Rabies affects the central nervous system (CNS) of the patient, who dies within 3-5 days of the onset of the disease.

Signs and Symptoms: The symptoms of rabies start with headache and fever. This is followed by salivation, muscle spasms in the throat, and periods of excitement and depression. Finally, the throat muscles become paralysed, and the patient is unable to swallow and drink water. This leads to a fear of water (hydrophobia). Human rabies is therefore also called hydrophobia.

Control: Once the disease develops, no drug can save the patient. Chance of surviving after being bitten by a rabid animal is to eliminate the virus before it affects the CNS (Central Nervous System)

Prevention after an animal bite: The following steps should be taken to prevent rabies when an animal bites a person.

1. The bite wound should be washed immediately with soap and water. This removes most of the viruses.
2. The patient should then receive an antirabies serum shot.
3. This should be followed by a course of vaccine shots. Older vaccines required 16 injections. Newer vaccines require 5 injections given over a period of time. The vaccines used most commonly nowadays are HDCV (human diploid-cell vaccine) and RVA (rabies vaccine adsorbed). The first antirabies vaccine was developed by the famous French scientist Louis Pasteur (1822–95), who was also the first to identify the rabies virus.

General preventive measures: Pets such as dogs and cats should be given antirabies vaccine. Stray animals should not be allowed to roam our streets. All those who handle animals regularly (zookeepers, veterinary surgeons) should take antirabies vaccine.

AIDS: Acquired immunodeficiency syndrome (AIDS or aids) is caused by the human immunodeficiency virus, or HIV. This virus belongs to a group of viruses called retroviruses. HIV gradually reduces the efficiency of the human immune system, i.e., it destroys the body's ability to fight diseases. This makes the body vulnerable to other life-threatening diseases that finally cause the patient's death. This virus is transmitted through blood, semen and breast milk. Thus, a person can get HTV by transfusion of infected blood, sharing of needle with an infected person or having sexual intercourse with an infected person. An unborn child can get the infection from the mother. Mother's milk can infect an infant.

Signs and Symptoms: The common symptoms of AIDS are swollen lymph glands, weight loss, frequent fever, night sweats and diarrhoea. The disease may affect the central nervous system, which may cause memory loss and difficulty in speaking.

Control: No drug has yet been developed to cure AIDS. A patient is usually given a combination of drugs that manage to slow down the progress of the disease. Scientists are working on drugs that promise to cure this disease in the near future.

Prevention:

1. We should make sure that the blood used in transfusion for our family members or us has been screened for HIV. Blood banks and hospitals should test potential blood donors for HIV.
2. Disposable needles and syringes should be used.
3. We should not share shaving blades or razors.
4. We should not have multiple sex partners. Condoms can be used to prevent the transmission of HIV through sexual fluids.

