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VECTOR BORNE DISEASES AND THEIR CONTROL

House fly Bait Station

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DR. INAMULLAH KHAN[1], DR. ABDUS SATTAR[1], ALAMZEB[1] & DR IFTIKHAR[2]

[1]NIFA, Peshawar, [2]Manager Malaria Control ACD

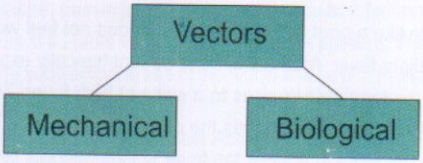
Nuclear Institute for Food and Agriculture (NIFA)
Tarnab, Peshawar

1. What is a Vector?

Traditionally in medicine a vector is an organism that does not cause disease itself but which spreads infection by conveying pathogens mechanically or biologically from one host to another. There are insect vectors that spread diseases in agricultural crops, live-stock poultry birds and in animals including human being. The most common carriers in human being are the mosquitoes, house flies, fleas, head and body louse, cockroaches, sand flies, black flies, ticks, mites, midges and bed bugs.

2. How Vectors Transmitted Diseases?

All vectors transmit diseases mechanically through their body or moth parts as done by house flies and cockroaches or biologically. Biological transmition of pathogens is carried through mosquitoes, sand flies or black flies.



3. Some Common Vectors and Diseases

3.1 Mosquitoes

There are about 2700 species of mosquitoes. Females can lay up to 300 eggs at a time. *Aedes* mosquito deposit eggs on moist surfaces, such as mud or fallen leaves or dry soil near a water body. Later on rain or high tides re-flood these surfaces and stimulate the eggs to hatch into larvae. Some Aedes deposit their eggs directly on the surface of still water in places such as ditches, street catch basins, tire tracks, streams that are drying up, and fields or excavations that hold water for some time. *Anopheles* and *Culex* lay their eggs directly in water canals, ponds, pools, ditches tanks, catch basin, reservoirs, wells and irrigation channels. Breeding habitat of *Culex* may vary from fresh water to the most polluted water and gutters. All mosquitoes have four stages of development; egg, larva, pupa, and adult stage and spend their larval and pupal stages in water. At ambient temperature mosquito complete their development from egg to adult stage within 6 9 days. They can fly across 150 miles in their life and travel as far as 75 -100 miles. Mosquitoes can smell an animal at 20 35 meters distance and detect infra-red radiation emitted by warm bodies and chemical signals such as Co_2 and lactic acid. Adult females are the only blood feeders and disease carrying stages involved in the biological transmission of pathogens. Mosquitoes transmit many diseases in different regions of the world but in Pakistan Malaria, Dengue fever, Dengue hemorrhagic fever DHF and filariasis are the more important diseases.

3.2 Malaria

Malaria is the most dangerous inset transmitted disease result from the bite of infected *Anopheles* mosquitoes. Half of the world's human population lives in malaria-affected areas. There are approximately 1 million deaths a year, 250 million cases of clinical malaria each year and about 3.3 billion people at risk of malaria transmission (WHO 2009).The mosquito injects

parasites 'Plasmodium' that infect the liver. After having multiplied about 10-20 days in the liver, the parasites are released in the bloodstream and enter the red blood cells. This causes the clinical disease of Malaria. The 10-20 days are called the incubation period, in which the number of parasites is increasing even the patient may not have known symptoms.

3.2.1 What does Malaria do to your body?

When the parasites enter the red blood cells, the cells eventually burst. Often so many cells may burst that the patient becomes anemic. The products of the burst cells may cause jaundice, and cause the liver and spleen to grow as they are performing the task of clearing the blood from the products of the burst cells. Other products may cause other cells in the blood to stick together in small clots that may close the tiny blood vessels.

3.2.2 Symptoms

Fever: The first symptoms are like a bout of Flu. The patient does not feel well and has headache, muscle and joint pain and a slight fever. After a while the patient typically experiences a feeling of being cold and shivers while the temperature rises to a spike of high fever. The fever goes down while the patient is normally sweating profusely. After this the patient feels relatively well until the fever comes back at irregular intervals. With in a week the fever spikes become regular at interval of 48 to 72 hours.

Anemia

When more and more red cells burst the patient becomes anemic. This leads to a feeling of heaviness and reduced ability to perform physical activities.

The products of the burst cells may lead to a slight jaundice, where the skin gets a slight tan, whilst the white in the eyes becomes yellowish.

Enlarged liver and spleen

In cleaning the blood the two organs grow. As an enlarged liver or spleen is quite brittle, the patient may suffer internal bleeding following minor trauma to the abdomen.

3.2.3 Why do people die from Malaria?

The products of burst cells may make other cells sticky, and facilitate those making small blood clots. Small clots may get stuck in the thin vessels of vital organs and cause malfunction.

Parasites may "steal" vital nutrients and Oxygen from normal cells. This may result in vital organ's breaking down or malfunctioning. Death follows this breakdown. In endemic countries 75% of those dying are young children. Individuals with an immune system affected by other disease or drugs get more severely affected. This is an important cause of death in HIV/AIDS patients.

3.2.4 Is there any immunity?

People from areas with a high rate of malaria are considered semi-immune. This does not prevent them from getting Malaria, but it generally seems to lead to a milder form of the disease, with less complications.

3.3 Dengue & Dengue Hemorrhagic Fever

Dengue is the most important vector-borne disease after malaria with approximately 50 to 100 million cases of dengue fever and 500,000 cases of dengue hemorrhagic fever (DHF) each year in about 100 countries. Dengue is the name of virus transmitted by mosquitoes of the genus *Aedes* that breed in cans, cups, tins, used tires, burrow pits and water storage tanks. There are several closely related dengue viruses, called dengue types 1, 2, 3 and 4. Two forms of the disease occur: dengue fever (DF) and dengue hemorrhagic fever (DHF).

Dengue fever occurs in explosive epidemics that mainly affect adults, sometimes with tens of thousands of cases, especially in urban areas. It is an acute febrile disease that starts suddenly and lasts for a week or more, causing intense headache, pain in joints, muscles, and rash. Infection rarely results in death. It can occur in rural and urban areas, if suitable vector mosquitoes are present. The disease is most prevalent in tropical countries and in some subtropical areas of the world and now in Pakistan too.

4.2 Dengue hemorrhagic fever (DHF)

DHF is a severe illness that occurs in south-east Asia, in the Americas and the South Pacific mainly affecting children. Infection starts with high fever, vomiting, headache, difficulty in breathing and pain in the abdomen. Signs of internal bleeding are common in this disease. Internal bleeding in dengue hemorrhagic fever may cause darkening of the skin, face and hands. Children are most commonly affected. Life-threatening complications such as dengue haemorrhagic fever (DHF) and dengue shock syndrome (DSS) are more likely to occur when individuals who are already immune to one of the four dengue virus serotypes become infected with another virus serotype. If in time treatment is not available, as many as 50% of patients with shock may die.

3.4 Lymphatic Filariasis

This is a disease caused by a worm known as *Wuchereria bancrofti*. In the urban setting the disease is transmitted mainly by *Culex quiquifasciatus*, mosquito that breeds in organically contaminated water especially in blocked drains and standing pools. Lymphatic filariasis is caused by three species of parasitic worm which occur in the lymph vessels and may cause huge swellings of the limbs and other parts of the body. Although the disease causes much suffering and disability it is rarely life-threatening. One hundred and twenty million people in at least 73 countries of the world are infected with lymphatic filarial parasites, and it is estimated that 1 billion (20% of the world's population) are at risk of acquiring infection. Ninety percent of these infections are caused by *Wuchereria bancrofti,* and most of the remainder by Brugia malayi. The chance of infection being established from a single bite by an infected mosquito is very low. The adult worms can live for many years, giving rise to large numbers of microfilariae in the blood. The adult worms live in the lymphatic vessels in the human body and produce embryos called microfilariae, which circulate in the bloodstream and are picked up by biting mosquitoes. After developing for several days in the mosquito, infective larvae enter the skin when the mosquito feeds, migrate to the lymph nodes and develop into adult worms in the lymph vessels. In Pakistan the vector for disease is abundantly present but number of disease person is low but there is fear that infected immigrants from fillaria endemic areas may increase the number of cases if not properly chandelled in near future.

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4. Sand Flies

There are about 700 species of phlebotomine sand flies of which about 70 are considered to transmit diseases to people. The term sand flies are also Sometimes confusingly used for other small biting flies, especially biting midges of the genus *Culicoides*. Sand flies are characterized by their densely hairy wings and more specifically by the way they hold their wings above the body in a vertical V shape. Sand flies are found mainly in the tropics with a few species also found in the temperate regions. They occur in a wide range of habitats and species often have very specific habitat requirements. Sand flies are blood suckers and their larvae inhabit places where there is high organic matter such as in animal burrows, termite hills and tree holes. The female sandfly lays its eggs in the burrows of certain rodents, in the bark of old trees, in ruined buildings, in cracks in house walls, in animal shelters and in household rubbish. Sand flies are best known as vectors of trypanosome species in the genus *Leishmania*, causing diseases collectively known as leishmaniasis.

4.1 Disease organisms transmitted

4.1.1 *Leishmania*

Leishmania is a protozoan parasite that causes vis Ceral **leishmaniasis** (kala-azar) and various types of cutaneous leishmaniasis (oriental sore) in people. The pathogens are intracellular protozoan parasites.

There is a large number of species and subspecies of *Leishmania*, grouped according to their development within the sand fly vector. Among the 30 known species, 21 infect humans. All are spread by bites of infected sand flies.

Most forms of leishmaniasis are primarily infections of small mammals. Humans are often infected by sandflies which previously fed on infected animals.

Cutaneous leishmaniases afflict 1.5 millions of people all over the World. They cause sores on the skin, which can be disfiguring. The risk of being infected is higher for people who sleep outdoors or have outdoor activities at night. An increased risk also occurs in places where there are infected rodents or other host animals.


Visceral leishmaniasis

Visceral leishmaniasis, also known in the Indian subcontinent by its Hindi name, kala-azar, is caused by *Leishmania donovani, L. infantum* or *L. chagasi*; it is a disease of the internal organs and is often fatal if left untreated. Visceral leishmaniases cause a disruption of the immune system, resulting in fever, enlargement of the liver, enlargement of the spleen, anemia, and loss of weight. There are half a million new cases of visceral leishmaniases around World each year. If untreated, visceral leishmaniases are fatal. There is social stigma associated with the deformities and disfiguring scars caused by some forms of leishmaniasis and epidemics flourish under conditions of famine, complex emergency, and mass population movement (TDR 2005)

4.2 Symptoms

The disease starts slowly with fever, malaise, loss of weight and, in many cases, cough and diarrhea. A major clinical sign is enlargement of the spleen and liver. Kala-azar may cause darkening of the skin of the face, hands, feet and abdomen. In cutaneous leishmaniasis the symptoms differ between and within regions, depending on the species of parasite and the immune response of the patient. A typical ulcer starts as a nodule at the site of the sandfly bite; a crust develops in the middle which, if it falls away, exposes the ulcer.

5. Prevention Control and Treatment

5.1 Prevention and Control

The most effective method of control for mosquito borne diseases is the control of vectors (mosquitoes) population. This can be done effectively through source reduction, indoor residual spraying and personal protection.

5.1.1 Source reduction (larval control)

Aedes are container-breeding mosquitoes and particularly susceptible to source reduction. People can be educated to remove or cover standing water in cans, cups, and rain barrels around houses. Sustained control is achieved most economically through removal or filling of breeding habitats in man-made and natural containers. The burning of organic waste, screening or fitting mosquito-

proof lids to drinking-water storage containers, installing piped drinking-water supply, and, applying safe and effective larvicides (oils, neem extract, Bts) to breeding sites can effectively reduce larval population of all mosquitoes.

5.1.2 Indoor residual spraying (adult control)

Indoor spraying with insecticides such as cypermethrin or deltamethrin is an effective method during disease out breaks for adult mosquitoes. Outdoor space spraying with insecticides is usually applied to the parts of towns where abundant breeding sites are available, supporting large populations of mosquitoes. Space sprays can be applied with knapsack or hand-carried fogging machines and by truck- or aircraft-mounted machines. Residual wall spraying against *Aedes aegypti* is generally ineffective as this species normally rests indoors on surfaces that are not suitable for spraying, such as curtains and other fabrics. For sand fly protection individuals can prevent infection by avoiding being bitten by sand flies.

5.1.3 Personal protection

Protection against mosquitoes and sad flies can be achieved through the use of protective clothing, repellents and house screening. Daytime protection is also obtainable from use of mosquito coils and mats. Use of insecticide treated bed nets (ITN) during night is also useful method for personal protection. The community-wide use of ITNs reduces the vector population and shortens the mean mosquito lifespan. In Pakistan, where malaria is one of the major vectors borne disease and where complex of vector species is present, the use of ITNs will greatly reduce the chances of malaria and dengue fever. Self-protection from sand flies is some times possible by avoiding places where sand flies are known to rest or breed. In dense forests it is recommended not to stand between large trees.

5.2 Treatment

Malaria is a treatable disease. The patients can be treated with artemisinin-based combination treatments (ACTs), chloroquine or nivaquine. There is no specific treatment for the dengue disease, but patients with dengue shock syndrome can be treated by rapid administration of fluid and plasma and monitoring of vital signs. Fillariasis is also a treatable disease and administration of avermectins alone or in combination with albendazole may be helpful. Miltefosine, the first oral treatment for visceral leishmaniasis, Paromomycin is being developed as an injectable formulation for leishmaniasis.