Module 1

Introduction: Vectors of Public Health Importance

Learning Objectives :

At the end of the module, the participant will be able to understand :

- The Vector and its role in disease transmission
- Different Vector transmitted Diseases
- Vectors of malaria, filaria, dengue, chikungunya, Zika, Japanese encephalitis, Kala-azar, CCHF, KFD & Scrub Typhus
- Names of the vector species
- Names of the agents causing VBDs
- Impact of Climate Change on VBDs

Vectors Borne Diseases

Vector-borne diseases account for more than 17% of all infectious diseases, causing more than 700 000 deaths annually. They can be caused by parasites, bacteria or viruses. Malaria is a parasitic infection transmitted by Anopheline mosquitoes. It causes an estimated 219 million cases globally and results in more than 400,000 deaths every year. Most of the deaths occur in children under the age of 5 years. Dengue is the most prevalent viral infection transmitted by Aedes mosquitoes. More than 3.9 billion people in over 129 countries are at risk of contracting dengue, with an estimated 96 million symptomatic cases and an estimated 40,000 deaths every year. Other viral diseases transmitted by vectors include chikungunya fever, Zika virus fever, yellow fever, West Nile fever, Japanese encephalitis (all transmitted by mosquitoes), and tick-borne encephalitis (transmitted by ticks). Most of the vector-borne diseases are preventable, through protective measures and community mobilisation besides early detection and complete treatment.

Vector: Any organism, which carries a pathogen or a virus and can play role in disease transmission, is known as a Vector In any public health programme on Vector-Borne Diseases; the study of vector biology is of great significance to plan any vector control interventions. Entomological tools and techniques are to be applied appropriately in field situations to identify vectors with morphological characteristics and taxonomic keys, which play a key role in malaria transmission and may lead to deciding the more effective application of vector control measures. The entomological risk factors for disease transmission in a particular ecological setting need to be identified for a proper understanding of the vector biology.

Vector biology mainly deals with the study of insects that carry and transmit pathogens, their contact for feeding blood with humans, and also their interaction with disease-causing parasitic species. In malaria transmission, the anopheline mosquito acts as the vector and Plasmodium species are the malaria parasite causing the disease. Humans and anopheline mosquitoes help in the completion of the life cycle of the malaria parasite and thus act as the parasite's hosts.

Arthropod	Disease	Agent
Mosquitoes		
Anopheles spp.	Malaria	*Plasmodium* spp.
	Lymphatic Filariasis	*Brugia timori**
Culex spp.	Lymphatic Filariasis	*Wuchereria bancrofti**
	West Nile	West Nile virus
Culex Vishnui group	Japanese encephalitis	Flavivirus
Mansonioides spp.	Lymphatic Filariasis	*Brugia malayi**
	Lymphatic Filariasis	*Wuchereria bancrofti**
Aedes spp.	Dengue / DHF / DSS	Dengue Virus Serotypes I, II, III & IV
	Chikungunya	Chikungunya virus
	Zika	Zika Virus
	Yellow Fever	Yellow Fever Virus
Phlebotomous spp.	Visceral Leishmaniasis	*Leishmania donovani*
	Cutaneous Leishmaniasis (Oriental Sore)	*Leishmania tropica*
Fleas	Bubonic Plague	*Yersinia pestis*
	Murine Typhus	*Rickettsia typhi*
Housefly	Q Fever	*Coxiella burneti*
	Amoebic Dysentery	*Entamoeba , Giardia*
	Bacillary Dysentery	*Shigella*
	Cholera	*Vibrio cholerae*
Ticks		
Hemophysalis spp	Kayasanur Forest Disease	KFD virus
Hyalomma spp	Crimean Congo Hemorrhagic Fever	CCHF virus
*Rhipicephalu*s spp	Indian tick typhus	*Rickettsia conori*
Ixodes spp	Lyme disease	*Borrelia burgdorferi*
Mites		
Leptotrombidium spp	Scrub typhus	*Orientia tsutsugamushi*

Note: *globally W.bancrofti is transmitted by Culex, Anopheles and Aedes group of mosquitoes and B.malayi is transmitted by Mansonia, Anopheles, Culex and Aedes group of mosquitoes.

Vector Transmitted Diseases

The following vectors play role in the transmission of following diseases.

The main vectors species with regard to other diseases are as follows:

- **Malaria:** *Anopheles culicifacies* (Rural Vector), *An. stephensi* (Urban Vector), (Breeds in freshwater pools related with post monsoon)
- **Dengue, Chikungunya, ZIKA:** *Aedes aegypti* (Tiger Mosquito), *Ae. albopictus* (Small clean water container breeder)
- **Filariasis:** *Culex quinquefasciatus, Mansonia annulifera* and *M. uniformis* (Breed in polluted water bodies), *Mansonia annulifera* and *M. uniformis* (Breed in water bodies with floating vegetation)

- **Japanese Encephalistis:** *Cx. vishnui, Cx. tritaeniorhyncus* etc. (Breed in paddy fields/ marshy landwater bodies with hyacinth, grass and weeds)
- **Kala Azar:** *Phlebotomus argentipes* (Sandfly) - Breed in muddy houses with soil rich in organic matter)

Impact of Climate Change on VBDs

Climate Change has a direct and close relationship to set a stage for the onset of transmission of any particular disease when the vector, pathogen and environmental congenial conditions establish close linkages. The rainfall, temperature and humidity have a direct relationship with the longevity of the vectors and propagation of the pathogen in humans and also in vectors. The vulnerability assessment is needed to properly justify the receptivity of an area for disease transmission. There may be direct or indirect effects of climate change at the macro and micro levels on the transmission of VBDs.

Direct Effects of Climate Change on Vector-Borne Diseases

Effect of Climate Change has the Potential to:

Increase range or abundance of animal reservoirs &/ or arthropod vectors

- e.g. Malaria, Schistosomiasis, Lyme disease

Enhance transmission

- e.g. West Nile virus & other arboviruses

Increase importation of vectors or pathogens

- e.g. Dengue, Chikungunya, West Nile virus

Increase animal disease risk & potential human risk

- e.g. Trypanosomiasis

Temperature Effects on Vectors & Pathogens

Vector

- Survival decrease/increase depending on the species
- Changes in the susceptibility of vectors to some pathogens
- Changes in rate of vector population growth
- Changes in feeding rate & host contact

Pathogen

- Decreased extrinsic incubation period of pathogen in vector at higher temperatures
- Changes in the transmission season
- Changes in geographical distribution
- Decreased viral replication

Precipitation effects on vectors

- Survival: increased rain may increase larval habitat
- Excess rain can eliminate habitat by flooding
- Low rainfall can create habitat as rivers dry into pools (dry season malaria)

- Decreased rain can increase container-breeding mosquitoes by forcing increased water storage
- Heavy rainfall events can synchronize vector host-seeking & virus transmission
- Increased humidity increases vector survival & vice-versa

Potential of Adaptation to Minimize VBD Health Risks & Impacts

- Strengthening surveillance
- Adopting a precautionary approach
- Mainstreaming response to disease threats
- Enhancing health system capacity
- Anticipating new & emergent pathogens & their potential to change current VBD burden

Some of the activities pertaining to community engagements may be related to vector surveillance, managing housing and domestic environment, modification of environmental in surroundings and sanitation, separate Animal -human habitations and water, sanitation and hygiene practices. Vector populations are influenced by rainfall, temperature and humidity that further impacts the land cover amd land use with population density distribution in a given area.