Module 13

Climate Change & Vector-borne Diseases

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

- VBDs as climate-sensitive diseases
- Health adaptation plan
- Key indicators of VBDs and climate change
- Framework for health adaptation plan- vector-borne diseases
- Stakeholders: role and responsibilities
- Key strategic components of health adaptation and action plan for climate-sensitive VBDs

Climate Sensitive Vector Borne Disease (VBDs)

In 2015, India's response to climate change was broadened by introducing four new missions including "Health". National Action Plan for Climate Change and Human Health (NAPCCHH) was prepared in 2018 with objective to strengthen health care services against adverse impact of climate change on health. The Ministry of Health and Family Welfare (MoHFW) approved National Programme on Climate Change and Human Health (NPCCHH) under National Health Mission in February 2019. The common climate sensitive diseases (CSDs) - air pollution, heat, water-borne, vector-borne, cardiopulmonary disease, mental health, food-borne, nutrition related illnesses etc. Currently the three key areas of focus for NPCCHH include air pollution, heat related illnesses and creation of green and climate resilient healthcare facilities. The other area of focus can be on the climate sensitive Vector Borne Disease (VBDs).

VBDs as Climate Sensitive Disease

The threat of a rapidly changing planet – of coupled social, environmental and climatic change – pose new conceptual and practical challenges in responding to vector-borne diseases. These include non-linear and uncertain spatial-temporal change dynamics associated with climate, animals, land, water, food, settlement, conflict, ecology and human socio-cultural, economic and political-institutional systems. To date, research efforts have been dominated by disease modeling, which has provided limited practical advice to policymakers and practitioners in developing policies and programmes on the ground.

Influence of Climate Change on Malaria Transmission

Changes in temperature, humidity, rainfall, and other climatic conditions have an impact on important factors that dictate the transmission of malaria, such as the lifespan of the mosquito and the development of malaria parasites in the insect. According to NASA, nineteen of the warmest years on record have occurred since 2000. Together, 2020 and 2016 have been the warmest years since records began in 1880. Data shows us that global average temperatures have been steadily and significantly rising over the past century, with accelerated increases observed since the 1950s, demonstrating the trend is hastening. Mosquito-borne diseases are benefiting from these rising temperatures and the other climatic changes they induce. The warmer climate is facilitating the geographical distribution of mosquito-borne diseases such as malaria, as well as the risk of transmission.

Data suggests that increases in temperature, humidity, and rainfall (all caused by climate change) are helping to proliferate the mosquito population at higher altitudes. This is widening the geographical distribution of the disease, allowing it to emerge in new locations which had previously not supported mosquito populations. Additionally, increases in temperatures at lower altitudes, where mosquitoes and malaria are already prevalent, have the impact of adjusting

the growth cycle of the parasite that causes the mosquito to carry the disease, allowing it to develop malaria faster and, therefore, increasing transmission rates.The El Niño climate cycle that impacts global weather patterns is greatly influenced by climate change. Scientists have already highlighted the link between alternations to the cycle and the transmission of mosquito-borne diseases including malaria, dengue, and Rift Valley fever. Additional rainfall that can result from changes to the El Niño cycle can provide good breeding conditions in locations that are usually dry, allowing the insect and, therefore, the disease to proliferate in new regions. On the other hand, droughts caused by changes to weather patterns in conjunction with increased humidity can also result in the proliferation of mosquito populations. In this case, rivers can be converted into strings of pools which provide the optimal breeding site for mosquitoes. Further to this, changes to the El Niño cycle that cause areas significantly impacted by malaria to become drier can lead to increases in malaria cases due to the loss of heavy rainfall that can wash away mosquito breeding sites. Data has shown, for instance, that dry conditions associated with El Niño were linked to a one-third increase in malaria cases.

Diseases transmitted to humans by vectors (mosquitoes, flies, Ticks, Mites, etc) remain significant public health problems especially in India. The geographic distribution of VBDs is influenced by a complex dynamic of environmental and social factors and their changing impact on the transmission and burden of VBDs through effects on their vectors, intermediate hosts and reservoirs.

Climate change creates new risks, particularly in non-endemic areas, for human exposure to vector-borne diseases (VBDs) — diseases which are transmitted to humans through the bites of insects (referred to as vectors) that carry the disease-causing pathogens. Common vectors include mosquitoes, ticks, and flies. Climate change creates new uncertainties about the spread of VBDs such as the Zika virus, dengue fever, malaria, JE, Scrub typhus, KFD and CCHF diseases by altering conditions that affect the development and dynamics of the disease vectors and the pathogens they carry.

According to the WHO, there are three key components that determine the occurrence of VBDs:

- vector and host abundance;
- local prevalence of disease-causing parasites and pathogens;
- and human population behavior and disease resilience.

Climate change affects these three key components through changes in temperature, precipitation, humidity, and other factors that influence the reproduction, development, behavior, and population dynamics of insects, pathogens, and people. Insect vectors have several physical traits that help them take advantage of climate impacts like flooding, increased precipitation, and warmer weather.

Body Temperature: Insects cannot regulate their body temperature and are dependent on external warmth to survive. Rising temperatures may cause vector range patterns to shift, increasing the risk to new populations.

Breeding: Humidity and water is crucial for vector breeding, so more insects can hatch in areas with standing water and high precipitation.

Pathogen Incubation: The incubation period of pathogens within vectors is also temperature-dependent, and becomes shorter in warmer conditions

Presently, VBDs are dealt with the simple methods of diagnosis and treatment with the reporting of cases at the passive agencies. However, little effort has been made to study the impact of climate and environmental changes which has direct influence on the occurrence and propagation of vector species and pathogens. Broadly, it is evident that the rainfall, temperature and humidity has direct impact on the population build up of vectors in a given area. However, ongoing environmental changes in the demographic profile play a vital role in shifting the mother foci to other areas, thereby, in the transmission of VBDs.

Key Indicators for VBDs

Risk Assessment

- Disease Burden
- Vector prevalence

- Vulnerable population
- Access to Health facilities
- Community Health seeking behaviour

Demographic Assessment

- Percentage of Agro-climate zone
- Proportion of plain / hilly / forest / desert cover
- Cropping pattern
- Recognisance of water sources as breeding potential
- Proportion of Cattle, livestock

Climate changes (Macro & Micro level)

- Monthly rainfall
- Monthly temperature
- Monthly Humidity

Human Vulnerability (Exposure Risk Assessment)

- Migration
- Sleeping habits
- Immunity
- Personal hygiene
- Presence of potential breeding places

Vector and Pathogen Interactions

- No. of breeding potential areas
- Entomological Surveillance
- Vector Biology
- Conditionsfavouringdiseasetransmission(Itisdesiredthattheconditionswhich favor disease initiation and propagation or threshold, be highlighted so that they can be communicated to the States for timelyaction)

Table 1.Conditions favouring Disease Transmission and Possible Threshold values of Climatic Variables

VBD	Conditions favouring disease initiation/outbreak	Threshold
Malaria	Rainfall related disease in most part of the country	Threshold of T and RH for transmissionare:18-32^{0}CT and >50 % RH
Dengue	Rainfall is crucial for transmission by creating suitable RH and or breeding grounds in peri-domestic habitats	T13-35 ^{0}C and 50-90%RH
Chikungunya	Similar to dengue	13-34° C, T and50-90%RH
Japanese encephalitis	Presence of rice fields; peak transmission during rainy season	Thresholdsnotknownclearly, however, 20-32°C T and >50% RH
Leishmanaisis: VL CL	Alluvial soil, high subsoil water support suitability Urbanization may reduceVL	Temp 7-32^{0}C and RH >70%

Kyasanur Forest Disease	Forested area having heavy rainfall. Transmission season is from November to May (non-rainy season)	Rainfall >1500mm (June to October) T: 21-30^{0}C
Scrub typhus	Not known clearly. Being studied	

There is a need to address vulnerability, building resilience in terms of community engagements for mitigation and adaptations for the prevention and control of vector borne diseases.

Identifying vulnerable populations to vector-borne diseases influenced by climate change involves assessing factors such as socio-economic conditions, access to health care and environmental exposures. Vulnerability mapping helps target resources and interventions effectively.

Enhancing resilience involves strengthening healthcare systems, promoting community awareness and implementing early warning systems. Building resilience can empower communities to better withstand the health impacts of changing climate conditions and emerging vector borne diseases.

Mitigating the impact of vector borne diseases due to climate change includes measures like vector control, habitat management and promoting climate smart health care practices. Implementing sustainable interventions helps reducing the prevalence and spread of VBDs contributing to long terms mitigation efforts.

Some of the community based activities are listed in the table given below.

1. Vector Surveillance and Risk Mapping

- Disease surveillance'
- Vector Surveillance

2. Housing and Domestic Environment

- Larval source reduction
- Housing improvement
- sanitation

3. Modifying Natural environment

- Reduce water collection
- Drainage
- Clean vegetation in drain
- Slid waste management

4. Animal Based Interventions

- Separate cattle shed
- Sleep away from cattle
- Proper sanitation

5. Water, Sanitation and Hygiene

- Improved sewage system
- Proper water supply
- Covered overhead tanks and underground water tanks
- Proper hygeinic conditions

6. Vector Control Efforts by Govt.

- Community Acceptance
- Community Participation
- Community Engagement