Annexure-I

GUIDELINES FOR
INTEGRATED VECTOR MANAGEMENT FOR
CONTROL OF AEDES MOSQUITO

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1 INTRODUCTION

Aedes aegypti (Ae aegypti) is the main vector species of Zika Virus Disease. This vector is widely prevalent in India and is common in most of the urban areas on account of deficient water management, presence of non-degradable tyres and long-lasting plastic containers as well as increasing urban agglomerations and inability of the public health community to mobilize the population to respond to the need to eliminate mosquito breeding sites. Overhead tanks, ground water storage tanks and septic tanks are usually the primary habitats. That is, *Ae aegypti* breeds almost entirely in man made water receptacles found in and around households, construction sites, factories.

Natural larval habitats are rare, but include tree holes, leaf axles and coconut shells. The population of *Ae aegypti* fluctuates with rainfall and humidity. Under the optimal conditions the life cycle of aquatic stage of the *Ae Aegypti* (the time taken from hatching to adult emergence) can be as short as seven days. At low temperatures, however, it may take several weeks for adults to emerge. During the rainy season, when survival is longer, the risk of virus transmission is greater.

The rural spread of *Aedes* is a relatively recent occurrence associated with expanding network of rural water supply schemes and other development projects without health impact assessments, scarcity of water with consequent water storage, changing lifestyle with improper use of air coolers and indiscriminate use of disposable containers, bottles, etc, improved transport system.

Therefore, the key to control Zika virus disease is adoption of a comprehensive approach by way of regular vector surveillance and integrated management of the *Aedes* mosquitoes through biological and chemical control that are safe, cost effective; and environmental management, legislations as well as action at household and community levels.

2 VECTOR SURVEILLANCE

2.1 Larval surveys: For larval surveys, the basic sampling unit is the house or premise, which is systematically searched for water holding containers. Containers are examined for the presence of mosquito larvae and pupae. Depending on the objective of the survey, the search may be terminated as soon as *Aedes* larvae are found, or it may be continued until all containers have been examined. The collection of specimens for laboratory examination is necessary to confirm the species. Four indices that are commonly used to monitor *Ae aegypti* infection levels are:

i) House index (Hl): percentage of houses infected with larvae and/or pupae

$$HI = \frac{\text{Number of Houses infected}}{\text{Number of Houses inspected}} \times 100$$

ii) Container Index (Cl): percentage of water holding containers infected with larvae or pupae.

$$Cl = \frac{\text{Number of positive containers}}{\text{Number of containers inspected}} \times 100$$

iii) Breteau Index (Bl): number of positive containers per 100 houses inspected

$$Bl: \frac{\text{Number of positive containers}}{\text{Number of houses inspected}} \times 100$$

iv) Pupae Index (Pl): number of pupae per 100 houses

$$Pl = \frac{\text{Number of pupae}}{\text{Number of houses inspected}} \times 100$$

2.2 Adult Surveys:

i) Landing/biting collection: Landing/biting collection of humans is a sensitive means of detecting low level infestations of *Ae aegypti*, but are very labour intensive. Because adult males have low dispersal rates, their presence can be a reliable indicator of clear proximity to hidden larvae habitats. It is usually expressed in terms of landing/biting counts per man hour.

ii) Resting collection: During periods of inactivity, adult mosquitoes typically rest indoors, especially in bedrooms and mostly in dark places, such as cloth closets and other sheltered sites. Resting collection requires systematic searching of these sites for adult mosquitoes with the aid of flashlight. Following a standard timed collection routine in selected rooms of each house, densities are recorded as the number of adults per house or number of adults per man hour of human efforts.

iii) Oviposition traps: Ovitraps are devices used to detect the presence of *Ae aegypti* where the population density is low and larval surveys are largely unproductive (when the Breteau index is less than 5) as well as normal conditions. The ovitrap is used for *Ae aegypti* surveillance in urban areas to evaluate the impact of adulticidal space spraying on adult female population.

3 VECTOR MANAGEMENT

3.1 Environmental Management

The major environmental management methods used for control of immature stages of Aedes mosquito are:

(i) **Environmental modification**: Long lasting physical transformation of vector habitats. For example, improved water supply, mosquito proofing of overhead tanks, cisterns or underground reservoirs.

(ii) **Environmental manipulation**: Temporary changes to vector habitats that involve the management of “essential” and “non-essential” containers and management of or removal of “natural” breeding sites.

(iii) **Changes in human habitations**: Efforts are made to reduce man-virus contact by mosquito proofing of houses with screens on doors/windows.

3.2 Personal Protection

Protective clothing and repellents are common means of personal protection against mosquitoes and other biting insects. Household insecticide products, namely, mosquito coils, pyrethrum space spray and aerosols have been used extensively for personal protection against mosquitoes. Insecticide treated mosquito nets have limited utility in Zika control, since the vector species bite during the day time. However, insecticide treated bed nets can be effectively used to protect infants and night workers while sleeping in daytime.

3.3 Biological Control

(i) Larvivorous fish are recommended for control of *Ae. aegypti* in large water bodies or large water containers.
(ii) Endotoxin-producing bacteria, Bacillus thuringiensis serotype H-14 (Bt H-14) has been found an effective mosquito control agent.

3.4 Chemical Control

Chemical control measures (larvicides, adulticides) are recommended in permanent big water containers where water has to be conserved or stored because of scarcity of water or irregular and unreliable water supply.

(i) **Larvicide**: Since *Ae aegypti* breeds in clean water, which is stored and used for household purposes, as such all the larvicides, which are safe, without any odour or colour, have residual effect with low mammalian toxicity and do not pose any health hazard should be used. Temephos, an organophosphate compound meets all the above mentioned requirements and this insecticide is being used under the public health programme. The recommended dose for application of Temephos (50 EC) is 1 ppm (1 mg per liter of water).
(ii) **Adulticide:** The following methods are recommended for the control of adult *Ae aegypti* mosquitoes:

a) Pyrethrum spray: It may be used in indoor situations as space spray at a concentration of 0.1% - 0.2% @ 30-60 ml/1000 cu. ft. Commercial formulation of
2% pyrethrum extract is diluted with kerosene in the ratio of one part of 2% pyrethrum extract with 19 parts of kerosene (volume/volume). Thus, one litre of 2% pyrethrum extract is diluted by kerosene into 20 litres to make 0.1% pyrethrum formulation ('ready-to-spray' formulation). After dilution, pyrethrum extract is sprayed with Flit pump or hand operated fogging machine fitted with micro-discharge nozzle.
b) Malathion fogging or Ultra Low Volume (ULV) spray: In application of ULV, minimum volume of liquid insecticide formulation is applied per unit area. That is, the insecticide is broken down into small droplets of a volume median diameter (VMD) of 40-80 microns with an objective of producing a cloud of insecticide droplets that remain suspended in air for an appreciable time and driven under the influence of wind. This provides maximum effectiveness against target vectors.

Since no diluent is used, the technique is more cost-effective than thermal fogging but it does not generate a visible fog. Most organophosphorus insecticides in their technical form can be applied as ULV spray. Under the public health programme, ULV spray (fogging) is undertaken by using 95% or pure technical malathion. The ground equipment mostly used for ULV spray includes portable motorized knapsack blowers and cold aerosol generators.

3.5 Legislative Measures

Suitable laws and byelaws should be enacted and implemented for regulating storage/utilization of water by communities, various agencies and avoidance of mosquitogenic conditions at construction sites, factories.

(i) **Model civic byelaws**: Under this act fine/punishment is imparted, if breeding is detected. These measures are being strictly enforced by Mumbai, Navi Mumbai, Chandigarh and Delhi Municipal Corporations.

(ii) **Building Construction Regulation Act**: Building byelaws should be made for appropriate overhead / under ground tanks, mosquito proof buildings, designs of sunshades, porticos, etc for not allowing stagnation of water vis-à-vis breeding of mosquitoes. In Mumbai, prior to any construction activity, the owners/builders deposit a fee for controlling mosquitogenic conditions at site by the Municipal Corporation.

(iii) **Environmental Health Act (HIA)**: Suitable byelaws should be made for the proper disposal/storage of junk, discarded tins, old tyres and other debris, which can withhold rain water.

(iv) **Health Impact Assessments**: Appropriate legislation should be formulated for mandatory HIA prior to any development projects/major constructions.

3.6 HEALTH EDUCATION FOR COMMUNITY MOBILIZATION AND INTER-SECTORAL CONVERGENCE

Involvement of household, community for *Aedes* mosquito control is of paramount importance as the problem revolves mainly around man and his environment. There should be a continuous dialogue between health personnel and the community so that people may accept *Aedes* control programmes as their own programme. Community should be involved in the task of elimination of *Aedes* breeding in and around their houses for keeping houses free of larval breeding and reduction/elimination of adult mosquitoes.

Towards these objectives, massive, repetitive, intense and persistent Behavior Change Communication (BCC) campaign is crucial. The community must be assured that this is a preventable disease and empowered with the knowledge about mode of transmission, vector control options, availability of services in addition to correct treatment, so that timely and appropriate action is taken. Special campaigns may be carried out through mass media including local vernacular newspapers/magazines, radio and TV, especially using local cable networks as well as outdoor publicity like hoardings, miking, drum beating, rallies, etc. Health education materials should be developed and widely disseminated in the form of posters, pamphlets, handbills, hoardings. Inter-personal communication through group meetings, traditional / folk media particularly must be optimally utilized.

At different levels, following action may be taken:

(i) At Household Level:

- *Ae aegypti* mosquito bites during daytime. Adult mosquitoes should be killed by using of commercially available safe aerosols (Pyrethroid-based). Rooms including closets, bathrooms and kitchens should be sprayed (by removing/covering all food items properly) for a few minutes and closing the room for 15-20 minutes. The timing of the spray should coincide with the peak biting time of the *Ae aegypti* mosquito, e.g., early morning or late afternoon.
- Taking personal protection measures like wearing protective clothing (full sleeved shirts & full pants during day time) and using mosquito nets, preferably insecticide treated ones, while sleeping, even during day time. Using commercially available repellents during day time.
- Using mosquito repellents or burning neem leaves, coconut shells and husk to kill or repel the mosquitoes.
- Using tight-fitting screens/wire mesh on doors and windows.
- Intensifying efforts to reduce actual or potential larval habitats in and around houses by:
  - Covering all water containers in the house to prevent fresh egg laying by the vector.
  - Emptying, drying water tanks, containers, coolers, bird baths, pets' water bowls, plant pots, drip trays at least once each week.
  - Regularly checking for clogged gutters and flat roofs that may have poor drainage.
  - Introducing larvivorous fishes (e.g., Gambusia / Guppy) in ornamental water tanks/garden. These small fishes eat mosquito larvae.

(ii) At Community Level:

- People should form groups to supplement and reinforce efforts at household level. Such groups can identify commercial activities such as traders dealing in used tyres or small construction projects, etc, which may be creating larval habitats for the vector.
- The Groups should launch awareness campaigns on Zika Virus Disease and seek cooperation for prevention of mosquito breeding and protection from mosquito bites. Community activities against larvae and adult mosquitoes can include:

  - Cleaning and covering water storage containers.
  - Keeping the surroundings clean and improving basic sanitation measures.
  - Burning mosquito coils to kill or repel the mosquitoes/burning neem leaves, coconut shells and husk to repel mosquitoes and eliminating outdoor breeding sites.
  - Aiding in screening houses.
  - Making available hand aerosols for killing mosquitoes.
  - Cleaning weeds and tall grass to reduce available outdoor resting places for adult mosquitoes near houses.
  - Promoting use of mosquito nets to protect infants and small children from mosquito bites during day time and also insecticide treated nets and curtains to kill mosquitoes attempting to bite through the nets or resting on nets and curtains. Organizing camps for insecticide treatment of community owned mosquito nets/curtains.
  - In case water containers cannot be emptied, applying Temephos (1 ppm) on weekly basis in coordination with the Health authorities.
  - Mobilizing households to cooperate during spraying / fogging.

(iii) At Institutional Level (Hospitals, Schools, Colleges, Other Institutions, Offices, etc):

- Weekly checking for *Aedes* larval habitats especially overhead tanks, ground water storage tanks, air coolers, planters, flower pots, etc
- Ensuring source elimination by:
  - Covering all water tanks with mosquito proof lids.
  - Emptying, drying water containers, coolers, plant pots at least once each week.
  - Checking for clogged gutters and flat roofs that may have poor drainage.
  - Introducing larvivorous fishes (e.g., Gambusia / Guppy) in orrnamental water tanks/garden.
- Carrying out Indoor Space spraying with Pyrethrum 2%. The timing of the spray should coincide with the biting time of the *Ae aegypti* mosquito, e.g., early morning or late afternoon.
- Carrying out fogging or Ultra Low Volume (ULV) spray by using 95% or pure technical malathion.
- Promoting personal protection measures like wearing protective clothing (full sleeved shirts & full pants during day time), using commercially available repellents during day time as well as mosquito nets, preferably insecticide treated ones, while sleeping, particularly during day time.
- Putting tight-fitting screens/wire mesh on doors / windows.
- In addition, notification of fever cases (suspected/confirmed) to concerned Health authorities and appropriate case management.

In order to achieve sustainability of successful Aedes vector control programme, it is essential to focus on involvement of hospitals, non-health sector departments including schools/colleges, civil society organizations (NGOs, Faith Based Organizations and Community Based Organizations like Residents' Welfare Organizations, Self-Help Groups), Panchayati Raj Institutions/Municipal Bodies or such like local self-governments, local Religious Bodies, Nehru Yuvak Kendras, NSS/NCC units in schools and colleges as well as professional associations like Indian Medical Association and corporate sector. These groups should be provided information on all aspects of Zika virus disease : what it is, how it spreads and the role of mosquitoes, where & how they breed/rest, and how they can be controlled.