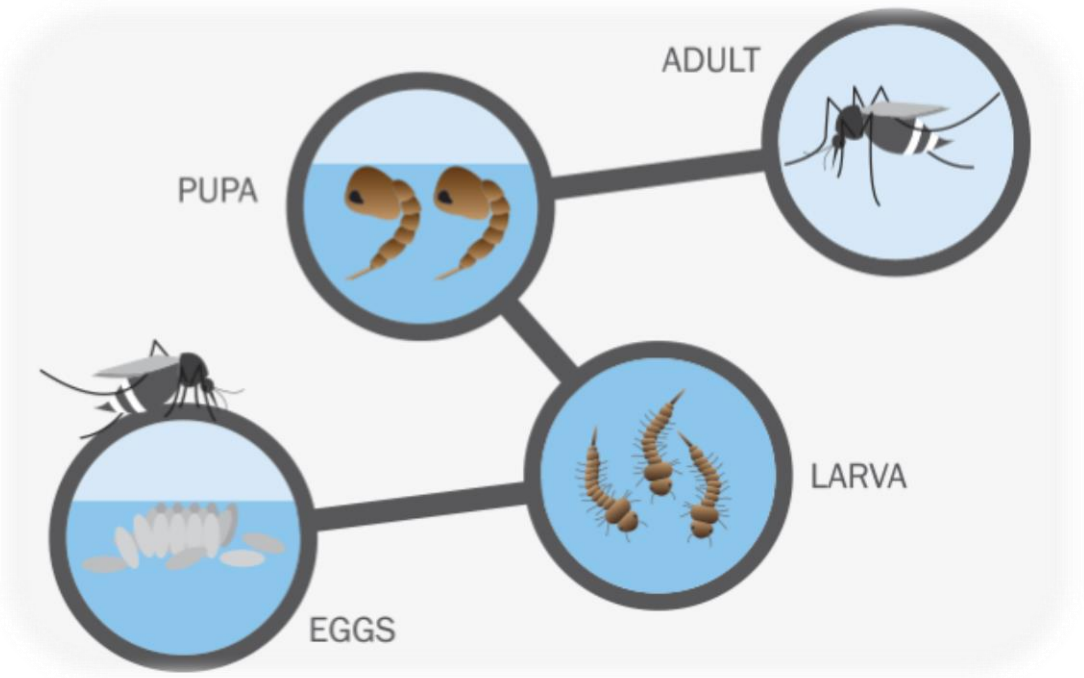
National Guideline for Aedes vector surveillance and control



VECTOR-BORNE DISEASE CONTROL PROGRAM, GELEPHU

DEPARTMENT OF PUBLIC HEALTH

MINISTRY OF HEALTH

2020

Foreword

Dengue fever is an increasing public health problem in Bhutan. The burden of the disease is restricted in mainly urban areas with major outbreaks being reported from Phuntsholing and in Doksum under Tashiyangtse Dzongkhag in 2019. The trend so far indicate that the disease has propensity to expand its geographic areas even to higher altitude areas within Bhutan if proper vector surveillance system is not put into place. The fact is that it is not dengue that spreads but it is the people who transport the disease including the vector mosquitoes to new areas and create conducive habitats for their multiplication. The vector mosquitoes breed and stay in close association with human niche transmitting disease within 50 meters radius around its breeding sites. Therefore, dengue vector surveillance is vital in all risk areas to assess vector prevalence, determine infestation levels and perform risk assessment for timely intervention and further decision-making. Reactive intervention as response during massive dengue outbreak is resource consuming and not always easy or effective.

This guideline developed by VDCP is intended to assist in dengue vector surveillance and report sharing at all levels within Bhutan. Therefore, it is suggested that all those health workers responsible to carry out dengue vector surveillance should read, understand and follow this guideline and Annexed SOPs.

Director

Department of Public Health

Contributors

1. Tobgyel, Program Analyst, VDCP
2. Tenzin Wangdi, Deputy Chief Entomologist, VDCP
3. Dr. Kinley Penjor, Epidemiologist (OSA), VDCP
4. Ugyen Zangpo, Assistant Program Officer, VDCP
5. Rinzin Namgay, Chief Entomologist, VDCP
6. Yeshi Dorji, Malaria Technician, VDCP
7. Sonam Tashi, Malaria Technician, VDCP
8. Karma Tshewang, Insect Collector, VDCP

All Malaria Technicians from Sarpang, Samdrupjongkhar, Samtse, Phuentsholing, Nanglam and Panbang are also acknowledged for testing applicability of the guidelines, SOPs and forms at field level prior to this printing.

Contents

1. Introduction

Biology, bionomics and identification of *Aedes aegypti* and *Aedes albopictus* larva and adult. *Aedes aegypti* breeds almost entirely in domestic and man-made water receptacles. These include a multitude of receptacles found in and around urban environments (households, construction sites and factories). Therefore, it becomes very important to understand the vector biology and bionomics in designing most appropriate vector control strategies. Correct identification of the species helps in determining the prevalence of vector species in a given location, their densities and trend over time. This chapter discusses the life cycle and key morphological characteristics used in the identification of *Ae. aegypti* and *Ae. albopictus.*

2. Distribution

Ae. aegypti is widespread in tropical and subtropical areas of South-East Asia. It is most common in urban areas. This species is much associated with human niche; breeding in domestic water containers and feeding on human indoor in winter season. Breeding expands when factors such as increase in their vitality during hot and humid season with rain in monsoon which also increases water filled outdoor containers. It can fly up to 100 meters and adult presence in a locality indicates its breeding nearby. The rural spread of *Ae.aegypti* is a relatively recent occurrence associated with developmental and infrastructural growth initiatives. *Ae. albopictus*is widely distributed in Asia in both tropical and temperate countries. It is primarily a forest species that has adapted to rural, suburban and urban human environments. It oviposits and develops in tree holes, bamboo stumps and leaf axils in forest habitats; and in artificial containers in urban settings. The northern limit for *Ae.albopictus* is the 0˚C isotherm during winter, and in summer its northward expansion is –5˚C isotherm, much further north than *Ae. aegypti* can colonize. Its flight range may be up to 500 metres.

3. Life Cycle of *Ae.aegypti and Ae. albopictus*

As like any other mosquitoes the life cycle of *Ae.aegypti* and *Ae. albopictus* completes in four distinct stages, viz. egg, larva, pupa and adult. The first three stages are aquatic while the adults are terrestrial. Egg and pupa are non-feeding stages. Several factors influence their development. However, temperature has the utmost significance in determining the duration of life cycle and their survival. Under optimal condition the time taken from hatching of eggs to emergence of adults can be between 7 to 10 days.

Eggs

Eggsare deposited on damp surfaces of containers just above the waterline. Embryonic development is usually completed in 48 hours in a warm and humid environment. Once the embryonic development is complete, the eggs can withstand long periods of desiccation (for more than a year). Eggs hatch once the containers are flooded, but not all eggs hatch at the same time. The capacity of eggs to withstand desiccation facilitates the survival of the species in adverse climatic conditions and unintentional transportation to other areas.

Larva and Pupa

The larva passes through 4 stages of 1st, 2nd, 3rd and 4th instar before developing into a pupa. All the larval stages are mobile and moves in a characteristic "S" shape movement. After 4-5 days of larval period the 4th instar develops into a pupa. The pupal stage is a non-feeding stage with a characteristic comma shape. They are mobile and develops into adults within 2 days. Natural larval habitats are rare, but include tree holes, leaf axils and coconut shells. In hot and dry regions, overhead tanks and groundwater-storage tanks may be primary habitats. In areas where water supplies are irregular, residents store water for household use, thereby increasing the number of available larval habitats. While such man-made water receptacles may be removed to deny the *Ae. Aegypti* breeding, one must also be prepared to eliminate other unconventional breeding habitats that the mosquito would be forced to find.

Adults

Adult Aedes are small to medium sized, dark in colour with conspicuous white markings on their body and legs. Soon after emergence, the adult mosquitoes mate and the inseminated female may take a blood meal within 24–36 hours. Blood is the source of protein essential for the maturation of eggs.

Feeding Behavior

Ae. aegypti is highly anthropophilic, although it may feed on other available warm-blooded animals. Being a diurnal species, females have two periods of biting activity: one in the morning for several hours after daybreak and the other in the afternoon for several hours before dark. It is also indicated that they bite indoor and in shade at anytime. The actual peaks of biting activity may vary with location and season. As *Ae.aegypti*, bite when hosts are active during day which might disturbbefore full blood meal, females may feed on more than one person. This behavior greatly increases its epidemic transmission efficiency. Thus, it is not uncommon to see several members of the same household with an onset of illness occurring within

24 hours, suggesting that they were infected by the same infective mosquito. *Ae. aegypti* generally does not bite at night, but it will feed at night in lighted rooms.

Ae. albopictus is an aggressive feeder and takes the full blood meal in one go to complete genesis, as it is a concordant species. This behaviour as well as feeding on other mammals/birds reduces its vectorial capacity. Unlike *Ae.aegypti*, some strains are adapted to the cold of northern Asia with their eggs spending the winter in diapause. *Ae. albopictus* is an efficient bridge vector between enzootic and human cycles among the human population living near the forest fringes. It is also more efficient then *Ae. aegypti* in maintaining the virus transovarially (vertically) as a reservoir.

Resting Behavior

Ae. aegypti primarily rests indoor on non-sprayable surfaces in dark, humid and secluded places. The preferred indoor resting surfaces are the undersides of furniture, hanging objects such as clothes and curtains, and walls. Humid toilets and bathrooms are important breeding, resting and biting places in Bhutan. Hence, indoor residual spray is not an option for its control as with malaria vectors. *Ae. albopictus* generally rests outdoors near the ground and in any part of a forest.

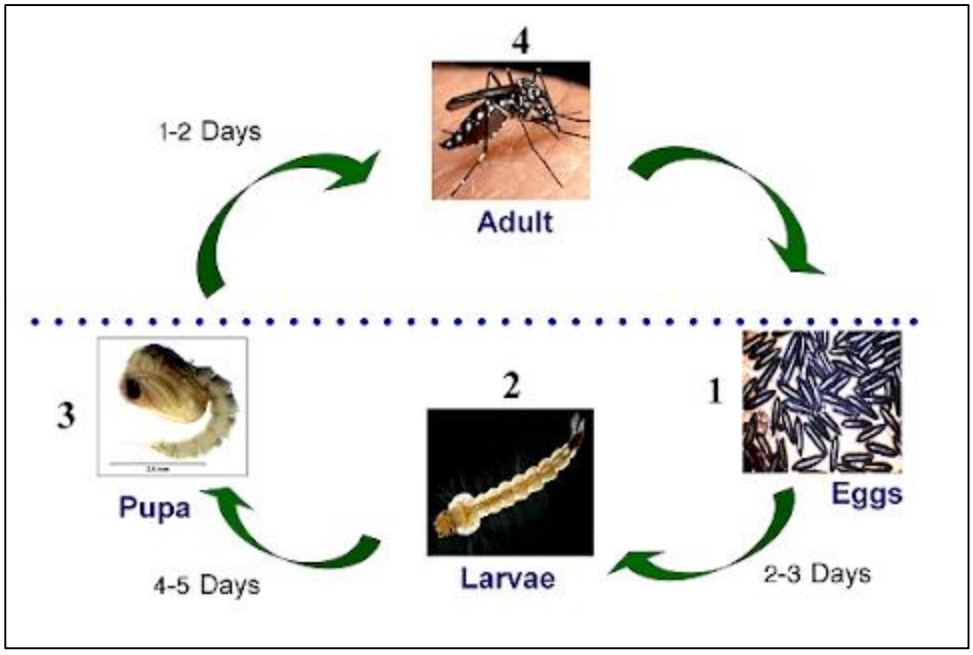


Figure 1: Life cycle of Aedes mosquitoes

4. Taxonomic Identification

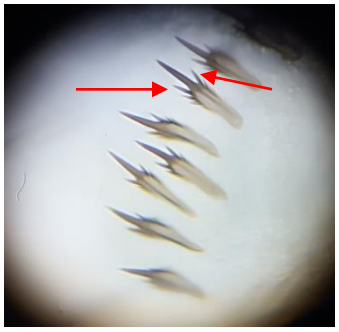
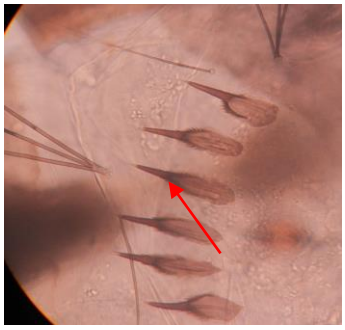
Out of more than 900 *Aedes* species identified worldwide, 49 *Aedes* species belonging to 15 genera have been identified to exist in Bhutan so far. The two species of *Ae.aegypti* and *Ae. albopictus* belong to subgenus Stegomyia (Theobald) of the genus *Aedes*. Their taxonomic status has been described in the table below ***Table 1***.

Table 1: The taxonomic status of *aedes* mosquito species

Kingdom	Animalia
Phylum	Arthropoda
Class	Insecta
Order	Diptera
Family	Culicidae
Genus	Aedes
Subgenus	Stegomyia
Species	aegypti albopictus

Ae. aegypti and *Ae. albopictus* larva can be identified through the shape of the comb scales on the 8th abdominal segment and length of plates supporting setae 9-12-M,T. The adults can be differentiated by the pattern of the white markings on their thorax ***Table 2***.

Table 2: Aedes differentiation and identification

Stage	Ae. aegypti	Ae. albopictus
Larva	Comb scales with lateral denticles  Courtesy: Tenzin Wangdi, Vector borne disease control programme, Bhutan	Comb scales without lateral denticles  Courtesy: Sonam Tashi, Vector borne disease control programme, Bhutan
Adult	Scutum with lyre shaped white marking  Courtesy: Karma Tshewang, VDCP	Scutum with median longitudinal white stripe  Courtesy: Karma Tshewang, VDCP

Most often field workers confuse and misidentify common Aedes species *Ae. pseudotaeniatus* for *Ae. Aegypti* (***Figure 2***). Such mis-identification will give wrong information and lead to wrong decision making both at ground level and at higher level.

Adult	Ae. aegypti	Ae. pseudotaeniatus
		

Figure 2: Ae. Aegypti & Ae. pseudotaeniatus

5. Aedes surveillance

Aedes surveillance is performed in order to determine thedistribution, density andmajor breeding habitats of *Ae. aegypti* and *Ae. albopictus*. These data will in turn help determine spatial and temporal risk of dengue and other arboviral transmission and enable the selection and use of most appropriate vector control tools. The surveillance for Aedes has been divided into two types of routine surveillance and spot surveys in predetermined clusters or area.

5.1 Routine Surveillance

Routine surveillance should be performed in areas where dengue transmission has been established for more than 3 years. For the ease of carrying out the surveillance, larger areas should be divided into clusters and then sentinel cluster should be selected for the continuous monitoring. Monitoring resistance development, intervention impact assessment and bio-efficacies for the chemical control in use should also form a part of the surveillance. The criteria for selection of sentinel clusters are-

1. The sentinel cluster houses residential area
2. The cluster reported increased breeding habitats in the past years
3. The selected sentinel be spatially representative of 3 to 4 nearby clusters
4. Can effectively guide expanded vector control or source reduction campaign

Surveillance Methods

The surveillance methods for routine surveillance should include

- Larval surveys in monthly interval/fortnightly during monsoon
- Whole cluster survey involving relevant stakeholders at least once in June

- Adult surveys using appropriate traps if applicable
- Insecticide resistance monitoring for *Ae. aegypti* and *Ae. albopictus* every one year
- Bio-efficacy tests for larva of *Ae. aegypti* and *Ae. albopictus* every one year

5.2 Spot Surveys

In addition to routine surveillance, spot surveys should also be conducted to generate entomological information for a particular locality to guide focused vector control activity. In non-transmission or new areas, spot surveys should be performed to determine the presence of *Ae. aegypti* and *Ae. Albopictus* and their degree of infestation. The survey should indicate appropriate vector control activities to be implemented involving relevant stakeholders. In transmission areas spot surveys can be done on need based basis in

- Institutions such as schools and colleges
- Public places including transport hub and conveyances
- Construction sites etc.
- Automobile workshops and backyard storages
- In areas where increased suspected cases are reported
- In areas where dengue cases has been reported
- In clusters where huts and bungalows are congested
- In clusters where drinking water supply are intermittent.

Surveillance Methods

- Larval surveys
- Adult surveys through appropriate traps

In both routine and spot surveys, besides inspecting breeding sites the objective of the surveillance should be to **search and destroy**. Where possible, any breeding habitat found should be destroyed through source reduction or larvaciding even during surveys. Public education on personal protection and larval source reduction in and around premises should also be carried out simultaneously.

6. Sample Size and Sampling Procedures

Although surveying the whole area gives better understanding of the level of infestation, it is usually impractical to survey a large area because of the limited human resource. Therefore, cluster sampling can

be adopted to carry out the survey. In a cluster sampling, the survey area is divided into several clusters of fixed number or groups of houses. Additionally landscape features and geographic boundaries can aid to form the clusters. A set of clusters are then selected for routine surveillance based on transmission intensity and vector indices in the past. For each selected cluster at least 30 buildings (sampling unit) has to be inspected to calculate the vector indices. To avoid any biases in the selection of buildings a systematic sampling technique can be used. For example, in a cluster with 100 buildings, to survey 30 buildings, divide 100 by 30 and derive the n^{th} number. (n=100/30=3.33). Select the first building randomly and then survey every n^{th} building (here every 3^{rd} building). It should be noted that regular visits to same buildings will result in low vector density over time. Therefore, different buildings should be inspected during subsequent visits (Random selection of the first house during each survey).

7. Common Entomological Surveillance Methods

Several methods exist for entomological surveillance. However, larval surveys (both larva and pupa) is the most commonly used technique. Adult surveys and oviposition traps are used in special studies and for research purposes.

7.1 Larval surveys

In larval surveys, the basic sampling unit is the house or a building. During the larval survey, all potential breeding sites in and around the selected house or building should be inspected for Aedes larva and pupa. During case based investigation, houses and premises within 500m radius of the index case should be surveyed.

Following equipment should be available during the survey

- Dipper
- Pipettes
- Vials and label
- Torch
- Siphoning pipette
- Strainer
- Notebook
- Pen or pencil
- Aedes larval surveillance form

From each Aedes larva/pupa positive container, a minimum of 10 samples should be collected by dipping, pipetting or netting. In containers with less than 10 larva or pupa, all larva and pupa should be collected. The collected sample should be transferred to a vial labeled with date, location (cluster number), building number and the type of container. Once the survey of building and its premises has been completed the details of the findings should be recorded in the Aedes larva surveillance form ***Annexure 2***. In places with multiple breeding sites such as tyres, heaps of scrap or in dump yards, collect larva/pupa from at least 10 randomly selected containers. At the end of the day carry all the larval/pupal sample to the laboratory. In the laboratory, third and fourth instar larva can be identified immediately using identification keys. First and second instar larva should be allowed to develop into 3rd and 4th for species identification. Pupa can be allowed to develop into adults. After identification do not forget to enter the findings (Species) into your surveillance form for data entering in computer, maintaining and reporting. This is the most important aspect that surveillance workers forget to record and report.

Calculation of *Aedes* indices

Once the collected samples have been identified, *Aedes* indices are calculated **separately for both *Ae. aegypti* and *Ae. albopictus*** for each cluster or survey area. If a container contains larva of both the species, it should be counted for both the species. Three indices, viz. Container Index, House Index and Breteau Index should be calculated to provide the larval density in the survey area. The method of calculation of these three indices are provided below;

Container Index (CI)

$$CI = \frac{\text{Number of containers positive for } \textit{Ae. aegypti/albopictus} \text{ larva or pupa}}{\text{Total No. of wet containers (both indoor/outdoor) checked in the locality}} \times 100$$

House Index (HI)

$$HI = \frac{\text{No. of premises/Units positive for } \textit{Ae. aegypti/albopictus} \text{ larvae or pupa}}{\text{Total No. of premises/houses/units checked in the locality}} \times 100$$

Breteau Index (BI)

$$BI = \frac{\text{No. of positive containers for } \textit{Ae. aegypti/albopictus} \text{ larva or pupa}}{\text{No of buildings/Units checked in the locality}} \times 100$$

For house index calculation, any containers positive, both inside and outside of a building should be counted as one positive premise.

Interpretation and limitations of the larval indices

As a routine surveillance for monitoring *Aedes* density, all the above three indices should be considered. Though it is difficult to have a clear cut-off point to indicate an outbreak as so many other factors are involved in disease transmission, especially for dengue, HI of more than 5 should be considered as an indication for dengue outbreaks risks and should lead to planning and implementation of appropriate control measures in our context.

Table 3: Below table show WHO Criteria for interpretation:

High Risk	Low Risk
CI > 50	CI < 5
HI >10	HI < 1
BI > 20	BI < 20

The House Index has been most widely used for monitoring infestation levels, but it neither takes into account the number of positive containers nor the productivity of those containers. Similarly, the container index only provides information on the proportion of water-holding containers that are positive. The Breteau Index establishes a relationship between positive containers and houses, and is considered to be the most informative, but again there is no reflection of container productivity. Nevertheless, in the course of gathering basic information for calculating the Breteau Index, it is possible and desirable to obtain a profile of the larval habitat characteristics by simultaneously recording the relative abundance of the various container types, either as potential or actual sites of mosquito production (e.g. number of positive drums per 100 houses, number of positive tyres per 100 houses, etc.). These data are particularly relevant to focus efforts for the management or elimination of the most common habitats and for the orientation of educational messages in aid of community-based initiatives.

8. Reporting and Communication

The strategy of house to house visits for *Aedes* control and community awareness by national programmes alone has not proven effective in dengue outbreak control. Since *Aedes* vector are domestic breeders, ,

unless communities themselves and other relevant stakeholders participate, it will not be effective. For that reason, there should be a well-established chain of communication on the findings of the vector surveillance to bring on board all the relevant stakeholders for the control. The local taskforce should be informed of the surveillance findings for necessary actions through the concerned DHO.

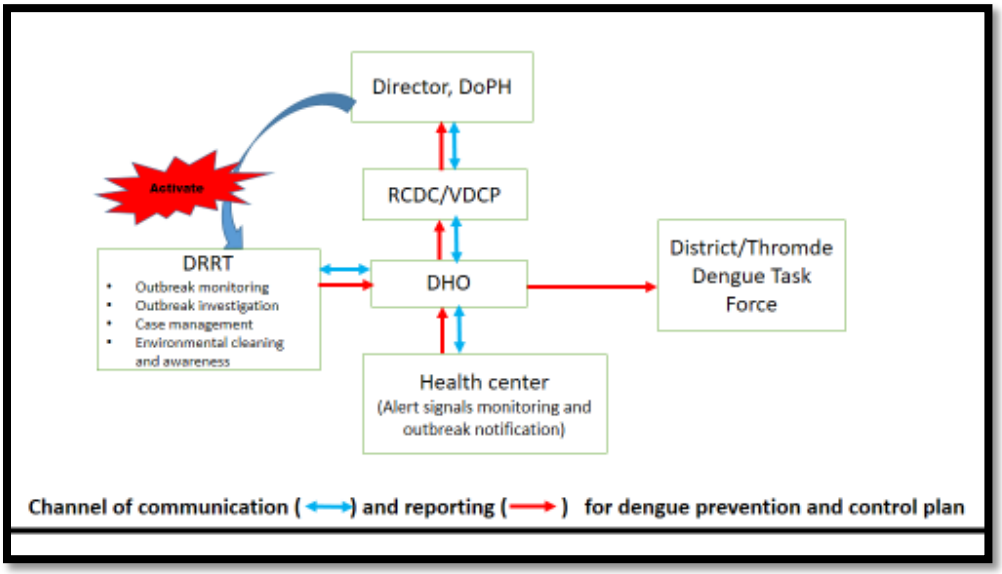


Figure 3: Reporting and communication flow chart for surveillance information sharing

Standard format of reporting should be used. The monthly *Aedes* survey summary report (***Annexure 3***) should be submitted to the DHO, CMO/Medical superintendent and the national programme by DMS. The DHO should in turn report to the chairman, local dengue task force and DoPH and seek necessary support to mobilize communities for source reduction and awareness campaigns based on the perceived risk as per the national plan for dengue prevention and control. CMO or MS on the other hand should keep note of the trend in vector density and notify DMS/MT of any suspected or confirmed dengue for immediate response.

9. Control Strategy

It should be kept in mind that no single control measure will be enough to bring down the population of dengue vectors. Since dengue outbreak in Bhutan has been seasonal the control of *Aedes* population can be targeted during specific time periods as before mosquito season, during season and during outbreaks. The control strategy should be based on the scientific evidence generated through the routine surveillance. The control activities can broadly be categorized as given in the below flowchart (***Figure 4***). However, community participation, mainly keeping homes and work place free of mosquito breeding by the community will be one single most effective approach. This can be targeted through community

sensitization and awareness programmes through various mediums or mandatory observation of dengue day every week from the onset of mosquito season.

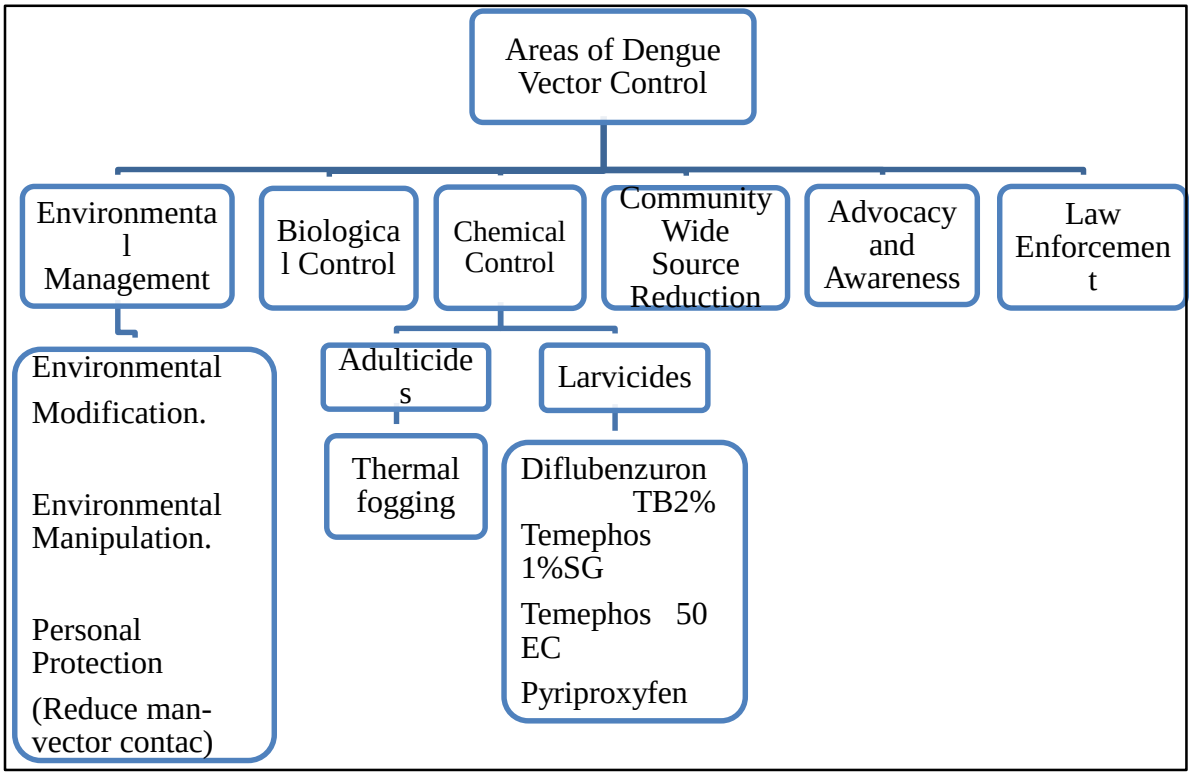


Figure 4: Flowchart of different aedes control options

9.1 Environmental management

The main objective of this method is to change the environment to prevent or minimize vector propagation and human contact by destroying, altering, removing or recycling non-essential containers that provide breeding ground for *Aedes* larva. This method should be the main component of the dengue vector control. Environmental management can be achieved through environmental modification, environmental manipulation and changes to human habitation and behavior.

I. Environmental modification

Environmental modification refers to long term physical alteration of vector breeding habitats to eliminate and prevent mosquito breeding. Some examples of environmental modification includes,

- Providing continuous water supply to minimize storage of water in areas with irregular water supply
- Mosquito proofing of water storage cement tanks, overhead tanks, cisterns etc. permanently.

- Construction of buildings without roof gutters
- Removal of unwanted breeding habitats such as unwanted water tanks and unserviceable roof gutter
- Proper drainage system

II. Environmental Manipulation

Environmental manipulation involves adopting temporary measures in vector habitats to prevent or reduce mosquito breeding. Examples include,

- Periodic cleaning and scrubbing of water storage tanks, barrels drums, flower pots and vases, refrigerator trays etc.
- Application of larvivorous fish or larvicides
- Proper draining of drains, water collection in cement floors and cleaning of roof gutters
- Proper disposal and management of solid waste
- Proper storage of tyres and other containers that can hold water
- Filling cavities and holes in iron or bamboo stumps with cement or soil

III. Changes to human habitation or behavior

This strategy involves any actions that reduce man-vector contact such as fixing screens on windows, doors and other entry points to prevent mosquitoes from entering houses, using mosquito nets while sleeping during day time. Use of protective cloths and repellents are also some of the measures. Netting windows of toilets and bathrooms will effectively prevent *Ae. aegypti* breeding in water containers.

9.3 Biological and bio-chemical methods

Biological vector control agents prey upon or parasitize and compete with the target vector species. A bio-chemical method interferes with the development process and thus helps in reducing vector population. Use of biological and bio-chemical agents avoids environmental contamination with chemical and averts development of insecticide resistance in the target species. Larvivorous fish such as *Gumbusia affinis* and *Poeciliareticulata* (guppy), Bti and insect growth regulators can be used in appropriate non-potable water containers.

9.4 Chemical methods

Chemical methods for *Aedes* control can be targeted to its immature stages (larva) or the adults through the use of chemical compounds as larvicides, space ultra-low volume space applications with fogging and mist spray. Indoor residual spraying may be considered when there is enough evidence that the targeted *Aedes* species rests on the wall surfaces and efficacy of insecticide well known. Some of the chemical compounds currently in use and methods of their application has been described below.

Larvicides - Temephos

Temephos are slow releasing formulation of larvicide recommended for *Ae. aegypti* and *Ae. albopictus* control in domestic water containers that cannot be removed or destroyed (Examples: Water storage tanks, barrel drums, tyres). Temephos comes in two formulation as Temephos 1% Granules (SG) and Temephos 50% Emulsifiable Concentrate (EC). Temephos 50% EC are recommended when other larval control measures are not practical in areas such as dump yards, scraps house, workshops, construction sites or large open storages. Their dosage, methods and frequency of application are shown in ***Table 4***.

Table 4: The dosage, methods and frequency of application of chemical larvicides

Product	Formulation	Application method	Dosage/dilution	Frequency of application
Diflubenzuron	2% TB	Dissolve required amount in non-drinking water	1 tablet in 40L of water	After every 3-4 weeks
Temephos	1%SG	Put the required amount in cotton pouches and keep it suspended in the water	1g of product in 10L of water	After every 3 months
Temephos	50% EC	By hand compression sprayer	20ml in 9L of water	After every two week
Pyriproxifen	10% EC	compression sprayer		

Adulticide

Space Spraying to control Adults using insecticides

Space spraying involves application of tiny droplets of insecticides in the air for rapid knock-down and eventual death of the adult vectors. This method is used during dengue outbreaks to bring down the adult population or to control the high density of adult population. It can be done either with thermal fogging or ULV spraying.

Table 5: Insecticides suitable for cold aerosol or thermal fog application against mosquitoes

Insecticide	Chemical Class	Dosage of AI (g/ha)		WHO hazard classification of AI
		Cold Aerosols	Thermal fogs	
Fenitrothion	Organophosphate	250-300	250-300	II
Malathion	Organophosphate	112-600	500-600	III
Pirimiphos-methyl	Organophosphate	230-330	180-200	III
Bioresmethrin	Pyrethroid	5	10	U
Cyfluthrin	Pyrethroid	1-2	1-2	II
Cypermethrin	Pyrethroid	1-3	-	II
Cyphenothrin	Pyrethroid	2-5	5-10	II
d,d-trans-Cyphenothrin	Pyrehtroid	1-2	2.5-5	NA
Deltamethrin	Pyrethroid	0.5-1.0	0.5-1.0	II
D-Phenothrin	Pyrethroid	5-20	-	U
Etofenprox	Pyrethroid	10-20	10-20	U
λ-Cyhalothrin	Pyrethroid	1.0	1.0	II
Permethrin	Pyrethroid	5	10	II
Resmethrin	Pyrethroid	2-4	4	III

Source: WHO 2006/2. Pesticide and their application for the control of vectors and pests of public health importance.

10. Thermal fogging

Thermal fogger uses heat to vaporize a fogging solution. It sprays insecticide solutions out of the nozzle of the fogger in the form of a mist or a fog that will remain suspended in the air for a long time in calm weather. The tiny suspended particles will also be able to get into hard-to-reach places both indoors and

outdoors such as dense vegetation and corners of open buildings. Once the droplets come in contact with the targeted adult species they are rapidly knocked down and eventually killed. Thermal foggers come in two forms, viz. hand carried and vehicle mounted. Hand carried foggers are meant for enclosed spaces such as congested housing areas, multi storied buildings or in areas that are inaccessible by a vehicle. They are not safe to be applied indoor, especially when there are flammable materials around and people with medical conditions such as COPD. During widespread outbreaks, especially in large urban areas, fogging is carried out using vehicle mounted fogging machines. The route of the vehicle should be well planned before the fogging operation with hand operated fogging machine to reach the inaccessible target areas. Relevant authorities such as traffic police, municipalities and communities needs to be informed before the actual operation.

Logistics and manpower per machine for fogging:

- Overall fogging supervisor (Entomologist/Malaria Technician).
  Responsible to inform concerned authorities for further notification and assistance from Municipalities, Traffic Police and communities. Ensure right dosage, application and coverage.
- For each fogging machine there should be two spraymen with proper training on safety and operation of the machine.
- 20 liters of pre-mixed diesel oil and chemical for fogging and 5 liters of fuel (Petrol)
- Three pairs of torch batteries for one month duration fogging per machine.
- Three pairs of overalls.
- Three pairs of gloves.
- Three pairs of suitable respirators.
- Three pairs of goggles.
- Three pairs of boots.
- Two cotton travel

10.1 Indication for Thermal fogging

Judicious application of fogging should be followed to prevent unnecessary insecticide pressure for resistance development in the target as well as non-target species.

- Fogging should be performed in an area as soon as possible after a suspected DF/DHF or chikungunya case from that area is reported

- Fogging should be applied during outbreaks of Dengue or chikungunya and also during period of high mosquito density such as rainy seasons when the relative humidity is high
- Fogging should be applied when there is evidence of high density of vector population
- Fogging should not be carried out if a period of over 2 weeks has lapsed since the case was detected, if no secondary cases have been reported

10.2 Timing of fogging

Ae. aegypti and *Ae. albopictus* are mostly active for few hours at dawn and dusk. Therefore, fogging should be carried out during this time of the day, preferable from 5 to 7 pm. Other factors such as rain, wind speed and wind direction should also be considered when planning fogging.

10.3 Area to be covered

Fogging should be applied within 100m radius of an index case. When there are cluster of cases (2 or more cases within 200 m radius), fogging should cover 100m radius from the perimeter of the cluster (**Figure 5**). When there is evidence of high vector density the target area should be the cluster.

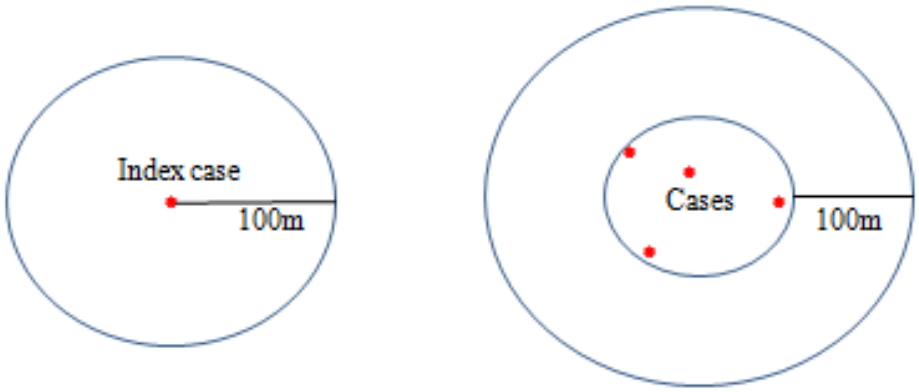


Figure 5: Area for thermal fogging to cover in single and cluster of cases

10.4 Frequency of fogging

The first round of thermal fogging can be initiated at the notification of an indigenous case or cluster of cases or during early phase of an impending outbreak. The first round should always be followed by a second round after about 5 to 7 days considering new adult emergence from pupae and viral infectivity in adult mosquitoes.

10.5 Activities to be followed before, during and after fogging

Before fogging

- Demarcate the target area to be covered by fogging by studying the sketch map of the area. When vehicle mounted is planned, study the street map and determine the route for the vehicle to cover the area
- Make the community aware of the fogging operation through social media, public addressing and local TV channels. Specific instruction to keep doors and windows open, foods and waters covered and extinguish fire sources should be included in the public awareness
- Study the wind direction and decide the path of fogging to ensure full coverage of the target area. Spraymen should be moving from the end points towards the wind direction
- Inform traffic police to control traffic during the fogging operation

During fogging

When fogging is done using hand operated (Portable) thermal fogging machines

- Spraymen should move from house to house
- Fog in and out of the premise(peridomestic fogging)
- Fog the interior of the premise by directing the fog to the interior of the premise through an open door or a window for 10-15 seconds with the nozzle of the machine at a distance of about 3m to the door/ window. Stepping into a house with the fogging machine should be avoided due to potential fire hazard with thermal fogging.
- In single storeyhouses, fogging can be done from the front door or through an open window without having to enter every room of the house. All bed room doors should be left open to allow dispersal of the fog throughout the house
- After spraying, all door and windows should be shut for half an hour to ensure good penetration of the fog within the house.
- When fogging is done in a multi-storied building, fogging should begin from the uppermost floor and the sprayman move from upstairs to downstairs and from the back of the building to the front ensuring full coverage of the target area. This motion gives good visibility of the path of the sprayman.

- Fogging should cover all possible resting sites including hedges, covered drains, bushes, tree shades etc.

When fogging is done using a vehicle mounted thermal fogging

- Study the street map of the area and determine the route for the vehicle
- Ensure prior traffic control to avoid traffic hazards to motorist and pedestrians
- In areas with narrow roads and close houses, the vehicle should move against the wind direction with the nozzle of the fogger pointing backward. If the roads are wider the vehicle can move in zigzag manner against the wind to cover the maximum area
- Put on the hazard light in the vehicle
- Drive the vehicle at a steady speed of 6-8Km/hr
- Turn off fogging machine just before the vehicle stop
- Use hand operated fogger to cover the inaccessible area
- The spray nozzle should be pointed at a 45˚ angle to the ground

10.6 Fogging inside houses/buildings

Ae. aegypti and *Ae. albopictus* are known to breed and bite both inside and outside of houses. Therefore, indoor fogging should also be considered during outbreaks or during an impending outbreak. Since indoor fogging involves some risk certain precautions needs to be followed to avoid any incidents.

- Put off all electricity at the main switch
- Turn off all flames and heating equipments and allow some time to cool off the heat before beginning with the spray
- Cover all food and water including aquariums
- Open all doors and windows
- Ensure all occupants and animals remain outside during the spray operation
- **Water diluted mist are recommended in indoor to prevent fire hazards**
- Start the spray from the innermost room in a backward movement or from the main entry of the house depending on the reach of the droplets or dispersal
- In a multi storied building spray should be started from the top of the building
- Close the doors and windows for about 30 minutes once the spray operation is completed
- Ensure that the house or building is ventilated before reoccupation by the residents

10.7 Limitations of thermal fogging

The objective of space spraying is the massive, rapid destruction of the adult vector population. However, there has been considerable controversy about the efficacy of aerosol insecticide applications during epidemics of dengue and yellow fever. Any control method that reduces the number of infective adult mosquitoes, even for a short time, should reduce virus transmission during that time, but it remains unclear whether the transient impact of space treatments is epidemiologically significant in the long run. There is no well-documented example of the effectiveness of this approach in interrupting an epidemic. Nevertheless, if space spraying is used early in an epidemic and on a sufficiently large scale, the intensity of transmission may be reduced, which would give time for the application of other vector control measures that provide longer-term control, including larviciding and community-based source reduction. Thus, if disease surveillance is sensitive enough to detect cases in the early stages of an epidemic, and if the resources are available, emergency space spraying can be initiated at the same time as source reduction measures and larviciding are intensified.

11. Community wide source reduction campaigns

Community wide source reduction campaign (cluster wise or the whole area) is a community based control program to prevent or reduce proliferation of dengue vector species during inter-epidemic and epidemic periods. It will instill community ownership to address the dengue menace. Active community participation is required to conduct the campaign through effective community mobilization. Community mobilization should be initiated with the involvement of local government and other relevant organizations and sector heads. Since dengue and other arboviral outbreaks related to *Aedes* mosquitoes are known to be seasonal in Bhutan, efforts should be made to take pre-emptive actions to minimize the magnitude of dengue transmission during this period. These pre-emptive actions, focusing on source reduction, should begin as early as up to three months ahead of the seasonal peak to first cover areas demonstrating lower to higher risk of dengue transmission. The areas at higher risk of dengue transmission should be covered once again at least a month before the seasonal peak. The overall goal of the campaign should be to motivate communities towards prevention of dengue outbreak through removal and disposal of any water holding containers.

Following steps can be taken during source reduction campaign to remove mosquito breeding-

Preparatory Phase

- Divide the area into operational clusters. The same Aedes cluster map or local area map can be used
- Divide volunteers into groups based on the number of clusters in the area and assign a group leader to each group
- Arrange vehicles for lifting collected wastes. Proper route plan of vehicles need to be developed
- Identify collecting points to lift the collected waste by the lifting vehicle.
- The main aim of the campaign is to remove any water holding containers that will allow Aedes mosquitoes to breed. Therefore, proper segregation and disposal needs to be planned as well
- Arrange larvicides
- Community awareness materials, mainly personal protection and source reduction messages should be available with the group to be handed out to households during the campaign
- Fix date and time for the campaign
- Inform local residents about the campaign with the aim to seek their participation on the said date

Implementation Phase

- Individual group with their team leader visits assigned clusters on the planned date and time
- Group visits every building/house in the assigned clusters and inspects in and around buildings/houses to remove any unwanted objects that holds water.
- Water holding containers that cannot be removed such as refrigerator pans, flower vases etc should be treated with larvicides and sticker should be put on the indoor containers treated with larvicide with date and name of applier.
- Sensitize and educate household members on preventive and control aspects of dengue mosquitoes. Preventive aspect includes personal protection measures such as wearing long sleeve clothings, using mosquito repellents. Control measures include proper disposal of unwanted water holding containers and changing water regularly every 5 days from those containers that cannot be disposed or keeping them properly covered to prevent mosquito entry
- Record presence or absence of mosquito breeding in every households or premises visited in the form provided.
- Collect all waste containers and reach it to the identified waste collecting point

12. Advocacy and awareness programme

Dengue vectors are around us primarily because of improper management of solid waste and water holding containers. For a successful dengue vector control there should be strong advocacy and awareness program conducted from time to time. The primary aim of the advocacy and awareness campaign should be to bring about a positive behavioral change in the communities in mitigating dengue vector breeding habitat in and around homes, offices, work place and institutions. Strong advocacy should also be maintained with authorities, planners, policy makers and other stakeholders for policy decisions and intersectoral collaboration. The awareness programme should include-

- Early diagnosis and treatment when patients have symptoms of acute onset of fever, headache and retro-orbital pain, muscle and joint pain, nausea or vomiting and bleeding manifestations.
- Those diagnosed with dengue should be encouraged to sleep under a net and apply insect repellents to break the transmission chain
- How to prevent mosquito breeding in their homes, work place and offices, institutions etc. through proper management of waste and water holding receptacles ***Annexure 4***.

13. Law Enforcement

Often during vector surveillance one finds a strong need to enforce legal actions when breeding sites are found in the same place over and over again due to poor compliance from the residents or the owner of the property. This poses significant threat to the general public, especially during outbreaks. However, there are provisions to take legal course against these individuals or entities that owns or occupies the premises under the following provisions;

- National Environment Protection Act, chapter IV, Protection of environment quality
- Penal Code of Bhutan, Chapter 27, Offences against the Public Welfare, Clause 408
- Penal Code of Bhutan, Chapter 28, Offences related to Public and civic duties, clause 424

In addition rules can be framed and adopted by the concerned authorities and regulators that can minimize or prevent conditions that are favorable for aedes breeding as per national prevention and management of waste act, 2009.

14. Vector control recommendations in transmission areas

Since dengue outbreaks appears to be seasonal in Bhutan the above describe control methods can be adopted as per the periods described below

Before mosquito season (March-April)

- Advocacy and awareness programs through public gatherings, social media and mass media
- Conduct surveys to determine abundance, distribution, and type of containers; large numbers of containers may translate into high mosquito abundance and high risk.
- Cover, dump, modify, or treat large water-holding containers with long-lasting larvicide.
- Reduce adult mosquito resting sites by keeping vegetation trimmed and tall grass cut.
- Develop mosquito education materials about *Ae. aegypti* and *Ae. albopictus* and personal protection measures

Beginning of mosquito season (June)

- Continue community awareness campaigns focusing on reducing or eliminating larval habitats for *Ae. aegypti* and *Ae. albopictus* vectors through mass media
- Continue to distribute mosquito education materials about *Ae. aegypti* and *Ae. albopictus* and personal protection measures.
- Initiate *Ae. aegypti* and *Ae. albopictus* community-wide surveys to:
    - Determine presence or absence and their distribution
    - Estimate relative abundance
    - Develop detailed vector distribution maps
- Evaluate the efficacy of source reduction and larvicide treatment.
- Continue/maintain community source reduction efforts.
- Initiate preventive adult control to reduce adult populations targeting areas of high mosquito abundance.
- Concentrate control efforts around places with high mosquito density.

Single or cluster of suspected/confirmed cases

- Begin public mosquito containment education campaigns aimed at preventing or minimizing contact between vectors and suspected or confirmed human cases, especially during the first week

of illness when an infected person is viremic and can infect mosquitoes, thereby possibly triggering or contributing to a local outbreak.

    - Educate the public to continually dispose of water-holding containers to eliminate larval habitats. Or, if funding allows, host a community volunteer/waste disposal program to help facilitate removal of larval habitats.
    - Treat with long-lasting larvicide any water-holding containers that cannot be dumped, covered, discarded, or otherwise modified.
    - Eliminate larval habitats within 100 meters around a case's home.
- Initiate community wide source reduction campaigns, adult mosquito, and case containment initiatives to minimize the spread of infected mosquitoes within 100m of index or cluster of cases.
- Educate the public about reported cases of disease and urge them to use:
    - Insect repellents
    - Window and door screens to prevent mosquitoes from entering the house
- Treat the outdoors within 100 meters around a case's home with adulticide.

Outbreaks; cluster of suspected or confirmed cases

- Divide the outbreak area into operational management areas where control measures can be effectively applied within few days; repeat as needed to reduce adult or larval density.
- With additional human resource support from relevant stakeholders, conduct door-to-door inspections and mosquito control in an area-wide fashion (reach >90% coverage of the control area within few days).
- Generate spot map of Aedes (aegypti&albopictus) habitats and conduct focused control interventions
- Organize community wide source reduction campaigns targeting disposable containers, including large junk objects that accumulate water (broken washing machines, refrigerators, toilets) in buildings, public areas, backyards etc.
- Combine outdoor spatial and residual spraying with source reduction and larviciding (including residual spraying of container surfaces and adjacent mosquito resting areas). Remember to treat storm drains, roof gutters, and other often overlooked cryptic water sources.

15. Roles and Responsibilities of different official in dengue control

I. Vector surveillance and control team (DMS/MLT)

- Conduct routine and spot entomological surveillance
- Identify vector species
- Analyse survey data
- Generate Aedes hotspots
- Communicate survey reports to DHO, MS/CMO, VDCP
- Implement vector control measures (larvicides and Adulticides)
- Respond to outbreaks

II. District Health Officer

- Provide necessary support for smooth functioning of the surveillance
- Analyze surveillance reports and coordinate control measures
- Function as member secretariat for the local dengue task force
- Distribute/display public education materials such as posters, banners, hand-outs etc
- Monitor dengue control and source reduction activities conducted in the affected area as well as analyze the trend of the disease in person, place and time for early detection and response to outbreaks
- Update information for action to all task force and DRRT members on dengue prevention and control measures
- As DRRT leader, oversee and coordinate to collect and compile data and submit reports, coordinate implementation of activities, and arrange for submission of daily technical report to the district task force and Director, DoPH

III. Medical Superintendent /Chief Medical Officer

- Ensure smooth conduct of monthly Aedes surveillance
- Direct or conduct field investigation of the outbreaks according to SOPs
- Direct vector control in emergence of any cases or cluster of suspected cases
- Guide vector control operations on the basis of epidemiological evidence

IV. Central Program (VDCP)

- Monitor field surveillance activities
- Analyze field data and provide timely recommendations for vector control

- Ensure adequate human resource for the conduct of the surveillance
- Provide technical guidance and HR back-up during outbreaks
- Conduct spot surveys
- Develop communication materials
- Receive surveillance reports and provide timely feedback

16. Annexures

Annexure 1: SOP on the conduct of Aedes surveillance

Aedesaegypti and *Ae.albopictus*, vectors of dengue, Chikungunya, zika and yellow fever are specialized mosquitoes that prefer to breed in and around human settlements in man-made and natural containers that hold clean water. Man-made containers include indoor water containers and solid wastes that can hold water including bamboo stumps and waste containers. Beautification and ornamental water containers such as flowerpots and vases should also be checked for their breeding. Natural containers include tree and rock holes, leaf axils and fallen leaves that hold rain water. Mostly widest Aedes infestations occur in urban areas with close human settlements without proper disposal system and erratic water supply where residents collect water in containers in bathrooms and toilets for domestic purposes including any containers without proper cover. Aedes surveillance should consider all above mentioned containers for larval collections.

Scope: This document is applicable to all staff of the project that performs Aedes larval surveillance

Purpose: This document is to provide instructions on the conduct of Aedes larval surveillance

Responsibility: It is the responsibility of the individuals conducting Aedes larval survey to follow this SOP VDCP/ENTO/SOP-05

1. It is the responsibility of the PI to ensure that the correct version of this SOP is in place at the study site and correct training has been given to all personnel that use this SOP.
2. It is the responsibility of all scientific staff to ensure that this SOP is correctly followed.

Equipment

- Torch
- Pipettes
- Vials or Uricol containers
- Larval scoop
- Net with handle
- Larval survey forms
- Notebook
- Pen or Pencil

Surveillance Methods

i. The basic sampling unit is the building in the sentinel cluster

ii. In each sentinel cluster 30 buildings/houses has to be inspected

iii. At least 10 buildings has to be surveyed per day (35-40 Units) by a team of 3 persons

iv. In the indoors, at least 3-4 residential units (both ground and upper levels) should be inspected.

v. Select the first building randomly. Then use the systematic sampling method to continue the survey in every n^{th} building

vi. Derive the n^{th} number as-

$$n = \frac{\text{Total Number of buildings in the area}}{\text{Number of buildings required for the survey}}$$

vii. Explain the purpose of visit and obtain the consent to inspect mosquito breeding sites

viii. After completing inspecting indoors, survey outside of the building for containers with mosquito breeding and ensure that the whole area is examined

ix. Countthe numbers of containers with and without water and number of containers positive for mosquito larvae or pupae

x. Collect about 10 larvae and all pupae from the positive containers with enough water to keep alive in a labeled collection vials. In a containers with lesser than 10 larvae, collect all the larvae present

xi. Record the findings in Aedes Larva Surveillance form (Form No. Version)

xii. The following collection methods can be used depending on the type of breeding sites.

1. Pipeting 2. Dipping 3. Siphoning 4. Netting

xiii. Carry the larva to the laboratory and identify the 3^{rd} and 4^{th} stage larvae with the help of a compound microscope. Allow 1^{st} and 2^{nd} stage larvae to develop to 3^{rd} or 4^{th} and pupae into adults for species identification.

xiv. Calculate the indices as defined below

Note: Remove all water from larvae positive containers where possible and ask owner to wash the container by rubbing the sides of containers as Aedes eggs stick to sides of container.This practice should

be carried out every 5 days by the household member. This is for mitigation of dengue breeding in the locality.

Indices calculations:

i. Container Index (CI)= $\frac{\text{No. of positive containers for Aedes larva or pupa in the locality}}{\text{Total No. of containers checked in the locality}} \times 100$

ii. House Index (HI)= $\frac{\text{No. of houses positive for Aedeslarvae}}{\text{Total No. of houses checked in the locality}} \times 100$

iii. Breteau Index (BI) = $\frac{\text{No of positive containers for Aedes larva or pupa}}{\text{No. of premises inspected}} \times 100$

Annexure 2: Aedes Larva Survey Form

Date of Collection (DD/MM/YY):_____ Site/Cluster No.:_____

Dzongkhag:_____ Gewog/Thromdey:_____

Building No.	Name of the building/property owner	Name of Location	No of Units Surveved	No of Units Positive	Container Type – (enter code as	Indoor/Outdoor (I/O)	Total Potential breeding habitat		No. of Container positive for	No. of containers Larvicide	Species	Geo-coordinates		What other measures were taken to eliminate the breeding
							Wet	Dry						

Code for Container Type:*water storage container**-1**, flower pots or ornamental plants**-2,** refrigerators**-3,** waste containers**-4,** tyres**-5,** others**-6***

Signature of Surveyor:…… **Date:……**

Annexure 3: Aedes Survey Summary Report

Name of the reporting health facility:……

Dzongkhag:……

Survey area:…… Date of Survey:……..to ……..

Parameters	Cluster Number									
										Others
Total number of buildings/premises inspected										
Number of buildings positive										
Total number of units inspected										
Number of units/premise positive										
Total Number of wet containers Inspected										
Number of containers positive										
Number of containers positive indoor										
Number of containers positive outdoor										

Comments and suggestions:

Name of reporting official: Date Signature:

Name of receiving official: DatedSignature:

Annexure 4: Messages to school for dengue prevention and control

Focal: Principal

Mode of deliver: To be read out by the Principal during the morning assembly

Frequency: Twice a week

Background

Dengue is a mosquito borne viral disease. Dengue virus is transmitted by female mosquitoes mainly of the species Aedesaegypti. It can manifest as simple fever or with serious bleeding and other complications. Dengue is globally a public health concern inflicting millions of people. Because the spread is mainly due to our behavior it is important that we play our roles at individual level by implementing the following measures:

Personal protection measures

Dengue mosquitoes bite during daytime. Biting intensity is highest towards evening and early morning. In order to protect yourself from mosquito bites and reduce the chances of getting dengue, adopt the following measures during mosquito season:

- Apply mosquito repellent such as mosrel, fabric roll, odomos etc. when you go out
- When outdoor, wear long sleeved shirts and pants to cover your arms and legs
- Sleep under a mosquito net, even during your daytime nap
- Use screens on windows and doors to stop mosquitoes from entering
- Use household mosquito repellents such as coils, allout and Baygon spray
- If you get sick with dengue prevent others from getting dengue from you by sleeping under a mosquito net for about a week

Source reduction measures

Dengue mosquitoes breed in stagnant water in your house, workplace and surroundings. Without taking measures to reduce the mosquito population in your homes and surroundings you would be constantly exposed to the threat of acquiring dengue infection through its bite. So in order to minimize mosquitoes in your area-

Dedicate one day in a week to-

- Remove all unwanted articlessuch as plastic cups, bottles, coconut shells, tyres, scraps or any other odd articles that may collect rain water in and around your house and work place
- Change water regularly from flower pots, vases, & ornamental plants etc.

- Empty accumulated water in refrigerator pans, plates under flower pots, AC ducts, roof gutters etc.
- Cover all stored water, including tyres in and outside of your housewith lid or put under a shade/roof/plastic sheets to prevent mosquito entry and breeding

Annexure 5: SOP for Insect Growth Regulators (IGR)

1. **Diflubenzuron 2%WT Tablet *use***

- Insect growth regulators are chemical that can inhibit chitin synthesis (body covering) of mosquito larvae and inhibit development of larva to pupa and to adult.
- IGR formulation comes either in tablet or granule forms for introducing into mosquito breeding habitats.
- Mosquito larvae die as larvae naturally after a few days without increasing adult population.
- The coverage should be maximum in all potential breeding habitats that remain with water without cover or with partial cover for more than a week.
- Drinking water sources and containers should not be treated with IGR.
- The dosage is 1 tablet in 40 liters of water
- Introduce IGR in barrel drums indoor and outdoor receptacle without cover and those with small holes through which mosquito can pass through to lay eggs.
- Water dipping pan at the back side of refrigerators are main mosquito breeding sites which surveillance inspectors and owner often forgets and these should not be missed. Divide tablet into 4 parts and add 1 part in water dipping pan.
- Add IGR in flower vases as per amount of water in each of them.
- Inform the residents that you have introduced IGR and it will remain effective for at least 3 weeks .
- Old tyres and drums with water around the houses should be covered fully with IGR.
- IGR can only be handled by Entomologist, DMS, Malaria Technicians, Insect Collectors, trained Thromde Sanitation Inspectors, BAFRA inspectors and Desups.
- Paste IGR treatment message on the indoor water containers where IGR is introduced and this is mandatory.

Insect Growth Regulator (IGR) Treatment Message

Mosquito Growth Regulator (IGR) is Introduced Here	
Water in this container is treated with IGR.	Do not remove whole water till 2 months period but can be covered well.
Cover rest all containers well. Or remove water and wash well weekly.	Do not keep standing water without cover up to a week.
IGR introduced on: DD……..MM……..YY……..by (Name)……..	

2. SOP for Pyriproxifen 10% EC use

- Pyriproxigfen is a broad-spectrum insect growth regulator (IGR) having insecticidal activity against pest of public health importance such as mosquitoes, houseflies and cockroaches.
- It has unique mode of action affecting the morphogenesis, reproduction and embroyogenesis of insects. The morphogenesis effect of pyriproxifen is primarily seen during larval-pupal transformation occurring death of pupal stage and fail to emerge adult mosquito.
- Unlike other insect growth regulators, it is proved that this chemical has property of auto-dissemination. That is when surviving adult female comes in contact with sprayed walls of containers during egg laying they carry chemical on their cuticle to other breeding sites.
- WHOPES considered its use for dengue control.

Required manpower equipment:

i. Two spray men and a supervisor
ii. Compression backpack spray pump (one used for IRS)
iii. Pyriproxifen chemical
iv. Measuring cylinder
v. Sieve/strainer
vi. Face mask
vii. Hand gloves
viii. Bucket

Target areas for Pyriproxifen spray.

- Auto workshops with large quantity of tires and old vehicles which are very difficult and time consuming for disposal with evidence of ***Aedes*** breeding.
- PWD and DOR Stores with huge rain water collecting containers including tires, drums etc with evidence of ***Aedes*** breeding.
- Scrap collection sites with various rain water collecting containers for disposal with evidence of ***Aedes*** breeding.
- Industrial areas where large quantities of containers without lid are kept in open areas without cover.
- Do not spray in containers of drinking water.

When to do Pyriproxifen spraying?

- The spraying is done after 3-4 days of heavy rain in urban areas having above sited target areas and conditions.
- During the rainy season in high risk clusters having above target areas.
- During outbreaks in areas having above target areas.

Annexure 6: SOP for Display of Dengue IEC Poster and other materials

1. **Poster on prevention (Both in English and Dzongkha)**
    - To be displayed in strategic places of public congregations such as park, religious areas, Public transport booking areas, hospital areas etc.
    - The same messages should be imparted during any public and mass gathering awareness to public on dengue by concern health workers.
    - Do not misuse as it cost money
2. **Pamphlets (DF Sign and symptoms both in English and Dzongkha on a page)**
    - To be handed over by any health advocacy personnel to individuals who can read for further communication to his/her family and beyond.
    - Can be given to households by surveillance workers during surveys in connection to outbreaks.
    - Do not misuse as it cost money

3. **Pamphlet "Household Guide to Prevent Dengue Outbreaks (both in English and Dzongkha separate)**
    - Should be given by any health personnel during surveillance, mass gatherings, health meetings, and household visits etc. depending on their preferences in English or Dzongkha.
    - Given to School Health Teachers for distribution to students.
    - Do not misuse as it cost money

4. **DOs and DON'Ts for Dengue Prevention and Control (Dzongkha & English)**
    - To be pasted on the wall at the entrance of multi-storied buildings with many residents and line of residential areas like RBP, RBA, Dratsang, etc.
    - It is responsibilities of DMS and Malaria Technicians to get prior approval from Thromde office and information to building owner for pasting, coverage in all high risk areas under his/her areas.
    - Should be done during vector surveillance, IRS and net distribution and use inspections.
    - Do not misuse as it cost money

5. **Sticker for Insecticide Growth Regulator (IGR) use message.**
    - The stickers should be always taken when one is intended for vector surveillance and IGR introduction in breeding habitats.
    - To be used by vector surveillance team where every individuals should go with the IGR and Sticker.
    - Any trained personnel like Insect Collectors from VDCP, DMS, Malaria Technicians and Insect Collectors from hospitals and BHUs.
    - Any trained Sanitation Inspectors from Thromde office, Desup, BAFRA also can use.
    - Should be pasted on vertical front wall of the indoor water container into which IGR is introduced.
    - Mention date and your name with fine tip permanent marker pen.
    - Should not waste or misuse this paper as it cost money.

6. Media Flaring messages

- VDCP develop and send messages to HID for further modification and translation to other languages before onset of transmission season with duration of airing through BBS reflecting budget heads and amount available.
- The HID negotiate with BBS.