Operational plan for the prevention and control of Chikungunya and Dengue in the Republic of Mauritius.
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1 INTRODUCTION

Chikungunya and Dengue are both important viral diseases that are transmitted by day-biting mosquitoes. The principal vectors that transmit both diseases are mosquitoes of the genus Aedes. In Mauritius; it is *Aedes albopictus* which is the local vector.

Chikungunya was first described in Tanzania in 1952, whilst Dengue Fever and Dengue Haemorrhagic Fever (DF/DHF) were first recognized in the 1950s, during the dengue epidemics in Philippines and Thailand.

Chikungunya usually produces a transient illness often, clinically, confused with dengue. Symptoms include fever, headache, polyarthralgia, myalgia and rash. Although serious complications are uncommon, the arthralgia is incapacitating and may persist for months. It is a self limiting disease found in tropical and sub-tropical regions around the world, predominantly in urban and semi-urban areas.

Dengue usually causes two main types of clinical disease, namely dengue fever and dengue haemorrhagic fever. Dengue fever is usually associated with symptoms such as sudden onset of fever, headache, retro orbital pain, severe myalgia, arthralgia and in many cases body rashes may also appear.

Dengue haemorrhagic fever is associated, in addition to above, with bleeding manifestations. This condition may, in some cases, progress to a dangerous condition known as dengue shock syndrome. The latter is associated with a high mortality rate.

1.1 Causative agents

Chikungunya fever is caused by Chikungunya virus which is member of Alpha virus. There is one serotype of chikungunya so far. Immunity to infection is believed to be lifelong.
DF/DHF is caused by dengue virus which belongs to genus Flavivirus family Flaviviridae and includes serotypes 1, 2, 3 and 4 (Den-1, Den-2, Den-3 and Den-4). When a person has had classic dengue (i.e. infection by one serotype), a second infection later by another serotype increases the likelihood of suffering from DHF.

1.2 Vulnerability of Mauritius to Chikungunya and Dengue Fever

A preparedness plan for the prevention of control of chikungunya and dengue is critical for Mauritius because the island is vulnerable to outbreaks of both Chikungunya and Dengue fevers for the following reasons:

1. The vector mosquito, *Aedes albopictus*, which can transmit both viruses is present in Mauritius.
3. Once introduced in a country dengue is very difficult to eradicate and tend to recur periodically.
4. Chikungunya epidemic tend to recur in a population, if the percentage of infected population is less than 70%.
5. Mauritius has extensive travel and trade links to dengue and chikungunya endemic zones.
6. Shipment of used rubber tyres containing larvae infected with dengue virus has been established as a source in many countries.
7. There are many high risk environmental pockets in the island favoring spread of imported viruses of the diseases in the local mosquito population.

1.3 Goal and Objectives of the Preparedness Plan

The main goal of the preparedness plan is to reduce morbidity and mortality from chikungunya and dengue. Consequently, the focus during epidemic phase is containment and mitigation while during the quiescent interepidemic phase is early...
warning by surveillance and control. Hence the surveillance objectives will accordingly be different in each phase. The main goals are to:

1. Provide a step-by-step approach to the management of the epidemics by all stakeholders.

1.4 The target users of the preparedness plan

This document is intended to all those involved in planning and in responding to the threat that represent dengue and chikungunya and include: 1) policy and decision makers, 2) hospital Administrators, 3) Regional Health Directors, 4) Regional Public Health Superintendents, 5) Public Health Inspectors, 6) Surveillance Officers and 7) Other Stakeholders.

2 Epidemiology of Dengue and Chikungunya

The global prevalence of dengue has grown significantly in recent decades. The disease is now endemic in more than 100 countries in South-east Asia, Western Pacific, Eastern Mediterranean, Africa, the Americas. South-east Asia and Western Pacific are most seriously affected. Once introduced in a country, dengue fever has a tendency to cause regular epidemics. A period with no epidemic is known as the interepidemic period. Before 1970 only nine countries had experienced DHF epidemic, a number that had increased more than four-fold by 1995. Recently dengue epidemics have been reported from Australia, New Caledonia, Malaysia, Puerto Rico, Reunion and Seychelles. Some 2500 million people are now at risk from dengue. WHO currently estimates that there may be 50 million cases of dengue infection worldwide every year with around 24,000 deaths.

Chikungunya epidemics have been reported in both Asia and Africa for a long time. In 2006, an epidemic of chikungunya swept across the Indian Ocean islands of
Comoros, Reunion, Mauritius, Madagascar and Seychelles. Subsequent outbreaks, in 2007, affected India and other Asian countries.

For both Chikungunya and Dengue, the epidemiology of the disease may be divided into two marked phases as shown in Figure 1 below. The viruses cause overt outbreaks during the epidemic phase. Following the epidemic phase, the viruses go into a quiescent phase also referred to the interepidemic phase from where it erupts back into the epidemic phase depending on various environmental factors. The environmental factors triggering the viruses from one phase to another poorly understood but includes temperature, rainfall, vector population and the number of immune subjects in the population commonly referred to as herd immunity.

![Figure 1: cyclic nature of CHIK and DEN epidemics:](image)

The control Strategy is different for the epidemic and the interepidemic phase

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3 **CONTROL STRATEGY OF CHIKUNGUNYA AND DENGUE**

The control strategy for chikungunya and dengue depend on whether one is in the epidemic or the interepidemic phase. The activities for interepidemic period primarily focus on the control of the larval population of the vector since there are no infected adult mosquitoes. During the epidemic phase the focus is on the control of both larval and adult mosquito population since the adult mosquitoes are infective. It is to be noted
that, in the case of dengue, the virus can be transmitted to the eggs of the mosquito transovarially.

### 3.1 Triggers of outbreak investigation and control

Forecasting and recognizing an outbreak at the outset is important for reducing the full impacts of the outbreak. As shown in Figure 2, an early warning system (EWARS) must be used to detect triggers of an outbreak. The CDCU shall use the following trigger criteria for outbreak investigation and control:

1. Patient source data of the occurrence of more than one suspected case of Dengue or Chikungunya in a locality.
2. Entomological data from the Vector Biology and Control Division consisting of House Index (HI), and Breteau Index (BI) in the range of 2 – 5 during interepidemic period and/or lesser (preferably Zero (0) ) in epidemic situations – depending on locality surveyed. The BI is determined as per Annexes 15-16.
3. Laboratory data showing increased laboratory request or positivity rate.

Flow chart 1 depicts the decision point for switching from interepidemic to epidemic periods. The set of activities are described below:

**Figure 2: Early Warning System for detecting Chikungunya and Dengue Outbreaks**

- **Patient source**
  1. Cluster of fever, myalgia/arthralgia and rash
  2. Returning from endemic zones

- **Laboratory data**
  1. Increase in positivity
  2. Increased lab request

- **Entomological source**
  1. House index> as at page 10 above
  2. Breteau index 2-5

- **Information Collection**

- **Signal Identification**

- **Event verification and confirmation**

- **Mounting an outbreak response**

- **Is the baseline exceeded?**
  1. Conduct site visit
  2. Gather preliminary information
  3. Confirm with lab tests

See Figure 3 for details
4 OPERATIONAL PROCEDURE FOR MANAGING OUTBREAKS

The main goals during an outbreak are to manage the patients to reduce morbidity and mortality by prompt and efficient management of the cases. In addition one must also promptly quell the outbreak and protect the community at large. A set of tasks outlined in the ensuing sections are aimed at achieving these goals.

4.1 Objectives during outbreaks

The objectives during outbreaks are:

1. Planning and coordination
2. Outbreak investigation
3. Management of cases
4. Situation monitoring
5. Mosquito control
6. Social mobilization and Communication

4.2 Outbreak response Procedures

The algorithm for mounting an outbreak response shall be as shown in figure 3. The alert, early warning signals are received and verified by the regional response team. Next this information is fed to the CDCU. The CDU launches a series of actions to coordinate, direct, monitor the outbreaks and disseminate information to others. The CDCU activates the regional response team and the operation centre as well as informs all stakeholders. The regional response team then conducts the outbreaks investigation and initiates control and monitoring measures. The regional response team works in collaboration with all stakeholders namely, the vector biology and control division, health inspectorate and other ministries and department. Daily information from the regional response team is fed back to the CDU operation centre that disseminates the information to all parties concerned. Specific details and protocols for each of these steps are given in the ensuing sections.
4.3 Overall Planning and coordination for logistic of an outbreak

Since several stakeholders are involved in the outbreak phase, it is important to define the roles and functions of each stake holder, through planning and coordination, to ensure smooth supervision and minimize duplications, redundancy or contradictory activities. From the health sector the following main persons have clearly defined roles and responsibilities: (1) the director of CDCU, (2) the head of the rapid response team, (3) the Head of the Vector Biology and Control Division, (4) the CHI and the private medical practitioners and private health institution. From the non-health sector the following department and Ministries are involved: (1) the Ministry of Environment, Ministry of Local Government, (2) Ministry of Agro Industry, Food production, and Security, (3) Ministry of Education, (4) Ministry of Tourism, (5) Ministry of Women’s Right Child Development and Family Welfares and (6) representative of Private Sector such as Mauritius Chamber of Commerce and Industry, The Chamber of Agriculture, L’AHRIM and other stakeholders. The participation of the non health sectors will be ensured through the setting of a task force. The general roles of these persons are described.
Figure 3: Summary of Outbreaks procedures

Outbreaks signals from figure 2

Step I: see section 4.4.1
Signals of outbreaks received and verified by Regional Response Team

Step II
Alert CDCU

Step III CDCU: See section 4.3.1 Central
Roles: coordinate, direct, monitor and disseminate

Step III a: see section 4.3.15
Activates Regional Emergency control teams

Step III b: see sections 4.3.3 & 4.3.4 Vector biology & Control & health inspectorates

Step III c: see section 4.3.6 to 4.3.14
Environmental cleaning and awareness campaigns

Step III d: see sections 4.4.2
Notify and declares the outbreaks

Step III e: see section 4.3.16
Activates Operation Centre

Step III f: see section 4.3.1
Information dissemination

Step IV: See section 4.4
Outbreaks investigation

Step V: see sections 4.5 to 4.9.5
Outbreaks control and monitoring

Step v: see section 4.3.2
Feedback to CDCU
4.3.1 Roles of the CDCU

The roles of the Communicable Disease Control Unit (CDCU) are as follows:-

1. Coordinate and oversee all activities pertaining to outbreaks.
   a. Collect and compile data and submit reports
   b. Coordinate implementation of activities at regional levels through the Regional Public Health Superintendents
   c. Arrange for submission of daily technical report, for each region, to the DGHS, DHS and the epidemiologist.
   d. Set up an evaluation committee to examine all report
   e. Ensure procurement of all consumables and equipment, including chemicals.

2. Direct all operations for:
   a. Outbreak investigations to be undertaken by the regional rapid response team
   b. Outbreak controls
   c. Provide training to staff in all aspects of outbreak investigation and controls
   d. Provide training to staff involved in fogging activities.

3. Monitor the following activities
   a. Larviciding and Fogging operations effected in the regions
   b. The implementation of strategies for vector control and vector surveillance
   c. Analyze the trend of the disease in person, place and time
   d. Conduct additional epidemiological studies if necessary

4. Produce and disseminate information for action
   a. Guide the fogging and larviciding operation by directing them where the “hot zones” of the disease are.
   b. Produce and disseminate updated case definition and case management protocols to all RPHS
   c. Supervise the training of clinicians in case definition and management
   d. Publish weekly bulletin of the disease trend and operation conducted
   e. Maintain a list of dengue-endemic countries and supplies it to the SHI

4.3.2 The roles of the head of the regional rapid response

The roles of the head of the regional rapid response team are as follows:

1. To carry out field investigation of the outbreaks according to set procedures
2. To report daily to the central command unit at the CDCU
3. To construct an epidemic curve of the disease
4. To analyze the prevalence of the disease in different risk groups and geographic areas
5. To instruct the fogging team for fogging operations
6. To liaise with local government, municipality or town council for cleaning up campaign
4.3.3 The roles of the Vector Biology and Control Division

The roles of the Vector Biology and Control Division are as follows:

1. To map the density of the larvae, pupae and adult mosquitoes by the various indices listed under section 4.6.4
2. To send daily report of the vector densities to the Operations centre at the CDCU by fax and email
3. To participate in the multi-sectoral meeting at the regional level for fogging and larviciding operation

4.3.4 The roles of the Health Inspectorate Cadre

The roles of the Health Inspectorate Cadre are as follows:

1. Carry out environmental survey of breeding places of vectors
2. Undertake or assist in fever surveys
3. Assist in active and passive case detection and contact tracing (see section 4.6.1-4.6.2)
4. Send daily reports to the central unit at CDCU and Vector Biology and Control Division Liaise with Vector Biology and Control Division for undertaking larval and pupal survey
5. Direct the fogging and larviciding operations
6. Liaise with local government for environmental cleaning of “hot zones”
7. To give technical advice for sensitizing the community and distribute information pamphlets
8. Reinforce enforcement of appropriate legislation

4.3.5 Setting up of a Task Force for coordination of health and non-health sectors

A task force has been set up under the chairmanship of the Minister of Health & Quality of Life comprising of Senior Officials of other Ministries namely: the Ministry of Environment and NDU; Ministry of Local Government, Rodrigues and outer Islands; Ministry of Agro Industry, Food production and Security; Ministry of Education, Culture and Human Resources; Ministry of Tourism, Leisure and External Communications, Ministry of Social Security, Ministry of Women’s Right Child Development and Family Welfares, SMF and representatives of Private Sector such as Mauritius Chamber of Commerce and Industry, the Chamber of Agriculture, L’AHRIM and other stakeholders including private medical practitioners and private health institutions.
The roles of the task force are as follows:

1. Identify and monitor control measures to be implemented by each sector
2. Meet regularly during an outbreak to review progress and advise the government on the control measures to be taken.

4.3.6 The roles of the Ministry of Environment and NDU

The roles of the Ministry of environment are as follows:

1. Step up clean up campaigns by providing waste litter bins in high risk areas
2. Help in the cleaning up of bare lands and river banks where waste accumulate.
3. Provide additional workforce whenever necessary
4. Implement the MOHQL intersectoral environmental cleanliness project for reduction of mosquito borne diseases

4.3.7 The roles of the Ministry of Local Government, Rodrigues and Outer Islands

The roles of the Ministry of local government are as follows:

1. Opening of temporary dump sites for receiving green waste and old tyres
2. Issuing of exemption from waste carrier’s license for carrying waste
3. Regular inspection and monitoring of bare lands/wasteland
4. Wasteland management by legal actions against offenders.
5. General cleaning campaigns in collaboration with “forces vives”
6. Assist in larviciding and fogging in collaboration with Ministry of Health &QL
7. Implement the MOHQL intersectoral environmental cleanliness project for reduction of mosquito borne diseases

4.3.8 The roles of the Ministry of Agro Industry, Food Production and Security

1. Ensure elimination of breeding sites from irrigation areas.
2. Sensitize planters on proper water storage for irrigation
3. Supplement workforce for vector control activities.
4. Implement the MOHQL intersectoral environmental cleanliness project for reduction of mosquito borne diseases
4.3.9 The roles of Ministry of Tourism, Leisure and External Communications

1. Support the national awareness campaign
2. Support the vector control activities
3. Sensitize hotels for the need to identify cases within their premises.
4. Implement the MOHQL intersectoral environmental cleanliness project for reduction of mosquito borne diseases

4.3.10 The Roles of Ministry of Education, Culture and Human Resources

1. Support the awareness campaign
2. Ensure a clean environment within their premises
3. Implement the MOHQL intersectoral environmental cleanliness project for reduction of mosquito borne diseases.
4. Incorporate health promotion in the school curricula

4.3.11 The Roles of Ministry of Social Security/ Women’s Right Child Development and Family Welfare

1. Support awareness campaigns

4.3.12 The roles of SMF

1. Provision of additional work force for vector control activities

4.3.13 The roles of private health sector

1. Detect and report any suspected cases
2. Implement the Ministry of health protocol for case detection, surveillance and management

4.3.14 The roles of the Private Sector

1. Support the cleaning campaign
2. Support the awareness campaign
3. Empower workers for a clean working environment
4. Implement the MOHQL intersectoral environmental cleanliness project for reduction of mosquito borne diseases
4.3.15 Activation of emergency control teams

Emergency control teams have been set up in each Health Region. See section 6.2.3. During an outbreak, the director of CDCU will activate the rapid response team as follows:

1. Instruct by phone all RPHS to activate the regional team
2. Assist in logistic arrangement for full outbreak operation
3. Procuring any missing equipment and supplies
4. Arrange for additional staff or redeployment of staff
5. Consult and advise relevant RPHS on the extent of the operation

4.3.16 Activation of the operation centre

During an outbreak, operation centres should be set up at the central and regional levels. *At the central level*, the unit will be headed by the Regional Public Health Superintendent of CDCU and will be assisted by

i. One epidemiologist
ii. Three community physicians
iii. One Principal Health Inspector,
iv. One Senior Health Inspector,
v. Two Health Inspectors
vi. Three Officers of medical records department
vii. Three Officers of medical statistics
viii. Two administrative staff.

The functions of the Central Operations Centre will be as follows:

i. Maintain a data base of outbreak investigation on a daily basis
   a. Task to be performed by medical record and administrative staff
ii. Analyze the trend of the epidemic by locality
   a. Tasks to be performed by medical statistics unit, with the support of the Epidemiologist
iii. Disseminate the result daily to all interested parties
4.4 Outbreak investigation

Outbreak investigation will be carried by the regional response team. The composition of the team and their function of each member are as follows:

1. Epidemiologist or senior community physician from CDCU
   a. For roles of CDCU see section 4.3.1

2. RPHS
   a. Function: directs the operation. See section 4.3.2

3. Entomologist/ Representative of the Head, VBCD
   a. Function: map larval and pupal density. See section 4.3.3

4. PHI
   a. Function: carry out environmental investigation of risk factors.
   b. Assist in active and passive case detection and contact tracing
   c. See section 4.3.4

5. Community physician
   a. Apply case definition for classifying cases
   b. Collect clinical and demographic information
   c. Collect and ship specimens for laboratory confirmation of etiologic agents
   d. Analyze the data for person, place and time

6. Public health nurse
   a. Assist the community physician in the above task

7. Laboratory representative
   a. Advises on the collection, storage and transport of specimens

The outbreak investigation team will be responsible for the logistic and operational aspects of the investigation. They will use the 8- components of outbreak investigation protocol of the CDCU; namely 1) document the existence of the epidemic, 2) confirm the diagnosis, 3) define a case and count cases, 4) orient the data in person, place and time, 5) determine who is at risk of being ill, 6) develop a hypothesis to explain how exposure has led to disease, 6) execute control measures and, 8) prepare a written report.
4.4.1 Establishing the outbreaks

An outbreak is confirmed by showing that the number of positive cases is above the expected baseline number. This will be done through the following steps:

1. Clinically confirming the suspected diagnosis by the application of the standard case definition
2. Laboratory confirmation of the index and linked cases

4.4.2 Notification of outbreaks

An outbreak is declared when the two criteria of section 4.4.1 are fulfilled. If only criterion 1 is fulfilled, the event is classified as potential outbreak.

It is incumbent of the CDCU in collaboration with the RPHS and the RHD to declare confirmation of an outbreak by:

1. Informing the SCE, DGHS and the DHS
2. The PS/PAS
3. The press attaché
4. Members of the regional outbreak rapid response team

4.4.3 Orienting the data in person, place and time

Under the outbreak situation, it is essential to orient the data with respect to person, place and time. The tasks of the emergency control team shall be:

2. Analyze the distribution of the cases in persons of different age group, gender, exposure category and geographical distribution.
3. Use table 1 of Annex 10 to summarize the data
4. Draw a hand map of the distribution of the cases

4.5 Management of cases

Proper patient management is critical for reduction of case fatality and limiting the spread of the infected mosquito in the community at large. As detailed in Annexes 2, 4, 6 and 7, the strategy for management shall be:

1. Isolation of cases
2. Administering clinical management

4.5.1 Isolation of cases

1. Patients suffering from dengue fever and receiving treatment to be confined in a health institution
2. Additional beds are to be provided for in hospitals
3. Mosquito nets to be made available in all hospitals
4. Community to be sensitized in the need to restrain themselves from travelling to high risk zones and to visit dengue fever affected patients

4.5.2 Clinical Management of Suspected cases

1. Case definition of the diseases given in Annexes 1 and 3 be circulated to all Medical Practitioners
2. Guidelines on Clinical Management of suspected or confirmed cases of Chikungunya or dengue are given in Annexes 2-4 must be distributed to all Medical Practitioners
3. All medical practitioners (physicians) must be made fully aware of the case definition through the web site or by mailing.
4. All medical practitioners should be fully aware of the guidelines on clinical management through the web site or by mailing

A strategy of triage must be followed to reduce the surge capacity on the hospitals and reduce morbidity and mortality of the patient.

4.6 Situation Monitoring

The CDCU will be responsible for situation monitoring by both active case detection and passive surveillance from sentinel sites.

4.6.1 Active case detection

Whenever an index case is detected, active case search will be undertaken for all contacts of the case. The following procedure will be used:

1. Interview the index case to enumerate a list of immediate contact
2. Draw a map of the location of all contacts
3. Trace the contacts using the above list
4. Interview the contacts to get epidemiological data using the contact investigation form in Annex 9.
5. Collect acute blood sample as per Annex 12
6. Observe the contacts for 7 days

4.6.2 Passive Case detection
Passive surveillance for case detection must be conducted by using sentinel sites comprised of:
1. Government Hospital and clinics
2. Private clinics
3. Private practitioners
The procedure for passive surveillance shall be as follows:
1. The sentinel sites should be chosen to represent all the health regions
2. Focal points for all sentinel sites should be identified for each health region
3. The focal point should be supplied with documentation and complete instruction on case definition and case investigation form including laboratory collection
4. Weekly communication should be maintained with the focal points

4.6.3 Laboratory Surveillance
Virology Unit of the Central Health Laboratory will be responsible for virological surveillance. The main roles of the virology unit will be as follows:
   i. To confirm the first and initial suspected cases by the most rapid test of PCR and ELISA
   ii. To perform virus isolation for Chikungunya
   iii. Perform PCR for DEN and CHIK on mosquito population
   iv. Submit daily report to CDCU in a standard format by fax and email
   v. To provide magnitude of the disease and the viral serotypes as the epidemic progresses
   vi. Participate in planning meeting for control of outbreak control
4.6.4 Vector Surveillance

The unit responsible for monitoring vector population density is the Vector Biology and Control Division. The roles of this Division in outbreak control are:

1. To conduct surveys to determine larval and adult density of the vector from the area of the index case and all houses within 500 meters radius of the index case house within 24 hour of notification of the first case.
2. Calculate the density by the following indices: See Annexes 15-16 for details
   a. House index (HI)
   b. Container index (CI)
   c. Breteau index (BI)
   d. Pupal index
3. To map the vector density of known high risk dengue and chikungunya prone areas
4. To submit a daily report on Vector population density to the operation center CDCU and the relevant regional health centre

4.7 Mosquito control

4.8 Adult control by space spray

For the control of adult vector population the following procedures are used:

1. Space spray operations (thermal fogging or ULV aerosols) must be carried out as soon as possible following the notification of the index case by the CDCU operation team or the regional team.
2. Spraying must be done within a radius of 300 meters of the case house
3. The protocols for space spraying are given in Annexes 17-18.
4.8.1 Larval source reduction

The following procedures will be used for larviciding:

1. All houses within 500 meter radius of the case house must be totally surveyed for *Aedes* breeding grounds by the PHI.

2. Larval surveys must be carried out within 24 hours of notification of the first case from an outbreak by Vector Biology and Control Division.

3. The protocols to be used are given in Annexes 19-21.

4.8.2 Reporting of mosquito control activities

During the epidemic period, the following daily reports must be submitted to the Ministry:

1. Advance programme of work for larviciding for the week as per Annex 19.

2. Advance programme of work for fogging for one day as per Annex 20.


5. Advance programme for Entomological survey as per Annex 23.


7. Daily application report.

4.9 Social mobilization and Communication

Social mobilization or community participation is a key component for sustainable prevention and control of mosquito-borne diseases. Community participation includes mobilization of civil society groups and inter-sectoral groups in health education, personal protection and law enforcement. The target is to deliver the messages of environmental management for:

a) Container management to reduce the sources of mosquito breeding habitats

b) Elimination or alteration of breeding sites including rubbish disposal, tyres etc.

c) Proper management of water storage device

d) Environmental protection through larviciding and use of repellents etc.
The WHO COMBI model for social mobilization and communication must be used to deliver the above messages and consists of the following components

4.9.1 Public relations/Advocacy/Administrative Mobilization

This component should target healthy behavior on the business sector’s and administrative programme management’s agenda via mass media such as news coverage, talk shows, soap operas, celebrity spoke persons etc. Active participation of the following stakeholders should be included in the campaign against dengue:-

4.9.2 Sustained Appropriate Advertising and Promotion

The approach here should be massive, repetitive, intense and persistent advertising via radio, television, newspapers and other available media to engage the people in recommended behavior change and the health cost of not changing the behavior. An effective media program should be developed and implemented in order to create awareness of dengue, proper disposal of refuse and waste and source reduction measures.

4.9.3 Community mobilization

The approach here is to use participatory research, group meetings, partnership sessions, school activities, community drama and home visit to distribute leaflets, posters, pamphlets and video for personal protection
4.9.4 Law enforcement

Legislation is necessary to ensure full compliance of the public with the outbreak control measures within the framework of social mobilization. The Public Health Act GN 30 of 2006 must be enforced for the abatement of water containing or likely to contain mosquito larvae.

A notice under section 32 (A) (4) (a) is served upon the occupier requiring him for forthwith remove or abate the collection or accumulation of water within such delay as may be specified. In the case of failure to comply with the above notice, the occupier is fined according to section 32 A (5) (a) and the work executed by the Sanitary Authority, 32 A 4 (b).

4.9.5 Communication

In addition to the above approaches it is also to provide regular press briefing and press communiqué on the situation of the outbreaks.

5 Surveillance tasks for interepidemic period

5.1 Objectives during interepidemic period

The objectives during the quiescent interepidemic period are:

1. Capacity building and preparedness
2. Planning and coordination
3. Situation monitoring
4. Mosquito control
5. Social mobilization and communication

5.2 Capacity building and Preparedness

The interepidemic phase provides an opportunity to build the capacity in preparedness of the CDCU for responding to outbreaks of day-biting mosquito-borne diseases.
5.3 Planning and coordination for logistic for interepidemic period

The interepidemic period is an excellent opportunity to foster and consolidate coordination. Since several stake holders are involved in the control of day-biting vector diseases, it is important to define the role and function of each stake holder through planning and coordination to ensure smooth surveillance and minimize duplication, redundancy or contradictory activities. In particular the following four main persons have clearly defined roles and responsibilities: (1) the director of CDCU, (2) the head of the rapid response team, (3) the Head of the Vector Biology and Control Division, and (4) the CHI. The general roles of these persons are described.

5.3.1 Roles of the CDCU

The roles of the Communicable Disease Control Unit (CDCU) are as follows:-

1. Coordinate and oversee all activities pertaining to outbreaks prevention
   a. Collect and compile data and submit reports
   b. Coordinate all RPHS
   c. Arrange for submission of weekly technical report to the DGHS, DHS and the epidemiologist for each region under the responsibility of the RPHS
   d. Set up an evaluation committee to examine all reports

2. Direct all operation for
   a. Environmental monitoring of mosquito-prone areas

3. Monitor the following activities
   a. Larviciding and Fogging operations effected in the region
   b. The implementation of strategies for vector control and vector surveillance
   c. Analyze the trend of the mosquito population place and time
   d. Conduct additional epidemiological studies if necessary

4. Produce and disseminate information for action
   a. Guide the fogging and larviciding operation by directing them where the “hot zones” of the disease are
   b. Publish weekly bulletin of the disease trend and operation conducted.

5.3.2 The roles of the head of the Regional Rapid Response Team

The roles of the head of the regional rapid response team are as follows:

1. Carry out the field investigation of the “hot zones” according to set procedures
2. To report weekly to the central command unit at the CDCU
3. To construct a map of hot spots of mosquito breeding sites
4. To analyze the prevalence of the mosquito population in different geographic areas
5. To instruct the fogging and larviciding teams for operation of hot spots
6. To liaise with local government, municipality or town council for cleaning up campaign

5.3.3 The roles of the Vector Biology and Control Division

The roles of the Vector Biology and Control Division are as follows:

1. To map the density of the larvae, pupae and adult mosquitoes by the various indices listed under Annexes 13-16.
2. Set up of ovitraps around airports and seaport terminals
3. To send daily report of vector densities to the Operation centre at the CDCU by fax and email
4. To participate in the multi-sectoral meeting at the regional level for fogging and larviciding operation

5.3.4 The roles of the Health Inspectorate Cadre

The roles of the Health Inspectorate Cadre are as follows:

1. Carry out environmental survey of breeding places of vectors from hot zones
2. Support survey of adult and larval vectors
3. Inspect port areas and warehouses or supply depots of imported tyres
4. Quarantine infected tyres with no fumigation and undertake methyl bromide fumigation
5. Regularly undertake larviciding with temephos or other chemical/biological agents at the airport and seaports.
6. Undertake or assist in fever survey on a regular basis
7. Assist in active and passive case detection and contact tracing (see section 4.6)
8. Send weekly reports to the central unit at CDCU and vector biology unit
9. Liaise with Vector Biology and Control Division for undertaking larval and pupal survey
10. Direct the fogging and larviciding operation
11. Liaise with local government for environmental cleaning of “hot zones”
12. To give technical advice for sensitizing the community and distribute information pamphlets
13. In consultation with heads of CDCU and Vector Biology and Control Division, issue warning and fine for persistent offenders.
5.3.5 Setting up of a Task Force for coordination of health and non-health sectors

A task force has been set up under the chairmanship of the Minister of Health & Quality of Life comprising of Senior Officials of other Ministries namely: the Ministry of Environment and NDU; Ministry of Local Government, Rodrigues and outer Islands; Ministry of Agro Industry, Food production and Security; Ministry of Education, Culture and Human Resources; Ministry of Tourism, Leisure and External Communications, Ministry of Social Security, National Solidarity and Senior Citizen Welfare and Reformed Institutions, Ministry of Women’s Right Child Development and Family Welfare, Special Mobile Force (SMF) and representatives of Private Sector such as Mauritius Chamber of Commerce and Industry, L’AHIRM and other stakeholders including private medical practitioners and private health institutions.

During the interepidemic period the roles of the task force are as follows:

1. Identify and monitor control measures to be implemented by each sector
2. Meet regularly review progress and advise the government on the control measures to be taken for reduction of mosquito population.

5.3.6 The roles of the Ministry of Environment and NDU

The roles of the Ministry of environment are as follows:

1. Step up clean up campaigns by providing waste litter bins in high risk areas
2. Help in the cleaning up of bare lands and river banks where waste accumulate.
3. Provide additional workforce whenever necessary
4. Carry out health impact assessment (HIA) of development projects related to from planning, to implementation and decommissioning to ensure source reduction of mosquito vectors.
5. Implement the MOHQL intersectoral environmental cleanliness project for reduction of mosquito borne diseases
5.3.7 The roles of the Ministry of Local Government, Rodrigues and Outer Islands

The roles of the Ministry of local government are as follows:
1. Opening of temporary dump sites for receiving green waste and old tyres
2. Issuing of exemption from waste carrier’s license for carrying waste
3. Regular inspection and monitoring of bare lands/wasteland
4. Wasteland management by legal actions against offenders.
5. General cleaning campaigns in collaboration with “forces vives”
6. Carrying larviciding and fogging in collaboration with Ministry of Health &QL
7. Implement the MOHQL intersectoral environmental cleanliness project for reduction of mosquito borne diseases

5.3.8 The roles of the Ministry of Agro Industry, Food Production and Security

1. Ensure elimination of breeding sites from irrigation areas.
2. Sensitize planters on proper water storage for irrigation
3. Supplement workforce for vector control activities.
4. Implement the MOHQL intersectoral environmental cleanliness project for reduction of mosquito borne diseases

5.3.9 The roles of Ministry of Tourism, Leisure and External Communications

1. Support the national awareness campaign
2. Support the vector control activities
3. Sensitize hotels for the need to identify and report cases within their premises
5. Implement the MOHQL intersectoral environmental cleanliness project for reduction of mosquito borne diseases

5.3.10 Roles of Ministry of Education, Culture and Human Resources

1. Support the awareness campaign
2. Ensure a clean environment within their premises
3. Implement the MOHQL intersectoral environmental cleanliness project for reduction of mosquito borne diseases
5.3.11 The Roles of Ministries of Social Security, Social Security, National Solidarity and Senior Citizens Welfare & Reform Institutions /Women’s Right Child Development and Family Welfare

1. Support awareness campaigns

5.3.12 The roles of SMF

1. Provision of additional work force for vector control activities

5.3.13 The roles of private health sector

1. Detect and report any suspected cases
2. Implement the Ministry of health protocol for case detection, surveillance and management

5.3.14 The roles of the Business Sector

1. Support the cleaning campaign
2. Support the awareness campaign
3. Empower workers for a clean working environment
4. Implement the MOHQL intersectoral environmental cleanliness project for reduction of mosquito borne diseases

5.3.15 Constitution of regional rapid response teams

Rapid response teams should be set up in each health region. The rapid response team will consist of:

i. One epidemiologist/community physician
ii. one public health nurse
iii. one Principal Health Inspector,
iv. one Senior Health Inspector,
v. one representative from the Vector Biology and Control Division
vi. One laboratory representative from the Central Health Laboratory
vii. One data manager/administrative support staff
During the interepidemic period the rapid response team as follows:

1. Review all protocols and SOP for outbreak controls and prevention in logistic
2. Undertake outbreak training modules and conduct regular exercises
3. Enlist and stock-PILE the necessary supplies and equipment for outbreaks investigation and control

**5.3.16 Constitution of operation centres**

Operation centres should be designated and set up at the central and regional levels. The operation centres shall be equipped with: Communication devices including fax, email, computers, printers and telephones

**5.4 Situation Monitoring**

The CDCU will be responsible for situation monitoring that shall consist of both active case detection and passive surveillance from sentinel sites.

**5.4.1 Active case detection at point of entry**

Health Inspectorate Division at points of entry to put under surveillance all passengers arriving from list of chikungunya or dengue endemic countries maintained by CDCU.

1) A list of such passengers to be submitted to all health offices and CDCU
2) Visiting of incoming passengers will be done by HSO according to protocol Annexed.
3) Suspected cases will be requested to attend nearest health institution. RPHS of region informed
4) Regionalized training for HSO
5) Control to be tightened at both the airport and the harbour
6) A list of such passengers is to be submitted to the Ministry of Health and Quality of Life and to Vector Disease section for monitoring surveillance
7) Contact tracing will be done by Health Inspectors. Prompt actions for isolation and management will be taken in case of appearance of any chikungunya and dengue–like symptoms.
5.4.2 Active case detection in the community
Whenever an index case is detected, active case search will be undertaken for all contacts of the case. The following procedure will be used:
1. Interview the index case to enumerate a list of immediate contacts
2. Tract the contacts using the list
3. Observe the contacts for 7 days

5.4.3 Passive Case detection in the community
The sentinel sites for case detection will be comprised of:
1. Government Hospital and clinics
2. Private clinics
3. Private practitioners

5.4.4 Laboratory Surveillance
Virology Unit of the Central Health Laboratory will be responsible for virological surveillance. The main roles of the virology unit will be as follows:
1. To confirm the first and initial suspected cases by the most rapid test of PCR and ELISA
2. To perform virus isolation for Chikungunya
3. Perform PCR for DEN and CHIK on mosquito population
4. Submit daily report to CDCU in a standard format by fax and email
5. To provide magnitude of the disease and the viral serotypes as the epidemic progresses
6. Participate in planning meeting for control of outbreak control

5.4.5 Vector Surveillance
The unit responsible for vector population density is the Vector Biology and Control Division. The roles of this unit in outbreak control are:
1. To undertake survey of larval/pupal and adult density of the vector from the area of the index case and all houses within 500 meters radius of the index case house within 24 hour of notification of the first case.

2. Calculate the density by the following indices: See Annexes 15-16 for details
   a. House index (HI)
   b. Container index (CI)
   c. Breteau index (BI)
   d. Pupal index (PI)

3. To map the vector density of known high risk dengue and chikungunya prone areas

4. To submit a weekly report on vector population density to the operation center CDCU and the relevant regional health centre

5.5 Mosquito control

5.6 Adult control by space spray

   For the control of adult vector population the following procedures are used:
   1. Space spray operations (thermal fogging or ULV aerosols) must be carried out immediately following the notification of the index case by the CDCU operation team
   2. Spraying must be done within a radius of 300 meters of the case house
   3. Spraying should also be used at the terminals of airports, seaport and deposit of tyres
   4. The protocols for space spraying are given in Annex 17

5.6.1 Larval source reduction

   The following procedures will be used for larviciding:
   1. All houses within 500 meter radius of the case house must be totally surveyed for Aedes breeding grounds by the PHI
   2. Larval surveys must be carried out within 24 hours of notification of the first case from an outbreak by the Vector Biology and Control Division
   3. The protocol to be used are given in Annexes 14-18
5.6.2 Reporting of mosquito control activities

Reports are submitted to the Ministry on a daily basis

1. Advance programme of work for larviciding for the week (Specimen per Annex 21)
2. Advance programme of work for fogging for one day (Specimen per Annex 22)
3. Advance programme for Entomological survey (Specimen per Annex 14)
4. Daily report on larviciding (Specimen per Annex 21)
5. Daily report on fogging (Specimen per Annex 22)
6. Daily Entomological report (Specimen per Annex 24)

5.7 Social mobilization and Communication

Social mobilization or community participation is a key component for sustainable prevention and control of mosquito-borne diseases. Community participation includes mobilization of civil society groups and inter-sectoral groups in health education, personal protection and law enforcement. The target is to deliver the messages of environmental management for:

a) Container management to reduce the sources of mosquito breeding habitats
b) Elimination or alteration of breeding sites including rubbish disposal, tyres etc
c) Proper management of water storage device
d) Environmental protection through larviciding and use of repellents etc.

The WHO COMBI model for social mobilization and communication must be used to deliver the above messages and consists of the following components

5.7.1 Public relations/Advocacy/Administrative Mobilization

This component should target healthy behavior on the business sector’s and administrative programme management’s agenda via mass media such as news coverage, talk shows, soap operas, celebrity spoke persons etc. Active participation of the following Ministries should be included in the campaign against dengue: 1) Ministry of Local Government, 2) all the Local Authorities, 3) Ministry of Environment, 4) Ministry of Youth and Sport, 5) Ministry of Tourism, Ministry of Agro Industry, 6) L’AHRIM, 7) The Mauritius Chamber of Commerce and Industry, and, 9) the Chamber of Agriculture
and other stakeholders including private medical practitioners and private health institutions.

5.7.2 Sustained Appropriate Advertising and Promotion
The approach here should be massive, repetitive, intense and persistent advertising via radio, television, newspapers and other available media to engage the people in recommended behavior change and the health cost of not changing the behavior. An effective media program should be developed and implemented in order to create awareness of dengue, proper disposal of refuse and waste and source reduction measures.

5.7.3 Community mobilization
The approach here is to use participatory research, group meetings, partnership sessions, school activities, community drama and home visit to distribute leaflets, posters, pamphlets and video for personal protection.

5.7.4 Law enforcement
Legislation is necessary to ensure full compliance of the public with the outbreak control measures within the framework of social mobilization. The Public Health Act GN 30 of 2006 must be enforced for the abatement of water containing or likely to contain mosquito larvae.

A notice under section 32 (A) (4) (a) is served upon the occupier requiring him for forthwith remove or abate the collection or accumulation of water within such delay as may be specified. In the case of failure to comply with the above notice, the occupier is fined according to section 32 A (5) (a) and the work executed by the Sanitary Authority, 32 A 4 (b).

5.7.5 Communication
In addition to the above approaches it is also to provide regular press briefing and press communiqué on the situation of the outbreaks or any imminent outbreaks.
6 LIST OF ANNEXES

6.1 Annex 1: Case definition of Chikungunya

<table>
<thead>
<tr>
<th>Chikungunya</th>
<th>Suspect Chikungunya if</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Incubation period:</td>
<td>1. High grade persistent fever (&gt;38.5°C) (Note: Fever may be modified by prior use of antipyretics)</td>
</tr>
<tr>
<td>2. 3-12 days Onset of symptoms Usually 4-7 days after mosquito bite</td>
<td>2. Arthritis – usually severe and several joints A skin rash – may be present in 35% in cases (When notifying suspected case state whether rash is present or not)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Notification</th>
<th>Virological Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All suspected cases should be notified to the nearest health office (Do not wait for virological studies)</td>
<td>Send: 5ml of blood – Collected in sterile plain tube to virology lab at first visit:</td>
</tr>
<tr>
<td>2. Patients details – Mandatory age, sex,</td>
<td>(i) In all sporadic cases; and</td>
</tr>
<tr>
<td></td>
<td>(ii) In only random selected cases during an epidemic</td>
</tr>
</tbody>
</table>
6.2 Annex 2: Management of Chikungunya

6.3

- Majority will be treated as outpatients

  Admission necessary for:
  (i) Critically ill patients
  (ii) Severe dehydration
  (iii) Associated complications i.e. major organ involvement:
    - Renal
    - Neurological
    - Cardiac
    - Pulmonary etc
  (iv) Gastrointestinal complications i.e. suspected perforation/bleeding
  (v) Pregnancy – all pregnant females with fever ≥ 39°C should be referred for specialist assessment or admitted as appropriate
  (vi) All neonates
Annex 3: Treatment of Chikungunya

<table>
<thead>
<tr>
<th>GENERAL MEASURES:</th>
<th>ANTI PYRETICS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ensure adequate hydration</td>
<td>1. Paracetamol in all age groups</td>
</tr>
<tr>
<td>2. Period of rest in selected cases</td>
<td>2. Dose adult 1 gm orally and rectally 4-6 hours (up to a maximum of 4 gm/24 hourly)</td>
</tr>
<tr>
<td>3. Give antibiotics if there is secondary infection</td>
<td>3. Children (i) 15mg/kg/6 hourly to a maximum 60mg/kg/24hourly</td>
</tr>
<tr>
<td>Note: Breast-feeding is not contraindicated</td>
<td>4. Note: 5ml syrup=120mg paracetamol</td>
</tr>
<tr>
<td></td>
<td>Paediatric suppositories = 15 mg</td>
</tr>
<tr>
<td></td>
<td>or 300 mg</td>
</tr>
<tr>
<td></td>
<td>(Treatment up to one week)</td>
</tr>
</tbody>
</table>

**ARTHRITIS**

1. Paracetamol may be adequate in mild cases
2. NSAIDS – small doses may be adequate
3. Diclofenac 50 mg BD instead of 100 mg doses
4. Children >6months ibuprofen syrup may be given in divided doses 5mg/kg 8 hours maximum 20 mg/kg/24hr (5ml syrup equivalent to 100 mg 1 ibuprofen)
### 6.4 Annex 4: further Chikungunya treatment for adults only

<table>
<thead>
<tr>
<th>For persisting and disabling arthritis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Consider short course of opiate analgesics i.e. Codeine phosphate 30-60 mg 8 hourly</td>
</tr>
<tr>
<td>2. Tramadol preparations 50 mg up to 8 hourly</td>
</tr>
<tr>
<td>3. Hydroxychloroquine 200-400 mg daily for 2-4 weeks</td>
</tr>
<tr>
<td>4. Refer for specialist opinion and treatment for resistant arthritis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NSAIDS – Contra Indications/Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toxic to G.I tract and other organs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AVOID:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Patients with known or suspected peptic ulcer disease</td>
</tr>
<tr>
<td>2. Patients with chronic kidney disease, chronic liver diseases and congestive</td>
</tr>
<tr>
<td>3. 3rd trimester of pregnancy</td>
</tr>
<tr>
<td>4. Multiple NSAIDS preparations at the same time</td>
</tr>
<tr>
<td>5. Combination with steroids, aspiring or anticoagulant</td>
</tr>
</tbody>
</table>

**NOTE:** Non-oral routes of administration do not prevent complications.
G.I side effects may be reduced by combination with a Proton Pump Inhibitor i.e. Omeprazole 20-40mg daily or equivalent

**NOTE:** AVOID USE OF STEROIDS IN ACUTE PHASE OF ILLNESS
6.5 Annex 5: Case Definition of Dengue Fever (DF)

An acute febrile illness (temperature 39-40 C) of 2 – 7 days duration with 2 or more of the following manifestations:

1. Headache
2. Retro-orbital pain
3. Myalgia
4. Arthralgia
5. Rash
6. Haemorrhagic manifestations
7. Leucopenia / thrombocytopenia (platelets less than 100,000).

Case classification

**Suspected case:** A case compatible with the clinical description

**Confirmed case:** A case compatible with the clinical description that is laboratory-confirmed

Laboratory criteria for diagnosis

1. Demonstration of IgG and IgM antibody titres by the Rapid Test
2. Demonstration of Dengue antibodies in serum samples by ELISA
3. Detection of viral genomic sequences in serum or CSF samples by PCR
6.6  **Annex 6: Management Protocol for Paediatrics Dengue Fever**

6.6.1  **Febrile phase: 2 to 7 days**

Treatment is symptomatic and supportive.

Paracetamol in a dose of 60 mg / Kg / day in not more than 4 doses per day

**DO NOT GIVE ASPIRIN OR BRUFEN**

Antibiotics are not recommended.

Oral fluids and electrolyte therapy is recommended for patients with any sign of dehydration.

6.6.2A  **A febrile phase: (Critical Stage) 2 to 3 days after febrile phase.**

Management is same as during febrile phase but needs careful monitoring of:

1. Complications e.g. abdominal pain, passage of black stool, bleeding into skin or from the nose or gums, sweating and cold skin are all danger signs. (These cases need admission to hospital)
2. Platelets counts
3. Haemotocrit values

6.6.3  **Convalescence phase: 7 to 10 days after critical stage**

1. Further improvement in general condition with return of appetite.
2. Bradycardia
3. Confluent petechial rash with white centre / itching
4. Weakness lasting 1 to 2 weeks

**Management of this phase:** No special advice. Normal diet encouraged.
6.7    Annex 7. Proposed Management Protocol For All Dengue Conditions

6.7.1 Chart 1: DF/DHF Management Charts Dengue Fever

<table>
<thead>
<tr>
<th>Febrile phase</th>
<th>Manifestation</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration 2 – 7 days</td>
<td>- Temp 39-40°C - Headache - Retro-orbital pain - Muscle pain - Joint/bone pain - Flushed face - Rash - Skin haemorrhage, bleeding from nose, gums - Positive tourniquet test - Liver often enlarged - Leucopenia - Platelet/haematocrit normal</td>
<td>- Bed rest - Keep the body temperature below 39º - Paracetamol - Yes* - No steroids no NSAIDS - No antibiotics - Fluid Therapy - Follow-up for any change in platelet/haematocrit daily - Oral fluids ORS ± iv fluids</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Afebrile phase (Critical)</th>
<th>Manifestation</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration – 2 – 3 days after febrile stage</td>
<td>- Same as during febrile phase - Improvement in general condition - Platelet/haematocrit normal - Appetite rapidly regained</td>
<td>- Bed rest - Check platelets/haematocrit daily - Fluid Therapy as required (Critical)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Convalescence Phase</th>
<th>Manifestation</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration – 7 – 10 days after critical stage</td>
<td>- Further improvement in general condition and return of appetite - Bradycardia - Confluent petechial rash with white centre/itching - Weakness for 1 or 2 weeks</td>
<td>- No special advice - No restrictions - Normal diet</td>
</tr>
</tbody>
</table>

*Platelet Transfusion recommended in patients having thrombocytopenia with significant bleeding.

- Platelet transfusion to be considered in patients with platelet <10,000 even in absence of obvious bleeding.

6.7.2 Chart 2: Dengue Haemorrhagic Fever (Grades I and II)
<table>
<thead>
<tr>
<th>Afebrile Phase (Critical stage)</th>
<th>Manifestation</th>
<th>Management</th>
</tr>
</thead>
</table>
| Duration 2 – 3 days             | Same as during febrile phase. - Thrombocytopenia and rise in haematocrit level (more than 20%) | - ORS  
- Check platelets/haematocrit. If haematocrit is more than 20%:  
- Initiate IV therapy (5% D/NS) 6 ml/kg/hr (for 3 hours) or Normal Saline or R/L  
- Check haematocrit/vital signs/urine output after 3 hours and in case of improvement  
- Reduce IV therapy to 3ml./kg/hr (for 3 hours)  
- In case of further improvement continue IV therapy at 3 ml/kg/hr (6 – 12 hours) and then discontinue IV therapy.  
- In case of no improvement increase IV therapy to 10 ml./kg/hr (for 1 hr). In case of improvement now, reduce the volume of IV from 10 ml/kg/hr to 6 ml/kg/hr and further to 3 ml/kg/hr accordingly. |

<table>
<thead>
<tr>
<th>Convalescence Phase</th>
<th>Manifestation</th>
<th>Management</th>
</tr>
</thead>
</table>
| Duration 2-3 days after critical stage | Further improvement in general condition and return of appetite  
- Bradycardia  
- Confluent petechial rash with white centre/itching  
- Asthenia and depression (Sometimes for a few weeks, common in adults) | - Normal diet  
- No need for any medication |
Figure 1: Volume Replacement Flow Chart for Patients with DHF Grades I and II

Haemorrhagic (bleeding) tendencies
Thrombocytopenia,
Haematocrit rise. Pulse pressure is

Initiate IV Therapy 6m1/kg/hr
Crystalloid solution for 1-2 hours

Improvement

Reduce IV 3ml/kg/h
Crystalloid duration 6-12 hours

Further Improvement

Discontinue M after 24 hours

No Improvement

Increase IV 10ml/kg/h
crystalloid duration 2 hours

Improvement

Reduce IV to
6ml/kg/h
Crystalloid with further reduction to 3ml/kg/h. discontinue after 24-48 hrs

Haematocrit Rises

IV Colloid (Dextran (40) 10ml/kg/hr
duration 1 hour

Improvement

No Improvement

Unstable Vital Signs

Haematocrit Falls

Blood transfusion 10ml/kg/hr
duration 1 hour

IV therapy by crystalloid successively reduce the flow from 10 to 6,6 to 3ml/kg/hr. Discontinue after 24-48 hours
<table>
<thead>
<tr>
<th>Afebrile Phase</th>
<th>Manifestation</th>
<th>Management</th>
</tr>
</thead>
</table>
| Duration two days after febrile stage | In addition to the manifestations of DHF Grade II: Circulatory failure manifested by rapid and weak pulse, narrowing of pulse pressure (20 mmHg or less) or hypotension with the presence of cold clammy skin and restlessness - Capillary relief time more than two seconds | - Check haematocrit/platelet  
- Initiate IV therapy (5% D/NSS) 10 ml/kg/h (NS or R/L)  
- Check haematocrit, vital signs, urine output every hour  
- If patient improves IV fluids should be reduced every hour from 10 to 6, and from 6 to 3 ml/kg/h which can be maintained up to 24 to 48 hours  
- If patient has already received one hour treatment of 20 ml/kg/hr or IV fluids and vital signs are not stable, check haematocrit again and  
  - If haematocrit is increasing, change IV fluids to colloidal solution preferably Dextran or Plasma at 10 mg/kg/h every hr.  
  If haematocrit is decreasing from initial value, give fresh whole blood transfusion, 10 ml/kg/h and continue fluid therapy at 10 ml/kg/h and reducing it stepwise bring down the volume to 3 ml/kg/h and maintain it up to 24-48 hours.  
  - Initiate IV therapy (5% D/NSS) 20 ml/kg as a bolus one or two times  
  - Oxygen therapy should be given to all patients  
  - In case of continued shock, colloidal fluids (Dextran or Plasma) should be given at 10 – 20 ml/kg/hr |
<table>
<thead>
<tr>
<th>Afebrile phase</th>
<th>Manifestation</th>
<th>Management</th>
</tr>
</thead>
</table>
|                | Profound shock with undetectable pulse and blood pressure | - if shock still persists and the haematocrit level continues declining, give fresh whole blood 10 ml/kg as a bolus  
- Vital signs should be monitored every 30 – 60 minutes  
- In case of severe bleeding, give fresh whole blood 20 ml/kg as a bolus  
- Give platelet rich plasma transfusion exceptionally when platelet counts are below 5,000 – 10,000/ mm³  
- After blood transfusion, continue fluid therapy at 10 ml/kg/h and reduce it stepwise to bring it down to 3 ml/kg/h and maintain it for 24 – 48 hrs. |

<table>
<thead>
<tr>
<th>Con. Pulse</th>
<th>Manifestation</th>
<th>Management</th>
</tr>
</thead>
</table>
| Duration 2 – 3 days after recovery from critical/shock stage | - 6-12 hours after critical/shock stage, some symptoms of respiratory distress (pleural effusion or ascites)  
- 2-3 days after critical stage, strong pulse, normal blood pressure  
- Improved general condition/return or appetite  
- Good urine output  
- Stable haematocrit  
- Platelet count > 50,000 per mm³  
- Patient could be discharged from hospital 2-3 days after critical stage.  
- Bradycardial/arrhythmia  
- Asthenia and depression (few weeks) in adults | - Rest for 1-2 days  
- Normal diet  
- No need for medication |
6.7.4 Figure 2 Volume Replacement Flow Chart for patient with DHF Grades III and IV

UNSTABLE VITAL SIGNS
Urine Output Falls
Signs of Shock

Immediate, rapid volume replacement: Initiate IV therapy
10-20 ml/kg/h Crystalloid solution for 1 hr

- Improvement
  - IV Therapy by crystalloid
    Successively reducing from 20
    To 10, 10 to 6, and 6 to 3 ml/kg/hr

- No Improvement
  - Oxygen
    Haematocrit
    Rises
    IV Colloid (Dextran 40)
    or plasma 10 ml/kg/hr as
    Intravenous bolus
    (repeat if necessary)

    Haematocrit
    Falls
    Blood transfusion
    (10 ml/kg/hr) if
    haemotacrit is
    still > 35%

    Improvement
    IV therapy by crystalloid,
    successively reducing the flow

Further Improvement
Discontinue intravenous Therapy after 24-48 hours duration 1 hour
6.7.5 Fluids Required for Intravenous Therapy

Fluids Recommended

Crystalloid:

(a) 5% dextrose in isotonic normal saline solution (5% D/NSS)
(b) 5% dextrose in half-strength normal saline solution (5% D/1/2/NSS)
(c) Ringer lactate
(d) Normal saline

6.7.6 Important Instructions for Treatment of DHF

- Cases of DHF should be observed every hour.
- Serial platelet and haematocrit determinations drop in platelets and rise in haematocrits are essential for early diagnosis of DHF.
- Timely intravenous therapy – isotonic crystalloid solution – can prevent shock and/or lessen its severity.
- If the patient’s condition becomes worse despite giving 20 ml/kg/hr for one hour, replace crystalloid solution with colloid solution such as Dextran or plasma. As soon as improvement occurs replace with crystalloid.
- If improvement occurs, reduce the speed from 20 ml to 10 ml, then to 6 ml, and finally to 3 ml/kg.
- If haematocrit falls, give blood transfusion 10 ml/kg and then crystalloid IV fluids at the rate of 10 ml/kg/hr.
- In case of severe bleeding, give fresh blood transfusion about 20 ml/kg/hr for two hours. Then give crystalloid at 10 ml/kg/hr for a short time (30 -60 minutes) and later reduce the speed.
- In case of shock, give oxygen.
- For correction of acidosis (sign: deep breathing), use sodium bicarbonate.
6.7.7 What not to do

- Do not give Aspirin or Brufen or NSAID for treatment of fever.
- Avoid giving intravenous therapy before there is evidence of haemorrhage and bleeding.
- Avoid giving blood transfusion unless indicated, reduction in haematocrit or severe bleeding.
- Avoid giving steroids. They do not show any benefit.
- Do not use antibiotics.
- Do not change the speed of fluid rapidly, i.e. avoid rapidly increasing or rapidly slowing the speed of fluids.
- Insertion of nasogastric tube to determine concealed bleeding or to stop bleeding (by cold lavage) is not recommended since it is hazardous.

6.7.8 Signs of Recovery

- Stable pulse, blood pressure and breathing rate
- Normal temperature
- No evidence of external or internal bleeding
- Return of appetite
- No vomiting
- Good urinary output
- Stable haematocrit
- Convalescent confluent petechial rash
6.7.9 Criteria for Discharging Patients

- Absence of fever for at least 24 hours without the use of anti-fever therapy
- Return of appetite
- Visible clinical improvement
- Good urine output
- Minimum of three days after recovery from shock
- No respiratory distress from pleural effusion and no ascites
- Platelet count of more than 50,000/mm$^3$
- PCR should be negative
6.8 Annex 8 Flow chart for management of Dengue

Patient with dengue like Symptoms

Blood sample

Blood sample sent to Central Health Laboratory, Victoria

Blood tested

Dengue virus present

Blood sample sent to reference laboratories if required

Report received reference Laboratories

Dengue fever virus confirmed

Patient given appropriate treatment

Responsibility
Medical Officer

Nursing Officer/
Laboratory Technician

Nursing Officer

Laboratory Analyst

Test report sent to concerned health centre/hospital

Report on suspected cases sent to CDCU

Ministry informed by CHL
4. Mortality review

To identify any preventable deficiencies during the pre-hospital or hospital course of management, mortality review to be held at institutional level.
6.9  Annex 9: Sample Case Investigation Form for Viral Fevers

CHIKUNGUNYA □ OR DENGUE □
(Click as appropriate)

1. IDENTIFICATION

UNIQUE STUDY ID: ------------------------------------------

NAME OF CASE: SURNAME ----------------- NAME: -------------------

Age in years & in months: Year □ Month □ Sex: Male □ Female □

Health center where detected: ----------------------------------

Residential Address 1: ------------------------------------------

Residential Address 2: ------------------------------------------

Residential Address 3: ------------------------------------------

Profession: --------------------------------------------------

2.  CLINICAL DATA

□ Fever Date of onset: -------/-----/----- Duration

□ Rash Date of onset: -------/-----/----- Duration

□ Joint pains (arthralgia) Date of onset: -------/-----/----- Duration

□ Muscle pains (myalgia) Date of onset: -------/-----/----- Duration

□ Retro-orbital pain Date of onset: -------/-----/----- Duration

□ Headaches Date of onset: -------/-----/----- Duration

□ Neck stiffness/
Disorientation/ Confusion/convulsion Date of onset: -------/-----/----- Duration

Admitted □ yes □ no Date of Admission: -------/-----/-----
If yes, name of Centre or Hospital:

3. EPIDEMIOLOGICAL DATA

History of travel overseas: __________________________________________________________

Date of travel: -------------- duration of travel: ------------- countries visited: ---------

Place of work: ________________________________________________________________

Is there another case in the same household having similar symptoms?  
Was there another case in the same household having similar symptoms?  

4. LABORATORY DATA

Blood sample taken?  [ ] Yes  [ ] No

If yes, date of sample collection and sent to the laboratory: _______________________

Results of the blood samples: ____________________________________________________

Types of tests: ---------------- virus type: ---------------- date of results: ---------------

<table>
<thead>
<tr>
<th>VIRAL RESULTS</th>
<th>Date of Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] ELISA for IgG</td>
<td></td>
</tr>
<tr>
<td>[ ] ELISA for IgM</td>
<td></td>
</tr>
<tr>
<td>[ ] ELISA for Antigen</td>
<td></td>
</tr>
<tr>
<td>[ ] PCR for viral genomes</td>
<td></td>
</tr>
<tr>
<td>[ ] Cell culture</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BLOOD RESULTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Blood counts</td>
<td></td>
</tr>
<tr>
<td>[ ] WBC</td>
<td>Platelets</td>
</tr>
<tr>
<td>[ ] ESR</td>
<td>Hb</td>
</tr>
</tbody>
</table>
5. DIAGNOSIS

- Suspected
- Epidemiologically linked/contacts
- Clinically confirmed
- Laboratory confirmed

6. OUTCOME

- Alive and well
- Alive and hospitalized [ ] Date of discharge: ---------/----------/---------
- Dead
- Unknown
- Lost to follow

7. CASE MANAGEMENT DATA

<table>
<thead>
<tr>
<th>Type of treatment:</th>
<th>Self medication</th>
<th>Doctors Prescription</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drugs taken</td>
<td></td>
<td></td>
<td>---------</td>
</tr>
<tr>
<td>Paracetamol</td>
<td></td>
<td></td>
<td>---------</td>
</tr>
<tr>
<td>NSAIDS</td>
<td></td>
<td></td>
<td>---------</td>
</tr>
</tbody>
</table>
### 6.10 Annex 10: Table for summarizing field investigation data

Provide a line listing for each case as below

<table>
<thead>
<tr>
<th>ID</th>
<th>name</th>
<th>age</th>
<th>sex</th>
<th>Address¹</th>
<th>Type of case²</th>
<th>Clinical findings</th>
<th>Date of onset</th>
<th>Outcome²</th>
<th>Sample taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>Name 1, Name 2</td>
<td>23</td>
<td>m</td>
<td>Montagne Blanche</td>
<td>suspected</td>
<td>Fever, joint pains</td>
<td>1 Jan 2009</td>
<td>alive</td>
<td>blood</td>
</tr>
<tr>
<td>002</td>
<td>Name 3, Name 4</td>
<td>67</td>
<td>f</td>
<td>Goodlands</td>
<td>Not classified</td>
<td>rash</td>
<td>3 Feb 2009</td>
<td>hospitalized</td>
<td>no</td>
</tr>
</tbody>
</table>

1, provide full address
2, case can be: probable, suspected, clinically confirmed, not known
3, outcome can be: dead, alive, hospitalized, lost to follow up
### 6.11 Annex 11: Disease surveillance form

Provide a cumulative summary of all cases

<table>
<thead>
<tr>
<th>Period of report: January 1st to January 7th, 2009</th>
<th>probable</th>
<th>suspected</th>
<th>confirmed</th>
<th>unknown</th>
<th>total</th>
<th>Administrative region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of case (cumulative number)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>12</td>
<td>3</td>
<td>20</td>
<td>1</td>
<td>36</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Dead (cumulative number)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>I</td>
</tr>
<tr>
<td>Sick (cumulative number)</td>
<td>30</td>
<td>40</td>
<td>10</td>
<td>20</td>
<td>100</td>
<td>I</td>
</tr>
<tr>
<td>Well</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>15</td>
<td>I</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>I</td>
</tr>
<tr>
<td>Lost to follow up</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>I</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>47</strong></td>
<td><strong>46</strong></td>
<td><strong>35</strong></td>
<td><strong>27</strong></td>
<td><strong>155</strong></td>
<td>I</td>
</tr>
</tbody>
</table>
6.12 **Annex 12: Laboratory reporting form**

Provide a line listing of the results

<table>
<thead>
<tr>
<th>name</th>
<th>epidid</th>
<th>labnum</th>
<th>Specimen 1 type</th>
<th>Condition</th>
<th>Collection date</th>
<th>Report date</th>
<th>ELISA IgG</th>
<th>ELISA IgM</th>
<th>ELISA Antigen</th>
<th>PCR</th>
<th>Culture</th>
<th>ESR</th>
<th>Platelets</th>
<th>WBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Henri</td>
<td>001</td>
<td>091</td>
<td>B</td>
<td>G</td>
<td>2309</td>
<td>30/09</td>
<td>pos</td>
<td>pos</td>
<td>den</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td></td>
</tr>
<tr>
<td>Hemlal</td>
<td>002</td>
<td>092</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Specimen, B=blood, T=throat swab

Condition: G=good, I=inadequate

These surveys should be carried out by the Vector Biology and Control Division of the Ministry.

These surveys could be to identify the presence of mosquito larvae in already identified types of containers in vulnerable areas and to quantify the number of such breeding sites. These surveys would not require the identification of vector species present and may be carried out by teams made up of a Health Surveillance Officers and two or more spray machine operators/General Workers.

6.14 Annex 14: Methodology of surveys by Entomological Teams

• A minimum of 100 houses should be surveyed within a radius of 300 – 500 meters at the sites selected. Factors that could help in identifying these sites are;

  a. Localities in which previous dengue outbreaks have been reported

  b. Localities with known potential for high vector breeding

  c. Localities from which several dengue cases are being reported.

• During surveys receptacles should be visually examined for evidence of vector larvae, pupae or eggs. All receptacles should be checked using dipping or siphoning techniques. At each premises the name of occupant or establishment, address, types of containers with water collections, no. of larvae and pupae collected should be documented. This data may be entered into a format shown at Annex 10 & 11. All collected larvae and pupae should be identified by Entomological Technicians into species. Teams should help occupants to modify or destroy breeding sites and educate the community on how to minimize dengue vector breeding.
6.15 Annex 15: Indices used for larval surveys

Four indices are commonly used to measure *Aedes* mosquito density levels:

a. The House (premises) Index (HI)

Presence of houses or premises positive for *Aedes* larvae. The HI is calculated as follows:

\[
HI = \frac{\text{No. of houses positive for } Aedes \text{ larvae}}{\text{No. of Houses inspected}} \times 100
\]

b. Container Index (CI)

Presence of water holding containers positive for *Aedes* vector larvae.

\[
CI = \frac{\text{No. of positive containers}}{\text{No. of water holding containers inspected}} \times 100
\]

c. Rubber Tyres Index (RTI)

\[
RTI = \frac{\text{NO. of rubber tyres with mosquito larvae}}{\text{Total Number of rubber tyres surveyed}} \times 100
\]

d. Breteau Index (BI):

Number of *Aedes* positive containers per 100 houses in a specific locality

\[
BI = \frac{\text{No. of Aedes positive containers}}{\text{No. of houses inspected}} \times 100
\]
6.16 **Annex 16: Indices used for pupal surveys**

The rate of contribution of newly emerged adults to the adult mosquito population from different container types can vary widely. The estimation of relative adult production based on pupal counts (counting all pupae found in each container) will help to identify the most productive containers which will be important for the control programme. The corresponding index is the pupal index.

Pupal Index (PI): No. of pupae per 100 houses

\[
PI = \frac{\text{No. of pupae}}{\text{No. of houses inspected}} \times 100
\]

Activities to be undertaken by surveillance teams during vector surveillance –

These surveillance units can be organized in the following manner.

This unit should consist of one Senior Health Surveillance Officer, 9 Health Surveillance Officers, 3 General Workers, 4 Insecticide Sprayer man and two drivers for each team.

For the time being there should be three units for the island.

2.6 A regional surveillance and intervention team attached to the regional Health Offices should follow the activities initiated by the above team.

i. Possible risk areas should be identified and prioritized.

ii. One surveillance unit should survey 50 houses per day.
iii. Duration of one round should be within 10 days. (that means each house is surveyed, at minimum, twice a month)

iv. Health education should be given to the occupants of the houses with Aedes positive breeding places for elimination /reduction of breeding places

v. The team can help the occupants on the houses to eliminate the breeding places

vi. When necessary larviciding could be carried out in the area
6.17 Annex 17: Guidelines for use of chemicals for vector control

Fogging

Objective of Fogging: To reduce the adult female population and its longevity as quickly as possible as a supplementary measure for source reduction during outbreaks of dengue.

Fogging treatments

Organization of the fogging team as per existing SOP

A fogging team should consist of one Public Health Inspector and three hot fog generators.

- The Health Inspector is responsible for one fogging team which is constituted as follows: 2 Hot fog generator with 2 helpers or a man power of 3 Hot fog generators with 3 helpers.

- All persons involved in fogging operation must wear personal protective equipments overalls, protective gloves, suitable respirator, ear plugs, goggles, and boots.

- Filter of the respirator must be periodically changed.

Pre Fogging activities

The steps listed below are to be followed in carrying out the fogging of a designated area.

- The maps of the area to be fogged must be studied carefully before the spraying operation begins.
• The area covered should be at least 300 metres within the radius of the house where the dengue case was located.

• Residents should be warned before the operation so that food is covered, fires extinguished, and pets are moved out together with the occupants.

• The most essential information about the operation area is the wind direction. Fogging should always be done with back in the direction of wind.

Information to be given to inhabitants 17 00 to 20 00 (if required)

• Time of spraying, for example 17 30 to 20 00 hours.

• All doors and windows should preferably be opened.

• Dishes, food, fish tanks, and bird cages should be covered.

• Stay away from open doors and windows during spraying or temporarily leave the house and/or the sprayed area until the spraying is completed.

To ensure proper quality of spraying the factors should be considered.

1. Optimum fogging conditions

• Fogging should be done in the early morning and at sunset as adult Aedes mosquitoes are most active at these hours.

• Fogging should not be done in the middle of the day, when the temperature is high as convection currents from the ground will prevent concentration of the spray close to the ground where adult mosquitoes are flying or resting, thus rendering the spray ineffective.

• Fogging should be carried out in steady winds (3-13 km/hr) while it shouldn’t be carried out in strong windy conditions (>13km/hr).

• In heavy rain, spraying should be stopped and the spray head of the ULV machine should be turned down to prevent water from entering the blower.

• Fogging is ineffective in rainy period.

Timing of application
Spraying should be carried out only when the right weather conditions are present and usually only at the prescribed time. These conditions are summarized below.

<table>
<thead>
<tr>
<th>Most favorable conditions</th>
<th>Average conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time</strong></td>
<td>Early morning (0600*-0800 hrs) or late evening (1800-2000 hours)</td>
</tr>
<tr>
<td><strong>Wind</strong></td>
<td>Steady, between 3-13 km/hr</td>
</tr>
<tr>
<td><strong>Rain</strong></td>
<td>No rain</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>Cool</td>
</tr>
</tbody>
</table>

**Frequency of application**

The commencement and frequency of fogging generally recommended is as follows:

- Fogging should be started in an area (residential houses, offices, factories, and schools) as soon as possible after a suspected Chikungunya or DF/DHF case from that area is reported.

- Fogging should be applied after outbreaks of Chikungunya or Dengue and also during period of high mosquito density such as rainy seasons when the relative humidity is high

- 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.

- At least two treatments should be carried out within each breeding cycle of the mosquitoes (seven to ten days for *Aedes*). Therefore, a repeat spraying should be carried out within seven to ten days after the first spraying.

**Hand operated (Portable) thermal fogging**

- Thermal fogging with hand operated thermal foggers should be done from house to house, always fog with wind on the back.

- All windows and doors should be shut for half an hour after the fogging to ensure good penetration of the fog and maximum destruction of the target mosquitoes.
• In single-storey houses, fogging can be done from the front door or through an open window without having to enter every room of the house. All bedroom doors should be left open to allow dispersal of the fog throughout the house.

• In multi-storey buildings, fogging should be carried out from upper floors to the ground floor and from the back of the building to the front to ensure the good visibility of the operator along his spraying path.

• When fogging outdoors, it is important to direct the fog at all possible mosquito resting sites, including hedges, covered drains, bushes, and tree-shaded areas.

• The most effective type of thermal fog for mosquito control is a medium/dry fog, i.e. it should just moisten the hand when the hand is passed quickly through the fog at a distance of about 2.5-3.0 meters in front of the fog tube. Adjust the fog setting so that oily deposits on the floor and furniture are reduced.

Back pack aerosol spraying with ULV attachments

House spraying technique

• Stand 3-5 meters in front of the house and spray for 10 to 15 seconds, directing the nozzle towards all open doors, windows and eaves. If appropriate, turn away from the house and, standing in the same place, spray the surrounding vegetation for 10 to 15 seconds.

• If it is not possible to stand three meters from the house due to the closeness of houses and lack of space, the spray nozzle should be directed towards house openings, narrow spaces and upwards.

• While walking from house to house, hold the nozzle upwards so that particles can drift through the area. Do not point the nozzle towards the ground. In multi-storey houses spraying is carried out inside the houses.

• Spray particles drift through the area and into houses to kill mosquitoes which become irritated and fly into the particles. The settled deposits can be residual for several days to kill mosquitoes resting inside houses and on vegetation not exposed to the rain.

• This technique permits treatment of a house with an insecticide ranging from 1 to 25 grams in one minute. The dosage depends on the discharge rate, concentration of insecticide applied, and time it takes to spray the house.

General Considerations
To obtain correct dosage calibration of a machine should be done periodically, usually after 25 hours of operation, or at any time when major maintenance is performed. Machines should be calibrated in a way to ensure adherence of following parameters;

1. **Optimum droplet size:**

   Optimum droplet size should be 10-30 mm. Teflon coated slides should be used to measure the droplet size of thermal fogging. Where water has been used to dilute the spray, water sensitive papers stripes can be used to collect droplet for sizing. Treating the water-sensitive paper with ethyl acetate will make the stains more permanent.

2. **Flow rate:**

   When using hand operated thermal fogging machine, at a walking speed of 60 meters per minute, and with track spacing of 10 meters, 600 m\(^2\) can be sprayed in one minute. For an application rate of 0.5 litre per hectare, the flow rate must therefore be 30 ml/minute (500 ml – 0.06) calibrate.

   Measurement of flow rate can be carried out by either

   i. marking the level on the tank, then to spray for one minute and measure the volume of liquid needed to fill the tank back to the mark.

   Or

   ii. Adding a measured volume of an insecticide, spray until the tank is empty and time how long it takes to spray the liquid.
Flow rate for vehicle mounted thermal foggers

Outdoor applications

To calculate the output rate of vehicle-mounted equipment, following formula can be used.

\[
\text{OUTPUT RATE (m}^2/\text{minute)} = \text{Vehicle speed (m/hour)} \times \text{width of the track spacing (m)}
\]

\(10000 \text{ m}^2 = 1 \text{ hectare}\)

If the insecticide label recommends an application rate of 0.5 litre of UL formulation per hectare, the flow rate must be adjusted to deliver 0.5 litre per minute.

For ULV fogging machine

Indoor applications

Time required for spraying a house can be calculated using the following formula:

Target application rate (ml/hectare) \times area of the house (hectare) / flow rate (ml/min)

2. Spray concentration

The WHO recommended targeted amount of active ingredient per unit area must remain within the specified range given below. Susceptibility/resistance levels of the recommended insecticide target species should be monitored regularly.

Insecticides suitable as cold aerosol sprays and for thermal fogs for mosquito control

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Chemical</th>
<th>Dosage of air. (g/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deltamethrin</td>
<td>PY</td>
<td>0.5 – 1.0</td>
</tr>
</tbody>
</table>

PY = Synthetic pyrethroid, OP = organ phosphorus, ai. = active ingredient

Source: WHO (1997), WHO/CTD/WHOPES/97.2
6.18 Annex 18: Evaluation of epidemic spraying

Epidemic spraying can be evaluated using the following indicators

I Parous rate:

A parous rate of 10% or less in comparison to a much higher rate before spraying indicates the effectiveness of spraying. However, a low parous rate after spraying can occur in the absence of a marked reduction in vector density. This can be attributed to the emergence of a new population of mosquitoes which escaped the spray.

II Reduction in hospitalized cases

A reduction in hospitalized cases after the incubation period of the disease in humans (about 5-7 days) has elapsed indicates the effectiveness of spraying.

Use of Larvicides for chikungunya and Dengue Vector Control

Themephos 50 E.C to be used 8.5 ml/ gallon or Bacillus thuringiensis (Bti) 2g/litre water
1 cubic meter = 1000 litres
### 6.19 Annex 19: Form for Weekly Programme of Larviciding

Ministry of Health & Quality of Life

**CUREPIPE HEALTH OFFICE**
Cossigny Street, Curepipe

**Programme of Larviciding – Period (28.08.06 to 03.09.06)**

<table>
<thead>
<tr>
<th>DATE</th>
<th>REGION TO BE COVERED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday 04.08.06</td>
<td>Brown Sequard St, Curepipe Road</td>
</tr>
<tr>
<td>Tuesday 05.08.06</td>
<td>Lees St, Lamaletie St, Corson, V. Hugo Street, Higginson St, Leclezio St</td>
</tr>
<tr>
<td>Wednesday 06.08.06</td>
<td>Eau Coulee</td>
</tr>
<tr>
<td>Thursday 07.08.06</td>
<td>Floreal, Cite Mangalkhan</td>
</tr>
<tr>
<td>Friday 08.08.06</td>
<td>Ruelle Dalais</td>
</tr>
<tr>
<td>Saturday 09.08.06</td>
<td>NIL</td>
</tr>
<tr>
<td>Sunday 10.08.06</td>
<td>NIL</td>
</tr>
</tbody>
</table>
### 6.20 Annex 20: Programme of Work for Fogging

**MINISTRY OF HEALTH & QUALITY OF LIFE HEALTH OFFICE**

#### 1. PROGRAMME OF WORK FOR FOGGING

<table>
<thead>
<tr>
<th>MANPOWER</th>
<th>REGIONS TO BE COVERED</th>
<th>REMARKS (State also if there are cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 2. RETURN FOR FOGGING FOR ..............................................

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>MANPOWER</th>
<th>REGION COVERED</th>
<th>PREMISES TREATED</th>
<th>WASTELAND TREATED</th>
<th>HEALTH INSTITUTIONS</th>
<th>AMOUNT OF INSECTICIDE USED</th>
<th>AMOUNTOF MOTOR SPIRIT USED</th>
<th>No. Fogging MACHINES USED</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
6.21 Annex 21: Programme Of Work For Larviciding
MINISTRY OF HEALTH & QUALITY OF LIFE HEALTH OFFICE

1. **PROGRAMME OF WORK FOR LARVICIDING**

<table>
<thead>
<tr>
<th>MANPOWER</th>
<th>REGIONS TO BE COVERED</th>
<th>REMARKS (STATE also if there are cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

2. **RETURN OF LARVICIDING FOR ........................................REGIONS COVERED:**

<table>
<thead>
<tr>
<th>No. of premises visited</th>
<th>NUMBER OF POTENTIAL BREEDING PLACES TREATED WITH ABATE (8.5 ML/Galloons)</th>
<th>QTY of Abate used (ML)</th>
<th>No. of Sprayer-men</th>
<th>No. of Helpers</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Roofs</td>
<td>Pools</td>
<td>Cistern/ Drums Concrete Basins</td>
<td>Canals</td>
<td>Rivers</td>
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</tbody>
</table>

**NOTIFICATION OF CASES OF CHIKUNGUNYA AND OTHER COMMUNICABLE DISEASES FOR .................**

<table>
<thead>
<tr>
<th>NAME</th>
<th>Age</th>
<th>Sex</th>
<th>Home Address</th>
<th>Address of Work</th>
<th>(Notified by State) Name of Doctor</th>
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</table>
### 6.22 Annex 22: Form Program of work – Fogging

**Program of work - FOGGING EXERCISE**

**Health Office:**

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Manpower</th>
<th>Region to be covered/ Sector/ Blocks</th>
<th>Remarks</th>
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</thead>
<tbody>
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</table>
### Annex 23: Form: Daily report on Larviciding

#### Ministry of Health & Quality of Life

Daily Return of Larviciding Exercise for …………………

**Health Office:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Team</th>
<th>Region Covered</th>
<th>Sector/Block</th>
<th>No of Premises Visited</th>
<th>No. of Potential breeding places treated with Abate</th>
<th>Health Institutions/Schools Treated</th>
<th>Qty of Abate used (ML)</th>
<th>Sprayer man / General Worker</th>
<th>SMF</th>
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</thead>
<tbody>
<tr>
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</tbody>
</table>

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Ministry of Health and Quality of Life: Operation Plan on Chikungunya and Dengue
### 6.24 Annex 24: Form: Daily report on Fogging

Ministry of Health & Quality of Life

Daily Return of Fogging Exercise for .........................................................

Health Office:

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Region Covered Sector/Block</th>
<th>No of Premises treated</th>
<th>Wasteland Treated</th>
<th>Institutions/Schools Treated</th>
<th>Sector/Block No of Premises treated</th>
<th>Amount of Insecticide Used (K)</th>
<th>Nebol Lts</th>
<th>Amount of Motor Spirit Used (L)</th>
<th>No of Fogging Machines Used</th>
<th>Inspector</th>
<th>Senior Medical Officer</th>
<th>Inspector</th>
<th>Inspector</th>
<th>Timekeeper</th>
<th>Gangman</th>
<th>Sprayer man</th>
<th>General Worker</th>
<th>Driver</th>
<th>SMF</th>
</tr>
</thead>
<tbody>
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</table>
### 6.25 Annex 25: Larval Survey Form:

[FORMERLY MEDICAL ENTOMOLOGY DIVISION]

**District ……………… **   **Locality ……………… **   **Weather Condition ………… **   **Date: …………………….. **   **D**

Name of collectors ………………………………………………………………………………………………………………………

<table>
<thead>
<tr>
<th>Bk no.</th>
<th>Breeding Sites: Name &amp; Address</th>
<th>Type of Container</th>
<th>No.</th>
<th>pos / neg</th>
<th>Larvae per 10 dips</th>
<th>SPECIES AND STAGES OF LARVAE</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Anopheles gambiae s.l. or other Culex quinquefasciatus or other Aedes albopictus or other</td>
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</tbody>
</table>

**Received by: …………..**
6.26 Annex 26: Daytime Incidence Of Mosquitoes

<table>
<thead>
<tr>
<th>Name of Collectors:</th>
<th>Method of Capture: Hand Catch (Suction Tube)</th>
<th>Weather:</th>
</tr>
</thead>
<tbody>
<tr>
<td>District:</td>
<td>Locality:</td>
<td>Sprayed/Unsprayed:</td>
</tr>
<tr>
<td></td>
<td>Date:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of Collectors</th>
<th>Outdoor Resting Places</th>
<th>Time Spent</th>
<th>No. of mosquitoes collected</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>FROM</td>
<td>ANOPHELES</td>
<td>CULEX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TO</td>
<td>gambiae</td>
<td>quinque.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M</td>
<td>F</td>
</tr>
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<td></td>
<td></td>
<td>others</td>
<td>others</td>
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<td></td>
<td></td>
<td>M</td>
<td>F</td>
</tr>
<tr>
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<td>M</td>
<td>F</td>
</tr>
</tbody>
</table>

Received by: ..................
## Annex 27: Daytime House Incidence Of Mosquitoes

**VECTOR BIOLOGY AND CONTROL DIVISION**

<table>
<thead>
<tr>
<th>No. of Persons</th>
<th>Block No.</th>
<th>House No.</th>
<th>Type of House</th>
<th>No. of Rooms</th>
<th>Anopheles gambiae s.l.</th>
<th>Culex</th>
<th>Aedes albopictus</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M</td>
<td>F</td>
<td>Stage</td>
<td>M</td>
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</tr>
</tbody>
</table>

Name of Collectors: ____________________  Method of Collections: ____________________

District: ____________________  Locality: ____________________  Date: ____________________

MINISTRY OF HEALTH and QUALITY OF LIFE
VECTOR BIOLOGY & CONTROL DIVISION
(Formerly Medical Entomology Division)

**DENGUE / CHIKUNGUNYA SURVEILLANCE**

**District:** 

**Locality:** 

**Date:**

<table>
<thead>
<tr>
<th>TOTAL</th>
<th>Type of Premises</th>
<th>No.</th>
<th>Number of Potential Breeding Places treated with Abate / BTI / Kirphos</th>
<th>Quantity Of Abate/ Kirphos BTI / Used</th>
<th>Number of Sprayerman</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ml / gram per gallon of water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>roof</td>
<td>pool</td>
<td>P. Drum</td>
<td>Drum</td>
<td>Flower Pot</td>
<td>Canal</td>
</tr>
<tr>
<td></td>
<td>Houses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vegetable/Backyard garden</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Commercial Sites</td>
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<tr>
<td></td>
<td>Government Inst.</td>
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<tr>
<td></td>
<td>Dumping Yards</td>
<td></td>
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<td></td>
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<td></td>
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<tr>
<td></td>
<td>Building Sites</td>
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<tr>
<td></td>
<td>Others(specify)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Senior Health Surveillance Officer:** 

**Head of Division:** 

---

80
6.29  Annex 29: Standard Operating Procedures for Fogging Activities

COMMUNICABLE DISEASES CONTROL UNIT

FOGGING OPERATOR (SPRAYERMAN)

You should ensure that:

- the fogging machine has been checked and is functioning properly and is fitted with the water formulation tube before proceeding on site.
- The appropriate nozzle is being used (0.8 mm nozzle to be used for water-based insecticides)
- The recommended dosage and dilution of insecticide are being used:
  - 10 ml Aqua-k-Othrine and 150 ml Nebol; to be mixed with 840 ml of water to obtain 1 litre of fogging solution
  - For one fogging machine (capacity for fogging solution 4L) 40 ml of Aqua-k-Othrine and 600 ml of Nebol; to be mixed with 3360 ml of water to obtain 4 litres of fogging solution

Stock of insecticide is available in the lorry
- The fuel tank of the fogging machine is full before operation starts
- Stock of fuel is available in lorry
- Appropriate protective clothing (as follows) is being worn while handling insecticides and during fogging operation.
  1. Breathable apron
  2. respirator
  3. goggles
  4. earmuffs
  5. gloves
  6. boots

- Insecticides, fuel, and all equipment (fogging machines, sprayers, and protective) are kept in the compartment provided for them in the lorry
- Fogging is carried out in a systematic and evenly way and at a steady pace
- during fogging activities insecticide is not sprayed directly onto human beings and animals
• Diluted insecticide is never stored; a fresh dilution is prepared when necessary.
• Insecticide is not sprayed on or near the moving parts of any machinery, electric motor or switchgear.
• Inhalation of spray mist is avoided.
• Contaminated clothing is immediately removed.
• While applying the product. You do not eat, drink or smoke.
• After pesticides usage, hands and face are immediately washed thoroughly with soap and water.
• Empty containers are not re-used.

**THE TIMEKEEPER**

Should ensure that

• above procedures are strictly followed
• Attendance of all personnel involved in fogging activities are taken
• time of departure from office, time of arrival on site and time reaching office after fogging operation are noted
• proper distribution of insecticide and fuel during fogging operation
• safe keeping of insecticides and equipment before the closing of office in the evening.

**THE HEALTH INSPECTOR**

The Health Inspector is the officer directly responsible for the proper functioning of the team on any vector control activities.

You should ensure that

• You are present as from 16.30 hrs on the site earmarked for fogging activities
• Locate exact area earmarked for fogging
• All inhabitants are informed about the reasons for fogging and precautions to be taken during and after fogging activities.
• All actual and potential breeding places for further action are identified.
• People are encouraged to reduce disease transmission within the house by back yard cleaning.
• all permanent breeding places are identified for further action (to be included in larviciding programme).

• the inhabitants are provided with comprehensive information on the vector, the disease and means of transmission.

• the inhabitants are informed about reasons for fogging and precautions to be taken during and after fogging activities.

• health education of the inhabitants are carried out (advise to stay indoor during evening, use mosquito repellent – coils, mats, liquid, sprays, cream, gel etc.).

• fogging is being carried out in a systematic and evenly way and at a steady pace and is not done in a haphazard way.

• all personnel in the team are protected by wearing appropriate protective clothing.

• dilution of fogging solution is according to recommendation.

• all personnel in the team are fully engaged in the operation and nobody is idle.

• The Timekeeper has recorded the attendance of all personnel present on site for fogging operation – time of arrival as well as time of departure of all personnel should also be recorded.

• proper recording of number of houses treated.

• Any incident or discrepancy is immediately reported to SHI/PHI

**Senior Health Inspector /Principal Health Inspector**

The Principal Health Inspector along with the Senior Health Inspector is responsible for supervising and coordinating above activities:

They should ensure that

• **Fogging activities is triggered only in cases of Chikungunya (suspected or confirmed)**
• As soon as a Chikungunya case (suspected or confirmed) is being notified to their office by a medical practitioner (GMO or private) the following is immediately initiated according to a programme of work within a radius of a hundred (100 kms) kilometers.
  o Fogging operation
  o Larviciding operation
  o Fever survey
  o House to house inspection
• Fogging activities is as far as possible be carried out on the same day a case is notified followed by larviciding activities on the next day.
• The Health Inspector and his fogging team have been briefed about the ongoing activities and the region to be fogged.
• all personnel involved in fogging activities are trained in said activity including safe use and handling of insecticides.
• during vector control activities teams are properly constituted and all officers are fully engaged in said activity and nobody is idle and every personnel (including the Health Inspector) is wearing appropriate protective clothing
• the Health Inspector is responsible for one fogging team which is constituted as follows:
  o two operators (Sprayerman) (2 fogging machines) with two helpers or
  o a maximum of three operators ( three fogging machines) with three helpers
  o Time Keeper
  o The Gangman shall not form part of the fogging team unless in the absence of the timekeeper.
• all discrepancies are reported to the Ministry.
• fogging activities is carried out at dusk, the best time to kill adult mosquitoes when they are most active and looking for food (female mosquitoes feed on human or animal blood) and should normally end at 20.00 hours.
• Fogging activities are well programmed and at no time is done haphazardly
- Climatical conditions are satisfactory, it is not raining heavily and the wind speed is less than fifteen kms

6.30 Annex 30: Standard Operating Procedures for Larviciding

COMMUNICABLE DISEASES CONTROL UNIT

Timekeepers, drivers, Insecticide Sprayermen, General Workers attend duty at 7.00 am at their respective health offices.

TIME KEEPER

Timekeeper should ensure that:

- each member of his team has signed the attendance register which should be barred at 7.15 a.m.
- each member of the larviciding team has been provided with the following:
  - protective clothing (apron, gloves, mask, boots)
  - sprayer
  - insecticide
  - the recommended dosage and dilution of Abate are used, that is:

  8.5 ml of Abate (Temephos 50EC) or 10 g of Bti (bacillus thuringiensis) to be added to five (5) litres of water (for one five litres capacity spraying apparatus) or, 17 ml of Abate/20 g Bti to be added to 10 litres of water (for ten litres spraying apparatus).

  - the larviciding team is briefed on the programme of work of the day
  - the lorry leaves the office yard for the site of work as early as possible and at no time later than 7.40 hrs
- a stock of Abate is always available in the lorry for replenishing of spraying apparatus on site of work
- ladders are available in the lorry before it leaves for the site of work
- prepares the antilarval report of the day for submission to SHI
- larviciding is carried out effectively according to programme of work
- whenever he performs supervisory duty on larviciding he should accompany the Team in the same government vehicle except under certain circumstances and in matters of urgency with the approval of the PHI
- larviciding is carried out in a systematic way and at a steady pace and all potential breeding places are treated.
- Larviciding is at no time done haphazardly
- His other duties are up to date and as such performs office duties twice weekly

**GANMAN**

Gangman should ensure that:

- The time of departure of the lorry from office yard lorry is immediately inserted in his notebook
- the lorry proceed directly to the site of work by the shortest possible route
- the time the lorry reaches site of work is noted in his notebook
- the driver never leaves the site of work during working hours except in matter of urgency or under instruction from PHI
- as soon as the team reaches the site of work a distribution of work is effected and work is immediately started and nobody is idle.
- He is aware of the whereabouts of each member of his team
- The sprayer men are entering each and every private and public premises paying particular attention to wasteland and flat roof concrete building in the block entrusted to him
- Water accumulating in artificial water collection, such as empty receptacles, bottles, used tyres etc is eliminated on the spot
- All water nuisances which cannot be abated on the spot are noted and in the afternoon reported to the health inspector for further action for their abatement
- the following is recorded for submission to the SHI:
  - the number of rooftop controlled
  - number positive for retaining rain water(record name and address of owner)
  - number of wasteland(record name and address of owner)
  - number of used tyres(record name and address of author of nuisance)
  - quantity of abate used
- Each member of his team is wearing protective clothing
- Nobody drinks, eats or smokes during larviciding operation
- Lunch time 11.00 to noon is strictly respected
- Works start immediately after lunch and continue up to 14.00 hrs and the larviciding team should at no time reach office before 14.30 hrs
- The work is going on smoothly and at the end of the day all the blocks programmed for larviciding operation have been completed
- Time larviciding team leaves site of work is recorded
- On reaching the health office in the afternoon, the Sprayerman clean their spraying apparatus and protective clothing and ascertain that the sprayers are functioning properly and there is no defects and is ready for use on the next day
- Any defect is reported to the timekeeper who will make necessary arrangement for their repairs and a spare sprayer will in the meantime handed over to the Sprayerman
- all cleaned spraying apparatus and protective clothes are handed over to the timekeeper for storing and will be given back to sprayer men the next day
HEALTH INSPECTOR

Health Inspector should ensure that:

- daily supervision of larviciding team is carried out
- at time of supervision check the note book of gang man for the following
  - presence of each member of the larviciding team
  - time left office yard
  - time reaching site of work
- larviciding is carried out as per programme of work
- walk with the gang man to control the sprayer men
- larviciding is carried out effectively in a steady pace and not haphazardly and nobody is idle
- all sprayer men are fully protected
- insert remarks about the way larviciding is being carried out, if you are satisfied or not, sign and insert time of inspection in the gagman’s notebook
- he has taken cognizance about all sanitary nuisances come across by the Sprayerman for further action.

SHI/PHI

Since the life cycle of the mosquitoes from egg to adult is about 7-14 days if all climatic conditions are favourable, larviciding should be carried out in all regions in a 7 day cycle.

SHI/PHI should ensure that:

- all localities in the sectors falling under the jurisdiction of his office have a total coverage on a 7 day cycle
- Larviciding is carried out as per programme of work in an effective way.
- Supervision is carried out by both the timekeeper and Health Inspector.
- They have overall control over the larviciding activities in their region.

### 6.31 Annex 31 Operating Procedure for Larval Survey

**COLLECTION OF LARVAE AND PUPAE FROM BREEDING SITES [LARVAL SURVEY]**

Each type of mosquito prefers to lay its eggs in a particular kind of water. Some will lay only in stagnant fresh, clear water with some shade, others only in brackish water or water rich in organic matters; some may even lay in very small quantities of water, such as that in a discarded container, tin can or trapped in hoof-print, wheel track, etc.

Prior knowledge of the preferred breeding sites of specific mosquitoes is very important so that the densities of larvae and pupae at these sites could be determined. The methods of the larval/pupal collection depend on the following variables:

- Determination of species present
- Determination of the preferred breeding sites of each vector species
- Determination of whether larvae and pupae are present during a control programme directed against adult mosquitoes even though these should be rare or uncollectable
- Assessment of the effectiveness of a programme directed against larvae and pupae.
F1. **ESSENTIAL EQUIPMENT**

The equipment required for the various methods of collecting larvae consists of: a dipper, a larval net, a well net, a spoon, a large tray, a pipette, stoppered specimen tubes (vials or jars), 70% alcohol solution or 2% formalin solution, a pencil, and a notebook.

If specimen are required for insecticide testing, larger jars or wide-mouthed vacuum flasks may be required.

**PREFERRED BREEDING SITES**

To identify the preferred breeding sites of a particular mosquito species, it is essential to be systematic and check all possible breeding places, even those that are hard to reach. This enables the determination of the types of sites most likely to harbour the larvae of a particular species of mosquito.

**Potential breeding sites include:**

Small pools, tin cans, other small containers, hoof-prints, drains and ditches, where the entire surface of water should be examined;

Brackish water, e.g. at sites where fresh water and salt water mix; streams, which should be searched at the edges where there is vegetation and the water moves slowly;

Ponds and lakes, where larvae usually occur in vegetation around the edges but can sometimes be found far from the shore among floating vegetation /objects (e.g. plastic)

Swamps and marshes, where larvae occur in places similar to those described for ponds and lakes;

Special sites, such as wells and water containers made of cement, where the entire surface of the water should be examined;

Rock-pools, ground pools, etc

Used rubber tyres, discarded domestic appliances (e.g. refrigerators / washing machines, etc)
Larvae and pupae are often concentrated in certain parts of large breeding sites. If these are known, they can regularly be inspected.

Whichever collecting method is used, care should be taken while approaching the breeding sites, which should preferably be facing the sun, as the larvae may be disturbed by shadows and may swim downwards and disappear from view. In such cases, the collector has to wait for several minutes until they return to the surface of the water before collecting the samples.

METHODS FOR COLLECTING LARVAE AND PUPAE

a. DIPPER

Various kinds of dipper may be used, including small frying pans, soup ladles and photographic dishes. It is important to use the standard / right type and size for each breeding place. A white enameled dipper is preferable as this allows to see the larvae easily. It should be always kept clean.

METHOD of USE

Lower the dipper gently into the water at an angle of about 45°, until one side is just below the surface.

While dipping, care should be taken not to disturb the larvae and thus cause them to swim downwards. If they are disturbed, wait for a minute or two until they come up to the surface again, and then continue dipping.

Move along the breeding site, skimming the surface of the water with the dipper.

Lift the dipper out of the water, making sure that the water containing the larvae/pupae is not spilt.

Hold the dipper steadily until the larvae / pupae rise to the surface of the water.

Collect the larvae / pupae by means of a pipette and transfer them to a tube or vial.

Do not throw the residual water back into the breeding place, as this may further disturb the larvae / pupae.
An alternative method is to hold the dipper at an angle of 45° and to lower it gently until it is just below the surface so that water flows in with any larvae / pupae that may be present.

Where there is dense, floating vegetation or debris, the following method may be used:
Disturb the water, causing the larvae and pupae to sink below the surface.
Clear away the vegetation or debris with the dipper and wait a few minutes for the larvae and pupae to return to the surface.
Collect the larvae and pupae with the dipper as described above.

b. LARVAL NET

A larval net for collecting larvae and pupae in ponds and lakes consists of a fine mesh net which has a plastic bottle or tube tied to one end and is mounted on a wooden/aluminium handle. To collect larvae and pupae, sweep the water surface by holding the net at an angle and moving it through the water. Larvae and pupae on the water surface will be swept into the net and will collect in the plastic bottle or tube.

Alternatively, a simple net with no attached bottle or tube can be used. After sweeping, the net should be inverted into a bowl of water and its contents dislodged. The water in the bowl is then searched for larvae and pupae, which are picked up and transferred to a bottle or vial by means of a pipette.

c. WELL NET

The net for sampling from wells is similar to the larval net but lacks the wooden Handle; instead. It is held at an angle by four strings and controlled by a long string or rope. The method of use is as follows:
Lower the net into the well so that the lower side of the net is just under the surface of the water and its opening is at an angle of about 45°.

Move the net right round the side of the well once or twice.

Withdraw the net and look for larvae and pupae in the bottle or tube at the end of the net.

d. **LARVAL COLLECTION USING A SMALL SPOON OR PIPETTE**

A small spoon or wide-mouthed pipette can be used for collecting larvae and pupae from small amounts of water, e.g. in a tin can or trapped in a hoof-print.

The method is as follows:

Stir the water vigorously with a stick to make it muddy.

Watch for the larvae and pupae to rise to the water surface: they are easily seen against the muddy background.

Pick up the larvae and pupae with the spoon or pipette.

After collecting by this method or any of the other methods, the larvae and pupae should be transferred to specimen tubes or vials.

e. **MAINTAINING ACCURATE RECORDS OF COLLECTIONS**

Sketch-map should be drawn to show the positions of the breeding sites relative to the locality surveyed. Each breeding place should be given an identity or number and recorded in the notebook. Should also be recorded: the district, the location, the date of
collection, the type of breeding place, the number of dips made and time spent sampling, and / or the name of the collector.

All specimen tubes / vials should be properly labeled and recorded in the notebook and the relevant forms.

f. TRANSPORTING LIVE LARVAE AND PUPAE TO LABORATORY

The larvae and pupae collected should arrive alive and undamaged at the laboratory.

Stopper each specimen tube / vial tightly so that water cannot spill.

Make sure that there is air in the top 1 – 2cm so that the larvae and pupae can breathe for a few hours. (if larger space is left, the water will become agitated during transportation and the specimens will suffer damage, particularly loss of hairs / setae).

If the journey to the laboratory is to take more than two to three hours, the stopper of the specimen tubes / vials should be removed every two hours to provide fresh air to the specimens.

7 List of reference documents used

1. Dengue in WPRO
2. SEARO