

**National Plan of Action for Prevention and
Control of Dengue Fever
2005 - 2009**

**Epidemiology Unit
Ministry of Health
Sri Lanka**

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1. Dengue Fever and Dengue Haemorrhagic Fever (DF/DHF) in Sri Lanka

1.1. Introduction

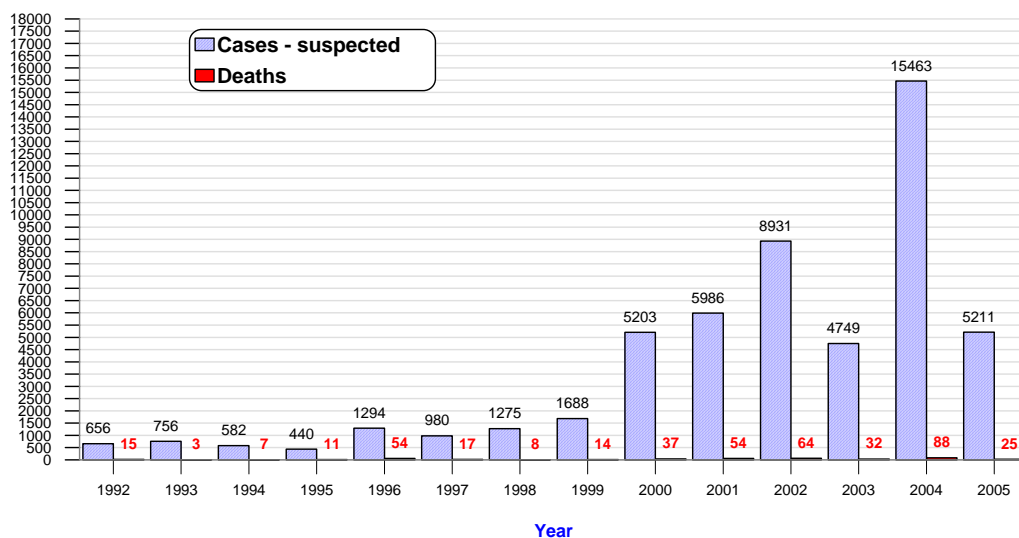
Dengue Fever and Dengue Haemorrhagic Fever (DF/DHF) are endemic in Sri Lanka. Since the first reported outbreak of Dengue Fever in 1965, there had been outbreaks on and off until the recent past with progressively large outbreaks occurring more frequently.

In the past 10 years we have witnessed a dramatic increase in the incidence of dengue and its severe manifestations making this infectious disease a major public health problem. Figure I below shows the increase in the number of notified DF/DHF cases and deaths from 1992 – 2004.

1.2. Current situation

The year 2002 recorded the largest outbreak in the recent past with 8931 cases and 64 deaths. The following year 2003, was one of the relatively low endemicity with only 4,749 suspected cases and 32 deaths reported. However, year 2004 there were 15463 suspected cases and 88 deaths reported to the Epidemiological Unit of the Ministry of Health. During the year 2005, 5211 cases of suspected cases of DF/DHF and 26 deaths were reported to the Epidemiological unit (Figure 1, Table 1).

Figure I: Notified Dengue Fever /DHF cases and deaths by year in Sri Lanka - 1992 – 2005



Source: Epidemiological Unit

Total suspected cases analysed from 1992 - 1999 - special surveillance data
Total notified cases analysed from 2000 - 2005 - Notification system

Date: 20/12/2005

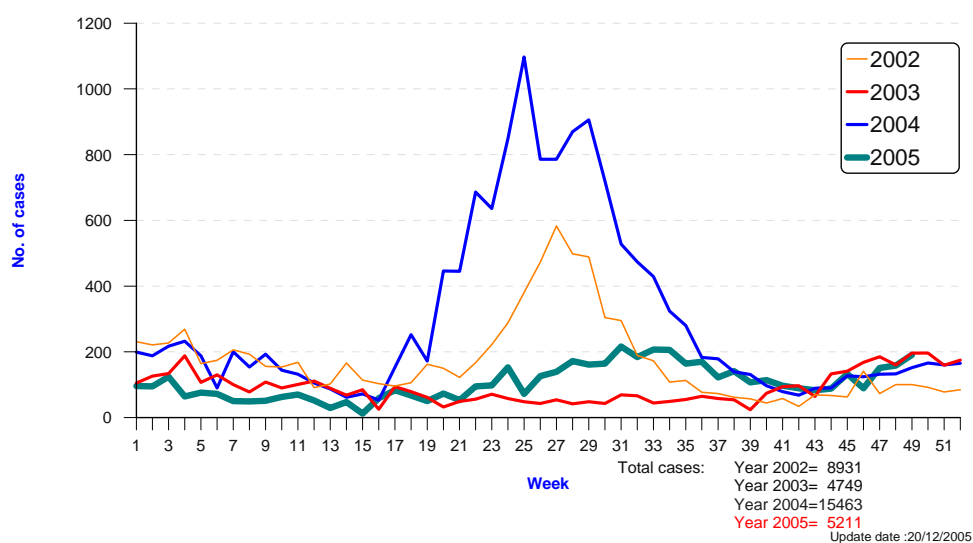
Table 1: Comparison of number of Dengue Fever/DHF cases and deaths, 2001 – 2005

Year	Number of cases DF/DHF	Number of deaths	Case Fatality Rate %
2001	4304	54	1.25
2002	8931	67	0.75
2003	4672	33	0.71
2004	15457	88	0.57
2005	5211	27	0.52

According to figure 1 and table 1, case reporting in 2004 has shown 3 fold rise in the incidence compared to that of 2003.

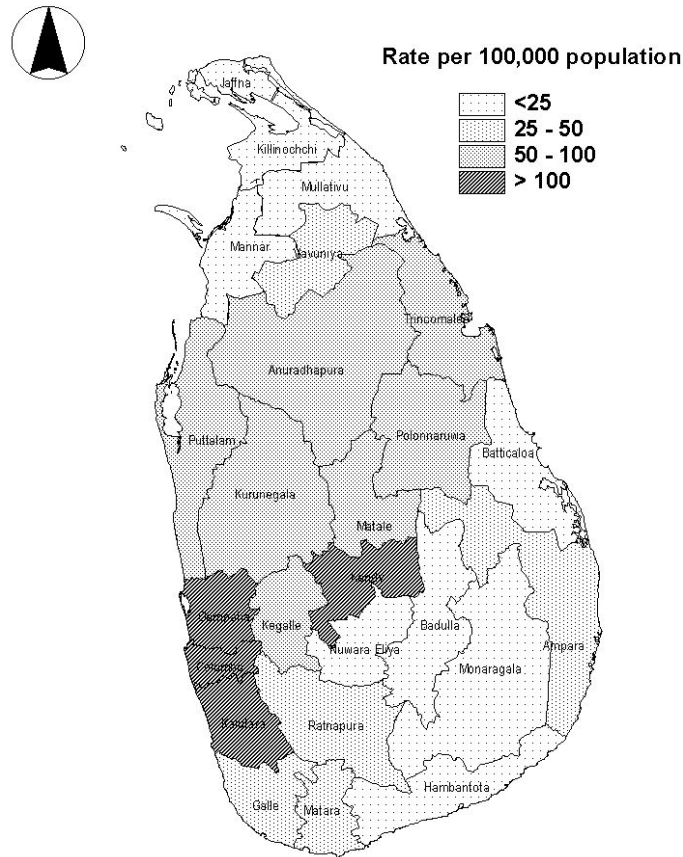
Figure 2 below shows the distribution of reported cases of DF/DHF during the last 4 year period in Sri Lanka.

Figure 2: Distribution of suspected Dengue Fever/DHF cases by week in Sri Lanka, 2002 - 2005



The disease has a seasonal trend, where two peaks of dengue occur following monsoon rains in June - July and October - December.

Figure 3 below shows cases reported by districts for 2004
Figure 3 : Dengue reported by district, 2004



Almost all the districts in Sri Lanka have reported DF/DHF cases and posed a threat to the health of the people. Colombo, Gampaha, Kalutara and Kandy districts have recorded highest number of cases up to November 2004.

The Ministry of Healthcare, Nutrition & Uva Wellassa Development with the support of the other agencies has taken steps in intensifying dengue prevention and control activities.

At national level, a National Task Force on dengue prevention and control chaired by Secretary/Health and Advisory Committee on Communicable Diseases chaired by D.G.H.S. meet regularly to review the current situation and make policy decisions to intensify activities.

Epidemiology Unit continues to monitor disease trends and alert all districts and divisional level health authorities regularly.

Vector surveillance and integrated vector control activities continue in all high-risk areas. Anti-Malaria Campaign takes the leading role in vector surveillance and control with Entomology Division of Medical Research Institute and the Anti-Filariasis Campaign.

Health care institutions in vulnerable areas are vigilant and ready to provide prompt clinical care.

However, with all the above efforts DF/DHF incidence has increased in exponential proportions in 2004. Possible reasons for this situation may be as follows;

1. Ever increasing use of non-bio degradable plastics, polythene and other containers with poor disposal systems.
2. Lack of co-ordination and co-operation among public health authorities and local government institutions
3. Poor response and participation of the community to keep their compounds free of mosquito breeding places.
4. Rapid urbanization with poor adherence to health concerns in building construction, refuse disposal and other sanitary measures.

For an effective and sustained dengue control programme the fullest co-operation of the public and media along with other agencies should be given to the health authorities in carrying out their activities.

Health education/public awareness activities continue with special emphasis on removal of mosquito breeding places and environmental management. The Health Education Bureau co-ordinates these activities with the support of all electronic and print media.

2. Current control strategies of Dengue Fever/Dengue Haemorrhagic Fever

In Sri Lanka, the following strategies are carried out to control DF/DHF.

- Surveillance
 - Disease surveillance
 - Vector surveillance
 - Laboratory surveillance (serological)
- Management of DF/DHF cases
- Vector Control
- Social mobilization
- Emergency response

2.1 Surveillance

The Advisory Committee on Communicable Diseases is the technical committee in the Ministry of Health where policy decisions on the control of all communicable diseases are made. This committee comprises of professors of medicine, paediatrics and community medicine, virologist of the Medical Research Institute, all Deputy Directors General of the Ministry of Health and heads of specialized campaigns.

This committee is chaired by the Director General of Health Services and the Secretary is the Epidemiologist. This committee meets quarterly and the country situation of all communicable diseases is reviewed in order to take necessary preventive and control measures.

2.1.1 Disease Surveillance (Passive)

DF/DHF is a notifiable disease in Sri Lanka since 1996. All officers treating cases of DF/DHF or suspected DF/DHF should notify such cases immediately to the Medical Officer of Health (MOH)/Divisional Director of Health Services (DDHS) of the area of the patient's residence. A special investigation form is also sent for each case to collect detailed information. The information is reported to the Central Epidemiological Unit weekly in the weekly return of communicable diseases sent by each MOH/DDHS. At the Epidemiological Unit these data are entered into a computer-based information system and the disease situation is monitored according to MOH/DDHS areas. Necessary instructions are given to the respective MOOH / DDHS regarding control DF/DHF.

In the event of notification of unusual number of cases, all other relevant agencies are alerted and action is taken to prevent further spread.

2.1.2 Laboratory surveillance

The objective of active laboratory based surveillance is to provide early and precise information to public health officers on four aspects of disease incidence, i.e. time, location, virus serotype and to clinicians serology and virus isolation data for confirmation of the diagnosis of DF/DHF.

Active surveillance is carried out at present at selected sentinel stations in and around the city of Colombo by the Virology Department of the MRI.

2.1.3 Vector Surveillance

The main purpose of this is to obtain information on larval and adult vector densities which can be used to control the *Aedes* mosquitoes which transmits the dengue virus. The high risk areas are covered by

the Entomology Department of the MRI in the city of Colombo and its suburbs. The other high-risk areas are covered by the entomological teams of the Anti-Malaria Campaign and Anti-Filarial Campaign of the provincial and regional levels. These vector surveillance reports are forwarded to the A.M.C. to co-ordinate the vector control activities.

Monthly meetings are held at the Head Quarters of A.M.C. to monitor the surveillance and vector control activities.

2.2 Vector Control

As a long-term control measure, larval source reduction activities are carried out through environmental management such as regular solid waste disposal and container removal programmes by the municipal council staff and field health staff. Further, these officers conduct clean up campaigns with the assistance of the public and non-governmental organizations (NGOs). Similar activities are carried out in high risk areas by the field staff in MOH office, with the support of the community and other organizations.

2.3 Social Mobilization

In respect of the Ministry of Health, the Health Education Bureau (HEB) takes the lead in providing technical guidance for social mobilization focusing in health issues in DF/DHF control activities in collaboration with the Epidemiological Unit and other special units in the Ministry of Health.

Efforts to ensure proper disposal of refuse and source reduction are the main emphasis of social mobilization. The electronic and print media play an important role in getting the public support during an outbreak situation.

2.4 Dengue Task Force

Following the 1996 epidemic, a multi disciplinary Dengue Task Force was established by Her Excellency, the President of Sri Lanka, to plan and monitor activities for community-based larval source reduction, aimed at controlling the *Aedes* mosquito. Subsequently, similar committees were formed at the provincial, regional and divisional levels to organize the necessary resources and to implement various dengue control activities.

2.5 Emergency Response

In November 1996, a National Consultative Meeting was held to identify strategies to strengthen outbreaks response to new emerging and re-emerging infectious diseases. At this meeting a draft action plan was formulated on epidemic preparedness and control of DF/DHF. At present, activities are carried out by the district team headed by the Deputy Provincial Director of Health Services.

Emergency Responses are co-ordinated at the national level by the Epidemiology Unit.

2.6 Integration of Disease Surveillance

Following the Integrated Disease Surveillance and Response Workshop held in January 2004 in Sri Lanka, a plan of action was developed for integration and strengthening of disease surveillance activities, where the following recommendations have been made to enhance DF/DHF surveillance;

1. Development of case definitions for DF/DHF.
2. Expansion of the surveillance system to include outpatients and community level case finding using suitable mechanisms.
3. Strengthening of laboratory surveillance.
4. Inclusion of private sector (institutions as well as Private Practitioners) into the mainstream/ambit of the surveillance system.
5. Strengthening of Epidemic Preparedness and response at all levels.
6. Consolidation of notification through managerial and supervisory inputs at all levels of the health system.
7. Establishment of the position of Regional Epidemiology Units/ Information Units in the mainstream of the surveillance system.
8. Flow and analysis of data from periphery to centre in a phased manner and the feed back in the reversed direction.

2.7 Establishment of Sub-committees of Technical Experts

Further to the consultative meeting of technical experts held at the BMICH on 14th August 2004 with the Hon. Minister of Healthcare, Nutrition & Uva Wellassa Development, it was decided to form sub-committees to address key issues with regard to dengue control and prevention in Sri Lanka.

Subsequently, six sub-committees comprising of experts have been formulated to address key issues different fields, regarding future control and prevention of dengue in the country. These sub-committees include renowned experts from universities and other government ministries, in addition to distinguished personalities who have retired from universities and government service (Annexure I).

The six sub-committees are as follows.

1. Clinical Management
2. Vector control
3. Virology and Vaccine Development
4. Social Mobilization
5. Legislative Enactments
6. Co-ordination of Research on DF/DHF

The National Plan of Action for dengue control has been developed based on the comprehensive plan of action prepared by each sub-committee.

3. Proposed framework for the control and prevention of Dengue Fever and Dengue Haemorrhagic Fever

The following framework is proposed to be carried out in Sri Lanka through integrated approach to reduce morbidity and mortality due to DF/DHF.

3.1 Proper management of DF/DHF cases.

The sub committee on clinical management has developed new guidelines on proper clinical management of DF/DHF cases. The committee comprised of several consultant physicians and pediatricians attached to government hospitals (Annexure II).

The guidelines are in the process of being finalized and will be disseminated to relevant authorities as given in the proposed plan of action.

It includes,

- management of patients / suspected patients at OPD
- admission criteria
- clinical management
- discharge criteria

3.2 Strengthening of surveillance

▪ Disease surveillance

In addition to the routine notification data, active surveillance of all cases with fever and hemorrhages at sentinel stations is suggested. The sentinel stations need to be selected based on disease incidence and vector indices in order to detect early epidemics (AFP sentinel sites).

Active laboratory surveillance is carried out at present at selected sentinel stations by MRI. This needs to be expanded to other high-risk areas.

Since at present there is no routine system of recording and disseminating of DF/DHF from OPD, general practitioners and private hospitals (except for routine notification system) it is suggested that health information system be developed for DF/DHF.

- **Vector surveillance**

The main purpose of this is to obtain information which can be used to detect early epidemics and improve effectiveness of vector control activities. Currently vector surveillance (larval and adult) is carried out in an ad hoc manner in the absence of specific criteria. Therefore criteria have to be developed to identify high risk areas to be targeted for entomological activities, based on vector surveillance data.

There is a need to co-ordinate activities of all units engaged in vector control by the dengue control unit.

Adequate staff and facilities should be made available for an effective vector surveillance system. Co-ordination of the surveillance activities should be developed for best possible monitoring.

- **Laboratory surveillance**

The main objectives of active laboratory surveillance is to provide early and precise information on confirmation of diagnosis, magnitude of the disease and viral sero-type.

Active surveillance is carried out at present at selected sentinel station by the Virology Department of the MRI. It is proposed to expand laboratory surveillance to health facilities in high risk areas, in order to forecast outbreaks and case confirmation.

- **Health information system for DF/DHF**

The information on disease surveillance, vector surveillance and laboratory surveillance should be appropriately co-ordinated at district, provincial and central level into one data system. There needs to be an identified mechanism for flow of information and action that needs to follow DF/DHF information system should be an integral part of the overall communicable disease surveillance system.

3.3 Integrated vector control activities

Source reduction by elimination of breeding places, chemical and biological control of the vector mosquito must be carried out on a planned basis, complemented by vector surveillance indices. Surveillance of vectors should be an essential routine step in the

planning of control measures and their evaluation. Surveys are also necessary for studying the ecology and distribution of vectors as well as to determine the risk of outbreaks.

Since vector density has a positive correlation of rainfall, it is necessary to forecast future outbreaks in relation to the rainfall. Incorporation of rainfall and entomological data could help to predict future outbreaks and map out high-risk areas for preventive measures.

3.4 Social mobilization

One of the components identified for sustainable prevention and control of DF/DHF is social mobilization. Along with social mobilization, active community participation including the civil society groups, inter-sectoral co-ordination, health education and legislative support are cited as other components for sustainable prevention and control measures.

In Sri Lanka, health education activities are handled at the national level by the Health Education Bureau. At provincial and regional levels, the health education activities are carried out by the respective field and hospital health staff co-ordinated to develop an effective media programme to create awareness of dengue, proper disposal of refuse and waste and source reduction measures through sustained community action, for prevention and control of dengue.

3.5 Establishment of Dengue Control Unit

In the absence of a national programme for dengue, the Minister of Health has taken steps to appoint a Director/Dengue Control, to co-ordinate and mandate the dengue control programme in the country. Infra-structure, logistics and funds necessary for the planning, implementation, monitoring and evaluation will be allocated from the Ministry of Health.

4. Plan of Action for Prevention and Control of Dengue in Sri Lanka

Objectives :

1. To reduce morbidity and mortality due to DF/DHF.
2. To forecast and prevent dengue epidemics.
3. To strengthen liaison with civil society groups, NGOO, media and other relevant stakeholders for social mobilization in dengue control.
4. To identify and mobilize resources to carry out research on dengue.
5. To develop and sustain an effective dengue prevention and control programme in Sri Lanka.

Objective 1 – To reduce morbidity and mortality due to DF/DHF.

Strategy	Activities	Responsibility
1. Ensure proper management of DF/DHF.	<ol style="list-style-type: none"> 1 Development and circulation of new guidelines on clinical management of DF/DHF, <ul style="list-style-type: none"> - assessment of the patient at OPD, ETU - admission criteria - in ward management - referral - discharge and follow up 2 Ensuring availability and use of new guidelines on case management by <ul style="list-style-type: none"> - admitting officers, MOO/OPD in state and private hospitals - RMPs /AMPs in district hospitals, Peripheral units, Central Dispensaries - full time and part time Private Practitioners - all other clinicians 3 Training of all relevant health workers on <ul style="list-style-type: none"> - correct knowledge - attitudes and practices on case management - using the above standard guidelines 4 Re-organization of OPD of at least in major hospitals for, <ul style="list-style-type: none"> - screening for DF/DHF - fever surveillance for DF/DHF - emergency care - reduction of long waiting hours for suspected dengue patients 	<ul style="list-style-type: none"> - Sub-committee on '<i>clinical management</i>' - Ministry of Health/ National Coordinator /DC (NC/DC) - Epidemiology Unit - Heads of Institutions - Clinicians in Government & Private Sector

	<p>5. Establishment of “model management centres” (semi-intensive care units/ dengue ward) in major hospitals in high risk districts.</p> <p>6. Provision of dengue diagnostic facilities including micro-centrifuges, micro-haematocrit and other equipments for basic investigations in wards, intensive care units, laboratories etc.</p> <p>7. Provision of essential medical supplies including i.v. fluids and other colloids</p>	DDG/Logistics D/MSD
<p>2. Development of health education messages for the community on early identification of dengue fever, early signs of DF/DHF and proper case management at household level.</p>	<p>Development and communication of task oriented, clear IEC materials to the parents, households and community through mass media/ leaflets/ posters or any other relevant mechanism on,</p> <ul style="list-style-type: none"> - how to recognise early the suspected cases of dengue including early clinical features - danger signs of DF/DHF/DSS to seek early hospital care to prevent deaths - proper management of fever at household level (increased fluid intake, bed rest, correct dosage of paracetamol, tepid sponging, avoidance of NSAIDS etc). - use of mosquito nets by patients undergoing treatment <p>screening of houses to prevent entry of mosquitoes</p>	<ul style="list-style-type: none"> - Health Education Bureau - Media
<p>3. Periodic reviews of deaths due to DHF/DSS in order to identify and rectify deficiencies in management.</p>	<p>Conduction of Dengue Mortality Review according to the guidelines/format prepared, (<i>annexure iv</i>) for all and suspected deaths due to DHF/DSS quarterly in each hospital with the following information .</p> <ul style="list-style-type: none"> - detailed clinical history. - laboratory investigations carried out and their interpretation. - possible deficiencies at primary, pre-hospital or hospital care levels which could have been prevented. 	<ul style="list-style-type: none"> - Sub-committee on ‘clinical management’ - Epid Unit - Heads of Institutions - Clinicians in Government & Private Sector - Public Health Staff
<p>4. Development of Health Information System for dengue.</p>	<ol style="list-style-type: none"> 1. Maintenance of good record keeping system of DF/DHF patients according to standard classification criteria in OPD, wards and laboratories. 2. Delegate responsibilities to designated officers to ensure recording and dissemination of accurate information on time. 	<ul style="list-style-type: none"> - Epidemiology Unit/RE - Heads of Institutions - Clinicians in Government & Private Sector - ICN -D/Information

<p>5. Improve notification of suspected DF/DHF by all clinicians for early detection of epidemics, adhering to new case definition.</p>	<ol style="list-style-type: none"> 1. Notification and investigation of all cases and confirmed /suspected deaths due to DHF/DSS to MOH, REE and Epidemiology Unit. 2. Establish a mechanism to liaise MOH and clinicians in government and private institutions for prompt notification of DF/DHF on suspicion. 3. Strengthening of the mechanism for notification of DF/DHF in private hospitals. 	<ul style="list-style-type: none"> - Epid Unit/RE - Heads of Institutions - Clinicians in Government & Private Sector - ICN
<p>6. Improve disease surveillance and outbreak investigation</p>	<ol style="list-style-type: none"> 1. Identification and surveillance of high risk populations 2. Monitor case notification from all health facilities 	<ul style="list-style-type: none"> - NC/DC - Epid unit/RE - MOH/DDHS

Objective 2 - To forecast and prevent dengue epidemics.

Strategy	Activities	Responsibility
<p>1. Use of serological and virological diagnosis timely and effectively at reference labs for early identification of dengue outbreaks.</p>	<ol style="list-style-type: none"> 1. Identification and supervision of sentinel surveillance stations for fever monitoring in OPD in selected hospitals in high-risk areas. 2. Expansion of surveillance of clinically suspected fever cases seen at OPD of major hospitals in high-risk areas. Dengue serology should be performed on blood samples taken from these patients (systematic sampling). 3. Liaison of PHI from RMO office / MOH office to visit sentinel institutions on weekly basis to get data on dengue actively. 	<ul style="list-style-type: none"> - MRI/Other laboratories (Private/universities) -NC/DC - RE - Heads of Institutions - Clinicians in Government & Private Sector - MLT, ICN, MOH, PHI
<p>2. Implement a systematic ongoing entomological surveillance system and control activities targeting high risk areas and organization and implementation of vector control activities.</p>	<ol style="list-style-type: none"> 1. Development of clear guidelines for field level staff on vector control (adult and larval) <i>annexure iii.</i> 2. Larviciding in selected containers with appropriate larvicides. 3. Biological control using fish e.g. <i>Poecilia reticulata</i> (guppy) for water storage tanks/ ponds. 4. Insecticide spraying for adult vector control in areas where patients are being reported and/or clusters of patients are reported. 	<p>Sub-committee on ‘vector control’</p> <ul style="list-style-type: none"> - AMC/AFC/ regional staff -RE - MOH - PHI - EAA - PHFOO - Local Government Officers - Community

	<ol style="list-style-type: none"> 5. Training of public health staff on entomological surveillance and practical application of suitable control measures for different breeding places. 6. Identify high risk areas (stratification of the area) for surveillance and implementation of control activities based on vector indices and disease incidence. 7. Stratification of area by mapping of data according to the disease incidence, adult vector and larval indices for emergency vector control measures and health education activities. 8. Mapping of permanent and semi-permanent breeding sites e.g. tyre dumps, cemeteries, CTB depots, plant nurseries, water tanks etc to intensify vector control activities and regular larviciding whenever indicated. 9. Ensure elimination of larval breeding habitats within houses, peri-domestic and commercial environment with the involvement of the community at risk, especially before the monsoon rains. 10. Develop and distribute a composite checklist to strengthen quality of field performance for vector surveillance and control. 	
<p>3. Ensure effective monitoring and evaluation of surveillance and control activities at Local, Regional and National level.</p>	<ol style="list-style-type: none"> 1. Identification of focal points at national, regional, district and MOH levels for coordination and integration of activities (Emergency Action Committee and Rapid Response Team). 2. Develop and distribute tools/ formats to monitor progress in implementation. 3. Conduct quarterly review meetings to evaluate control measures. 4. Pre outbreak acceleration of control activities. 	<ul style="list-style-type: none"> - Epidemiology Unit -RMO/AMC -RFO/AFC - NC/DC - DPDHS - RE - MOH -Community NGOO/CBOO
<p>4. Reduction of man-vector contact</p>	<ol style="list-style-type: none"> 1. Elimination of mosquito breeding places. 2. Encourage residents to get their houses screened to reduce mosquitoes from entering the houses for feeding and resting. 3. Use of bed nets/repellents 	<ul style="list-style-type: none"> - Media - Clinicians in Government & Private Sector -HE&P - Field Health Staff

	4. Encourage patients/suspected patients to rest under a bed net at home/hospital.	
5. Monitoring of rain fall data to forecast outbreaks and impending epidemics.	<ol style="list-style-type: none"> 1. Forecasting of rain fall pattern for preventive measures to be initiated before rain starts. 2. Monitoring of rain fall pattern in vulnerable areas by following two indicators to be disseminated to relevant authorities <ul style="list-style-type: none"> - rain fall volume - number of raining days 3. Establishment of rain fall monitoring stations in selected areas. 4. Development of an early warning system using available information <ul style="list-style-type: none"> - entomological data - morbidity data - virological data - rainfall data 	<ul style="list-style-type: none"> - Meteorological Department - Epid Unit -RMO/AMC NC/DC

Objective 3 - To strengthen liaison with civil society groups, NGOO, CBOO and relevant authorities for social mobilization in dengue control.

Strategy	Activities	Responsibility
1. Intersectoral coordination with the relevant ministries including Ministry of Education, Environment and Local Government to be strengthened to address the issues related to dengue fever and its control.	<ol style="list-style-type: none"> 1. Initiation of a National Programme to cover all urban councils and Pradeshiya Sabha, to have an effective solid waste disposal management system. 2. Strengthening advocacy for necessary political commitment and support. 3. National policy on minimizing, recycling and proper disposal of non-biodegradable plastics and polythene. 	Primary Responsibility - Ministry of Health (NC/DC) - Epidemiology Unit -Supported by CEA, Local Authorities, NGOO
2. Enhancement of participation at various voluntary organizations, NGOO, CBOO, religious groups & relevant authorities to eliminate breeding places and to reinforce efforts at household level.	<ol style="list-style-type: none"> 1. Development of an effective media programme to create awareness of DF/DHF, which would lead to sustained community action for prevention and control. 2. Intensive and effective education programmes regarding waste disposal and source reduction to include community organizations for environmental sanitation and proper garbage disposal. 	Primary Responsibility- HEB Supported by – - NC/DC -Epid. Unit -- HEB - Local authorities - Ministry of Environmental Affairs - PHI

	<p>3. Specifically address the issue of large collection of tyres that constitute a major breeding place of dengue vector.</p> <p>In this context,</p> <p>(i). Create awareness among dealers at the sites of tyre storage</p> <p>(ii) Mapping of sites of major collection of tyres</p> <p>(iii) Mobile units to spray larvicides where relevant</p> <p>4. District Environmental Committees be further strengthened by training, to organize the community (schools, youth clubs etc) for dengue prevention and control activities</p> <p>5. Health workers and volunteers to deliver a checklist of indoor and outdoor breeding places to householders for elimination of breeding places.</p> <p>6. MOOH to take action to eliminate breeding sites within a specified time, which are inaccessible to householders.</p> <p>7. In MOH office maintain and update a list of common breeding places and appoint a responsible person to take action. Facilitate building partnership for community mobilization with Samurdhi Niyamakas, members of NGOO (Sarvodaya, Lions), religious organizations, school principals and Zonal Education Directors etc.</p> <p>8. Liaise with Department of Education and make it compulsory for children to have small projects on vector control and environmental sanitation in the schools and surroundings by,</p> <ul style="list-style-type: none"> - sending circular to school in collaboration with Health Ministry. - appointing a responsible person/ teacher for co-ordination. - Awareness programmes through school health clubs within the schools and surrounding neighbourhood. <p>9. (i) Dissemination of comprehensive, accurate, clear and consistent messages through mass media regarding,</p> <ul style="list-style-type: none"> - Spread of the disease - responsibility of community for prevention and control 	<p>- Ministry of Health NC/DC</p> <p>- PHI</p> <p>- EAA</p> <p>- FAA</p> <p>Primary Responsibility- Ministry of Health</p> <p>Supported by</p> <ul style="list-style-type: none"> - Ministry of Education -Regional & Zonal Directors - MOH, PHI, - Principals, Teachers <p>Primary responsibility - HEB</p> <p>Supported by – NC/DC</p>
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	<p>(ii) Spots/messages through TV, radio and print media based on a co-ordinated approach by the media.</p> <p>10. Separate sets of messages to be developed for each target group (parents, children, traders etc) to ensure sustainability of community efforts</p>	<p>- Epid Unit - Media</p>
3. Ensure proper waste management	<ol style="list-style-type: none"> 1. Carry out regular collection and appropriate disposal of solid waste. 2. Subsidised price garbage bin for composting domestic bio-degradable waste. 3. Identification of, <ul style="list-style-type: none"> - collection centres - dumping sites for garbage. 4. Establishment of small scale projects for recycling plants and for composting. 5. Maintaining rain water draining system 6. Recycling of used tyres/ plastics. 	<p>Primary Responsibility - Ministry of Environment</p> <p>Supported by – Local Authorities</p>
4. Enforcement of legislation.	<ol style="list-style-type: none"> 1. Review and suitably amend the existing laws related to vector control 2. Ensure enforcement of legislative enactments by the relevant authorities. 	<p>Primary Responsibility -Ministry of Health - NC/DC</p> <p>Supported by - Local Authorities - MOH, PHI</p>
5. Preparation of Action Plans commencing with the high risk M.O.H. areas in collaboration with the relevant health and Local Government Authorities.	<p>Enlist the support of</p> <ul style="list-style-type: none"> - field staff of MOH - relevant organizations -Health Education Units in the hospitals - Mobile Health Education Units of the DPDHS offices 	<p>Primary Responsibility- Epidemiological Unit</p> <p>Supported by – MOH, PHI -Local Authorities</p>

Objective 4 - To identify and motivate resources to carry out research on dengue.

Strategy	Activities	Responsibility
1. Identify vector and its bionomics.	1. Carry out research on <ul style="list-style-type: none"> - efficacy of larvicides (chemical and biological) against mosquito larvae. - resting and biting behaviour, susceptibility levels to insecticides and bio-assays etc. - biological control methods. - virology and vaccine development. - serotyping - isolation of the virus strain during epidemics. - community acceptance of Bti to be utilised in water storage tanks - correlation of incidence and Breteau index, in order to validate the suitable indices for prediction of outbreaks. - contribution of Aedes albopictus to the transmission of disease. 2. Conduction of immunity studies for primary and secondary infections.	- MRI - AMC - Universities - Industrial Technology Institute
2. Improve the laboratory facilities for virus and vector studies.	1. Co-ordination and collaboration with universities, research institutions to obtain data, entomological support and training. 2. Trained the man power to improve knowledge and skills of technical staff. 3. Improve laboratory facilities in hospitals and universities.	- Epid Unit - AMC - MRI - Ministry of Health - Heads of Institutions
3. Improve the community participation for prevention and control of DF/DHF	1. Develop community based approaches and models on prevention and control of dengue. 2. Conduct studies on behavioural changes in the community with regard to prevention and control of dengue.	-Universities - Social scientists - HEB

4. Develop early warning system to predict dengue outbreaks.	<ol style="list-style-type: none"> 1. Collection of necessary information 2. Review EWS in other countries in the Region. 3. Development of a suitable system 	<ul style="list-style-type: none"> -Epid Unit - NC/DC - Universities
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Objective 5 - To develop and sustain an effective dengue control programme in Sri Lanka

Strategy	Activities	Responsibility
1. Appoint an authority with vested administrative powers for dengue control at central level.	<ol style="list-style-type: none"> 1. Appoint a Director/Dengue control programme at central level. 2. Creation of necessary cadre positions and appointment of technically competent supportive staff for the Directorate. <ul style="list-style-type: none"> - MOO, - PHII, - Entomologists - Data management staff etc. 3. Creation of necessary cadre positions and appointment of technical staff at regional level for co-ordination and implementation of control activities with divisional level staff. <ul style="list-style-type: none"> - Regional medical officers - Dengue control PHII - Entomological teams (FAA, EAA) - Data management staff 4. Delegate responsibilities at all levels to carry out the proposed activities. 	<ul style="list-style-type: none"> - Ministry of Health - Epid Unit
2. Ensure proper Health Information System	<ol style="list-style-type: none"> 1. Strengthen epidemiological surveillance system and motivate private hospitals and GPP to notify suspected and confirmed patients and deaths due to DF/DHF. 2. Implement training programmes on case definition, writing diagnosis, notification and criteria in identifying cases in OPD. 3. Notification registers and forms be made available in all reporting facilities including private sector. 4. Strengthen sentinel surveillance activities in institutions 	<ul style="list-style-type: none"> - Ministry of Health - Epid Unit - Heads of Institutions - ICN

<p>3. Regular entomological surveys during epidemics and inter-epidemic periods.</p>	<ol style="list-style-type: none"> 1. Strengthen and improve detection of outbreaks through possible mechanisms. 2. Ensure preparedness for early and effective response for disease prevention and control. 3. Identify laboratories in the district to provide collaboration and support for on-going activities. 	<ul style="list-style-type: none"> - Epid Unit - Meteorological Department - RE - MOH - PHI - FAA, EAA - PA
<p>4. Periodic reviews of preventive and control activities</p>	<ol style="list-style-type: none"> 1. Ensure continuous, accurate and timely collection of disease related data at all levels of health service and its appropriate analysis. 2. Hold regional level review meetings monthly with the proposed regional staff. 3. Hold reviews at district level monthly with MOOH, participated by an authority from central level. 4. Conduct quarterly reviews of dengue control activities at central level by Regional officers and entomological staff. 5. Strengthen capacity for data analysis and the use at district and divisional levels. 6. Develop software programmes for the new forms and formats. 7. Monitor quarterly data complication, reporting and disseminating. 8. Aggregate data at district, provincial and national level on quarterly and annual basis, for appropriate analysis. 	<ul style="list-style-type: none"> - NC/DC - Epid Unit - PDHS, DPDHS
<p>5. To strengthen and improve supportive supervision, monitoring and evaluation .</p>	<ol style="list-style-type: none"> 1. Monitoring by reviewing routine reports and by supervisory visits. <ul style="list-style-type: none"> - provincial and district supervision by central staff - divisional supervision by district level 2. Supervisory visits with appropriate checklists and indicators for monitoring. 3. Continuous technical support for training laboratory work and data handling. 4. Feedback of morbidity and mortality data to mobilise efforts for control activities with information about: <ul style="list-style-type: none"> - the number and location of reported cases - the completeness and timeliness of surveillance reports - specific recommendations on how to solve 	<ul style="list-style-type: none"> - NC/DC - Epid Unit - RE - Epid Unit

	<p>problems.</p> <p>5. Conduct annual reviews on dengue control activities.</p>	<p>- Epid Unit - NC/DC</p>
<p>6. Provision of necessary fund for the dengue control programme</p>	<p>1. Creation of specific Budget lines in the Ministry of Health and provincial health budgets.</p> <p>2. Allocation of necessary funds.</p> <p>3. Mobilization of additional funds from INGO/NGO (WHO/CDC/WB/ADB/UNICEF/USAID)</p>	<p>-Ministries of Health, Finance, External resources - Epid Unit - NC/DC</p>
<p>7. Establish information exchange with Regional countries / WHO/CDC</p>	<p>1. Access WHO Dengue Net, CDC and WHO websites on dengue.</p> <p>2. Inform the relevant units on early warning (including Epid unit web site)</p>	<p>- Epid Unit - NC/DC</p>

Annexure I.

MEMBERS OF THE SUB-COMMITTEES OF TECHNICAL EXPERTS ON CONTROL AND PREVENTION OF THE SPREAD OF DENGUE FEVER IN SRI LANKA

Sub-committee 1 - Clinical Management of DF/DHF

Name	Designation
Prof Narada Warnasooriya	(Co-ordinator), Dean/Faculty of Medical Sciences, Professor of Paediatrics, University of Sri Jayawardenapura
Prof Manori Senanayake	Professor of Paediatrics, University of Colombo
Dr D H Karunathilaka	Consultant Paediatrician, LRH, Colombo
Dr J S D K Weeraman	Consultant Paediatrician, GH, Matara
Dr Sarath Gamini de Silva	Consultant Physician, NHSL, Colombo
Dr Maxie Fernandopulle	Consultant Paediatrician
Dr. Sujatha Ruwanpathirana	Consultant Physician, TH, Ragama
Dr. Padmakanthi Gunaratna	Consultant Paediatrician, TH, Ragama
Dr Bandula Wijesiriwardena	Consultant Physician, TH, Colombo South
Dr Ranjani de Almeida	M.O. i/c OPD, LRH, Colombo
Dr. M.R.N. Abeysinghe	Epidemiologist
Dr. Devika Mendis	Medical Officer, Epidemiology Unit
Dr. Hasitha Tissera	Medical Officer, Epidemiology Unit

Sub-committee 2 - Vector Control

Name	Designation
Dr Rabindra Abeysinghe	(Co-ordinator), Consultant Community Physician, Anti-Malaria Campaign
Dr W Abeywickrama	Senior Lecturer in Parasitology, University of Kelaniya
Dr Lakshman Siyambalagoda	Director, Anti-Malaria Campaign
Dr Tilaka Liyanage	Director, Anti-Filariasis Campaign
Dr Punsiri Fernando	Consultant, Anti-Malaria Campaign
Dr Mervyn Wickramasinghe	Entomologist
Dr Nalini Jayasekera	Entomologist
Dr A M G M Yapa Bandara	RMO/ Anti-Malaria Campaign, Matale
Mr S H Kariyawasam	Deputy Director, Meteorology Department
Dr Indira Weerasinghe	Entomologist, Medical Research Institute, Colombo
Ms. Subhashini Ariyaprema	Entomologist, Anti-Filariasis Campaign
Dr. M.R.N. Abeysinghe	Epidemiologist
Mrs Devika Perera	RMO/ Anti-Malaria Campaign, Kurunegala
Mrs B.S.L.Peiris	RMO/ Anti-Malaria Campaign, Hambantota
Dr. Devika Mendis	Medical Officer, Epidemiology Unit

Sub-committee 3 - Virology and Vaccine Development

Name	Designation
Prof. Sirimalee Fernando	(Co-ordinator) Professor of Microbiology, University of Sri Jayawardenapura
Dr. Sunethra Gunasena	Virologist, Medical Research Institute, Colombo
Dr. M.R.N. Abeysinghe	Epidemiologist
Dr. Sudath Samaraweera	Medical Officer, Epidemiology Unit
Dr. Hasitha Tissera	Medical Officer, Epidemiology Unit

Sub-committee 4 – Social Mobilization

Name	Designation
Dr. N W Vidyasagara	(Co-ordinator), Former Director, F.H.B.
Prof. Dulitha Fernando	Senior Professor of Community Medicine, Colombo
Dr. Kanthi Ariyaratna	Director (HE&P), Health Education Bureau,
Dr. M.M. Janapriya	Visiting Surgeon, NHSL
Dr. Prasanna Cooray	Health Editor. <i>The Island</i> .
Dr Ajantha Perera	Environmentalist
Dr. Palitha Abeykoon	Consultant, WHO
Dr. Nirupa Pallewatta	Medical Officer, Health Education Bureau
Mr.D.M. Seneviratne	Health Education Officer, Health Education Bureau
Mrs. Lalitha Fonseka	Deputy Director General, Central Environmental Organization
Ms. Kumuduni Hettiarachchi	Deputy Editor, Sunday Times
Dr. Vinya Ariyaratna	Executive Director, Sarvodaya
Dr. M.R.N. Abeysinghe	Epidemiologist
Dr.K.D.P. Jayathilaka	Malariologist
Dr. Devika Mendis	Medical Officer, Epidemiology Unit

Sub-committee 5 – Legislative Enactments

Name	Designation
Dr Manil Fernando	(Co-ordinator), DDG (PHS), Ministry of Healthcare, Nutrition & Uva Wellassa Development.
Dr S Shanmugarajah	Director (E&OH), Ministry of Healthcare, Nutrition & Uva Wellassa Development.
Dr Pradeep Kariyawasam	CMOH, CMC
Dr T A Kulatilaka	Former Epidemiologist
Dr.E. Sundaralingam	Former Assistant Epidemiologist
Dr.T.S.R. Peiris	Assistant Epidemiologist
Dr H M S S D Herath	Former DDG (PHS)
Dr. Hasitha Tissera	Medical Officer, Epidemiology Unit

Sub-committee 6 – Co-ordination of Research on DF/DHF

Name	Designation
Prof Rajitha Wickramasinghe	(Co-ordinator), Professor of Community Medicine, Faculty of Medicine, University of Kelaniya
Dr W Abeywickrama	Senior Lecturer in Parasitology, University of Kelaniya
Prof Sirimalee Fernando	Professor of Microbiology, University of Sri Jayawardenapura
Dr Indira Weerasinghe	Entomologist, Medical Research Institute, Colombo
Dr Radhika Samarasekera	Senior Research Officer, Industrial Technical Institute, Colombo
Dr R R Abeysinghe	Consultant Community Physician, AMC, Colombo
Dr A M G M Yapa Bandara	RMO/AMC, Matale
Ms. P H D Kusumawathie	RMO/AMC, Kandy
Dr. Paba Palihawadana	Deputy Epidemiologist, Epidemiology Unit

Annexure II

Guidelines on Clinical Management of DF/DHF

With the increase in morbidity and mortality due to DF/DHF, several issues with regard to clinical management were identified and guidelines were prepared on the following major areas.

1. Out patient and first contact management-

- Admission criteria to prevent overcrowding of the wards due to unnecessary hospitalisation
- Investigation and assessment of the patient at outpatient basis for early detection of severe forms and complications of DF/DHF with the aim of prevention of mortality.

2. Improvement of the management of hospitalised patients

- Indications for fluid replacement with special emphasis on prevention of fluid overload
- Indications for administration of colloid solutions,
- Indications for blood transfusion
- Indications for platelet transfusion
- Discharge criteria

3. Improvement of laboratory investigations

Provision of facilities required for laboratory investigation including haematocrit and platelet count at various levels of health care delivery

- Fully automated blood counters for provincial and teaching hospitals
- Microhaematocrit for paediatric and medical wards
- Strengthening of night lab staff during epidemics

4. Mortality review

To identify any preventable deficiencies during the prehospital or hospital course of management, mortality review to be held at institutional level.

The detailed guidelines are available as a printed manual and in the website of the Epidemiology unit.

Annexure III

Guidelines on Vector Surveillance and Control

1. Vector surveillance and control activities for control of DF/DHF need to be carried out **through out the year even during the low transmission season.**
2. National level clean up programmes needs to be carried out bi-annually before the onset of monsoon rains preferably during **the first week of April and August.**
3. High-risk MOH areas for transmission of DF/DHF and high-risk areas/localities within MOH areas need to be identified, where control interventions should be strengthened.
4. In each high-risk area, the important breeding places of vector mosquitoes need to be mapped out and regularly monitored to facilitate surveillance and control activities.
5. In the selected high-risk areas, sentinel sites for vector surveillance should be identified based on case incidence and available entomological data and regularly monitored , in order to forecast epidemics/ outbreaks.(Refer guidelines for vector surveillance , *Annexure A*).
6. **The main strategy for dengue control is elimination/reduction of breeding places.** Whenever necessary suitable larval control agents (biological/chemical) could be applied to permanent collections of water identified as breeding places, to achieve sustainable reduction in vector density.(Refer guidelines for use of chemicals for vector control *Annexure B*).
Larvivorous fish (*Poecelia reticulata*) or temephos 1% SG are recommended for use as dengue larval control agents where water collections in tanks or barrels have been identified as a major contributor to vector breeding.
7. Space spraying of insecticides in the form of thermal fog or ULV spraying needs to be carried out as early as possible within a period of 2 weeks of case identification, in an area with a minimum radius of 200 metres around a cluster* of suspected dengue cases to reduce the population of infective mosquitoes. **This activity should be augmented by mandatory clean up programmes to remove vector-breeding sites.**

**Even a single case of dengue fever in a high- risk area and more than 1 case in other areas will be considered as a cluster if evidence for local transmission has been established.(This definition of a cluster has been adopted due to the fact that there could be many sub-clinical cases when one case of dengue fever is reported).*

8. In order to prevent the serious repercussions of indiscriminate use of various types of insecticides for adult and larval control of dengue vector mosquitoes, it is advised that only the chemicals recommended by the advisory committee on communicable diseases should be utilized for this purpose.
9. The community should be motivated to avoid growing of plant species, which serve as breeding places of dengue vector (e.g. Bromelia, cordiline species etc.).
10. It is the primary responsibility of the public health staff to obtain active participation of the community, NGOO / CBOO, government departments and the private sector in the elimination of breeding places.
11. The MOH and PHI should implement the regulations under the mosquito borne disease prevention act, once it is in effect.

Annexure A

Guidelines for dengue vector surveillance

1. Vector Surveillance

The main purpose of dengue vector surveillance (larva, pupal and adult) is to obtain information regarding dengue vectors, which can be used to control dengue transmission.

The objectives of vector surveillance activities are;

1. To determine the major breeding sites in the environment
2. To forecast possible dengue outbreaks based on vector indices
3. To determine seasonal fluctuations in vector populations.
4. To utilize data on vector densities and breeding sites to plan and implement control activities.

2. Larval Surveys

These surveys can be carried out by entomological teams attached to Regional Medical Officers of the AMC and AFC or through larval survey teams established at MOH offices.

2.1. Surveys by Entomological Teams attached to Regional Offices of AMC and AFC these surveys could be in sentinel sites or in potentially vulnerable areas

2.2. Surveys by Larval Survey Teams attached to the MOH Offices – 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 Public Health Field Assistants and two or more spray machine operators/labourers.

2.3. Methodology of surveys by Entomological Teams

- A minimum of 100 houses should be surveyed within a radius of 200 – 300 meters at the sentinel sites selected. Such sentinel sites could be one or several within districts or towns, based on the epidemiological potential for dengue outbreaks in an area. Factors that could help in identifying sentinel 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 in Table 1. All collected larvae and pupae should be identified by Entomological Assistants into species. The Breteau Index, Container Index and House Index should be calculated for each survey carried out. Teams should help occupants to modify or destroy

breeding sites and educate the community on how to minimize dengue vector breeding.

2.4. Indices used for larval surveys

Three indices are commonly used to measure *Ae. aegypti* and *Ae. albopictus* density levels

a. The House (premises) Index (HI)

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

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

b. Container Index (CI)

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

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

c. Breteau Index (BI) :

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

$$\text{BI} = \frac{\text{No. of } Aedes \text{ positive containers}}{\text{No. of houses inspected}} \times 100$$

2.5. 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

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

3.0 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 Public Health Field Officer and 2 Labourers/Spray machine operators

- i. These surveillance units should permanently be attached to the relevant MOH office.
- ii. Possible risk areas should be identified and prioritised.
- iii. One surveillance unit should survey 50 houses per day.
- iv. Duration of one round should be 2 weeks. (that means each house is surveyed twice a month)
- v. Health education should be given to the occupants of the houses with *Aedes* positive breeding places for elimination /reduction of breeding places

- vi. The team can help the occupants of the houses to eliminate the breeding places
- vii. When necessary larviciding could be carried out in the area.
- viii. All relevant information of each house should be included in a data form (already this form has been designed). PHFO should give this form to Public Health Inspector/ Anti Malaria Campaign (PHI/AMC) or relevant range PHI.
- ix. If there is any urgent matter action should be taken by relevant PHI immediately.
- x. At the end of the week (Saturday) data should be summarized and a weekly report should be prepared. This should be submitted to MOH through the PHI with a copy to RMO/AMC and DPDHS.
- xi. Houses with heavy mosquito breeding should be followed up by the relevant PHI.
- xii. During the house visits for vector surveillance PHFO should inquire the inmates regarding the fever cases & these data should also be included in the data form.
- xiii. These fever cases should be blood filmed & examined for malaria in malaria endemic areas.
- xiv. According to the survey if both mosquito density & fever incidence is high, the MOH and RMO/AMC should be informed for a detailed entomological investigation.
- xv. If dengue vectors are found according to the detailed entomological investigation (under no. (xi) and suspected dengue fever cases are also found during the further investigations made by MOH vector control activities should be carried out as per guidelines on vector control.

4.0 **Special activities**

These activities should be carried out by Entomological Teams specially the teams attached to the MRI. Data collected from these activities will help control personnel identify effective control strategies, and help make necessary changes based on changes in vector bionomics. Some of the special activities that need to be carried out are

- Determining indoor resting densities
- Determining outdoor resting densities
- Identifying preferred resting surfaces
- Determining feeding behaviour – indoor/outdoor, time of biting etc.
- Determining susceptibility of vectors to insecticides.

ENTOMOLOGICAL INVESTIGATIONS 200..
 DISTRICT
DENGUE VECTOR (*Aedes*) LARVAL SURVEY

Locality :-Name of EA.....

MOH Area :-

Date of Investigation :-

Name and address of patient:-----

Se No	Ass No	House Holder's Name and Address	BREEDING PLACES								Results And Remark										
			Type of Container	In/Out	Water			+ve	Species			No. of pupae									
					+	-	volume		A	B		No.	A	B							
				I/O																	
				I/O																	
				I/O																	
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 Entomological assistant

ENTOMOLOGICAL INVESTIGATION 200----

Report of Larval surveys

----- District

Locality:-----

MOH area:-----

Date:-----

Name of patient:-----

Address:-----

Type of premises	No. examined	No. positive for <i>Ae. aegypti</i> (A) and <i>Ae. albopictus</i> (B)			
		A	B	AB	
Houses					
Commercial sites					
Government Institutions					
Dumping yards					
Building sites					
Others (specify)					

Summary of containers

Type of container	No. examined	No. positive for <i>Aedes aegypti</i> (A) and <i>Ae. albopictus</i> (B)				
		A	B	AB	A	B
INDOOR						
Flower vases						
Water storage tanks						
Water storage barrels						
Discards receptacles						
OUT DOOR						
Tyres						
Water storage tanks						
Water storage barrels						
Discarded receptacles						
Ornamental						
Natural plants						
Roof gutters						
Others (specify)						

Index	A	B	AB
House Index			
Container Index			
Breuteu Index			

Recommendation by the Regional Medical / Malaria Officer:-----

.....
 RMO/ District

Annexure B

Guidelines for use of chemicals for vector control

Space spraying

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

Space spray treatments

Organization of the spray team

A spray team should consist of one Public Health Inspector, a PHFO trained for space spraying and three Spray Machine Operators.

- The responsible officer (PHI or PHFO) of the spray unit should be present with the spray unit through out the activity for observation and attending to any emergency.
- All persons involved in the application of space spraying must wear overalls, protective gloves, suitable respirator, ear plugs, goggles, and boots.
- Filter of the respirator must be periodically changed.

Pre-space spraying activities

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

- The maps of the area to be sprayed must be studied carefully before the spraying operation begins.
- The area covered should be at least 200 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. Spraying should always be done from downwind to upwind, i.e. going against the direction of the wind.

Information to be given to inhabitants

- Time of spraying, for example 0800 to 1000 hours.
- All doors and windows should 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.
- Children or adults should not follow the spray squad from house to house.

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

1. Optimum spraying conditions

- Spraying should be done in the early morning and late evening hours as adult *Aedes* mosquitoes are most active at these hours.
- Spraying 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.
- Spraying 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.
- Spraying is permissible during light showers as the mosquito activity increases with the relative humidity.

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.

	Most favourable conditions	Average conditions
Time	Early morning (0600*-1000 hrs) or late evening (1600-1800 hours)	Early to mid-morning or late afternoon, early evening
Wind	Steady, between 3-13 km/hr	0-3 km/hr
Rain	No rain	Light showers
Temperature	Cool	Mild

* For practical reasons spraying should be commenced at 0800 hrs.

Frequency of application

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

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

Spraying Technique

Vehicle-mounted spraying

- Doors and windows of houses and buildings in the area to be sprayed should be opened.
- The vehicle is driven at a steady speed of 6-8 km/hr (3.5-4.5 mile/hr) along the streets. Spray production should be turned off when the vehicle is stationary.
- When possible, spraying should be carried out along streets that are at right angles to the wind direction. Spraying should commence on the downwind side of the target area and progressively move upwind.
- In areas where the roads are narrow, and houses are close to the roadside, the spray head should be pointed directly towards the back of the vehicle.
- When there are inadequate roads to cover an area by the vehicle mounted fogging machine, additional hand operated fogging machines need to be utilised to spray the inaccessible houses.
- In dead-end roads, the spraying should be done only when the vehicle is coming out of the dead-end, not while going in.
- The spray head should be pointed at a 45° angle to the horizontal to achieve maximum throw of droplets.

Hand operated (Portable) thermal fogging

- Thermal fogging with hand operated thermal foggers should be done from house to house, always fogging from downwind to upwind.
- 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 μ m. 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.

$$\text{OUT PUT RATE (m}^2/\text{minute)} = \text{Vehicle speed (m/hour) X width of the track spacing (m)}$$

$$10000 \text{ m}^2 = 1 \text{ hectare}$$

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:

$$\frac{\text{Target application rate (ml/hectare) X area of the house (hectare)}}{\text{flow rate (ml/min)}}$$

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

Insecticide	Chemical ^a	Dosage of ai. ^b (g/ha)	
		Cold	Thermal
Malathion	OP	112-693	500-600
Deltamethrin	PY	0.5 – 1.0	-
Cypermethrin	PY	1-3	-
Etofenprox	PY	10-20	10-20

^a PY = Synthetic pyrethroid, OP = organophosphorus,

^b ai. = active ingredient

Source: WHO(1997), WHO/CTD/WHOPES/97.2

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 Dengue Vector Control

Temephos (Abate) 1% granules can be used in water containers to kill mosquito larvae. If kept in a cloth sachet it will be more cost effective than direct application of granules in the water as the sachet can be reused after washing the water storage containers.

Size of water container in litres	Grams of 1% granules required	No. of teaspoons required assuming one teaspoon holds 5 g
Less than 25	Less than 5	Pinch : small amount held between thumb and finger
50	5	1
100	10	2
200	20	4
250	25	5
500	50	10
1000	100	20

1 cubic meter = 1000 litres

**Daily application report
(portable and vehicle-mounted equipment)**

- Date:
- Make and model of equipment:
- Serial Number:
- Type and No. of nozzle:

- Locality and description of area sprayed (a map may be attached):

- Type of space spraying (thermal fogging/cold fogging):

- Wind condition :

Low

Medium

Strong

- Time of application
 - start
 - Finish:
 - Total time of spraying:

- Insecticide used
 - Product name and concentration:
 - Amount of formulated product used:
 - Dilution rate and type of diluent:
 - Targeted application rate (ml/ha):

- Spray coverage
 - Area targeted (ha)
 - Area actually sprayed (ha):
 - Number of houses/rooms:

Vehicle mounted equipment
▪ Vehicle speed (km/h):

- Remarks:

Name and signature of sprayman:

Supervisor: Name and signature and date:
Remarks: