17. Annexes

1. Arbovirus laboratory request form

Name of patient _____ Hospital No. _____

Address _____ Hospital _____

Age _____ Sex _____ Physician _____

Date of admission _____ Admission complaint _____

Date of onset _____

Clinical findings:

1. Fever _____ °C or °F (max). Duration _____ days
2. Tourniquet test _____ Petechiae _____ Epistaxis _____
   Haematemesis/melaena _____ Other bleeding (describe) _____
3. Hepatomegaly _____ (cm at right costal margin). Tenderness _____
4. Shock _____ Blood pressure _____ (mmHg) Pulse _____ (per min.)
   Restlessness/Lethargy _____ Coldness of extremities/body _____

Clinical laboratory findings:

Platelets (X103) _____/mm^3 (on _____ day of illness)

Haematocrit (%) _____ (max) _____ (min)

Blood specimens

(Acute) Hospital admission	Hospital discharge	Convalescent
Date_____	Date_____	Date_____
○	○	○

Instructions: Fill the form completely with all clinical findings in duplicate. Saturate the filter-paper discs completely so that the reverse side is saturated and clip them to the form. Obtain admission and discharge specimens from all patients. If the patient does not return for a convalescent sample, mail promptly.

Source: *Dengue Haemorrhagic Fever: Diagnosis, treatment, prevention and control, Second edition, WHO, Geneva, 1995.*

2. International Health Regulations (IHR, 2005)

Core obligations for Member States

- Designate a National IHR Focal Point as the operational link for urgent communications concerning the implementation of the Regulations.
- Develop, strengthen and maintain the surveillance and response capacity to detect, assess, notify, report and respond to public health events, in accordance with the core capacity requirements under the IHR (2005).
- Notify WHO of all events that may constitute a public health emergency of international concern (PHEIC) within 24 hours of assessment by using the decision instrument [an algorithm].
- Respond to requests for verification of information regarding public health risks.
- Provide WHO with all relevant public health information, if a State Party has evidence of an unexpected or unusual public health event within it territory, which may constitute a PHEIC.
- Control urgent national public health risks that threaten to transmit diseases to other Member States.
- Provide routine inspection and control activities at international airports, ports and some ground crossings to prevent international disease transmission.
- Make every effort to fully implement WHO-recommended temporary and standing measures and provide scientific justification for any additional measures.
- Collaborate with other States Parties and with WHO in implementing the IHR (2005), particularly in the area of assessment, provision of technical and logistical support, and mobilization of financial resources.

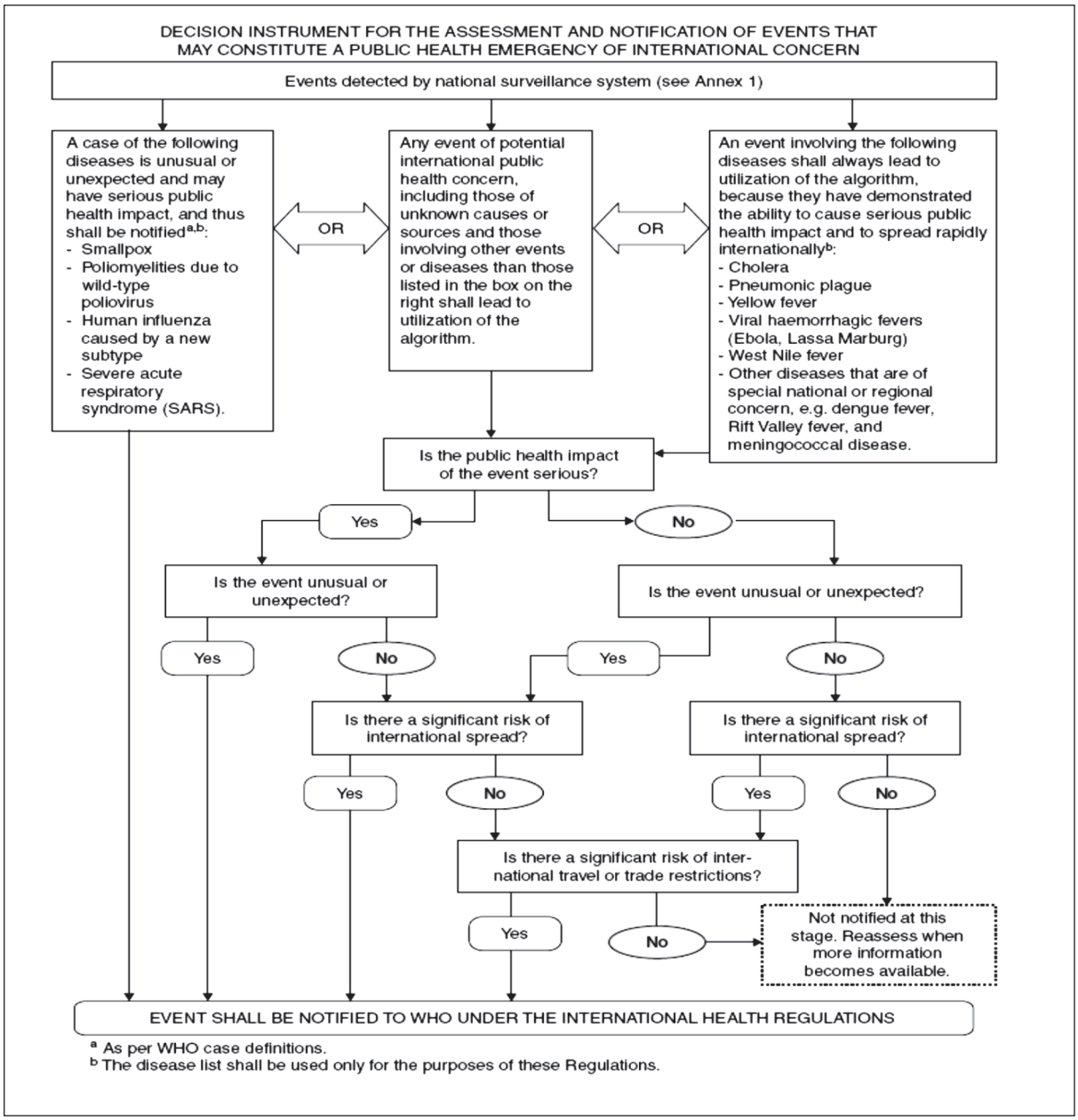
Core obligations for WHO

- Designate WHO IHR contact points as operational links for urgent communications concerning the implementation of the IHR (2005).
- Support Member States' efforts to develop, strengthen and maintain the core capacities for surveillance and response in accordance with the IHR (2005).
- Verify information and reports from sources other than official notifications or consultations, such as media reports and rumors, when necessary.
- Assess events notified by Member States (including on-site assessment, when necessary) and determine if they constitute a public health emergency of international concern.
- Provide technical assistance to States in their response to public health emergencies of international concern.
- Provide guidance to States to strengthen existing surveillance and response capacities to contain and control public health risks and emergencies.

- Provide all Member States with public health information to enable Member States to respond to a public health risk.
- Issue temporary and standing recommendations on control measures in accordance with the criteria and the procedures set out under the Regulations.
- Respond to the needs of Member States regarding the interpretation and implementation of the IHR (2005).
- Collaborate and coordinate its activities with other competent intergovernmental organizations or international bodies in the implementation of the IHR (2005).
- Update the Regulations and supporting guides as necessary to maintain scientific and regulatory validity.

Source: *http://www.who.int/ihr/about/en/ and http://www.who.int/ihr/about/FAQ2009.pdf*

3. IHR Decision Instrument for assessment and notification of events



Source: http://www.who.int/ihr/en/

4. Sample size in *Aedes* larval surveys

For *Aedes* larval surveys, the number of houses to be inspected in each locality depends on the level of precision required, level of infestation, and available resources. Although increasing the number of houses inspected leads to greater precision, it is usually impractical to inspect a large percentage of houses because of limited human resources.

Table A shows the number of houses that should be inspected to detect the presence or absence of infestation. For example, in a locality with 5000 houses, in order to detect an infestation of >1%, it is necessary to inspect at least 290 houses. There is still a 5% chance of not finding any positive houses when the true House Index = 1%.

Table A: Number of houses that should be inspected to detect *Aedes* larval infestation

Number of houses in the locality	True House Index		
	>1%	>2%	>5%
100	95	78	45
200	155	105	51
300	189	117	54
400	211	124	55
500	225	129	56
1000	258	138	57
2000	277	143	58
5000	290	147	59
10 000	294	148	59
Infinite	299	149	59

Table B shows the number of houses that should be inspected in a large (>5000 houses) positive locality, as determined by the expected House Index and the degree of precision desired. For example, if the preliminary sampling has indicated that the expected House Index is approximately 10%, and a 95% confidence interval of 8%–12% is desired, then 1000 houses should be inspected. If there are only sufficient resources to inspect 200 houses, the 95% confidence limits will be 6%–14%. In other words, there is a 5% chance that the true House Index is less than 6% or greater than 14%.

In small localities, the same precision may be obtained by inspecting fewer houses. For example, if the expected House Index is 50% and a 95% confidence interval of 44%–56% is acceptable, then in a large locality it would be necessary to inspect 300 houses (Table B). However, as seen in Table C, if the locality consists of only 1000 houses, the same precision will be obtained by inspecting 231 houses.

Table B: Precision of the *Aedes* House Index in large localities (>5000 houses)

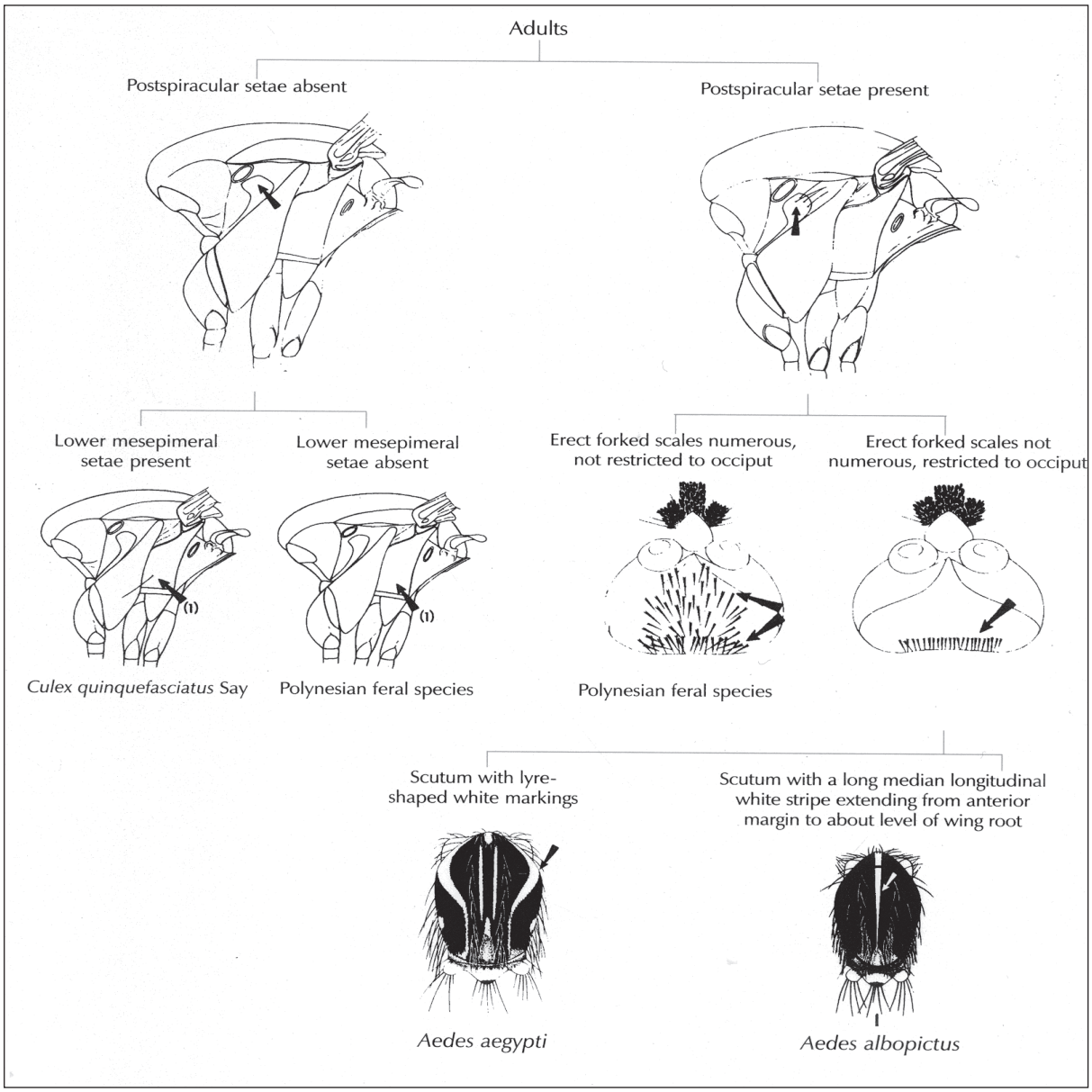
House Index (%)	95% confidence interval of the House Index Number of houses inspected			
	100	200	300	1000
2	0.2–7.0	0.5–5.0	0.7–4.3	1.2–3.1
5	2–11	2–9	3–8	4–7
10	5–18	6–14	7–14	8–12
20	13–29	16–26	16–25	18–23
50	40–60	43–57	44–56	47–53
70	60–79	62–76	64–75	67–73

Table C: Number of houses to inspect in small localities

Total number of houses in the locality	Number of houses to be inspected for desired precision if this were a small locality (from Table B)			
	100	200	300	1000
50	33	40	50	50
100	50	66	75	100
200	67	100	120	170
300	77	122	150	230
400	80	134	171	290
500	83	142	189	330
1000	91	166	231	500
5000	100	200	285	830
10 000	100	200	300	910
20 000	100	200	300	950
30 000	100	200	300	1000
40 000	100	200	300	1000
100 000		200	300	1000

Source: Pan American Health Organization. Dengue and dengue haemorrhagic fever in the Americas: Guidelines for prevention and control. Washington: WHO/PAHO; 1994. (Scientific publication; no. 548).

5. Pictorial key to *Aedes (Stegomyia)* mosquitoes in domestic containers in South-East Asia

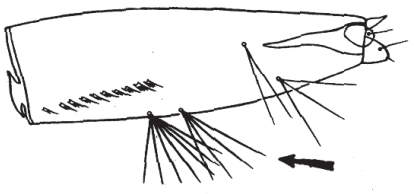


Source: Adapted from: Yiau-Min Huang. The mosquitoes of Polynesia with a pictorial key to some species associated with filariasis and/or dengue fever. Mosquito Systematics, 1977, 9(3): 289-322.

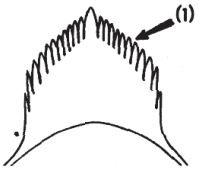
Annex 5 (contd)

Larvae

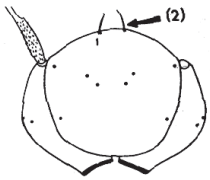
Siphon with 4 pairs of subventral tufts



(1) Mental plate with at least 10 teeth on each side of median tooth

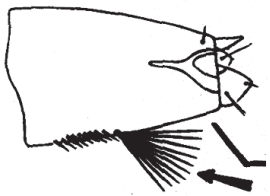


(2) Seta 1-C very slender, filamentous distally, usually very lightly pigmented

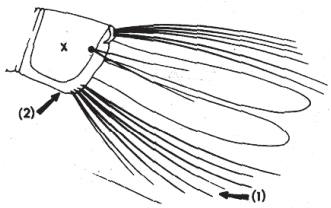


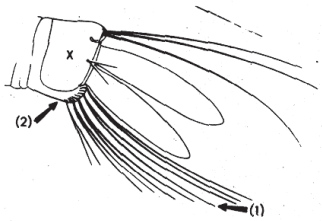
Culex quinquefasciatus Say

Siphon with a single pair of subventral tufts

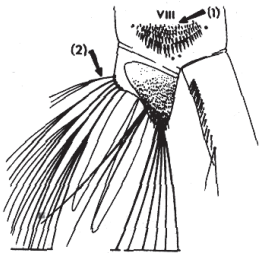


(1) Ventral brush with 4 or 5 pairs of setae and
(2) no precratal tufts



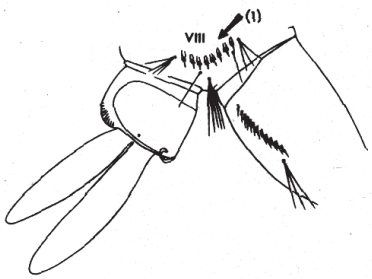


(1) Comb in a patch of several rows of scales, those of distal row elongate and varied in development

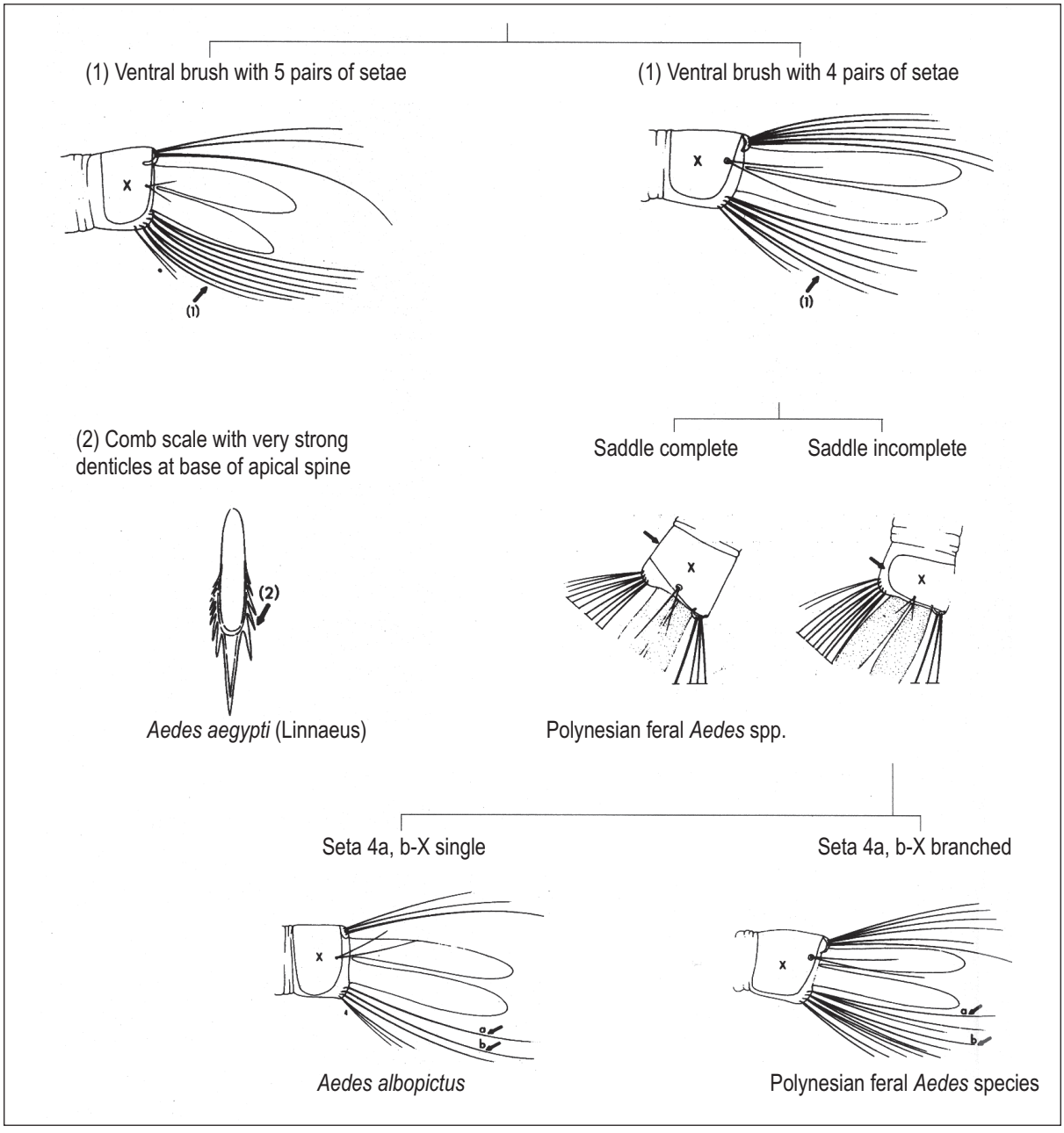


Polynesian feral *Aedes* species

(1) Comb in a single row

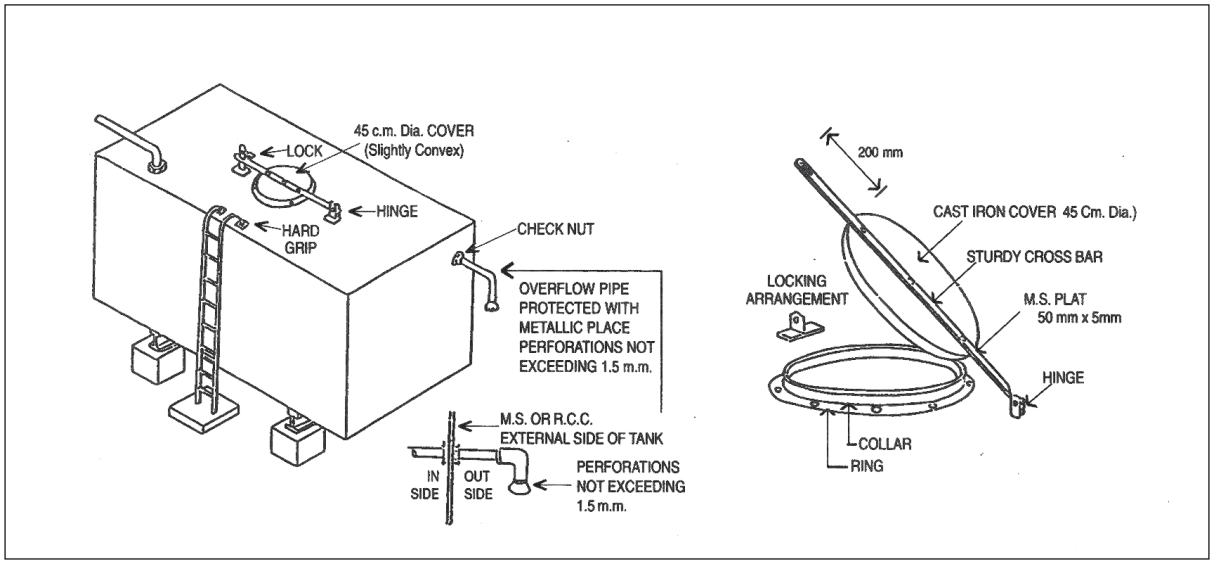


Annex 5 (contd)

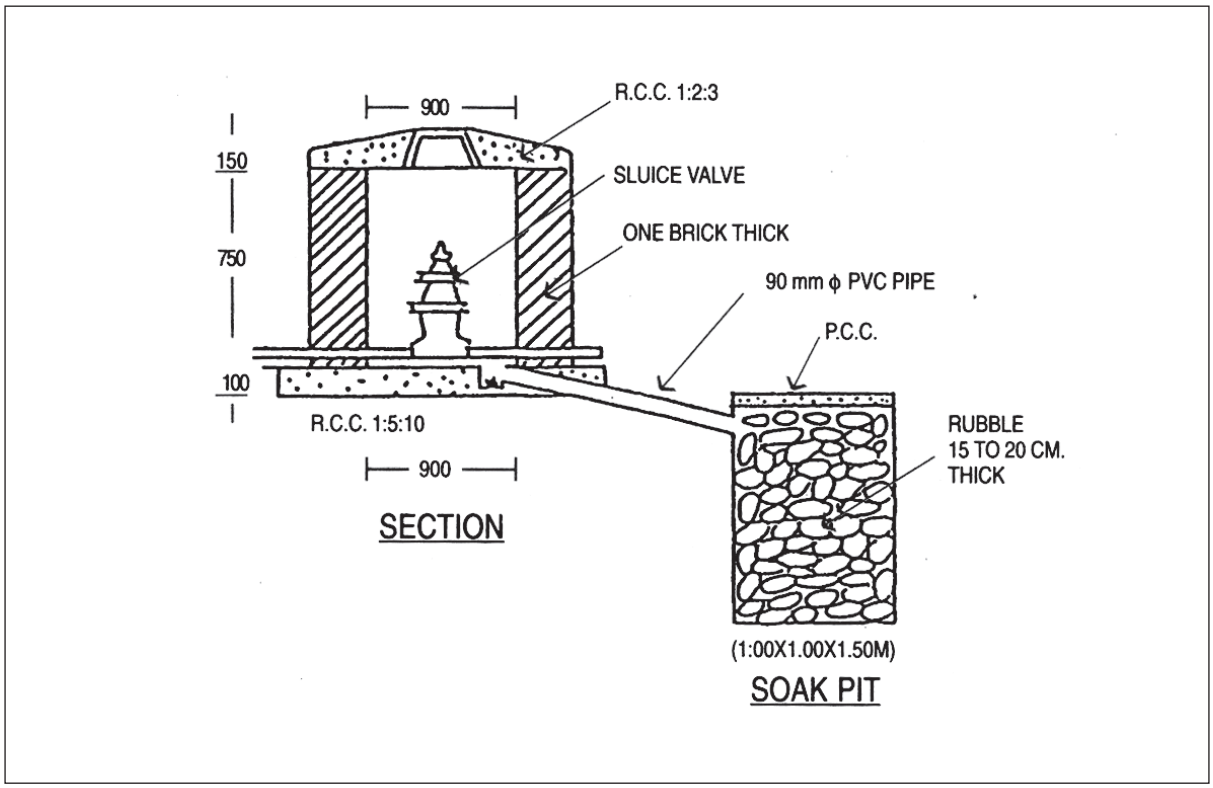


6. Designs for overhead tank with cover, masonry chamber and soak pit

(a) Standard design for overhead tank with cover design for mosquito proofing of overhead tanks and cisterns



(b) Design for masonry chamber and soak pit for sluice valve and water meter



Source: Sharma R.S., Sharma G.K., Dhillon GPS, Epidemiology and control of malaria in India. 1996. Dte. of NMEP, 22 Shamnath Marg, Delhi 110 054, India.

7. Procedure for treating mosquito nets and curtains

The steps described below mainly refer to treatment of mosquito nets with permethrin. The net treatment technique can be easily used for curtains.

(a) Calculate the area to be treated

Measure the height, length and width of the net. Assuming a rectangular mosquito net is 150 cm high, 200 cm long and 107 cm wide, the calculations are as follows:

Area of one end = 107 x 150 = 16 050 cm^2

Area of one side = 200 x 150 = 30 000 cm^2

Area of top = 107 x 200 = 21 400 cm^2

The sides and ends need to be multiplied by 2:

2 (16 050 + 30 000) = 92 100 + 21 400 = 113 500 cm^2

(end) (side) (top)

If 10 000 cm^2 = 1 m^2 then

113 500/10 000 = 11.35 m^2 area of net

(b) Determine how much insecticide is needed

Assume that a permethrin emulsifiable concentrate will be used, and the dosage desired is 0.5 grams per square metre.

To determine the total grams required, multiply the net size by the dosage:

11.35 x 0.5 = 5.67 grams of insecticide needed.

(c) Determine the amount of liquid required to saturate a net

In order to determine the percentage solution to be used for dipping, it is first necessary to determine the approximate amount of water retained by a net. Another term for dipping is soaking.

Pour five litres of water, but preferably a dilute solution of the insecticide to be used, into a plastic pan or other suitable container. For cotton, a 0.3% solution can be tried; for polyethylene or other synthetic fibre, a 1.5% solution can be tried. Add the net to the solution till it is thoroughly wet and then remove it. Allow the drips to fall into a bucket for 15 to 30 seconds. Set the net aside. Repeat the process with two other nets. Cotton nets can be lightly squeezed but not the synthetic ones. Measure the water or solution remaining in the dripping/soaking container and in the bucket to calculate the amount of liquid used per net.

Assuming that one polyethylene net retained 280 ml of solution, the percentage concentration required for dipping is calculated as follows:

$$\frac{\text{grams required per net}}{\text{ml solution retained per net}} = \frac{5.67}{280} = 2\%$$

(d) Preparation of dipping solutions to treat bulk quantities of mosquito nets or curtains

The general formula is:

$X = (A/B) - 1$

in which,

X = parts of water to be added to one part of emulsifiable concentrate.
A = concentration of the emulsifiable concentrate (%).
B = required concentration of the final solution (%).

Example: A 2.0% solution of permethrin for dipping nylon mosquito nets or curtains is to be prepared from a 25% concentrate.

$X = (25/2.0) - 1 = 12.5 - 1 = 11.5$

Therefore 11.5 parts of water to one part of concentrate are required, or one litre of concentrate to 11.5 litres of water.

Example: A 2.0% solution of permethrin for dipping nylon mosquito nets or curtains is to be prepared from a 50% concentrate.

$X = (50/2.0) - 1 = 24$

Therefore, 24 parts of water to one part of concentrate are required, or one litre of concentrate to 24 litres of water.

Example: A 0.3% solution of permethrin for dipping cotton mosquito nets or curtains is to be prepared from a 25% concentrate.

$X = (25/0.3) - 1 = 83.3 - 1 = 82.3$ or rounded to 82.

Therefore, 82 parts of water to one part concentrate are required, or one litre of concentrate to 82 litres of water, or half a litre of concentrate to 41 litres of water to accommodate a smaller container.

Example: A 0.3% solution of permethrin for dipping cotton mosquito nets or curtains is to be prepared from a 50% concentrate.

$X = (50/0.3) - 1 = 166.6 - 1 = 165.6$ or rounded to 166.

Therefore, 166 parts of water to one part of concentrate are required, or one litre of concentrate to 166 litres of water, or half a litre of concentrate to 83 litres of water to accommodate a smaller container.

(e) Preparation of a 2% dipping solution using a one litre bottle of 25% or 50% permethrin emulsifiable concentrate for soaking polyethylene or other synthetic fibre nets or curtains. This operational approach minimizes detailed measurements in the field.

For 25% concentrate:

Add 11.5 litres water to a container (with premeasured marks to indicate volume).

Add 1 litre (1 bottle) concentrate to the container.

Total volume: 12.5 litres

Grams permethrin: 250

% concentration: 2%

For 50% concentrate:

Add 24 litres water to a container.

Add one litre (one bottle) concentrate to the container.

Total volume: 25 litres

Grams permethrin: 500

% concentration: 2%

(f) Preparation of a 0.3% dipping solution using a one litre bottle of 25% or 50% permethrin emulsifiable concentrate for soaking cotton nets or curtains

For 25% concentrate:

Add 82 litres of water to a container.

Add one litre (one bottle) concentrate to the container.

Total volume: 83 litres

Grams permethrin: 250

% concentration: 0.3%

For 50% concentrate:

Add 166 litres of water to a container.

Add one litre (one bottle) concentrate to the container.

Total volume: 167 litres

Grams permethrin: 500

% concentration: 0.3%

(g) Drying of nets

Polyethylene and synthetic nets are dried in a horizontal position. Do not hang to dry. Drying the nets on mats removed from houses has proved to be convenient and acceptable. The nets should be turned over about once every hour for up to three or four hours. If the weather is good, the nets can be dried outside in the sun but for not more than several hours. Under rainy conditions, they can be placed in sheltered areas or inside and left overnight to dry. When dripping stops, they can be hung for completion of drying. Treated cotton nets which are not oversaturated and do not drip can be hung up to dry soon after the soaking procedure.

(h) Treatment of one net in a plastic bag (soaking)

As shown in (a) above, if it is assumed that the net size is 11.35 m^2, 5.67 grams of permethrin are needed to achieve a target dosage of 0.5 grams per square metre, and a net of this size absorbs 280 ml of solution.

The amount of 25% permethrin emulsifiable concentrate to use is determined as follows:

grams required x 100 = 5.67 x 100 = 22.68 ml (rounded to 23 ml)
% concentrated used: 25

Therefore, 23 ml of 25% permethrin is mixed with 280 ml of water. The net is placed inside the bag and the solution added. The net and solution are mixed together, shaken and kneaded in the bag. The net is removed and dried on top of the bag or a mat as described in (g) above. The amount of water can be reduced by 23 ml if there is excess run-off after the net is removed from the bag.

(i) Summary of treatment procedures

The important points in the treatment are summarized as follows:

(1) Dipping is the preferred method of net treatment. A 2% solution is usually sufficient to achieve a target dosage of 0.5 grams per square metre of permethrin on polyethylene, polyester, nylon or other type of synthetic fibre net or curtain. The residual effect lasts for six months or more. A 2% solution can be prepared simply by pouring the contents of a one litre bottle of 25% permethrin emulsion concentrate into a container with 11.5 litres of water. With a 50% concentrate, one litre is poured into 24 litres of water. The container used can be marked to show one or both of these volume levels. A 0.3% solution is normally required for cotton material, which absorbs more liquid. Staff need to check on the dosage applied and refine the operation accordingly. With bamboo curtains or mats used over doors or windows, a higher dosage (1.0 gram per square metre) can be used.

(2) Dipping the nets in a permethrin solution is a fast and simple method for treating nets and curtains in urban or rural housing conditions. Community members can easily learn the technique required for follow-up treatment. A dish-pan type of plastic or aluminum container which holds 15 to 25 litres of solution has been found to be quite suitable. Normally, about one litre of solution can treat four to five double (10m^2)-sized polyethylene or polyester nets. When the nets are removed from the solution, they should be held to drip in a bucket for no more than one minute before being laid out to dry in a horizontal position. Straw mats removed from houses are quite suitable for drying the nets outside in the open air. With one dipping station, about 150 nets or curtains can be treated in two hours or less.

(3) About 100 treated double-sized nets or an equivalent area of curtain material can protect 250 persons. It is not reasonable to expect every person in a crowded household to sleep under a net. It is important that every house in a community or village has one or two treated nets to kill mosquitoes so as to reduce the vector density. When used in this manner, protection is provided to those who do not even sleep under the nets. Infants and small children can sleep under the nets during the day.

8. Quantities of 1% temephos (abate) sand granules required to treat different-sized water containers to kill mosquito larvae

Table D: Quantities of 1% temephos (abate) sand granules required to treat different-sized water containers

Size of water jar, drum or other container (in litres)	Grams of 1% granules required	Number of teaspoons required, assuming one teaspoon holds 5 grams
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

Methoprene (altosid) briquettes can also be used in large water drums or overhead storage tanks. One briquette is suitable to treat 284 litres of water. Briquettes of *Bacillus thuringiensis H-14* can also be used in large cistern tanks.

Source: WHO/Western Pacific Region Background Document No. 16, 1995.

9. Procedure, timing and frequency of thermal fogging and ULV space spray operations

Basic steps

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

- The street maps of the area to be sprayed 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.
- Ensure proper traffic control when conducting outdoor thermal fogging since it can pose a traffic hazard to motorists and pedestrians.
- The most essential information about the operational area is the **wind direction.** Spraying should always be done from downwind to upwind, i.e. going against the direction of the wind.

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/h (3.5–4.5 miles/h) 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 streets run parallel as well as perpendicular to the wind direction, spraying is only done when the vehicle travels upwind on the road parallel to the wind direction.
- In areas with wide streets with houses and buildings far away from the roadside, the spray head should point at an angle to the left side of the vehicle (in countries where driving is on the left side of the road). The vehicle should be driven close to the edge of the road.
- 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.
- In dead-end roads, the spraying is 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 effect with droplets.
- Vector mortality increases downwind as more streets are sprayed upwind in relation to the target area.

Portable thermal fogging

- Thermal fogging with portable thermal foggers is 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-storeyed 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 multistoreyed buildings, fogging is carried out from upper floors to the ground floor and from the back of the building to the front. This ensures that the operator has good visibility 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 metres in front of the fog tube. Adjust the fog setting so that oily deposits on the floor and furniture are reduced.

Backpack aerosol spraying with ULV attachments

- Each spray squad consists of four spraymen and one supervisor.
- Each sprayman sprays for 15–30 minutes and is then relieved by the next sprayman. For reasons of safety, he must not spray when tired.
- The supervisor must keep each sprayman in his sight during actual spraying in case he falls or needs help for any reason.
- Do not directly spray humans, birds or animals that are in front of spray nozzles and less than five metres away.
- Spray at full throttle. For example, a ULV Fontan nozzle tip 0.4 can deliver 25 ml of malathion per minute, and a 0.5 tip, 65 ml. The smaller tip is usually preferred unless spraymen move quickly from house to house. Some machines can run for about one hour on a full tank of petrol.

House-spraying technique

- Do not enter the house. House spraying means spraying in the vicinity of the house.
- Stand 3–5 metres 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 metres 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.
- 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 gram to 25 grams in one minute. The dosage depends on the discharge rate, concentration of insecticide applied, and the time it takes to spray the house. For comparison, an indoor residual house spray may require 30 minutes of spraying to deposit 300 grams of insecticide. This assumes a dosage of two grams per square metre to 150 square metres of sprayable surface.

Information to be given to inhabitants

- Time of spraying, for example, 0630 to 1000 hours.
- All doors and windows should be open.
- 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.

Timing of application

Spraying is carried out only when the right weather conditions are present and usually only at the prescribed time. These conditions are summarized below:

For optimum spraying conditions (Table E), please note the following:

- In the early morning and late evening hours, the temperature is usually cool. Cool weather is more comfortable for workers wearing protective clothing. Also, adult *Aedes* mosquitoes are most active at these hours.
- In the middle of the day, when the temperature is high, 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.
- An optimum wind speed of between 3 km/h and 13 km/h enables the spray to move slowly and steadily over the ground, allowing for maximum exposure of mosquitoes to the spray. Air movements of less than 3 km/h may result in vertical mixing while winds greater than 13 km/h disperse the spray too quickly.
- In heavy rain, the spray generated loses its consistency and effectiveness. When the rain is heavy, spraying should stop 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. Also, mosquito activity increases when the relative humidity reaches 90, especially during light showers.

Table E: Conditions for spraying

	Most favourable conditions	Average conditions	Unfavourable conditions
Time	Early morning (0630–0830 hrs) or late evening	Early to mid-morning or late afternoon, early evening	Mid-morning to mid-afternoon
Wind	Steady, between 3–13 km/h	0–3 km/h	Medium to strong, over 13 km/h
Rain	No rain	Light showers	Heavy rain
Temperature	Cool	Mild	Hot

Frequency of application

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

- Spraying is started in an area (residential houses, offices, factories, schools) as soon as possible after a DF/DHF case from that area is suspected.
- At least one treatment should be carried out within each breeding cycle of the mosquitoes (seven to ten days for *Aedes*). Therefore, a repeat spraying is carried out within seven to ten days after the first spraying. Also, the extrinsic incubation period of dengue virus in the mosquito is 8 to 10 days.

Evaluation of epidemic spraying

Within two days after spraying during outbreaks, a parous rate of 10% of female mosquito have already laided eggs or less, compared with a much higher rate before spraying, indicates that most of the mosquito population is newly emerged and incapable of transmitting the disease. This also indicates the spray was effective and had greatly reduced transmission by killing the older infected mosquito population.

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, a relatively low adult density before spraying and adult sampling methods which show considerable variations in density in the absence of control. An effective spray programme should also be accompanied by a reduction in hospitalized cases after the incubation period of the disease in humans (about 5–7 days) has elapsed. The spraying should be repeated at seven-day intervals to eliminate the possibility of infected mosquitoes.

Source: WHO Western Pacific Region Background Document No.16, 1995.

10. Safety measures for insecticide use

Safety measures for insecticide use are adopted to protect the health and lives of those applying insecticides. These measures seek to minimize the degree of poisoning by insecticides and exposure to insecticides, prevent accidental poisoning, monitor sub-acute poisoning, and provide adequate treatment for acute poisoning. These measures can be broken down into the four broad categories listed below.

Four issues for safety measures:

- the choice of insecticides to be used;
- the safe use of insecticides;
- the monitoring of sub-acute insecticide poisoning; and
- the treatment of insecticide poisoning.

The human population exposed to insecticide treatment is of prime importance. It must be ensured that they are not exposed to health hazards.

1. Choice of insecticides to be used

The choice of an insecticide for vector control is determined by the following factors:

- toxicity and its safety to humans and the environment;
- effectiveness against the vector; and
- cost of the insecticide.

In weighing the relative importance of the three factors above, the following are important aspects from a safety standpoint:

- An effective and/or cheap insecticide should not be used if the chemical is highly toxic to humans and other non-target organisms.
- Pyrethroids, generally, have very low mammalian toxicity when compared with other groups of insecticides such as carbamates.
- The liquid formulation of an insecticide is usually more dangerous than a solid formulation of the same strength. Certain solvents in liquid formulation facilitate skin penetration.
- With regard to occupational exposure, dermal exposure is more important than gastrointestinal or respiratory exposure. Thus, an insecticide with low dermal toxicity is preferred.
- The latest information on the safety aspect of insecticides being considered must be available before a wise choice can be made.

2. The safe use of insecticides

The key to the safe use of insecticides is to control and minimize the level of routine or accidental exposure of an individual to a given insecticide. The level of exposure is in turn dependent on many factors, as outlined in the box below.

Level of exposure depends on:

- Insecticide storage conditions.
- Personal hygiene and attitude of workers.
- Knowledge and understanding of workers concerning insecticides.
- Equipment used.
- Method and rate of application.
- Environmental conditions such as prevailing winds, temperature and humidity.
- Duration of the work.
- Protective clothing and mask used.

In order to minimize the routine and accidental exposure of staff to insecticides, safety precautions must be observed at all stages of insecticide use.

Safety precautions during storage

- Store insecticides in containers with the original label. Labels should identify the contents, nature of the material, preparation methods and precautions to be employed.
- Do not transfer insecticides to other containers, or to containers used for food or beverages.
- All insecticide containers must be sealed.
- Keep insecticides in a properly-designated place, away from direct sunlight, food, medicine, clothing, children and animals and protected from rain and flooding, preferably in a locked room with warning signs such as "Dangerous: Insecticides; Keep Away" posted prominently.
- To avoid unnecessary and prolonged storage of insecticides, order only sufficient amounts needed for a given operation, or order on a regular basis (e.g. every three months depending on routine needs), or order only when stocks get low.
- Stocks received first must be used first. This avoids prolonged storage of any batch of insecticide.

Steps before insecticide use

- Read the label carefully and understand the directions for preparing and applying the insecticides as well as the precautions listed, then follow the precise directions and precautions.
- Know the first-aid measures relevant and antidotes for the insecticides being used.

During mixing and spraying/fogging with insecticides

- Do not drink, eat or smoke while working. This prevents accidental inhalation or ingestion of insecticides.
- Mix insecticides in a well ventilated area, preferably outdoors.

- Mix only as much insecticide as is needed for each application. This will reduce the problem of storing and disposing of excess insecticide.
- Do not smell or inhale insecticides.
- Never mix insecticides directly with bare hands.
- Stand with the wind blowing from behind when mixing insecticides.
- Do not clear blocked spray nozzles by blowing with the mouth.
- Make sure that the spray equipment does not leak; check all joints regularly.
- Keep all persons not involved away from where the insecticides are being mixed.
- Exposure to spraying normally should not exceed five hours a day.
- When spraying is undertaken, the hottest and most humid period of the day should be avoided if possible. It is best to apply insecticides early in the morning or late in the evening. This minimizes excessive sweating and encourages the use of protective clothing. Also, high temperatures increase the absorption of insecticides.
- Those applying insecticides should always wear long-sleeved shirts and trousers.
- Wear protective clothing and headgear, where necessary, to protect the main parts of the body as well as the head and neck, lower legs, hands, mouth, nose and eyes. Depending on the insecticide and type of application, boots, gloves, goggles and respirators may be required.
- Mixers and baggers should wear rubber boots, gloves, aprons and masks, since they come in contact with technical material and concentrated formulations.
- Those engaged in thermal fogging and ULV spraying should be provided with overalls, goggles, hats and masks.
- Those engaged in larviciding (e.g. with temephos) need no special protective clothing because the risk of toxicity is low.
- To protect yourself and your family, never work with insecticides in your street clothes.
- Do not wear unwashed protective clothing. Make sure your gloves and boots have been washed inside and outside before you put them on.
- Take heed of the wind direction to avoid drift.

Steps after spraying/fogging of insecticides

- Wash all spray equipment thoroughly and return to the storeroom. It is important to maintain equipment in good working order after usage.
- Empty insecticide containers should not be used in the household to store food or drinking water. They should be buried or burned. Larger metal containers should be punctured so that they cannot be reused.
- Used containers can be rinsed two or three times with water, scrubbing the sides thoroughly. If a drum has contained an organophosphorus compound, an additional rinse should be carried out with washing soda, 50 g/l (5%), and the solution should be allowed to remain in the container overnight. A soakage pit should be provided for rinsing.
- All workers must wash thoroughly with soap and water. This removes deposits of insecticides on the skin.
- All protective clothing should be washed after each use.
- All use of insecticides must be recorded.
- Eat only after thoroughly washing hands with soap and water.

3. Monitoring sub-acute insecticide poisoning

Regular medical surveillance of all spraying personnel may be required if space spray operations are done on a routine, long-term basis.

- Mixers, baggers and spraymen should be instructed to detect and report any early signs and symptoms of mild intoxication.
- Any undue prevalence of illness not associated with well recognized signs and symptoms of poisoning by a particular insecticide should be noted and reported.
- A regular medical examination, including the determination of blood cholinesterase for those applying organophosphorus compounds, should be conducted. If the level of cholinesterase activity decreases significantly (50% of a well-established pre-exposure value), the affected operator must be withdrawn from exposure until he recovers. Test kits for monitoring cholinesterase activity are available.

Symptoms of insecticide poisoning

Field workers should be taught to recognize the following symptoms:

DDT and other organochlorines

Symptoms include apprehension, excitement, dizziness, hyperexcitability, disorientation, headache, muscular weakness and convulsions . These compounds are normally not used for DHF vector control.

Malathion, fenitrothion and other organophosphates

Early symptoms include nausea, headache, excessive sweating, blurred vision, lacrimation (tears from eyes), giddiness, hypersalivation, muscular weakness, excessive bronchial secretion, vomiting, stomach pains, slurred speech and muscular twitching. Later, advanced symptoms may include diarrhoea, convulsions, coma, loss of reflexes, and loss of sphincter control.

(Note: Temephos has a very low toxicity rating and can safely be used in drinking water to kill mosquito larvae).

Carbamates

Symptoms include headache, nausea, vomiting, bradycardia, diarrhoea, tremors, convulsive seizures of muscles, increased secretion of bronchial, lacrimal, salivary and sweat glands .

Pyrethroids (e.g. permethrin and S-bioallethrin)

These insecticides have very low mammalian toxicity, and it is deduced that only single doses above 15 gm could be a serious hazard to an adult. In general, the effective dosages of pyrethroids for vector control are much lower when compared with other major groups of synthetic insecticides. Although pyrethroids may be absorbed by ingestion, significant skin penetration is unlikely. Symptoms, if they develop, reflect stimulation of the central nervous system. No cases of accidental poisoning from pyrethroids have been reported in humans. Some pyrethroids such as deltamethrin, cypermethrin and lambdacyhalothrin, can cause eye and skin irritation if adequate precautions are not taken.

Bacterial insecticide bacillus thuringiensis H-14 and insect growth regulators (methoprene)

These control agents have exceedingly low mammalian toxicity and cause no side-effects. They can be safely used in drinking water.

4. Treatment of acute insecticide poisoning

- Know the symptoms of poisoning due to different insecticides.
- Call a physician.
- Begin emergency treatment in the field. This treatment is continued during transport and ends in a medical centre.
- Provide supportive treatment for the patient. This may include:
  - Artificial respiration if spontaneous respiration is inadequate.
  - A free airway must be maintained. Excess vomitus and secretions should be removed.
  - Oxygen therapy for cyanosis (a blue or purplish discolouration of the skin due to insufficient oxygen).
- Decontaminate the patient as soon as possible. This may involve:
  - Removal of contaminated clothing.
  - Thorough washing of the skin and hair with soap and water.
  - Flushing contaminated eyes with water or saline solution for 10 minutes.
  - Evacuation to fresh air.
- Eliminate the poison. Determine whether the insecticide is in water emulsion or petroleum solution, if possible.
  - If the insecticide is dissolved in a water emulsion, induce vomiting by putting a finger or spoon down the throat. If this fails, give one tablespoon of salt in a glass of warm water until vomitus is clear.
  - If the insecticide is dissolved in a petroleum product, have the doctor or nurse perform gastric lavage, sucking the insecticide out of the stomach with a tube to prevent the possibility of the petroleum product entering the lungs and causing pneumonia.
  - Administer a laxative such as Epsom salts or milk of magnesia in water to eliminate the insecticide from the alimentary tract. Avoid oily laxatives such as castor oil, which may increase the absorption of insecticide.
- Administer an antidote where possible. This involves the following steps:
  - The insecticide container must be made available to the physician wherever possible. This will help in determining the group of insecticides involved in the poisoning. The label will indicate if it is a chlorinated hydrocarbon, an organophosphate, a carbamate, a pyrethroid or a bacterial insecticide.
  - If the insecticide is an organophosphate, either airopine sulphate or a 2-PAM chloride (pralidoxime chloride) can be used as an antidote. An injection of 2 mg to 4 mg atropine sulfate is given intravenously. More atropine may be required depending on the severity of the poisoning. The dose of 2-PAM chloride is 1 gram for an adult and 0.25 gram for an infant.
  - If the insecticide is a carbamate, atropine sulphate is used as an antidote; 2-PAM and other oximes are not to be used.

Source: WHO Western Pacific Region. Background Document No.16, 1995

11. Functions of Emergency Action Committee (EAC) and Rapid Action Team (RAT)

(A) Emergency Action Committee (EAC)

Constitution

The EAC will comprise administrators, epidemiologists, entomologists, clinicians and laboratory specialists, school health officers, health educators and representatives of other related sectors.

Functions

(1) To take all administrative actions and coordinate activities aimed at the management of serious cases in all medical care centres and undertake emergency vector control intervention measures.

(2) To draw urgent plans of action and resource mobilization in respect of medicines, intravenous fluids, blood products, insecticides, equipment and vehicles.

(3) To liaise with intersectoral committees in order to mobilize resources from non-health sectors, namely the ministry/department of - urban development, education, information, law, water supply, waste disposal for the elimination of the breeding potential of *Aedes aegypti*.

(4) To interact with the news media and NGOs for dissemination of information related to health education and community participation.

(B) Rapid Action Team (RAT)

Constitution

The RAT at the state or provincial levels will comprise epidemiologists, entomologists and a laboratory specialist (at state and local levels).

Local levels

Medical officer, public health officer, non-health staff, local government staff.

Functions

- Undertake urgent epidemiological and entomological investigations.
- Provide required emergency logistical support, e.g. delivery of medical and laboratory supplies to health facilities.
- Provide on-the-spot training in case management for local health staff.
- Supervise the elimination of breeding places and application of vector control measures.
- Carry out health education activities.
- Sample the collection of serum specimens.

Source: Management of Dengue Epidemic, Report of a WHO Technical Meeting, New Delhi, 28–30 November 1996, WHO Regional Office for South-East Asia, New Delhi (SEA/DEN/1, SEA/VBC/55, May 1997, 38 pp).

12. Case Investigation Form (prototype)

ID no.:
Name of hospital/institution/clinic:
Locality/town/city:
Date:
Case investigation:
Name:
Age:
Sex:
Father's/mother's name:
Address:
Whether visited any other area during last two weeks:
Signs and symptoms:
Date of onset of fever:
Date of admission:
Course of fever: continuous/intermittent/remittent
Presenting symptoms:
Haemorrhagic manifestations: Yes/no
Petechiae, parpura, ecchymosis, epistaxis, gum bleeding, haematemesis, malena
Enlarged lever: Yes/no
Torniquet test: Positive/negative/not done
Rash: Yes/no
Shock: Yes/no
Condition of patient: stable/critical
Any platelet or blood transfusion given:
Laboratory findings:

Haematocrit (percentage)	Serial readings	1
		2
Platelet count	Serial readings	1
		2
Differential leucocyte count	Serial readings	1
		2
Seroogical input: NS1, IgM, IgG		
Acute sera collected on date:	Sent on date:	
Convalescent sera collected on date:	Sent on date:	
Outcome of the patient:	Recovered/expired/discharged on:	
		Signature (Medical Officer/ Designated authority)

Source: Adapted from Dengue Fever, Dengue Haemorrhagic Fever, Dengue Shock Syndrome Investigation Guidelines. Version 01/2010. Kansas, USA