
CHAPTER 6

Disease surveillance and outbreak prevention and control

Factors increasing the risk of DHF outbreaks

The occurrence of DHF outbreaks is linked to a number of factors, including the density of mosquito vectors, particularly that of *Aedes aegypti*. The precise population density of *Ae. aegypti* that is needed to sustain dengue virus transmission epidemically or endemically has yet to be determined, but experience in Singapore in recent years suggests that house indices as low as 2% are sufficient for the epidemic transmission of dengue in areas where there is a low level of immunity in the human population. In many instances, a small number of actively biting female mosquitos has infected an entire household. Virus transmission is, of course, increased by denser human populations. Urbanization in tropical countries has resulted in both a proliferation of *Ae. aegypti* and an increase in the number of susceptible human hosts.

In cities, the movement of viraemic persons is a more important means of transporting dengue viruses than the movement of *Ae. aegypti* mosquitos. Places where people congregate during the day may be important sites of dengue virus transmission. For example, children at school bitten by infected mosquitos may take the virus home or to other parts of the city. Dengue virus may also spread in settings involving large numbers of people, such as in hospitals where visitors, patients and staff may be bitten by infected *Ae. aegypti*.

Infected persons may carry dengue virus to towns and rural areas from cities where the disease is epidemic or endemic, but the factors affecting dengue virus transmission and maintenance in towns are not well documented. Introduction of dengue virus by the air travel of infected passengers over long distances has repeatedly occurred in the Pacific and Caribbean regions during the past 30 years.

A distinct seasonal pattern in DHF outbreaks is evident in most places. In tropical regions where monsoon weather patterns prevail, DHF hospitalization rates increase during the rainy season and decline several months after the cessation of the rains. This decline may be related to a decrease in mosquito biting activity, a decrease in the longevity of female mosquitos, or both, and

possibly to a small decrease in the vector population. During these seasonal lulls, virus transmission is most likely to occur in endemic urban areas where high densities of human population ensure a constant supply of susceptible individuals, and numerous vector breeding and resting sites around human dwellings insulate vector populations from the effects of seasonal rainfall.

Surveillance of dengue

The objective of a DF and DHF surveillance programme is the early detection of outbreaks that permits the prompt implementation of control measures. In order to accomplish this, the factors favouring an outbreak should be monitored. This requires the monitoring of suspected cases of DF and DHF (using the diagnostic criteria outlined in Chapter 2), case reporting, and epidemiological and entomological investigations. Surveillance is indicated in all endemic and receptive areas, defined as locations where *Ae. aegypti* is known to be present. With modern air travel, a viraemic patient can quickly move from an endemic to a receptive area. Thus, the introduction of dengue virus into areas with *Ae. aegypti* should be expected at any time. The following activities, therefore, should be included in a basic programme of DF and DHF surveillance.

Fever surveillance

For the surveillance of fever cases, sentinel clinics at strategic locations throughout high-risk areas should report to the national public health authority on a weekly basis the number of patients seen and the number of patients with an oral or axillary temperature higher than 38°C. In this way, abnormal increases in the incidence of febrile illnesses can be detected. If an increase is reported there should be an attempt to determine the etiology of the illness by virus culture and serology (see Chapter 4).

Recognition of dengue haemorrhagic fever cases

The standard criteria for the clinical diagnosis (see Chapter 2) and laboratory confirmation (see Chapter 4) of DHF should be followed. Most dengue virus infections in young children are mild and difficult to distinguish from other acute febrile diseases. Classical dengue fever is most commonly seen in adolescents and adults; but in areas where dengue virus is endemic, resident adults are often immune and overt disease may be limited to arriving susceptible adults such as travellers. Considerable numbers of mild dengue infection precede and accompany DHF epidemics, and the magnitude of this uncomplicated DF may be difficult to assess. It has been estimated that, during outbreaks, between 150 and 200 cases of dengue infection occur for each patient

with DSS seen in a hospital. Recognition of this is essential for the planning of prevention and control programmes.

Reporting cases to health authorities

Presumptive cases of DHF (designated as with or without shock) should be reported to the appropriate local, national and international health authorities. An agency within the national public health authority is often designated to receive and compile this information as a part of dengue fever surveillance. These data should be processed rapidly, and reports should be submitted through the national public health authorities to WHO and others as required, with copies to the individuals and institutions who contributed the data. Reports should include the number of patients with and deaths due to DHF by age, sex, location and date. Reports may be submitted in either narrative or tabular form (a sample reporting form is shown in Annex 7) and should be signed by the responsible medical officer.

Aedes surveillance

Country-wide surveys should be made to determine the presence, population density, and seasonal prevalence of *Aedes* vectors and their susceptibility to available insecticides (see Chapter 5). Countries may obtain assistance from WHO Headquarters or Regional Offices in organizing and conducting entomological surveys and surveillance programmes. The information from national surveys should be submitted to WHO so that the Organization can track potential problem areas.

Virological surveillance

Monitoring dengue virus infections and the surveillance of dengue serotypes in endemic areas may be instituted if facilities and trained staff are available. These efforts could consist, for instance, of obtaining reports of virus isolation from febrile patients and the systematic collection and processing of suspect mosquitos for virus isolation attempts. Original specimens (viraemic serum or infected mosquito pools), as well as viral strains that have been successfully cultured, should be preserved for future study. The isolation of virus from patients suspected to have DHF is important, and WHO or the WHO Collaborating Centres listed in Annex 6 can be contacted for advice and assistance on virus isolation procedures and the proper storage or transport of dengue virus (see also Chapter 4).

Development of epidemic contingency plans

Contingency planning should involve estimating the number of people at risk, determining the quantity of equipment (including hospital beds and intensive

care facilities), supplies and personnel required for vector control and patient management (Annex 8), and documenting the location of these resources. These efforts should be supplemented with clinical training for physicians, nurses and laboratory staff on the management of dengue patients (see Chapter 3). The fundamental therapeutic principle for the treatment of DHF is the rapid replacement of fluids by intravenous infusion. The following assumptions make it possible to estimate the quantity of supplies required during a DHF outbreak:

- In the worst situation to date (Cuba, 1981), the prevalence of seriously ill patients admitted to hospital approached 1 per 100 population.
- Hospitalized patients usually require intravenous therapy.
- About 20% of hospitalized patients require intravascular volume expanders, such as dextran 40, albumin or plasma.
- About 10% of hospitalized patients require blood transfusion.

On the basis of these estimates, the following supplies would be required per 10 000 population (100 possible cases of DHF):

- 100 cases of DHF: 200–300 litres normal saline
- 20 cases of DHF with hypovolaemia: 20 litres of a volume expander in appropriate units
- 10 cases of DHF with haemorrhage: at least 10 units of whole blood.

Most urban hospitals would be expected to have these quantities in stock. Adjustments should be made to provide for the population at risk in a given area and provisions made for timely resupply in the case of an epidemic.

Control of dengue haemorrhagic fever

To control outbreaks of DHF, two operations must be conducted simultaneously: emergency mosquito control and treatment of patients in hospital.

Emergency mosquito control

The following steps should be immediately taken when an outbreak of dengue or DHF is suspected:

- A public information campaign should be instituted, stressing the basic epidemiological characteristics of dengue and DHF and the measures the individual can take to reduce the risk of infection, e.g. personal protective measures, the use of household aerosol insecticides, source reduction efforts at home and in the neighbourhood.
- The geographical area should be defined in order to determine the extent of the insecticide spraying operation required. For this purpose, presumptive cases of dengue and DHF should be confirmed in the laboratory by serological examination of paired sera.

- An inventory of the location, quantity and availability of pesticides and the equipment for their application (see Annex 8) should be made.

Operations for emergency mosquito control are described in Chapter 5. The objective of these measures is to eliminate infected mosquitos and to break the transmission cycle by reducing mosquito populations to extremely low levels during the time necessary for viraemic subjects to recover. Control of an epidemic may not be feasible if adult populations of *Ae. aegypti* cannot be sufficiently reduced. However, a sustained reduction of vector populations will inevitably result in fewer cases.

Management of clinical care

Organizational aspects

An organizing or coordinating committee should be established and should consist of administrators, epidemiologists, clinicians, entomologists and workers from virus laboratories. The responsibility for establishing this committee is usually vested in the ministry of health. The committee should:

- Design and distribute protocols for the clinical diagnosis and treatment of DHF/DSS.
- Prepare and circulate information on DHF/DSS for health care workers, the public and the press.
- Plan and implement training programmes for health care workers and auxiliaries (e.g. hospital staff, medical students, nurses and laboratory technicians).
- Assess the need for intravenous fluids, medications, blood products, intensive care equipment, teaching materials and equipment for transporting patients.
- Supervise the use of supplies and the outcome of clinical care programmes (daily, if necessary).
- Coordinate clinical research on DHF/DSS during any outbreak.

It may be necessary for hospitals to postpone elective surgery and other non-critical care in order to provide beds for the acute care of DHF/DSS patients. Even a moderate DHF outbreak, such as that which occurred in Venezuela in 1989–1990, may significantly burden the health care system, especially if an effective contingency plan has not been implemented. It may be necessary to set up hospitals in schools or other institutions as was done in Cuba in 1981, but this should be considered only if medical personnel and a laboratory capable of performing haematocrit and platelet count determinations are also available, since these are essential for the successful treatment of DHF patients.

Triage

During epidemics, outpatient and inpatient facilities may be overwhelmed and medical staff can rapidly become exhausted. In these circumstances, only those persons genuinely requiring hospital care should be admitted (see the outpatient and hospital flow charts in Annexes 3 and 4). A fever and a positive tourniquet test, or other manifestations of bleeding, are sufficient for DHF to be suspected. When possible, haematocrit and platelet count determinations should be completed in the outpatient department. Patients with thrombocytopenia and an elevated haematocrit can be sent to a rehydration ward or, if circulatory failure is suspected, admitted to a hospital (see Chapter 3). It may also be necessary to admit less seriously ill patients who live far from a hospital and who do not have access to nearby accommodation. For those patients who can be treated as outpatients, they and their parents or other care providers should be carefully instructed to return to the hospital promptly if they experience restlessness, lethargy, abdominal pain, oliguria or circumoral cyanosis.

Paramedical workers can also perform patient triage if properly instructed. Competent laboratory assistance is desirable, but without a laboratory patients can be evaluated by physical examination—a rapid pulse, skin congestion, circumoral cyanosis or cool extremities are indications that a patient should be admitted to hospital. If possible, patients who have been admitted to hospital should stay in hospital for observation, or be warned to remain near the hospital, until two days after their fever has subsided.

Prevention of dengue haemorrhagic fever outbreaks

Prevention of DHF outbreaks is based on vector control (see Chapter 5), as a vaccine is not yet available. Currently, the only effective way to avoid dengue virus infection is to avoid being bitten by infected mosquitoes.

A broad approach to the prevention of DHF involves integration of the measures described in previous chapters. Such a programme would combine two or more of the following components:

- Disease surveillance and treatment, whether centralized or based on local health care systems.
- Vector surveillance and control, with a mixture of environmental management and chemical and biological control.
- Provision of reliable potable water, sanitation and solid waste management.
- Health education, public health communication and community participation.

Dengue virus transmission is often a problem of domestic environmental management, and members of a household can frequently reduce their risk of

DF and DHF at little or no cost by controlling larval habitats and combating adult mosquitos by screening windows and doors and using household insecticide space sprays. A challenge for public health authorities is to find ways of getting a community to recognize the problem, assume a share of the responsibility for its solution and acquire the capability and motivation to prevent and control dengue fever.

Exchange of information

Exchange of information is essential for preventing and controlling outbreaks of DF and DHF. Narrative epidemiological reports, results of clinical studies, dengue virus isolations (with source and date), entomological surveys of dengue vectors, details of control measures planned or carried out, new developments in insecticides and spray equipment and other pertinent information are published in the *Dengue bulletin* of the WHO Regional Office for South-East Asia, the *Dengue surveillance summary* of the Centers for Disease Control and Prevention (in Puerto Rico), the *Epidemiological bulletin* of the WHO Regional Office for the Americas and the WHO *Weekly epidemiological record*. Addresses of editorial offices are given in Annex 8.

An increasing emphasis is being placed on the surveillance and reporting of DF and DHF in order to make a better estimate of the global burden of these diseases; exchange of this information is strongly encouraged.