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Dengue in the Americas

Dengue-4 virus was reported in the Caribbean from February to April 1981 when serologic determinations were made from two tourists returning to the United States of America from St. Bartholomew and St. Martin; at about the same time, Guadeloupe appeared to be having a dengue epidemic. In May, Dominica reported a dengue outbreak which was laboratory confirmed at CAREC (Caribbean Epidemiology Center) as dengue-4. The disease occurred in a mild form, with symptoms of high fever, gastroenteritis, and rash and lasted a short time (2 to 4 days). There were no deaths.

Also in May, the Ministry of Health of Cuba reported a widespread outbreak of dengue-2. This epidemic has caused deaths, mostly in children, from shock and hemorrhage which appear to meet the WHO criteria for dengue hemorrhagic fever (dengue shock syndrome). By 20 August, 337,160 cases and 149 deaths had occurred. The majority of the deaths occurred in children under 15 years of age. On 6 July the outbreak reached its peak when 11,721 new cases started being reported. This is the first time that dengue hemorrhagic fever has been reported in the Americas.

Background

Dengue epidemics have occurred in the Americas since 1827. Some countries have fairly adequate epidemiological records, as the Bahamas, which experienced its first dengue outbreak probably around 1882, followed by subsequent outbreaks in 1921-1922 and 1946.

In 1941-1942 there was an outbreak of dengue-2 in Panama and epidemiological evidence indicates that dengue-1 may have occurred in previous years. In 1953-1954 dengue-2 was isolated repeatedly in Trinidad where it was endemic. Earlier, this same virus was endemic in the Upper Magdalena Valley, Colombia. By 1952, except for an area near Venezuela, *Aedes aegypti* was eradicated from Colombia and dengue disappeared.

Dengue-2 spread through the Caribbean and by 1968 was reported in most islands with epidemics in St. Martin, St. Bartholomew, Guadeloupe, and Martinique. In 1969-1971 dengue-2 caused epidemics in Haiti and the Dominican Republic and by 1971-1972 dengue-2 epidemics had occurred in coastal Colombia, reaching epi-

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demic proportions in 1975-1976 in the Upper Magdalena Valley.

Prior to 1970, there were no definite data available on dengue epidemics in the Leeward Islands of the Netherlands Antilles of Saba, St. Eustatius, and St. Martin. Although clinical observations indicate that an epidemic of dengue may have occurred in Cuba in 1943, a serologic survey done in 1975 showed no recent dengue virus activity.

Dengue-3 epidemics appeared in the Caribbean in 1963. Jamaica had a dengue-3 epidemic in 1963 and 1964 and a combination dengue-2 and -3 epidemic in 1968-1969. Puerto Rico had confirmed dengue epidemics in 1963, 1969, 1975, and 1977; from 1969 to 1976 only the dengue-2 virus was isolated on the island, but in 1977, cases of dengue-1 were registered and are still being reported.

Dengue-1 virus was isolated for the first time in the Americas in Jamaica in 1977. The earliest confirmed cases in Kingston were on 26 February, and by 30 May of the same year, epidemic foci existed throughout the Kingston-St. Andrews Corporate Area. The epidemic spread throughout the Caribbean. Cases soon occurred in Cuba, Bahamas, Dominica, Haiti, Puerto Rico, Barbados, Martinique, Trinidad, St. Kitts, and Guyana. By 1978, it had reached the northern part of South America and Central America. In August 1979 dengue-1 had spread to the States of Quintana Roo, Chiapas, and Oaxaca in southern Mexico and by 1980 cases were reported in Texas.

There is some evidence of severe thrombocytopenia and hemorrhagic phenomena associated with dengue-1 in Jamaica, Bahamas, and Puerto Rico. No deaths were attributed directly to dengue-1, but two possible cases occurred in Jamaica, and Honduras had five deaths with symptoms of initial high fever, hemorrhagic phenomena, ecchymases, petechiae, and circulatory insufficiency. However, the cases were not confirmed serologically as being caused by dengue and it is doubtful that they met the WHO criteria for hemorrhagic dengue or dengue shock syndrome.

Dengue Hemorrhagic Fever

Dengue hemorrhagic fever (DHF) or hemorrhagic dengue can be defined as an acute febrile illness characterized clinically by hemorrhagic phenomena and a tendency to develop a shock syndrome (dengue shock syndrome, DSS), which may be fatal. Thrombocytopenia with concurrent hemoconcentration is regularly observed.

Typical cases are characterized by four clinical manifestations: high fever, hemorrhagic phenomena, hepatomegaly, and frequently circulatory failure. Moderate to marked thrombocytopenia with concurrent hemoconcentration is a distinctive clinical laboratory finding which differentiates hemorrhagic from classical dengue fever, including the type presenting hemorrhagic manifestations.

In man, each of the four types of dengue viruses (DEN-1, DEN-2, DEN-3, and DEN-4) can cause either classical dengue or dengue hemorrhagic fever, and it is not known whether one virus type is more pathogenic than another.

The acute phase of the infection, which lasts about 5-7 days, is followed by an immune response. During the first attack, there occurs a predominant production of neutralizing antibodies against the virus type inoculated by the mosquito vector (primary dengue). The first attack gives only temporary, partial protection against the other three types and secondary or sequential infections are possible after a rather short period of time.

Although the four serotypes are antigenically very similar, they are sufficiently different to elicit only partial cross-protection after infection by one of them. After an incubation period of 4-6 days (minimum 3, maximum 10), the virus is present in the patients' blood during the acute phase of the disease, thus constituting a reservoir of virus readily accessible for transmission by mosquitoes.

Two main pathophysiologic changes occur in DHF/DSS. One is an increased vascular permeability, which causes a loss of plasma from the vascular compartment. This results in hemoconcentration, low pulse pressure, and other signs of shock if plasma loss is critical. The second change is a disorder in hemostasis which involves all three major factors, namely vascular changes, thrombocytopenia, and coagulopathy.

Since the number of dengue virus infections is unknown most of the time, the attack rate of DHF is difficult to evaluate. A retrospective evaluation of the impact of the disease during the May-November 1962 outbreak in Bangkok-Thonburi showed that in a population of 870,000 children under 15 years of age, there were an estimated 150,000 to 200,000 minor illnesses caused by dengue or Chikungunya viruses; 4,187 were hospitalized and diagnosed as dengue patients; and 4,000 additional cases were treated in private clinics or at home. Shock syndrome occurred in approximately one third of the hospitalized DHF cases.

***Aedes aegypti* Surveillance**

Aedes aegypti is the most efficient of mosquito vectors because of its domestic habitat. The female mosquito

bites man during the day, and after feeding on a person whose blood contains the virus, it is able to transmit dengue immediately, by changing hosts when its blood meal is interrupted, or after an incubation period of 8–10 days, during which the virus multiplies in its salivary glands.

The *A. aegypti* is the only vector of dengue in the Americas. It is present in a number of countries of South and Central America, and is found in fairly high densities in most of the Caribbean islands.

Areas in which *A. aegypti* is known to exist should establish a surveillance system which includes dengue case detection and control of mosquito populations. Ideally, the landing rate and/or resting indices for adult *A. aegypti* at any given moment should be determined in risk areas. Unfortunately this has rarely been done in the Americas. Some countries are using ovitraps as an alternative means to monitor the density of adult mosquitoes. This method should be used in sea and air ports of entry, on border cities where *A. aegypti* is known to breed, and in areas of risk or where control activities are being carried out. This method also should be used in hospitals, especially if windows are not screened.

Traditionally *A. aegypti* surveys in the Americas have been directed toward the larvae. Three indices are used: (1) premises index (percentage of houses positive for *A. aegypti* larvae), (2) container index (percentage of containers positive for *A. aegypti* larvae) and (3) Breteau index (number of positive containers per 100 houses). Most *A. aegypti* control programs have records of premises and container indices. This information should be reviewed to determine areas where mosquito densities are high. Spot surveys should be made in these areas to determine the validity of earlier evaluations. The surveys should indicate the types of containers where breeding most frequently occurs.

Risk areas are usually crowded sections, slums, places with poor roads and inadequate solid waste facilities, and other areas of recorded high premises indices. The areas may be small and represent some specific socioeconomic condition. All areas under insecticide control should be evaluated and remedial measures applied where needed.

A. aegypti Control

Most routine operational programs are aimed at larval control through insecticiding, breeding source reduction, or a combination of both. When a potentially explosive situation exists, as at present in the Caribbean, larviciding and other appropriate measures to reduce breeding places should be intensified.

Temephos (Abate) is the only insecticide readily available for treatment of potable water. The preferred formula is 1 per cent sand granules. Fenthion, malathion, and other insecticides are being used in the Americas for treating non-potable water containers.

Reduction of breeding sources, combined with health education aimed at developing community participation, can be of value in areas where bottles, tires, cans, and other objects are the principal breeding sources rather than water-holding containers.

Adult mosquitoes can be controlled by residual or aerial spraying. Either thermal or ultralow volume equipment is used to apply the most common insecticides, malathion and fenitrothion.

In order to reduce breeding sources, long-term control should be based on health education and on community participation, supported by legislation and law enforcement wherever socioeconomic conditions permit. This can be accomplished by providing the communities concerned with adequate water supply and solid waste disposal. Use of larvicides should be considered as a supplementary measure. Temephos in 1 per cent sand granules can be applied to potable and non-potable water at a target dose of 1 ppm (e.g., 10 g of material to 100 liters of water), especially in high risk localities before periods of anticipated outbreaks. Other insecticides can be used for the treatment of non-potable water.

The community should participate in these activities by disposing all water containers no longer in use (e.g., old tires, empty tins and bottles, and broken jars), either through vehicle disposal units or simply burying the containers where they cannot be filled. Systematically changing the water or adding sand to flower vases on a weekly basis will eliminate this breeding source.

Water jars and drums that cannot be disposed of should be adequately covered or cleaned and scrubbed weekly to prevent oviposition by *A. aegypti.* When this is not possible because of their shape or size, *A. aegypti* larvae can be eliminated by transferring the water from one container to another and filtering it through a cloth.

Emergency Measures

1. To be effective, operations should begin when the first cases are detected or when there are sound reasons for anticipating an outbreak. Since virus activity is already known to exist in the Caribbean, it is not necessary to have laboratory confirmation.

2. The size of the area (or areas) to be treated should be determined through epidemiological and entomological information. Initially, if cases are scattered, adulticide aerial spraying should be implemented within

a minimum radius of 100 meters from houses which have had cases.

3. Two ultralow volume or thermal adulticide treatments can be made at 4–10 day intervals if resources are available or if they can be obtained. Vehicle-mounted or portable ultralow volume aerosol generators, thermal foggers, or mist blowers can be used to apply a suitable insecticide (e.g., technical malathion or fenitrothion) at the dosages recommended by the equipment manufacturer or insecticide label.

4. If necessary, use of ultralow volume spraying by local air force C-47 aircraft or smaller agricultural type planes and helicopters can be explored.

5. Priority areas for vector control are those with a concentration of cases and/or high vector density. Special attention should be given to areas where people congregate, for example, in hospitals and schools.

6. Hospital rooms with hemorrhagic dengue patients should be made mosquito-proof.

The following table provides estimates, based on field operations in South East Asia and the Western Pacific, of the relative size of the area that can be covered a day with different types of application equipment (subject to slight variation due to wind and temperature conditions):

Equipment	Possible daily coverage
Twin engine aircraft (e.g. C-47 or large helicopter), ULV	6,000 hectares
Single engine aircraft or small aircraft, ULV	2,000 hectares
Vehicle mounted cold fogger (e.g., LECO)	225 hectares
Vehicle mounted thermal fogger (e.g., Dyna-Fog)	150 hectares
Back-pack ULV mist blower (e.g., Fontan)	30 hectares
Hand carried thermal fogger (e.g., Swing Fog)	5 hectares
Hand carried indoor ULV aerosol generator (e.g., Mity Moe)	5 hectares or 250 houses

(*Source:* Parasitic Diseases and Vector Control, Division of Disease Prevention and Control, PAHO.)

Amendment of the International Health Regulations (1969)

As announced in the last issue of the Epidemiological Bulletin, *the Thirty-fourth World Health Assembly adopted a resolution introducing certain amendments to the International Health Regulations (1969), bearing in mind the worldwide erradication of smallpox. A transcript of the text of the resolution follows.*

AMENDMENT OF THE INTERNATIONAL HEALTH REGULATIONS (1969)

WHA34.13 The Thirty-fourth World Health Assembly,

Recalling resolution WHA33.3, which declares solemnly that the world and all its peoples have won freedom from smallpox;

Considering that, in consequence, the time has come for smallpox no longer to be included among the diseases subject to the International Health Regulations (1969), as amended by the Additional Regulations adopted on 23 May 1973;[1]

Recalling the amendments relating to Articles 18, 19, paragraph 2(e), and 47, paragraph 2, kept in abeyance in accordance with resolution WHA27.45;[2]

Having examined the report forwarded to it by the Executive Board at its sixty-seventh session;

Having regard to Articles 2(k), 21(a) and 22 of the Constitution;

1. DECIDES that smallpox shall no longer be included among the diseases subject to the International Health Regula-

[1] World Health Organization. *International Health Regulations (1969)*. Second annotated edition, Geneva, 1974.

[2] World Health Organization. *Official Records* 217, 1974, pp. 21, 71, and 81.