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WORLD HEALTH ORGANIZATION

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THE IMPLICATIONS OF DENGUE FEVER TO THE HEALTH AND ECONOMIES OF THE COUNTRIES OF THE REGION

Health Effects

Dengue fever has been recognized as an epidemic disease in the Americas for over two hundred years. However, only in the past three decades has there been laboratory diagnosis of the infection permitting reliable estimates of the total population affected during outbreaks. A review of dengue in the Americas since 1910, including an exhaustive review of the pandemics in the Caribbean since 1927, has been presented (Ehrenkranz, 1971). At intervals of seven to ten years, dengue has periodically swept through the entire Caribbean area affecting from 10 to 40 per cent of the population in those areas infested with *Aedes aegypti* mosquitoes. Only the United States of America and Cuba have escaped the periodic waves during the last 40 years. The last dengue outbreak in the United States of America was reported in 1941 and in Cuba in 1944. However, during 1977 Cuba suffered a major outbreak with the newly introduced dengue serotype 1.

Classical uncomplicated dengue fever is an illness of seven to ten days duration in which the patient suffers severe headaches, retro-orbital pain, myalgia and arthralgia. The general discomfort has lead to the common eponymn "breakbone fever." In large outbreaks of classical dengue, mild hemorrhagic phenomena may occur such as epistaxis, gingival bleeding, skin petechiae and menstrual disturbances. Death following classical or uncomplicated dengue is an extremely rare event. Mortality has been estimated from 3 to 20 per 10,000 cases. A study of the death reports during the epidemics of 1926 in New South Wales and in Queensland, Australia, led to the conclusion that the mortality due to dengue itself was approximately three per 10,000 cases. During the years 1965 and 1966, Venezuela reported 23 deaths coded as dengue while during these years there were 11,801 reported cases of dengue, leading to an estimate of case mortality of 20 per 10,000 reported cases.

In the usual dengue case, there are no sequelae, although the convalescent period may be prolonged for a number of weeks due to a persistent neurasthenia. There is suggestive evidence of foetal damage that may be produced by intrauterine dengue infection. However, the evidence which is being obtained in Jamaica and in the Dominican Republic is as yet inconclusive.

The principal complication of dengue is the hemorrhagic fever and shock syndrome, such as occurs in the Western Pacific and in South-East Asia. The diagnosis of dengue fever in the Caribbean is a matter of great importance because it may mean that as numbers increase rapidly in the future a situation may develop comparable to that which exists in South-East Asia and in the Western Pacific. The pathophysiology of dengue hemorrhagic fever is not completely elucidated at present. There is evidence of plasma leakage with increased vascular permeability and hemorrhage. In South-East Asia the shock syndrome occurs in approximately 10 per cent of the children hospitalized for dengue hemorrhagic fever. The shock is reversible if treated in its early phase by the replacement of plasma volume and by adequate maintenance of blood electrolyte balance. If inadequatedly treated the case fatality rate may exceed 10 per cent. Dengue hemorrhagic fever and dengue shock syndrome cases have been observed in South-East Asia and the Western Pacific more frequently when different types of dengue viruses are hyperendemic, and more frequently following secondary or multiple sequential infections. These antecedent conditions are becoming increasingly evident in the Caribbean area.

In 1953-1954 dengue type 2 was first isolated in Trinidad, and in 1963 dengue type 3 appeared in the Caribbean. In 1968 dengue type 2 spread to the other islands, and caused a large outbreak in Colombia in 1971-1972 and again in 1976. Moreover, in Colombia there were outbreaks of dengue 3 in 1975 and 1977. Dengue 1 virus was first introduced in the Caribbean in February 1977, appearing in a military garrison just outside Kingston, Jamaica. It spread rapidly through Jamaica, reaching its peak by July, and then through the Caribbean to Dominica in July, Turks and Caicos Islands and Bahamas in August, St. Vincent, Haiti, Cuba, and Antigua in September, Guyana and Grenada in October, St. Kitts in November, Tobago, Puerto Rico and Suriname in December, and Barbados in February 1978. In 1978, dengue 1 was also isolated in French Guiana, Martinique and the American Virgin Islands. A concurrent epidemic of dengue types 2 and 3 occurred in Puerto Rico during 1977, and dengue type 2 was also isolated in Dominica and French Guiana.

Although the study of the epidemics varied greatly in different territories, the overall attack rates were estimated from detailed studies in Jamaica, Bahamas, Puerto Rico and Dominica. These varied from 6 to 20 per cent or more. If we assume a median attack rate of 10 per cent in those countries and territories affected which, according to the 1970 census had a population of 25,718,000, then a minimum of 2.5 million cases of dengue occurred in 1977. This may be compared with an estimate of 3.4 million dengue cases which occurred during the period 1961-1970*. These estimates ignore the extensive experience with dengue fever in Colombia in 1971-1977, where it is estimated that at least half a million cases occurred in 1971 and 1972 alone in the coastal areas which were reinfested with Aedes aegypti mosquitoes. Currently, both Colombia and Venezuela are experiencing large outbreaks of dengue, similar in magnitude to the epidemic in Venezuela in 1964-1966 in which an estimated 1.022 million cases occurred.

Economic Effects of Dengue

The current dengue epidemic in the Caribbean emphasizes once again the considerable suffering, lost time from school and work and unanticipated expenditures of scarce funds in the provision of medical care and emergency vector control measures. These effects have been particularly well documented in Jamaica and Puerto Rico. Epidemiological studies indicated that 200,000 persons in the Jamaican work force and 74,000 Puerto Rican workers were affected by clinical illness in 1977. In Puerto Rico, the total economic impact, including cost of medical care and epidemic control, and loss in wages and work output has been estimated at between US$6.0 and $15.5 million. The lower estimate divided by the total number of clinical cases (200,000) gives an estimate of $30 per clinical case. If we apply this to the previously mentioned estimate of 2.5 million cases of dengue for the entire Caribbean area in 1977, then the total estimated cost is $75 million for medical care, epidemic control and loss in wages and work output.

No estimate was made during 1977 of the loss of revenues from tourism but they may be significant. In Puerto Rico, during the study of 1977, no attempt was made to document losses of tourism revenue. Puerto Rico actually experienced a significant increase in tourism towards the end of the epidemic period and during the early months of 1978 compared to the same period in 1976 and 1977. It is possible that the increase

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*The Prevention of Diseases Transmitted by Aedes aegypti in the Americas. A Cost-Benefit Study. Arthur D. Little, Inc., 1972.

might have been greater if the epidemics had not occurred. However, while the epidemic cost varied from US$6 to $15 million, that range of costs would easily have been doubled by an epidemic-induced drop in total tourism revenue of only a few per cent. The Arthur D. Little report concluded that the diversion of tourism revenue would be an overwhelming cost for the Caribbean area. If the diversion of tourism income amounted to as much as one per cent of the expenditures of US tourists alone, the total present value of an eradication program would be paid for in about two years by this amount of money.

In the above report, estimates were made of losses from dengue caused by morbidity (work loss), medical care expenses and mortality. At a 4 per cent discount rate these were US$95 million for morbidity losses, $5.6 million for medical care, and $103.9 million for mortality. At a 20 per cent discount rate, these dropped to $17.8 million for morbidity losses, $0.7 million for medical care, and $8.2 million for mortality. The discount rates are interpreted as the interest rate required to pay for future financial costs with today's investment, should the losses from morbidity, mortality, or medical care continue over the next 20 years.

Summary

As the area of infestation of *Aedes aegypti* mosquitoes continues to slowly expand in the Caribbean region, the risk of dengue fever increases. This has been clearly documented by the major pandemic in 1977, in which at least 20 countries and territories were involved and an estimated 2.5 million cases occurred. The principal economic risks are the losses due to medical care, epidemic control, and absenteeism from either work or school. A conservative estimate of this cost in the Caribbean during 1977 is $US75 million. The principal health risk is the threat of dengue hemorrhagic fever or dengue shock syndrome as seen in South-East Asia and in the Western Pacific, where 10 to 30 per cent case fatality rates may occur in a disease which primarily affects children.