DENGUE HEMORRHAGIC FEVER IN THAI SOCIETY

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Abstract. Dengue hemorrhagic fever (DHF) is one of the most important infectious diseases in Thailand for many decades. Knowledge of DHF is vital to its control. Like other tropical countries, Thailand is facing this resurgent disease. The Thai National Dengue Prevention and Control Plan has been recently implemented to prevent and reduce the problems resulting from the spread of DHF. In this paper, a three-pronged strategy is offered that will create social mobilization at family, community, and national level and that will, therefore, reduce the socio-economic and health impacts of DHF.

INTRODUCTION

At an early stage, a correlation between dengue hemorrhagic fever (DHF) and the occurrence of *Aedes aegypti* was noted, even when other species of *Aedes* were endemic in the areas concerned. In 1903, *Ae. aegypti* was recognized as the vector of dengue. This mosquito entered Asia during the second half of the last century; its arrival was immediately followed by serious epidemics since *Ae. aegypti* lives in the vicinity of man, prefers human blood when feeding, requires artificial water containers for breeding purposes, and avoids dense vegetation. Human settlements offer environments that favor *Ae. aegypti*. DHF epidemics continue to burden Thailand and have prompted novel public health strategies. This paper presents an overview of DHF in Thailand. Vector ecology, epidemiology, and the socioeconomic impact of DHF are discussed; the control and prevention of DHF are illustrated and a three-pronged strategy for improving the control of DHF is introduced.

Vector ecology and human settlement

Wherever man has altered the environment, he has done so in favor of *Ae. aegypti* (Wellmer, 1983). In Thailand – and the whole of Southeast Asia – the population explosion and the rapid growth of cities led to deterioration in sanitary conditions. The reduction of vegetation and shade outside houses, together with an increase in man-made containers for drinking water, promoted the breeding of *Ae. aegypti*; at the same time, conditions became worse for *Ae. albopictus*, the autochthonous vector, which has almost disappeared from Bangkok.

Pant *et al* (1973) were able to establish that with a Breteau index below 20, very few cases of DHF were found, whereas many more occurred with a Breteau Index of more than 50; indices of 69-153 were found in epidemic areas in 1971. Pant *et al* (1973) went on to describe the potential breeding sites of the vector: large and small containers filled with water, as well as traditional earthenware storage jars with capacities of up to 200 liters. The Container Index is used to express the average number of possible breeding places per house and to predict a possible epidemic.

The density of infestation is indicated by the House Index. Earthenware jars are not the only breeding places: to these must be added water containers placed at the foot of furniture to trap ants – these are seldom emptied; every discarded can, old car tire, and any other items of refuse capable of filling with water contribute to mosquito breeding. The breeding places have one thing in common: they occur as a

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Table 1
Dengue/DHF situation in Thailand, 1989-1999.

Year	Cases	Deaths	Morbidity per 100,000	Mortality per 100,000	CFR (%)
1989	74,391	290	133.95	0.52	0.39
1990	92,005	114	163.43	0.74	0.45
1991	43,511	137	76.79	0.24	0.31
1992	41,125	136	71.16	0.24	0.33
1993	67,017	222	114.88	0.38	0.33
1994	51,688	140	87.47	0.24	0.27
1995	60,330	166	101.82	0.28	0.28
1996	37,929	116	63.09	0.19	0.31
1997	101,689	253	169.14	0.42	0.25
1998	127,178	434	209.12	0.71	0.34
1999	19,544	48	31.80	0.078	0.25

Source: DHF control office (Saengtharatip, 1999).

Table 2
Reported cases of DF/DHF/DSS per 100,000 population in Thailand by age group, 1992-1996 (median), 1997,1998.

Year	0-4 yrs	5-9 yrs	10-14 yrs	>15 yrs
Median				
1992-1996	162.86	449.22	285.09	12.52
1997	329.49	804.68	542.08	35.91
1998	349.25	845.58	556.46	46.18

Source: DHF control office (Saengtharatip, 1999).

result of, and in the vicinity of, human settlements.

The epidemiology of DHF in Thailand

In Thailand, over the past 40 years, the number of infected patients (dengue/DHF) has been rising steadily. Case surveillance, mainly clinically based, has been conducted for several years (Jatanasen and Thongcharoen, 1993). The epidemic pattern has been changed from one of alternate years to an irregular pattern. Table 1 summarizes annual dengue/DHF cases, deaths, morbidity and mortality rates per 100,000 population and CFR in Thailand from 1989 to 1999. The epidemic in 1997-1998 was probably due to poor prevention, undue public concern, and financial problems in Thailand secondary to the economic crisis.

Table 2 shows that approximately 65% of reported cases were confined to the 5-14 years age group. The reason for this is likely to be an increase in mosquito breeding and an epidemic of dengue in schools.

The social and economic impact of DHF in Thailand

The social impact of DHF may be direct and indirect (Sornmani *et al*, 1994). The direct impact was the effects of the illness directly on the patients and their parents. These effects included the duration of illness, the period of nursing care, and the financial cost. The indirect impact of DHF was of two kinds: the life disruption and the psychological effects. These impacts are abstract and difficult to quantify. The life disruption in DHF was mainly

related to the economic status of the family, such as the absence from work and the increase in family expenses. The impact on the family economy also extended to other members of the family and in many cases to friends and other relatives. The illness caused significant stress: a psychological burden shared by patients and families.

This social impact, although considerable, is usually neglected. In fact, this impact should be quantified in the terms of monetary loss to image its burden on Thailand's economy and development (Table 3). As shown in Table 3, prevention and control are more cost-effective than treatment.

The strategies to control DHF, in Thailand or elsewhere, should be directed at primary prevention and the control of epidemics; such strategies will reduce the global burden of this disease.

The control and prevention of DHF in Thailand

The control of dengue infection depends on controlling the vector, *Ae. aegypti*. Peridomestic breeding places, *ie* artificial water containers in and around a housing area, should be eliminated. The periodic use of larvicides and insecticides have been recommended by the World Health Organization (1986).

Vector control in Thailand: Integrated vector control has been performed in Thailand for several years. Source reduction via community participation is the main measure. Although

Table 3
Summary of the economic perspective of DHF in Thailand, 1994

		Baht	US$
1. Costs due to morbidity (per patient)			
Direct patient cost		1,589.29	63.60
Patient opportunity cost		1,040.00	41.60
Caretaker opportunity cost		1,235.00	49.40
Total patient cost.	Child	2,824.29	113.00
	Adult	3,864.29	154.60
Provider cost (hospital, drugs, laboratory costs)		1,100.00	44.00
Total cost of morbidity.	Child	3,924.29	157.00
	Adult	4,964.29	198.60
2. Costs due to mortality (per patient)			
Funeral cost.	Child	9,875.00	395.00
	Adult	16,200.00	648.00
Potential income loss (50 working yrs)		3,000,000.00	120,000.00
Total cost of mortality.	Child	3,009,875.00	120,395.00
	Adult	3.016,200.00	120,648.00
3. Costs due to prevention and control (per year)			
MOPH annual budget		46,724,200.00	1,868,968.00
BMA annual budget		2,800,000.00	112,000.00
MOI 75 provinces		72,285,000.00	2,891,400.00
Total prevention and control cost		121,809,200.00	4,872,368.00

MOPH = Ministry of Public Health
BMA = Bangkok Metropolitan Administration
MOI = Ministry of Interior
(Sornmani *et al*, 1994)

physical and biological methods are emphasized, a chemical method using abate sand granules is also applied depending on the type of water containers. The use of larvivorous fishes is practical in rural areas, whereas *Bacillus thuringiensis* var *israelensis* receives more attention in urban areas. Other natural enemies of mosquito larvae, *eg* water boatman, *Toxorhynchites* larvae, nymphs of dragonflies, and certain copepods, are commonly found in man-made water containers, although people are not convinced of the usefulness of these natural enemies.

Personal protection against mosquito bites and the reduction of man-mosquito contact are recommended. A variety of mosquito repellents are available in Thailand. N,N-diethyl-meta-toluamide (DEET) is the most commonly used active ingredient. Although DEET has proven to be the most effective, repeated application of repellents containing more than 35% DEET to skin over a short period of time should be avoided. Besides, DEET-containing repellents should not be applied to infants and children below 5 years of age.

Adulticide fogging is performed to kill infected mosquitos only during outbreaks or immediately after notification of dengue/DHF cases. Synthetic pyrethroids are the chemicals of choice. However, in areas where resistance to synthetic pyrethroids is evident, organophosphorous chemicals may be applied.

The control of imported vectors: Preventive and emergency vector control measures should be implemented in international ports of entry such as seaports, airports, train stations, and bus and haulage terminals. Space spraying and larviciding are appropriate methods of insect control, with space-spraying being extended to include the disinfection of international aircraft and shipping, including small craft.

Vaccination: There was an agreement between Mahidol University, Thailand, and Pasteur Merieux Connaught of France for the development and production of DHF vaccine: a DHF vaccine has been produced. A phase I trial of this tetravalent vaccine was carried out in the USA in order to assess the vaccine's safety and immunogenicity; a phase II trial was conducted in Thailand to determine the appropriate dosage and formulation and to test for the need for booster doses. The vaccine has produced satisfactory results: side-effects were minimal and responses to all four dengue virus serotypes were observed.

Thai National Strategies: The WHO (1986) recommended that each country in the endemic zone define a national control strategy against DHF taking into consideration the local epidemiological and socioeconomic conditions. The WHO (1986) went on to encourage the development of regional strategies that would underpin national prevention and control measures.

Due to the re-emergence of DHF and to celebrate His Majesty the King's 72nd Birthday in 1999, the Royal Thai Ministry of Public Health initiated an intensive vector control program, in collaboration with the Ministry of Education, the Ministry of Interior, private agencies, and others. The aim of this program was the elimination of breeding places of *Aedes* mosquito in households, schools and communities. Since the inception of the program, a number of activities have been undertaken to reform DHF control in Thailand. These include: (1) the formation of the National Dengue Prevention and Control Committee; (2) the establishment of the Office of DHF Control; (3) the development of the National Plan for Dengue Prevention and Control.

The National Dengue Prevention and Control Plan (NDPCP) (Saengtharatip, 1999) in its first two years (1999-2000) aimed to prevent and reduce the problems resulting from the spread of DHF and to reduce the socio-economic and health impacts of DHF at the family, community, and national level.

Strategic objectives of the plan are:

(1) To control the environment in communities so that it is not suitable as a breeding site for *Aedes* mosquitos.
(2) To realize the potential of individuals, families, communities, and community-

based organizations to control and reduce sources of DHF.
(3) To develop the prevention and care capabilities of concerned governmental and non-governmental agencies or institutions.

The specific objectives are:
(1) the reduction of morbidity and mortality
- not more than 50 cases of DF/DHF/DSS per 100,000 population.
- Case Fatality Rate of DF/DHF/DSS not more than 0.2%.

(2) the reduction of mosquito breeding places
- Breteau Index (BI) of below 50
- Container Index (CI) of below 10.

The NDPCP emphasizes the improvement of the environment in the community, human development, including education, information and community activities that aim to raise awareness of DHF, and the development of technology to promote dengue prevention and medical care for DHF patients. The main dengue control interventions currently being conducted are:

(1) *Aedes* larvae abatement programs
(2) The integration of DHF control into primary health care programs
(3) A massive public education campaign
(4) A national DHF seminar
(5) A DHF Newsletter
(6) An external review
(7) The development of technical materials
(8) The training of Master Trainers and Operation Trainers.

These NDPCP objectives and interventions are ambitious: both an adequate budget and a good team of administrators, physicians, and paramedical officers are essential. Moreover, communities and both the public and private sectors need to cooperate with the plan's organizers; an excellent follow-up and monitoring team is of equal importance.

The External Review Team concluded that large urban centers of the country should be targeted by an integrated, community-based approach to *Aedes* control by larval source reduction. The team's recommendations include the following:

1. Surveillance, emergency response, clinical diagnosis and case management; community-based, integrated mosquito control; research to be included in the NDPCP.
2. Identify and strengthen the roles and responsibilities at each level of the program structure.
3. The inclusion of both passive and active components in the surveillance system; the active surveillance should be laboratory-based with a predictive capability for epidemic transmission.
4. The emergency response should be sensitive to seasonal and epidemiological indicators of increased transmission.
5. Intensive training of physicians, nurses and paramedics in clinical diagnosis and disease management.
6. Detailed guidelines on the sustainable environmental management of mosquito control should be distributed to all levels of the health system.
7. National training on *Aedes* control should be carried out for those who are responsible for implementing the NDPCP.
8. Reduction of mosquito larvae habitats in the areas that do not fall within the jurisdiction of the government and volunteer health workers, such as businesses, tire shops, vacant lots, etc.
9. Formalization of a core group of experts in social and behavioral sciences to advise on developing and utilizing educational materials and programs.
10. Continuity of message production and dissemination through direct communication links among related health offices.
11. Ensuring intersectoral collaboration and support from NGOs.
12. Development of a management plan designating lines of authority for policy decisions and supervision, communication and coordination.
13. Developing greater policy, advocacy and intersectoral collaboration at the national level.
14. A new extramural research program to strengthen the implementation of NDPCP.

Because prevention is better than cure, Thailand expects to continue this NDPCP in the long term. Whereas the vector in Thailand is under control, it remains necessary to take steps to prevent its reintroduction in vehicles or in water containers carried from overseas, especially given the long period of viability of the dried mosquito eggs. The best insurance against the reintroduction of vectors is the taking of steps to ensure a standard of environmental sanitation which eliminates all potential breeding places.

Continuous vector control is only practicable in relatively densely populated areas such as towns, and this form of control should be maintained in all tropical and sub-tropical towns whether within the defined zones or not.

Improving the implementation of the NDPCP

The bold and laudable objectives set out in the NDPCP need to be met. In order to do this, individuals and communities must be mobilized. A *three-pronged strategy* is proposed: the strategy is designed to maximize social mobilization.

The three-pronged strategy is the collaboration of school officers (administrators, teachers, students, etc), health officers (medical and paramedical personnel including administrators at any level of provinces), and community leaders (*eg* heads of villages, districts, cities and provinces at all levels). The purpose is the dissemination of information, education and communication (IEC), which educate people about DHF and its transmission and control. The activities that are key to the dissemination of IEC are: field management, resources (*eg* funding, local groups, manpower, time, personnel, etc) and teamwork cooperation of three-pronged strategy.

Although globalization may affect the community, the root of Thai society remains. Thai people continue to respect monks, teachers, physicians and paramedical personnel. Therefore, the three- pronged committee should comprise of these leaders.

These committees will decide on policy matters, run control activities, motivate community participation, administer internal and external resources, and maintain the control program. To sustain these activities, principal teachers, district officers, and provincial doctors must be at the core of these committees. It is hoped that the inclusion of leading community figures will result in the maintenance of the three-pronged strategy through the generations. DHF, its cause, transmission, and prevention should be added to the teaching schedules of every school in the country, thereby integrating the control program into the national primary healthcare system. Each member of the three-pronged committees must be able to cope with outbreaks of DHF and manage emergency situations. Three-pronged committees should initiate the following activities:

1) Educate school children about DHF control; use cartoon books as part of teaching DHF in elementary schools.
2) Educate villagers, people, officers, teachers, administrators, housewives, families, monks, medical and paramedical personnel with regards to DHF.
3) Institute larval control campaigns in all households, offices, schools, temples, public and private areas, and especially in toilets; consider the use of larvivorous fishes, or abate sand granules. Cover storage water jars, pails, cisterns, etc by nets and lids. Integrate anti-DHF measures into primary healthcare in order to make the program sustainable.
4) Mosquito fogging should be performed during outbreaks.
5) Establish active and passive surveillance in the community in order to anticipate and rapidly manage (within 24 hours) epidemics.
6) Prevent mosquito bites by sleeping under nets, or the use of repellents or window

and door screens. Protect those with DHF from mosquito bites.

7) Commission research about DHF in the community to improve control effectiveness.
8) Organize mass media campaigns to promote DHF knowledge, signs and symptoms, transmission, and prevention.
9) Secure funding support, which should be administrated effectively.
10) Recruit volunteer workers who will be accountable for sustainable environmental management.
11) Formalization of a core group to create and monitor the control campaigns.

These challenge posed by DHF, a hazardous disease, will only be met if society comes to recognize that the education of every level of the community and the use of every medium should be undertaken. In the current economic crisis, cost-effectiveness is more important than it was. Thailand has to control DHF: it is hoped that the three-pronged strategy proposed in this paper, will contribute to the success of the NDPCP.

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