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Proceedings of the CAREC/PAHO Sub-Regional Dengue Meeting Port of Spain Trinidad June 1-3, 1999

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PAN AMERICAN SANITARY BUREAU, Regional Office of the
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Contents

Introduction
The PAHO/CAREC Regional Dengue Meeting was held in Port of Spain 1-3 June, 1999. There were 46 participants, mainly directors of Vector Control (VC) departments from all 21 (except two) CAREC Member Countries (CMC), plus participants from two French departments - Martinique and Guadeloupe- as well as participants from Cuba and Puerto Rico. (see appendix 1). Dr. Gabriel Schmunis, Program Co-ordinator, Dept. of Communicable diseases, PAHO and Dr. Renato Gusmão, Regional Advisor of the same Dept. were on hand to give PAHO support for the meeting. In addition, Dr. Bruce Knudsen, Consultant and Marco Suarez, recently appointed entomologist at the CPC, Bridgetown, Barbados, as well as joint co-ordinator of the meeting Dr. Christian Frederickson of the Brasilia PAHO office provided valuable assistance for the meeting.

The Objectives of the Dengue Meeting were as follows:
1. To further sensitise Regional Director**s** of Vector Control of the seriousness of the emerging issues of Dengue and Dengue Haemorrhagic Fever (DHF) in the Caribbean.
2. To help strengthen programs in the region for increased action for surveillance, prevention and control of the vector(s) and of dengue/DHF.
3. To receive and to discuss regional country reports on their dengue control/elimination programs.
4. To analyse and discuss the results of a Sub-Regional Dengue Questionnaire.
5. To review the PAHO draft document: "A Blueprint for Action for the Next Generation: Dengue ~~p~~**P**revention and ~~c~~**C**ontrol**".**

The Program
This present proceeding of the meeting is intended to serve as a record of the program of the regional dengue meeting. The program (Appendix 2) consisted of some of the enclosed formal presentation, including lectures by epidemiologist, VC specialists, dengue laboratory personnel as well as VC field personnel. In addition, participants provided country presentations, which are included herewith in an abridged format. The reports of the working groups deriving from discussions on a variety of pertinent subjects are also included. The draft PAHO document: A blueprint for action for the next generation: dengue prevention and control", (Appendix 3), was also discussed in detail with suggestions for improvement of the proposal**.**

A summary was made of the responses to a Sub-regional dengue questionnaire, to which there were responses by 22 countries (appendix 4). The questionnaire and the responses are included so that individual country VC staff may assess their country's responses with those of their counterparts in other countries.

Results of the Meeting:
By all accounts, the meeting was ~~a~~ highly successful. There was heightened awareness of the dengue situation in our region; participants returned to their countries with improved tools for the surveillance and control of dengue and its vector. There was a strong desire to launch inter-sectoral and inter-country participation for the challenge of facing this progressively important disease in the Caribbean. Above all, participants went away with an understanding of the tremendous role the community needs to have in partnership with the public health authorities

for the mitigation of this disease. Each participant was encouraged to take home bundles of the new poster on the checklist of the dengue vector breeding places for distribution of their communities. Time will tell how successful we were in helping to bring about changes for the better in dengue/DHF control or elimination in the countries of the region.

Dengue Fever in the Caribbean. An Epidemiologic Perspective

Dr. Merle J. Lewis.
Caribbean Epidemiology Centre PAHO/WHO, Port of Spain, Trinidad & Tobago

Basic Information about Dengue and Dengue Transmission.

Dengue Fever is an Arthropod-borne infection caused by a Group B Flavivirus, which is biologically transmitted through the bite of an infected female *Ae. aegypti* mosquito. The etiologic agents are a viral complex consisting of four distinct serotypes, namely DEN 1,2,3, and 4. Infection with one serotype induces homologous lifelong immunity.

Brief Clinical Description

The clinical features of Classic dengue fever vary depending upon the age of the patient. In general the symptoms consists of an acute onset of fever, headache, retro-orbital, muscle and joint pains, and a rash. The patient may be incapacitated for a week after which if no complications occur recovery will be complete and without sequelae. The case fatality rate is very low.

Dengue Haemorrhagic fever is a more severe manifestation of the illness and include four major clinical manifestations: high fever, haemorrhage phenomena, hepatomegaly (abnormal enlargement of the liver.) and often circulatory failure. Moderate to marked thrombocytopenia (an abnormal decrease in the number of platelets in circulatory blood) with concurrent hemoconcentration (increase in the concentration or proportion of formed elements in the circulating blood usually resulting from the loss of plasma from the blood stream) are distinctive clinical laboratory findings. Patients usually recover spontaneously or after fluid and electrolyte therapy.

In severe cases the patient's condition may suddenly deteriorate after 2-3 days of fever and dengue shock syndrome may occur. This is characterised by a drop in temperature three to seven days after the onset of symptoms with signs of circulatory failure. The skin becomes cool and blotchy, cyanosis and the pulse becomes weak and rapid. The patient may become lethargic or restless with acute abdominal pain shortly before the onset of shock. Shock is characterised by a rapid weak pulse, hypotension, cold clammy skin and restlessness. Patients in shock are in danger of dying if prompt treatment is not initiated. Shock lasts for 12-24 hours during which time the patient may die without appropriate volume replacement therapy. Convalescence in DHF with or without shock is short and uneventful usually lasting 2-3 days. The return of an appetite is a good prognostic sign.

Major Determinants of Transmission.

The major environmental and climatic determinants for dengue transmission are abundant rainfall, which creates conditions for amplification of *Ae. aegypti* populations and elevated temperature which shorten the extrinsic incubation period of the virus in the mosquito.

The behaviour of the arthropod vector is an important component in transmission. *Ae. aegypti* is intimately associated with and has a marked preference for feeding on man. Due to its timidity its feeding may be frequently interrupted which creates conditions where one infected mosquito may infect several susceptible hosts while attempting to complete a single blood feeding. Transmission is determined by the frequency, nature, and duration of exposure of susceptible humans to infected arthropod vectors. Data from a dengue epidemic in Barbados during 1997-8 illustrate a rapid rise in the number of cases over a short period of time followed by a rapid decline in the number of cases reported due to control efforts, changing environmental conditions and a reduction in the number of available susceptible hosts in the area.

Historical Record of Dengue Transmission in the Caribbean.

A review of the occurrence of dengue in the Caribbean is presented and is summarised in Table 1.

Table 1
History of Occurrence of Dengue in the Caribbean Area

Year	Area	Serotype	Outcome*
1635	Pandemic	?	CDF
1953	Trinidad and Tobago	2	CDF
1963	Greater Antilles, Jamaica Puerto Rico	3	CDF
1968	Jamaica, Hispanola	2,3	CDF
1977-8	Pandemic Caribbean, Central America, USA	1	CDF
1981	Cuba epidemic	2	CDF, DHF, DSS
1981	Dominican Republic	4	CDF
1981-4	sporadic throughout Caribbean	1,2,4	CDF
1984	Aruba epidemic	1	CDF
1985-6	Puerto Rico small outbreak	1,2,4	CDF, DHF, DSS
1986	Brazil	1	CDF
1986	Trinidad and Guyana	2	CDF
1989-90	Venezuela epidemic	1,2,4	CDF, DHF, DSS
1989	Trinidad	2	CDF
1990	Trinidad and Grenada	1,2	CDF
1990	Barbados and Dominica	1	CDF
1994	Nicaragua	3	CDF
1994	Puerto Rico	1,2,4	CDF
1995	Pandemic	1	CDF
1996	Trinidad and Tobago	1	CDF, DHF
1997	Belize	3	CDF
1997	Trinidad and Barbados	2	CDF

*CDF Classic Dengue Fever; DHF Dengue Haemorrhagic Fever; DSS Dengue Shock Syndrome.

The incidence rates per 100,000 population in CAREC Member Countries **(**CMC**)** remained low with minor peaks of ten or less occurring in 1982, 1986 and 1990. In 1993 the incidence increased to 55 dropping to 15 in 1994 and then increasing to 83 in 1995. In 1997 the rate declined to 67 and then increased to 89 in 1998. In 1998 the number of cases in CMC began during in January and February declined until May and then increased rapidly through the second half of the year with a peak in October. A comparison of the number of cases reported during the first 16 weeks of 1998 and 1999 indicate a marked reduction in 1999 in the number of cases reported. In 1999 the number of cases reported per week from CMC for weeks 5-16 remained below 20 and for most weeks fewer than **ten** cases per week were recorded. Dengue 1, 2 and 3 serotypes were recorded circulating in 1999.

Dengue Control and Surveillance

Effective dengue control requires that the *Ae. aegypti* indices are reduced to levels below which transmission cannot occur. This will decrease or eliminate the incidence of dengue infection and disease and the occurrence of complicated cases is avoided. For effective Dengue Fever Control source reduction must be the lynchpin of any vector control initiative with other measures being implemented during emergencies.

The objectives of Dengue Fever Surveillance are to quantify the magnitude of the disease to identify the circulating etiologic agents, to monitor its spread to new geographic areas and to monitor severe, complicated and fatal cases.

The strategies include virus surveillance, syndromic surveillance and the surveillance of selected specific factors

Important requisites for effective virus surveillance include an effective infectious disease surveillance system with enhanced laboratory capabilities and rapid communication of the results so that control measures can be implemented.

The Current Situation of the Dengue Vector *Ae. aegypti* in the Caribbean.

S.C. Rawlins, CAREC.

Dr. Rawlins discussed the status of *Ae. aegypti* in the Caribbean region. While *Aedes albopictus* is also a potential vector it is not present in most of the region and the principal vector in the Caribbean is known to be *Ae. aegypti.* In the Caribbean region *Ae albopictus* has only been reported to be endemic in the Cayman Islands, the Dominican Republic, Cuba and French Guiana. It is has been confirmed that *Ae. aegypti* is present throughout the region with the exception of the Cayman Islands where there is no permanent presence apart from the occasional introductions which are rapidly eliminated.

Dr. Rawlins presented information on the history of *Ae. aegypti* in the hemisphere and the Caribbean. In the 1930's *Ae. aegypti* was present throughout the Americas from the 10°C July isotherm in the south (around Buenos Aires**,** Argentina) to the 10°C January isotherm in the north which included the southern United States and up the east coast as far as Baltimore. After the launch of the hemispheric eradication program the *Ae. aegypti* distribution was reduced to the southern US and a few areas of Mexico and northern South America. With the discontinuation of

the program, *Ae. aegypti* gradually re-infested the areas previously free of infestation. Presently this mosquito occupies most of its former range of distribution. Shortly after re-infestation cases and epidemics of dengue occurred throughout much of Latin America and the Caribbean.

A comparison of house inspections and ovitrap sampling methods indicated that the later is 3x more sensitive. In working class areas ovitraps were almost 13 times more effective in detecting the presence of *Ae. aegypti.*

In Trinidad and Tobago a household survey indicated that potential breeding sites such as bottles, tires, buckets, clay pots and drums occurred in similar numbers in rural and urban situations. Urban areas tended to have more tires and clay pots whereas rural areas had more drums and bottles on the premises. The Breteau index BI for these areas indicated that drums were 10x more likely to be positive in the rural areas than in urban areas and were the most important source of *Ae. aegypti*. Tires**,** clay pots and cans were also slightly more positive in rural areas with BI of less than 4%. Bottles were rarely encountered with larvae.

The 1996 insecticide resistance status *Ae. aegypti* of various country to commonly used insecticides such as temephos and malathion were presented and are summarised in Table 2. The larval resistance ratio RR for temephos from the countries compared to the CAREC susceptible strain at the LD90 level ranged from 1.5 in Suriname to 9.8 in the British Virgin Islands. Eight countries had RR greater than 6.0. Malathion RR using adults ranged from 1.6 in Guyana and Anguilla to 4.7 in Trinidad & Tobago. Selection pressure appeared to be much stronger for temephos than for malathion. Despite the occurrence of resistance these two insecticides are still employed in many countries.

Table 2
Resistance Ratios for Temephos and Malathion in CAREC Member Countries, 1996.

	Resistance Ratios	
CMC Country	**Temephos**	**Malathion**
British Virgin Is.	9.8	1.7
St. Lucia	8.9	2.9
Dominica	8.7	2.3
Antigua	8.3	2.5
Grenada	8.2	*
St. Vincent	8.1	2.2
Curaçao	7.3	*
Trinidad & Tobago	6.0	4.7
Guyana	3.6	1.6
Anguilla	3.6	1.6
St Kitts	3.1	2.9
Jamaica	2.5	2.5
Barbados	2.2	3.3
Suriname	1.5	2.3

*** data not available**

The Role of the Laboratory in Dengue Surveillance and Control
Valerie Wilson, Manager, CAREC Laboratory Division

Dengue laboratory surveillance is based on the epidemiologic profile of countries, the appropriate use of testing services and the interpretation of laboratory and epidemiologic data for appropriate public health action.

There are four possible dengue fever epidemiologic situations:
The first is that there is no vector present or its presence is highly unlikely. This is mostly applicable to northern temperate climates and not applicable to any Caribbean country

The second is that there is no vector present or it is intermittently present at low levels but ecological conditions are favourable. This is applicable to Bermuda and the Cayman Island Under these circumstances most dengue cases are identified through measles elimination surveillance system (MESS).

The third is one in which the vector is present but there is no endemic dengue transmission. This is mostly applicable to small islands where transmission is probably not sustainable such as Anguilla, Montserrat, and the Turks and Caicos Islands. In this situation cases are likely to be identified through MESS and a sentinel surveillance network.

The fourth and final situation is where the vector is present and dengue is endemic with periodic epidemics. This occurs in most of the other Caribbean countries. Cases are identified as above. Areas at high risk have a high population density and vector indices and are often communities adjacent to port areas or with high proportion of new immigrants from endemic areas.

From a public health perspective, the main purpose for the laboratory confirmation of dengue fever is to confirm that dengue is the cause of the disease outbreak and to identify the introduction of new serotypes and their spread into geographic new areas. Laboratory surveillance is not intended to facilitate the clinical management of the individual patient. The public health laboratory should not attempt to fulfil the role of a hospital clinical laboratory.

Diagnostic samples must be accompanied by the information needed for disease surveillance and control. To facilitate the laboratory to conduct the most appropriate assay, it is imperative that the following information is provided with the sample;
- The date of onset of illness and the date of the specimen collection,
- A clinical summary,
- Detailed travel history with dates of travel, and other demographic and epidemiologic data,
- Indication of recent Yellow Fever vaccination.

The dengue laboratory surveillance operates in **five** basic modes.
- The baseline mode which is in effect when no outbreak is occurring,
- The investigative mode which is pre-diagnostic and occurs when an outbreak is suspected
- The monitoring mode, which is post-diagnostic and the outbreak has already been confirmed.

- The evaluation mode which is post-outbreak and surveying mode
- The post-outbreak switch during which the laboratory returns to the baseline mode.

Baseline Mode No Outbreak:
Between outbreaks or in the absence of any recognisable outbreak, samples from all cases suspected of dengue and samples from isolated cases should be sent to the laboratory for virological confirmation. These samples are valuable to determine the most prevalent types in each community. Most shifts in the most prevalent type(s) occur during this phase.

Investigative Mode / Pre-diagnostic Mode / Outbreak Suspected:
When the number of probable cases with clinical diagnosis of dengue is increasing the onset of an outbreak should be suspected. In this scenario the laboratory requires the fast submission of a sample of patient sera (at least 25 sera) drawn within three days after the onset. These sera are required to isolate and identify the viral typed causing the outbreak.

Monitoring Mode / Post-diagnostic Mode / Outbreak already Confirmed:
After the virus causing the outbreak has been identified there is little need to continue to confirm all cases of dengue fever. Under these circumstances the clinical diagnosis of dengue fever reinforced by the epidemiological diagnosis should provide the basis for firm diagnosis and patient management.
During an epidemic when the clinical syndrome and the disease diagnosis are established and the infecting serotype(s) has/have been identified, it is a misuse of resources to attempt serologic or virologic confirmation of every suspected dengue case. Laboratory resources should be focussed on identifying new areas where the disease might be spreading, detecting new serotypes coming into already infected areas, and monitoring severe and fatal cases attributed to dengue. Laboratory surveillance at this stage should be limited to a sample of suspected cases in order to:
- Identify the introduction of new serotypes into already infected areas;
- Identify the spread of the epidemic into new areas
- Monitor severe, complicated, and fatal cases attributed to dengue

Evaluation Mode / Post-Outbreak Mode/ Surveying Mode:
Immediately following the outbreak, from an epidemiology point of view the Public Health service of the country may wish to conduct population-based surveys with the aim, for example, of estimating the true incidence of disease. In this case the numbers and type of the samples being requested will be part of the design of the epidemiological study, to be determined in consultation CAREC.

Post-outbreak Switch/Return to Baseline Mode:
After the outbreak has subsided there is a need to explicitly indicate to Public Services and physicians to return to the baseline mode, and thus resume the normal submission of specimens for viral diagnosis.

Dengue Laboratory Tests. Range of Tests, Utility, Interpretation of Results:
Laboratory confirmation of dengue fever can be obtained through the use of different assays. Virus identification is best achieved though virus isolation or PCR from acute blood specimen. It is preferable to collect the acute blood specimen from newly suspected cases within 3-days of

symptom onset. However if the patient presents at the later date a sample should still be collected and sent to the laboratory. Serologic confirmation for IgM antibodies is best achieved when samples are taken after seven days post onset of illness. Samples taken on days four to **six** post onset of illness should still be submitted for testing though the proportion of confirmed positives would be low. Since false negative rates may be high, CAREC laboratory will inform you if a second specimen should be submitted for either IgM testing or the detection of sero-conversion.

A laboratory confirmed case of dengue is a probable case with one or more of the following:

- Detection of IgM antibodies to one or more of the dengue virus antigens by MAC-ELISA.
- Identification of dengue virus from acute serum.
- Demonstration of dengue virus in clinical material by PCR.
- Demonstration of a fourfold or greater rise in flavivirus antibody titres between acute and convalescent phase serum specimens by the Haemaglutination Inhibition test.

<u>Comparison of Laboratory tests</u>

Virus isolation and typing must be conducted on serum taken less than four days after onset of symptoms. A positive result will confirm the disease etiology and identify the dengue virus serotype. A negative result does not rule out dengue infection. The rate of false negatives depends mainly on the conditions of shipment. Virus isolation and typing using IFA is a type specific specificity a high sensitivity but usually takes 3-6 weeks to get results.

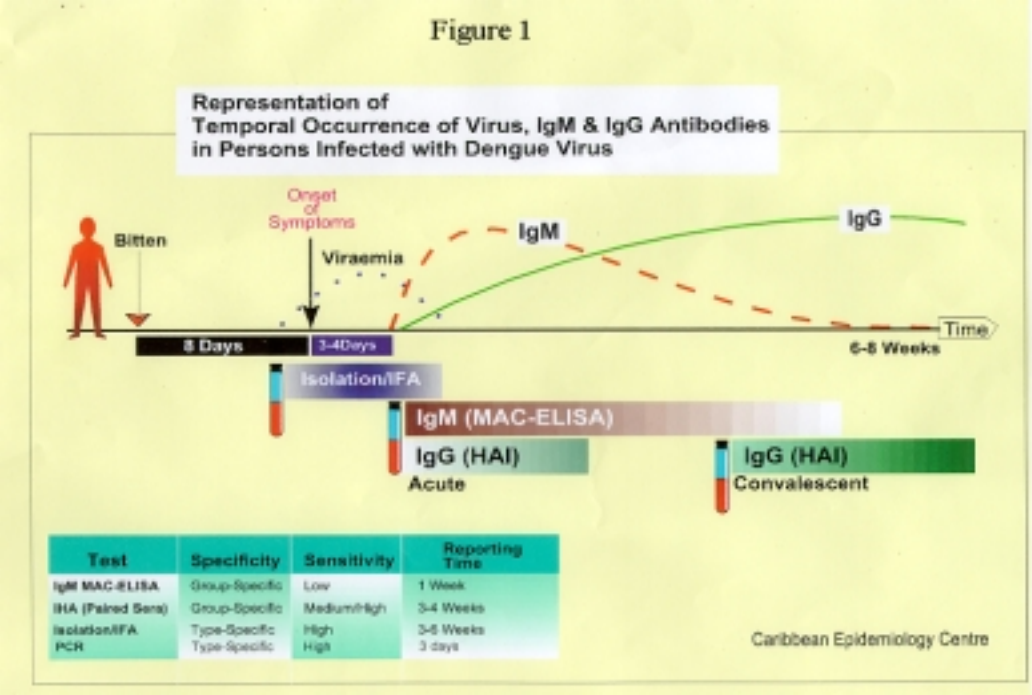
Under routine conditions RT-PCR (reverse transcriptase polymerase chain reaction) will yield less false negatives than virus isolation especially in poorly stored and post mortem samples. PCR tests are type specific have a high sensitivity and have a reporting time of three days.

Using IgM ELISA the serum must be taken after the first week of onset of symptoms. A positive result confirms that the etiological agent is a Flavivirus. False negative results commonly occur if the sera are taken very close to the onset of the disease. The IgM ELISA is group specific has a low sensitivity and usually has a one week reporting time when this test is used.

With the Hemogglutination inhibition assay HI paired serum must be taken. If a single serum is taken within the first week after the onset of symptoms a positive result is a titre >1280. This result is suggestive of a secondary infection. A result of <1280 is not informative. If paired sera are taken the first one should be taken during the first week after onset and the second one taken 10-15 days after the first. A 4x increase in titre between the first and second sample confirms that the etiology is a Flavivirus. Results less than a four-fold increase in titre rules out the possibility that the etiological agent is a Flavivirus. The paired HI test is group specific, has a medium to high sensitivity and has a 3-4 week reporting time.

A summary of the tests is presented in Figure 1.

Figure 1



Spatial Distribution of Resistance to Insecticides in Caribbean Populations
of the Dengue Vector, *Aedes aegypti* and it's Significance

SAMUEL C. RAWLINS

INTRODUCTION

Aedes aegypti (Linn), the only known vector of dengue, dengue haemorrhagic fever (DHF), and dengue shock syndrome (DSS), in the Caribbean as well as a potential vector of urban yellow fever, has continued to wreak havoc in the region by visiting nearly every country with outbreaks of dengue in the last two years (1,2).

The pattern of insecticide usage for *Ae aegypti* management has been more or less uniform throughout the Caribbean for the last 18-20 years (7,8). The organophosphorus (OP) insecticides temephos (larvicide) and malathion (adulticide) have been the mainstay of *Ae aegypti* control and dengue prevention for some 20-30 years in CMC's (Table 1).

This present report

- Reviews in detail the prevalence of Temephos resistance in larval populations and Malathion resistance in adult populations of *Ae aegypti* from 16 Caribbean Countries.
- Evaluates the impact of reduced control of the vector associated with increased resistance.

MATERIALS & METHODS

Laboratory Studies

One hundred and two (102) strains of *Ae aegypti* from 16 CMC's ranging from Suriname on the South-American continent through the chain of islands to the Bahamas in the north were collected for the present studies. These strains which were collected as eggs from enhanced ovitraps between 1995 and 1996 were bio-assayed for insecticide resistance at CAREC.

Field Studies

Test were designed to detect whether our observed resistance to Temephos in Ae aegypti larvae was likely to result in failure of control operations depending on the use of standard dosages of Temephos (Abate) at 1ppm in a 200-liter drum environment. The following strains were selected for the study:

Most resistant Long Look (Tortola), R.R. = 14.8

Moderately resistant Calliaqua II (St. Vincent), R.R. = 10.9

Less resistant Keartons (St. Vincent),

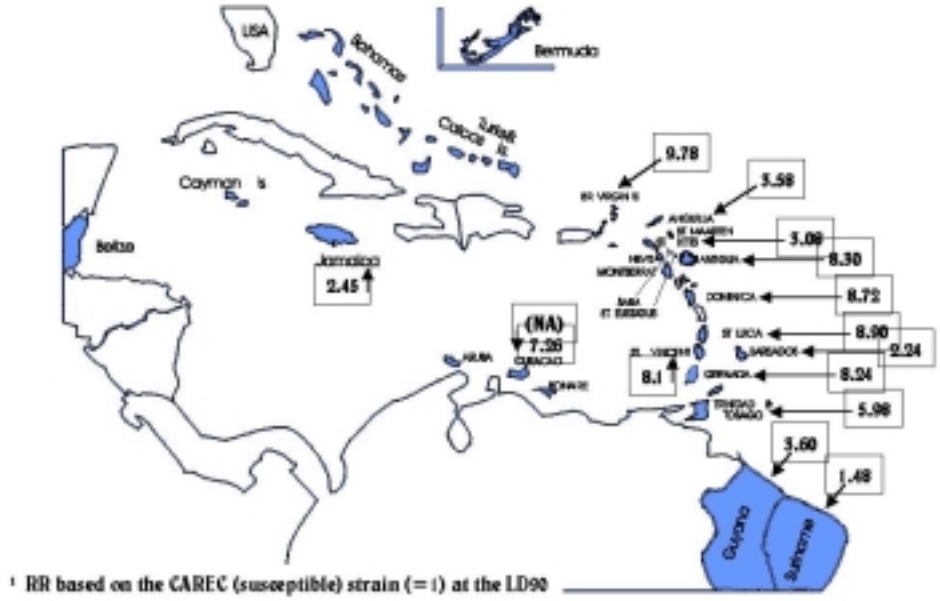
COUNTRY	HISTORY OF INSECTICIDE USAGE		
	Larvicide (yrs)	Frequency/yr	Adulticide (yrs)[1,2]
Suriname	T(20)	Sporadic	M(20)
Barbados[3]	T(20)	2-3	M(20)
Jamaisca	T(25)	Sporadic	M(20)
St. Kitts	T(18)	2	M(15)
Anguilla	T(17)	1	M(17)
Guyana	T(20)	Sporadic	M(20)
Trinidad[3]	T(20)	3-4	M(20)
Netherlands Ant.	T(20)	2-3	M(20)
St. Vincent	T(20)	3-4	M(20)
Grenada	T(15)	2-3	M(15)
Antigua	T(15)	1-2	M(15)
Dominica	T(30)	2	M(20)
St. Lucia	T(30)	7	M(30)
Tortola	T(30)	4	M(30)

1. T= Temephos; M = Malathion
2. Frequency of use of Malathion adulticide was sporadic in all countries.
3. Fenthion also used.

R.R. = 5.0
Susceptible CAREC (Trinidad) R.R. = 1

Table 1. Insecticide usuage for *Aedes aegypti* control in selected Caribbean Countries

Fig. 2: Caribbean *Aedes aegypti* Insecticide - Resistance Patterns in Larvae: Resistance Ratios (RR)1 to Temephos, 1996



[1] RR based on the CAREC (susceptible) strain (=1) at the LD90

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Fig. 3: Caribbean *Aedes aegypti* Insecticide - Resistance Patterns in Adults: Resistance Ratios (RR)1 to Malathion, 1996

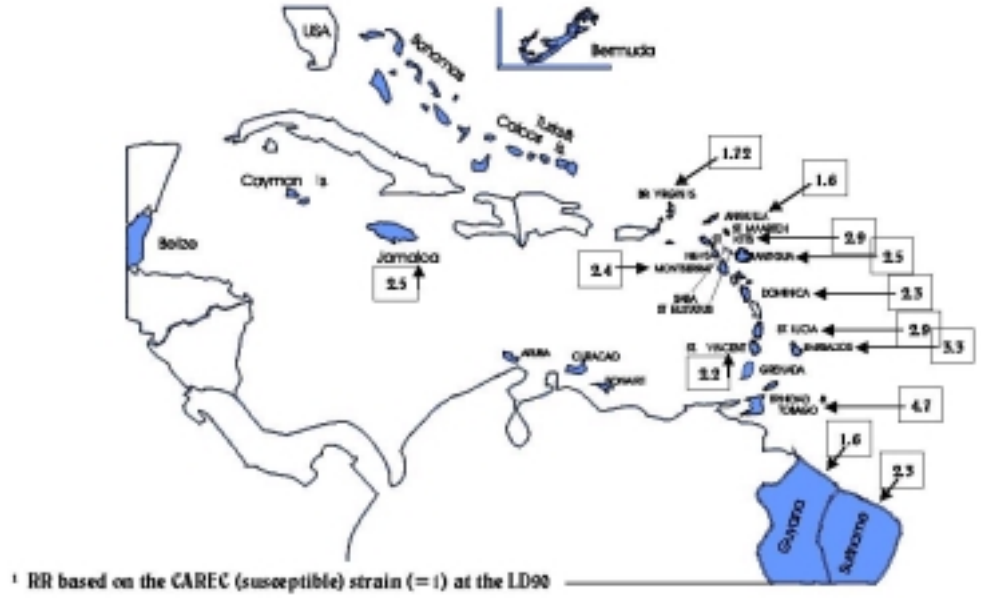

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Figure 2
Comparison of Resistance Ratios and Diagnostic Dosage Survival (0.02 mg /L) for Temephos in Caribbean Strains of *Aedes aegypti*, 1996.

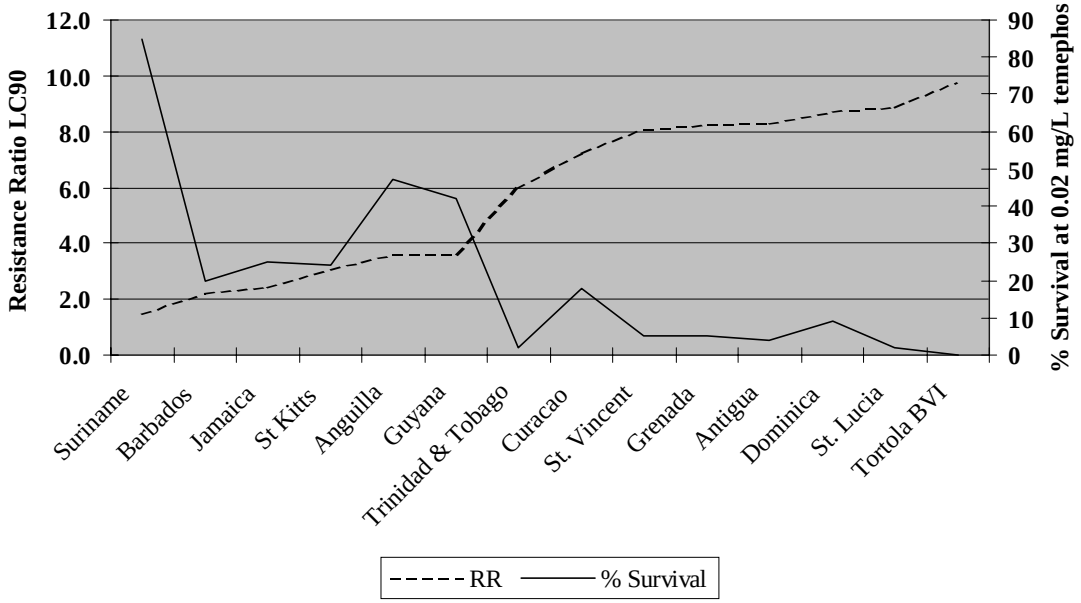
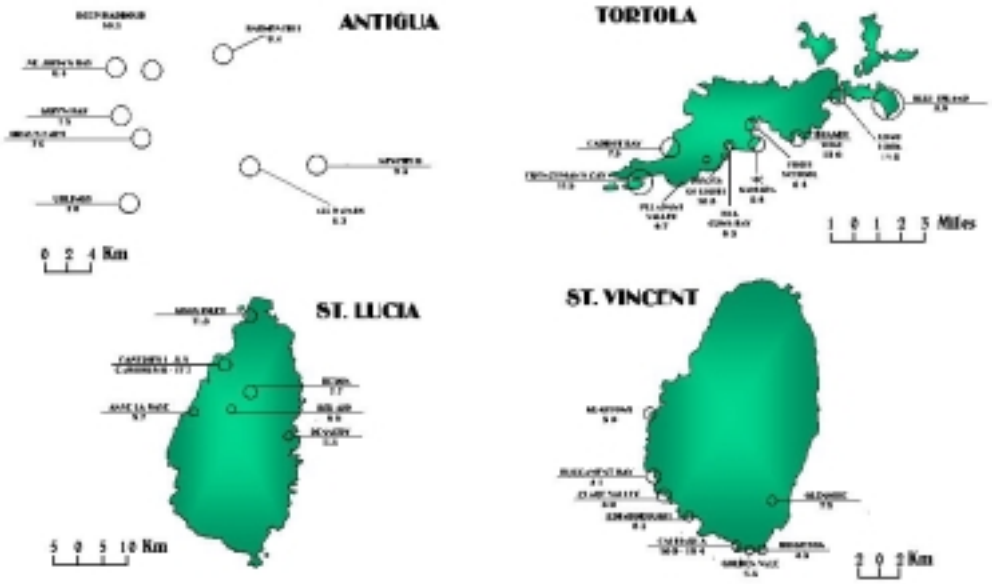


Fig. 4: Spacial distribution of Temephos resistance in *Aedes aegypti* populations in four Caribbean countries



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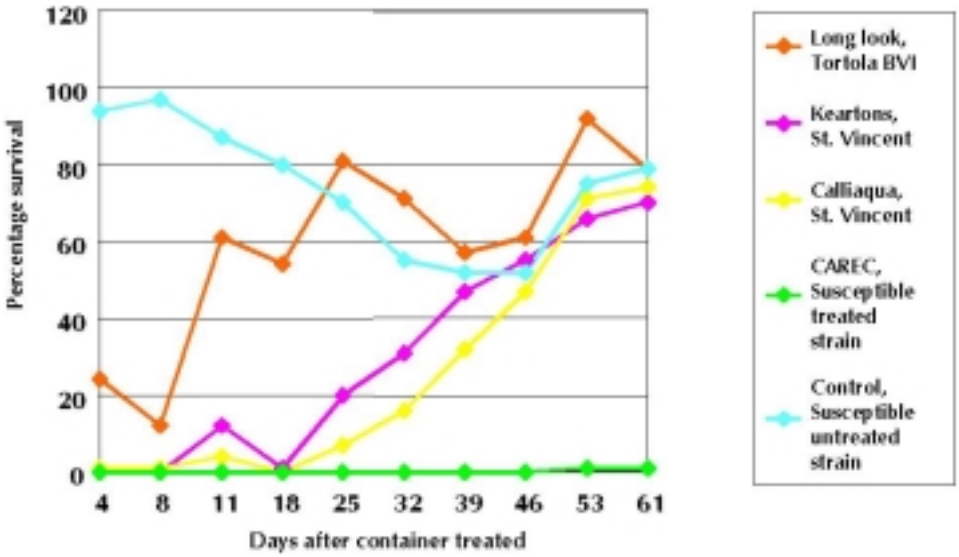
Survival of four strains of Aedes aegypti with varying levels of Temephos sensitivity in drums treated with 1ppm. Temephos



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PESTICIDE USE POLICY

- There needs to be access to a greater variety of insecticides, with a monitoring system - by the use of diagnostic dosages so that the communities themselves can monitor any loss of efficacy of chemicals.

- The policy should also indicate rotation systems to switch from one insecticide type to another which could prevent the selection of resistant populations.

- At the same time, the policy could suggest the frequency of applications to be more effective.

- Intra-domiciliary treatments by the community with recommended aerosols may become formalized, since it is known that truck-mounted or even aircraft dispensed chemicals do not very effectively penetrate households and kill adult mosquitoes

CONCLUSION

A controlling issue on all this is the matter of costs. In relatively poor societies, choice of methods of vector control is limited by the availability to access funds. Consequently, the use of less expensive methods of biological and physical control could become more attractive. Creating a culture of source reduction of container-breeding mosquitoes or community involvement in mass production, distribution and use of bio-control tools such as copepods may be the way forward.

ABSTRACT

Bioassay studies to monitor resistance to insecticides were performed on 102 strains of the dengue vector, *Aedes aegypti* from 16 countries ranging from Suriname in South America, through the chain of Caribbean Islands to the Bahamas, where Temephos, the larvicide and Malathion the adulticide had been use for 15-30 years. There was a large diversity in sensitivity to the larvicide in mosquito populations within and between countries.

How to Mobilise the Population in Dengue Vector and Mosquito Control: The Martinique experience.

Renélise Moutenda and André Yebakima,

The development of community participation is one of our objectives in the mosquito and dengue control program. In this way we have developed intersectoral actions and social communication. In 1998, three new actions have been initiated with municipal authorities, NGO's, population and schools services (health units, teachers and pupils).

Clean-up Campaigns

Since the dengue outbreak in 1997 (52 cases of DHF and nine death) cleaning campaigns were initiated with more than 60% of the municipalities. The objective of this action was to involve the population in the elimination of mosquitoes breeding sites.

In addition entomological surveys (using larva indices) were conducted according to the distribution of dengue cases. Information was provided to the municipalities about the dengue cases and the entomological surveys results. The service provided advice to organised meetings in concerned neighbourhoods and promoted clean up campaigns. Discussions were held local residents and NGO's in order to involve them in solid waste collection. The technical services of the municipalities were mobilised during the clean up campaigns. Human and material resources were provided to the local population to collect solid waste. During the collection, our inspectors worked together with municipalities agents to provide sanitary education to the population.

The activities were evaluated at meetings with the participants and municipalities authorities using the results of the entomological surveys. In 1998, 37 cleanup campaigns were conducted in **six** parishes.

Primary School Educational Reference Material

Using educational reference material provided by Dr. Gary Clark, CDC Puerto Rico as a guide, we provided in October 1998, more that 6 000 pupils from primary schools (172 public schools and **ten** private schools) with educational information concerning mosquitoes and dengue. This campaign was held in collaboration with other institutions such as the French National Educational Board. All the promoter participants in this campaign (17 schools doctors - 43 schools nurses and 262 teachers) received training on mosquito and dengue control. This campaign was promoted during a press conference by the Recteur (Vice-Chancellor). Teachers had to conduct the activities with their pupils during a two-week period. Over 8 300 pupil books and 500 teachers' guides were distributed.

An evaluation of student knowledge was conducted before and after the campaign. The evaluations indicated a significant change in knowledge after the campaign. For example before the campaign only 36% of the students knew that dengue was transmitted by *Aedes* mosquitoes. After the campaign this increased to 91%. Before the campaign only 11% indicated that dengue prevention could be assisted by elimination of unused water containers whereas after the campaign 48% indicated this as a means of prevention. The major aim of this campaign was to promote community participation through modification of the behaviour of these students.

All Saint's Day "Operation" in Cemeteries

Flower vases in cemeteries are an important source of *Ae. aegypti* in Martinique. In order to reduce these breeding sites we initiated a pilot operation during the last All Saints' Day (November 1st, 1998) in one of the municipalities (Schoelcher). The objectives were to sensitise the population to the dengue problem and to fill the flowers vases that they used to decorate graves with wet sand instead of using water. This operation was organised one week before the 1st of November and was considered a success because the population who visited this cemetery (270 persons) used the wet sand. Most of those visitors asked us to repeat this action next year. For the next all Saints' Day we plan to amplify this program to include more cemeteries.

Dengue Emergence. The Global Situation

Dr. Knudsen presented detailed information concerning the global situation of dengue as an emerging disease. Apart from the situation in the Americas where dengue has increased dramatically in the past 25 years, dengue has become an important public health problem in much of SE Asia, East Indies, northern Australia, India and central and West Africa. (Table 5).

Table 5. Dengue and DHF Cases reported by WHO Region 1995-8

WHO Region	No. Countries	Cases Officially Reported to WHO 1995	1996	1997	1998
WPRO	21	124,317	131,724	152,660	264,476
Deaths		28	532	801	1,379
SEARI	9	105,777	102,229	136,030	209,920
Deaths		1,142	1,923	1,037	1,980
AMRO	37	284,483	250,707	389,917	708,146
Deaths		106	18	107	83
Total Cases		514,577	484,660	678,607	1,182,542
Total Deaths		1,276	2,473	1,945	3,442

*EMRO did not report any cases

The number of dengue classic and dengue haemorrhagic fever cases reported in the Americas from 1980-1995 were presented. (Figure 3) and the population at risk in 1995. (Table 6)

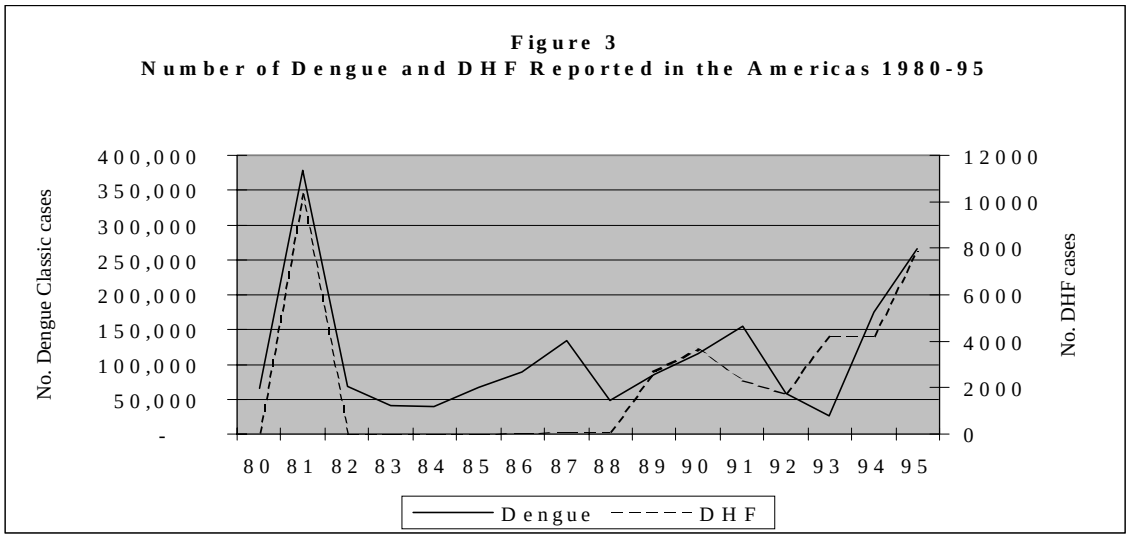


Table 6
Population at Risk and Incidence of Dengue and Dengue Haemorrhagic Fever DHF in the Americas, 1995.

Country	Population at Risk	Dengue/ DHF cases	Serotype	Incid. Rate /100,000	DHF Cases	Deaths	Ratio DHF/den 1:x	DHF Case Fatality Rate
Venezuela	1,515,905	32,280	1,2,4	2129.4	5380	43	6	0.8%
French Guiana	115,000	896	1,4	779.1	1	0	896	0.0%
Honduras	3,605,978	27,575	1,2,3,4	764.7	15	3	1,838	20.0%
Monserrat	10,639	75	na	705.0	0	0	-	-
El Salvador	1,767,565	9,658	1,2,3,4	546.4	129	5	75	3.9%
Costa Rica	996,700	5,134	1,3	515.1	1	0	5,134	0.0%
Nicaragua	4,139,486	19,260	1,2,3	465.3	806	0	24	0.0%
Dominica	64,795	293	1,2	452.2	11	0	27	0.0%
Barbados	260,491	976	1	374.7	2	1	488	50.0%
Puerto Rico	2,096,640	6,765	1,2,4	322.7	24	2	282	8.3%
Belize	44,039	107	na	243.0	0	0	-	-
Brazil	56,000,000	124,887	1,2	223.0	105	2	1,189	1.9%
Peru	1,726,270	2,732	1,2	158.3	0	0	-	-
Panama	1,992,672	3,083	1,3	154.7	3	1	1,028	33.3%
Colombia	15,245,071	19,131	na	125.5	733	10	26	1.4%
St Kitts/Nevis	23,244	27	na	116.2	0	0	-	-
Ecuador	6,205,691	6,607	1	106.5	0	0	-	-
Antigua/Barbuda	59,355	56	1	94.3	0	0	-	-
Grenada	95,600	83	1	86.8	1	0	83	0.0%
Mexico	19,988,371	17,088	1,2,3,4	85.5	539	30	32	5.6%
Jamaica	2,366,067	1,884	2	79.6	51	3	37	5.9%
Guatemala	9,744,627	3,980	1,2,3,4	40.8	1	0	3,980	0.0%
Dominican Rep.	7,600,000	249	na	3.3	38	2	7	5.3%
Bolivia	1,470,740		na	0.0			-	-
Argentina	1,500,000	na	na	na	na	na	na	na
Paraguay	4,152,588	na	na	na	na	na	na	na

The pattern for endemic dengue/DHF follows the distribution of *Ae. aegypti*. Once *Ae. aegypti* is established in an area the risk for dengue transmission is present and in tropical areas where adequate control measures are unable to respond to this threat it is only a matter of time before the first outbreak of disease transmission will occur. The pattern for *Ae albopictus* is different. *Albopictus* is present in limited areas of Mexico, Guatemala, Costa Rica, Cayman Is. and extensively in southern Brazil and south eastern USA. At present it has not been shown to be responsible for dengue transmission in Brazil and has only recently been found to be naturally infected in northern Mexico where a pool of male *albopictus* were found to be positive for dengue virus.

Appropriate Tools and Methods for *Ae. aegypti* and *Ae. albopictus* surveillance
Bruce Knudsen

Basic peridomestic *Aedes* surveillance methods include house to house larval inspections, spot checks, randomised inspections and inspections in high-risk areas. Routine house hold inspection consists of thorough indoor and outdoor checks of all wet and dry water containers for potential larval and pupal breeding sites using the correct tools. Spot check inspections consist of arbitrary checks at select locations in various premises using thorough inspection techniques. Randomised checks consist of using a table of random numbers to select areas where inspections are to be carried out. The same thorough inspection techniques are employed. High-risk area checks consist of conducting inspections in areas considered to be at risk for disease transmission. Follows same thorough surveillance.

The tools for larval and pupal inspections include a torchlight, long stemmed pipette, mirror, dipper, collection vials, recording forms, pen/pencil. It is important that the inspector also have an inquisitive mind, interest in the work, think like a mosquito in order to conduct a thorough and deliberate search for breeding sites and after the inspection share results with homeowner.

The results of Larval Surveys can be used as data for determining risk indicators such as the house index, the container index, the potential breeding index and the Breteau index. Other surveillance methods for determining potential risk of vector transmission include the pupal index, the ovitrap index and the adult landing rate index

There are numerous components in effective dengue control programs. They can be summarised as follows which when taken together and used effectively spell dengue control.

Demography
Wat**E**r Supply
Vector Co**N**trol
Sewa**G**e and Waste Water disposal
Urbanization
Environmental Management
Larvi**C**ides
Bi**O**cides
Trai**N**ing
Adul**T**icides
Source **R**eduction
C**O**mmunity Participation
Intersectora**L** Collaboration

Yellow Fever, Risk Stratification and Control Strategies in the Caribbean
Sylvain Aldighieri

The risk for Yellow Fever transmission has been stratified for CAREC member countries. The following is an outline of the three risk groups, a brief description of the group characteristics and countries that are presently in each risk group.

Group A: Are countries at greatest risk because they are in enzootic Yellow Fever zones plus they are areas infested with *Ae. aegypti*. Countries in this group include Guyana, Suriname and

Trinidad. Suriname and Guyana are part of the group A because the interior rain forest of these countries belongs to the Amazon rain forest ecosystem. At least six monkey species (*Alouatta, Ateles, Cebus, Tamarin, Saimiri, Aotus*) involved in the sylvatic YF cycle are found in these countries. There are also at least two efficient sylvatic vectors *Haemagogus. janthinomys, Sabethes chloropterus* are found in these countries . There is previous history of recent jungle Yellow Fever outbreaks. In these countries the last cycle occurred in the 1960's and 1970's
Trinidad is part of group A countries because the Trinidad forest ecosystem belongs to those of the South America mainland where enzootic Yellow Fever exists, it has at least two monkey species (*Alouatta seniculus, Cebus albifrons*) involved in the sylvatic cycle and at least three efficient sylvatic vectors are present (*Hg. janthinomys, Hg. leucocelaenus, Sabethes chloropteurs*). Also there is previous history of repeated epizootics/ outbreaks during the last 50 years. Epizootics were reported in Trinidad in 1954-55, 1959, 1978-79 and 1988-89. Outbreaks were reported in 1954, 1959 and 1979.

Group B: Are countries with risk because they have a history of vectors and hosts of epizootic Yellow Fever although no ongoing virus activity has been noted in recent years plus they are areas infested with *Ae. aegypti*. Belize is in this group. Belize is in Group B because Districts of the interior have large zones with a rain forest ecosystem that are still linked to other Central American countries. At least two monkey species (*Alouatta pigra, Ateles geoffroyi*) involved in the sylvatic cycle are found in Belize. At least two efficient sylvatic vectors (*Hg. mesodentatus, Sabethes chloropterus*)are found in Belize. Also the 1950's outbreak reached Belize where an epizootic was reported in 1956-57.

Group C: Areas infested with *Ae. aegypti*
Granada, St. Vincent, St. Lucia, Dominica, Antigua, St. Kitts and Nevis, Barbados, Netherlands Antilles, Aruba, Anguilla, Montserrat, Jamaica, Turk & Caicos/ Cayman Is., Bermuda, Bahamas, British Virgin Is..

The assessment of the risk of urban Yellow Fever re-emergence in the Caribbean is based upon several components. Group A and B countries are at greater risk due to the close proximity of potentially infected monkeys in the jungles. Group C countries have a lower risk because the virus must be introduced into the area via infected humans returning from enzootic areas in other countries. Urban environments with no *Ae. aegypti* present are an epidemiological "cul de Sac" for Yellow Fever transmission. Urban environments that are infested with *Ae. aegypti* but have an immunisation coverage rate close to 90% are also an epidemiological dead end for virus transmission. Areas with no vaccine coverage or poor coverage of less than 80% run the risk of secondary cases if an infectious carrier enters the area.

There are two strategies to prevent the introduction of Yellow Fever. The first strategy is the fire-fighter strategy that depends upon early detection and control of an outbreak. This strategy depends upon the early detection and immediate reporting of the suspected cases. Prompt confirmation of suspected cases by a reference laboratory is required. Successful prevention of transmission requires the advanced preparation for implementing emergency immunisation and vector control activities. The second strategy is preventative and is for the long term. Mass vaccination campaigns are required that target all age groups but focus on geographic zones at risk and that Yellow Fever vaccination be included in routine childhood immunisation schedules.

The strategy for the CAREC member countries depends upon which Group the country is in. Countries in Group A must achieve 100% vaccination coverage in enzootic Yellow Fever zones and contiguous areas infested with *Ae. aegypti*. These countries should incorporate Yellow Fever in routine childhood immunisation schedules. Yellow Fever surveillance must be strengthened using specific tools and laboratory network. Countries must prepare plans for emergency immunisation and urban vector control activities.

Countries in Group B must strengthen their Yellow Fever surveillance using proactive methodology to detect epizootic (ie post mortem examination of monkey's and periodic examination of pool samples of mosquitoes). These countries must require a valid Yellow Fever vaccine certificate from any traveller coming from enzootic Yellow Fever zones and prepare plans for emergency immunisation and urban vector control activities.

Countries in Group C must require a valid Yellow Fever vaccine certificate from any traveller coming from enzootic Yellow Fever zone and prepare plans for emergency immunisation and urban vector control activities.

COUNTRY PRESENTATIONS

Dengue Situation in Aruba
V. Krozendijke

Aruba is located in the Southern Caribbean and is the smallest and most western island of a group of three Dutch islands. It is located 15 miles of the northern coast of Venezuela. The Island encompasses a total area of 77 square miles (190 km^2). The climate is dry and sunny. The average rainfall is 20 inches per year and occurs in showers during the months July to January.

Language:
Dutch is the official language. It is used both in education and in the civil service. Papiamento is the national language. It is used in the Parliament as well as in the media. It is the language spoken in Aruba, Curaçao and Bonaire. English and Spanish are compulsory in the grades of primary school and they are spoken by a large of the population.

Economy:
Aruba's economy depends largely on Tourism. The total population is 93,424. The rate of unemployment is very low (6-7%). The Island is in the last years in a construction and economic boom. This is why we have guest workers from the Netherland Antilles, Caribbean Islands and neighbouring Spanish speaking countries living and working in Aruba.

Ae. aegypti Control
For the purpose of *Ae. aegypti* control, Aruba is divided in three Area's. Area I includes Oranjestad (the capital) and the airport and seaport perimeters. This area is divided in 14 zones with a total of 6558 premises. Area II includes St. Nicolas and Seroe Colorado and consists of nine zones with 5767 premises. Area III includes Savaneta, Sta. Cruz and Noord. This area

consists of 18 zones (4+4+10) and a total of 15,550 premises. At present the Unit is understaffed. The total personnel (employees) is 23 with 13 vacant posts.

Ae. aegypti Control Unit:
The Unit started in 1970 as an *Ae. aegypti* Eradication Program. It was a success until 1983. Due to circumstances (political, Organisation, lack of funds and interest) the island was reinfested. At present the Unit controls the *Ae. aegypti* mosquito. Financial resources for the Program vary each year. In 1997 the annual budget was US$730,737., in 1998 US$599,036 and in 1999 the budget is US$ 600.000.

The following mosquitoes are found in Aruba: *Ae. aegypti, Aedes taeniorhynchus, Culex pipiens quinquefasciatus* and *Psorophora confinnis*

Techniques/Strategies:
We do comprehensive survey and Area's and zones with high indices are inspected more often. Ovitrapping is done at Seaport, Airport and in the Freezone. We provide information to the public on *Ae. aegypti* control and Dengue prevention through the media (newspaper, radio & television) and on the spot by the mosquito inspectors during the house to house inspections. We distribute folders, stickers and posters with instructions on source reduction. We do spot-checks of incoming vessels and conduct cisterns, water tanks, fire-pit and sewer lines surveys. Second hand tire importers and plant importers and outlets are inspected. Hotels, bungalows, guesthouse, apartments, schools, church, churchyards, elderly homes, hospital and clinics are more often inspected. We use legal measures but at this moment we are updating the warning and penalty forms because of the changing of local laws. We do chemical and biological control when and where it is necessary and work very close with the refuse collection dept. and the city inspectors. Chemical control measures include the use of the organophosphates malathion and temephos and the pyrethroid K-Orthine (deltamethrin)and Icon (lambda cyhalothrin). Larval control is also conducted using Vectobac G and AS, Bactimos briquettes and the introduction of the larivorous fish *Poecelia reticulata* (guppies).

Breeding Places:
The most common *Aedes* breeding places are water-holding containers in the yards (70%), water plants inside the homes (20%), water drums (5%), tyres (3%) and cisterns and water tanks (2%). The most recent *Ae. aegypti* indices indicate that Aruba has a premise index of 15.7%, a container index of 2.9% and a Breteau index of 28.8%. The total number of premises on the Island is 27,740 of which approximately 30% are closed during each inspection cycle.

History of Dengue in Aruba
During 1984/1985 approximately 24,000 cases and two deaths due to dengue were reported. The serotype was identified by CAREC/CDC-PR as serotype 2. In 1995 a total of 86 cases were reported of which 30 were confirmed. CDC-PR and the Institute of Virology, Erasmus University, Holland identified DEN-2. In 1998/1999 182 cases were reported of which 134 were confirmed. The Instituto Nacional de Hygiene, Caracas, Venezuela, isolated DEN-3. The General Physicians & Specialists reported the Dengue cases.

Control Measures during **DEN-3**Outbreak:

The first week of January, two General physicians in St. Nicolas reported to the Section Communicable Diseases SCD several cases of an acute febrile disease with dengue-like symptoms. Blood samples were collected from the suspect patients and sent to the Instituto Nacional de Hygiene in Venezuela for serological tests and virus isolation. The Vector Control Unit was informed by the SCD of the suspected cases and the necessary measures were immediately undertaken. Mosquito inspectors carried out focal and perifocal treatments at suspect dengue cases premises and all premises within a 100 meter radius were inspected. *Ae. aegypti* foci were treated or eliminated and sprayed with portable ULV equipment. ULV-spraying with vehicle -mounted equipment was also carried out in a radius of 300 meters of the suspected cases premises.

By the end of January, the first results were received form Venezuela. From 21 samples, eight were positive on the basis of IgM antibody results and three were isolated as Dengue Serotype 3. It was decided to start large-scale coverage using vehicle-mounted ULV and thermal fogging equipment. By February 12, the entire island had been sprayed once and some high-risk zones had been sprayed twice. There was a significant amount of media coverage on television, radio and newspapers alerting the public about the dengue outbreak.

The community was asked to co-operate in source reduction and to open doors and windows while spraying is being done to allow the insecticide to penetrate their homes to kill mosquitoes resting indoors. Homeowners were advised to cover birdcages, aquarium, food and drinks. The last dengue case reported was in the first week of April. The Dengue Outbreak Team presented two press conferences. The media showed great interest in attending both conferences. During the outbreak we were visited by Dr. Bañuelos (PAHO-Caracas) Dr. Chacón and Dr. Querales (Instituto Nacional de Hygiene) and Dr. Sam Rawlins (CAREC). The recommendations and suggestions in the trip-reports of Dr. Bañuelos and Dr. Rawlins were reviewed and were sent to the Minister of Health.

Future Prospective:

During the outbreak of this year, a permanent Dengue Outbreak Team consisting of professionals from the Public Health Department, such as Epidemiology, Communicable Diseases, Public Relation & Health Education, Laboratory and Vector Control was installed. The outbreak team meets once a week on Wednesday, to examine the present situation and seek solutions for the mosquito problems.

Productive meetings have been held with the Aruba Hotel and Tourism Association AHAT. and with the Aruba Resorts & Small Hotels Association ARASA with the objective that they co-operate and keep their premises free of mosquito breeding places. We have several meetings pending with Governmental Dept. and non-Governmental Organisations (NGO's).

One of our main objectives is to introduce and emphasise mosquito control in the primary schools. We have to go back to basics. It is necessary to educate the children because adult education appears to be ineffective.

There is a lot of work to be done, we need a lot of support from the public. We cannot do the job alone. Everybody has to be aware of the mosquito and dengue problem and needs to be an active

participant in the search and destruction of *Ae. aegypti* habitats. Everyone has the information but very few is willing to change their behaviour. It is time to change knowledge into behaviour.

Several maps and graphs were presented to illustrate the location and subdivision of Aruba, the annual precipitation, entomological indices, epidemiological situation and clinical symptoms of the cases investigated.

Dengue Situation in Barbados.
E. Yearwood

Vector Control
There are five (5) components of Vector Control:
1. Environment Management
2. Health Education
3. Biological Control
4. Chemical Control
5. Public Health Legislation

Health Education
Health Education includes the integrated participation of the community in order to raise public awareness and solicit their co-operation in source reduction activities. Public instruction is conducted via electronic and print media, public meetings and through the schools.

Chemical Treatment
The application of insecticides includes focal treatment using the larvicide, temephos (Abate); perifocal applications both around and inside the containers and space spraying with aerosol or thermal fog applications

Enforcement of Legislation:
Mosquito control is supported by the health services mosquito regulations which were implemented in 1969.

Synopsis of the above
Integrated Vector Control is the rational combination of all available control methods in the most effective, economic and safe manner to maintain vector populations at acceptable levels.

Dengue situation
In 1995 a total of 2149 cases were reported with one death. Dengue 1, 2 and 4 was reported. In 1996 141 cases were reported with DEN-1and DEN-2 identified. In 1997 2,110 cases with ten cases of DHF/DSS . Five deaths were reported. DEN-1 and DEN-2 were identified. In 1998 1,155 cases of all four serotypes were reported. A total of 41 cases of DHF/DSS and six deaths were reported. In 1999 up to May 22 a total of 168 cases were reported with DEN-2and DEN-3 identified. The distribution of suspected cases by age group in 1998 were age 0-19 27%; 20-29 27% ; 30-39 20% and 40 and older 26%. The distribution of cases amongst the 11 Parishes indicates that one Parish identified as M reported 52.4% of the suspected cases in 1997, 46.5% of the cases in 1998 and 34% of the cases in 1999. With confirmed cases the same parish reported

the most cases. The epidemiological data was provided by Deibert Maynard of the Epidemiology Unit of the Ministry of Health.

Entomological Situation

During the period January 4th to May 14th 1999 a total of 111,847 houses were inspected in six catchments resulting in a house index HI of 1.8% (1.3-2.3%) and a Breteau index BI of 2.5% (1.6-3.4%). Catchments identified as SWSPC and RPPC had the highest HI and BI.

Dengue Situation in Belize

H. Linares

Dengue Situation

Belize is located on the Caribbean side of Central America and is bordered by Guatemala and Mexico. The country is divided into six Districts. The annual number of cases reported were 1993 zero; 1994 eighteen; 1995 eighteen; 1996 zero ; 1997 twenty-three and in up to April 30th 1998 seven cases were reported. Of the total of 30 cases of dengue reported in 1997/98 , twenty-seven from were the District of Belize and three from the District of Cayo which shares its border with Guatemala.. Of the cases reported during 1997-8 46.7% were in males and 53.3% in females.

Entomological Situation

The monthly house index in 1997 ranged from 1-5% with October and November presenting the highest indices. The container index during the same period ranged from 2% in April to 18% in November. June July and October also had container indices of 13, 13 and 11 respectively.

In 1998 a total of 100,580 houses were inspected. The house index HI was determined to be 0.3% (0.24-0.38), the container index CI was 2.5% (1.3-3.7) and the Breteau index BI was 0.3 (0.1-0.5). The months with the highest HI, CI and BI were September, June and November respectively.

The containers most commonly found to be positive between 1993-7 were used tires (75%), 45 gal (200 L) drums, vats and cisterns 20% and miscellaneous containers such as cans bottles etc 5%.

Dengue Situation in Cuba

J. R Vazquez Cangas

History of Dengue in Cuba

Between 1945 and 1977, Dengue was not reported have occurred in Cuba. In 1977 a large epidemic of DEN-1 occurred with 447,440 cases reported. This gradually decreased until 1980. In 1981 a second large epidemic hit Cuba with 344,203 cases of which 10,312 were severe cases and 158 deaths. The last case was reported in October. Between 1982 - 1996, no cases were reported. An effective clinical, epidemiological and entomological surveillance was in place. In 1997, in the Province of Santiago de Cuba, and epidemic of 3,012 cases of DEN-2 were reported of which 205 were considered severe and 12 deaths occurred. The last case was reported in November of 1997. From 1997 until the present no cases of dengue were reported and the program of eradication and surveillance was strengthened.

Fundamental Legal Support for Dengue Control

Several laws, decrees and regulations support dengue control in Cuba. These include: Article 50 the Cuban Constitution; Public Health Law 41 (June 13, 1983), Decree 139 (February 4, 1988); Regulation of the Health Law Decree 54 (April 23, 1982); Basic Sanitary dispositions, State sanitary inspection Ministerial Resolution No. 215 (August 27, 1987), Decree 100 (January 28 1982); and Regulations of the General State inspection, regulations of the dispositions and infractions regarding the International Sanitary control decree 154.

Political Support for Dengue Control

There is strong political support for the Dengue control program starting with the statements of Fidel Castro whose Order No. 1 which states that Cuba is to immediately eradicate the dengue epidemic and reduce the density of *Ae. aegypti* to zero or to a level so that the threat of another epidemic such as that occurred in 1981 does not occur.

Resources for Dengue Control

In Cuba the work force for dengue control in 1998 included 10,542 field technicians, 1502 brigade leaders, 404 supervisors, 224 biologists and 242 technicians. This is supported by 177 professionals and 1,673 other workers for a grand total of 14,674 personnel.

In 1990 20.8 million Cuban pesos were spent for salaries, $416,000 US for insecticides, $60,000 for transport, $165,000 for equipment, and $47,163 for other resources. In 1999 18% more was spent for salaries, 223% for insecticides, 115% for transport, 53% for equipment and 479% for other resources. In 1998 69.5% of the budget was spent on insecticides, 14% on development, 4.1% on hygiene and protection, 4.4% on inspection equipment and 9.9% on other items. In 1999 the resources budgeted for development increased to 20%, hygiene and protection was reduced to 0.6%, inspection equipment increased to 9% and other items reduced to 3%.

Methods Used for Dengue Control.

The main actions taken for *Ae. aegypti* control include sanitation, source reduction, focal control with temephos and the *Flamed* burning eggs on the side of containers using alcohol. Perifocal treatment with fenthion and indoor/outdoor space spraying with cypermethrin and lambda cyhalothrin.

Eradication Program Indicators and Objectives

The aim of the eradication program is to obtain a house index of 0 with greater than 99% of the premises inspected. Larval entomological samples should be less than one per 40 premises. The index for larval habitats destroyed should be greater than 30%, with more than 40% of the breeding sites Flamed and treated with temephos. The application of the law enforcing the elimination of breeding sites should be less than one per 100 premises.

Organisation and Operations of Entomological Surveillance

A total of 66,134 larvitraps using quarter sections of used tires were used to monitor *Ae. aegypti* populations. These were in placed one in every 56.2 premises and inspected weekly. These were used to detect one out of every 6.9 foci of infestations that were encountered.

Cuban is stratified into risk areas. A total of 4,946 areas were determined to be at risk and larvitraps were used to monitor these areas. Areas were visited every two weeks to conduct human bait and resting collections. At the end of 1997 a total of 39 municipalities were positive for *Ae. aegypti*. Nine were located in the Havana area and the remaining was in Eastern Cuba centred around Santiago de Cuba. In May, 1999 14 municipalities reported of infestation of *Ae. aegypti* with the municipalities of Santiago de Cuba, Guantanamo and two municipalities near Havana reporting the heaviest infestations. Large areas of Cuba are reported to be free of *Ae. aegypti* infestations however the remaining 25% pose a risk to reinfest *Ae. aegypti* free areas and a smaller percent of these areas require intensive surveillance to prevent the reoccurrence of a dengue epidemic.

Surveillance

Between 1989-1996 a total of 2,767 samples were taken for dengue surveillance and an additional 4,928 samples were taken for routine surveillance. In 1997 dengue surveillance was increased with 9,538 samples taken. In 1998 and the first trimester of 1999 similar levels of surveillance were maintained.

Factors Enabling the Maintenance of the Eradication Program.

There are numerous factors that support the continuation of the eradication program in Cuba. First and foremost is a political willingness to continue the program. The technical structure of the program allows universal coverage. The extensive health system including 29,924 primary attention doctors and 345,878 health workers used to assist the program. There is an active and efficient participation by the community. The communities consist of persons with a high level of education and awareness. The program has the assistance of an entomological and epidemiological surveillance, An intersectoral co-ordination of activities occurs between the *Ae. aegypti* Eradication program and state organisations, local counsels, mass organisations, education, the press, and municipal health organisations. There is a two-way flow of information between the national, provincial, municipal and local organisations.

Dengue Status in Curaçao

L. Tromp,

Introduction/ Statistics

Curaçao is about 420 sq. km. The total number of inhabitants of Curaçao is about 150 000 with 26% of the population being between the ages 0-14, and 8% being over the age of 65. Curaçao is located about 100 km from Venezuela, between which extensive travelling takes place by air and sea. The rainy season in Curaçao starts in October and usually lasts until February, while the dry months start in March and last until September. Curaçao is one of the five islands of the Netherlands Antilles. The government of the Netherlands Antilles consists of two levels, the federal government and the local government. The Ministry of Health is at the federal level, and some of its executive powers awarded to the local governments. Guidelines concerning vector-borne diseases including dengue are set at the federal level.

Dengue is the most important non-reportable vector-borne-disease in the Netherlands Antilles and in Curaçao. Over the last six years the Department of Medical and Public Health Services of Curaçao (GGD) has accumulated the following data concerning dengue.

Table 7
Prevalence of Dengue fever in Curaçao /House Indices 1993, 1995-9

	93	95	96	97	98	99
House Index	30	18	16	10	<5	<5
Total Cases reported	232	555	146	?	?	?
Suspected	182	222	63	61	29	50
Confirmed	39	210	20	3	2	0

Source: Hygiene Department of the Med. And Publ Health Services

Vector Distribution

The dengue mosquito, *Ae. aegypti*, is widely distributed in the Netherlands Antilles and in Curaçao. In 1914 Van der Sarr *et al* mapped the distribution of the dengue mosquito. A recent source reduction program held in Curaçao concluded that the two most important breeding sources for the *Ae. aegypti* are cisterns and water plants.

Surveillance

The GGD conducts on a routine base house-to-house inspections based on incoming complaints. When an inhabitant has problems with mosquitoes, they call the health department for assistance. The inspections involve treatment with larvicide (gas oil, abate, fish, and *Bti*), repairing/modify of non/removable breeding sources like cisterns, and elimination of removable water containers.

The recent threat of dengue prompted the GGD to initiate a house-to-house inspection of the whole island. The initial objective was to bring the mosquito house index to 0%, and the total cost of the program would be US$200 000. The program consisted of hiring 22 temporary employees. The program involved the inspection of 60 000 homes and conduct source reduction and focal treatment. Initially the program was intended to last **six** months, but it soon became apparent that more time was needed, and the program was extended by **six** months. There was strong political support for the program

Emergency Preparation and Response

In January 1999 the health department reported 14 cases of suspected dengue. The political will was very strong, and the decision was made to start a space spraying campaign. The campaign involved **six** vehicle-mounted machines, five ULV mounted and one TIFA fogger. The total spraying program cost US$ 40 000.

Conclusion:

The cost for the programs implemented during the last 12 months are estimated to be around US$ 300,000. A large amount of data about dengue mosquito breeding places. There was a significant pressure from environmental groups.

The Dengue Situation in Dominica

Boniface Xavier/ Martin Anthony Scotland

Ae. aegypti and dengue fever control continues to be a priority programme for the Environmental Health Department and the Ministry of Health. The country has experience several dengue

epidemics over the years. High *Ae. aegypti* populations throughout the island, limited resources and a crisis-oriented approach in dealing with *Ae. aegypti* control made effective abatement almost impossible.

In 1989 a serious attempt was made a challenge *Ae. aegypti* colonisation of the island. Twenty temporary Vector Control Officers were employed in an attempt to avert a dengue epidemic which was already spreading in the region. The success of the program prompted the Ministry of Health to employ ten permanent Vector Control Officers. The country has not seen any large epidemics since that time, though cases has been reported every year and the *Ae. aegypti* indices continues to remain high.

Number of Cases for 1997-8.

The total number of cases reported was 16 for 1997 and 29 for 1998. Four cases of dengue haemorrhagic fever were reported in 1997 and **six** for 1998. Serotype 2 circulated for both periods.

System for Reporting Cases.

Private clinics report about 50% of cases. Hospitals report about 20% and the primary health care centres report 30%.

Control Situation and Changes

Following the results of the Italian project with great success from the two pilot sites in integrated vector control, and the winning of the Caribbean Media Award, the Ministry became convinced that this was the approach to Vector Control in the country.

The following represents the range of activities taken in *Ae. aegypti* control:

1) Treatment of tyres at port to prevent enter of *Aedes albopictus*
2) House to house inspection by Vector Control operators: distribution of leaflets, destruction of breeding, interaction with householders and chemical application
3) Community mobilisation: clean-up campaigns, habitat manipulation
4) Training of volunteers, teachers and community groups
5) Health education at schools
6) Poster competitions among school children
7) Inter-school competitions
8) Rallies and community meetings
9) Radio, television and newspapers clippings
10) Private sector and NGO involvement in community and schools projects
11) Biological treatment
12) Mobilisation of communities to organise their own solid waste collections efforts
13) Enforcement of legislation

Ae. aegypti Indices

Household indices for 1997 and 1998 recorded 18% and 17% respectively, failing to meet the 5% drop in projected target. Breteau indices for the same period were 35% in 1997 to 30% in 1998. A summary of the indices is presented in Table 8.

Table 8
***Ae. aegypti* Indices in Dominica 1998.**

District	House Index	Container Index	Breteau Index
Roseau Central	9	10	26
Roseau Valley	30	20	45
Roseau South	18	15	33
Roseau North	20	5	24
Roseau Goodwill	12	16	29
St. Joseph	12	7	27
Portsmouth	15	8	21
Vielle Case	11	7	20
Wesley/Woodfordhill	29	18	58
Marigot	18	10	25
Castle Bruce	11	10	20
La Plaine	20	7	30
Grand Bay	14	12	28
Average	**16.8**	**11.2**	**29.7**

Vector Control Program for 1998

National *Ae. aegypti* indices in indicate indices remains well above the World Health Organisation figure to prevent out break of dengue fever which is less that 1% household index. Vector Control records in 1998 shows *Ae. aegypti* mosquito is widespread though out the island with Roseau Valley, Wesley, La Plaine and Roseau North Districts having the highest infestation of these vector. Data obtained from these records revealed water drums, flower vases and tyres accounts for over 70% of the breeding foci (places) found in the island. The results clearly indicate inappropriate human behaviour continues to perpetuate this *Aedes* vector in our communities.

Other Vector Control Activities in 1998

1) Implementation of school Health Program at Primary Schools - 120 education sessions were held
2) Held **ten** radio discussions on D.B.S Radio and Kairi F. M.
3) Conducted **four** television interviews on Marpin TV Showed tem (10) minutes video on *Ae. aegypti* control measures on GIS Channel Seven
4) Trained 19 Vector Control Volunteers in Marigot Health District to assist in the implementation of an Integrated Vector Control Project in the area.
5) Continued implementation of river Zabrico Integrated Vector Control Project at Mahaut.

Conducted survey to identify Malaria Mosquito breeding sites in the island. Four areas were identified namely; Portmouth, Hartford, Anse De Mai and Belfast. Information will be utilised to implement Malaria Prevention Program in 1999.

Future Prospectives

The Ministry aims to see communities develop a sense of ownership for the *Ae. aegypti* and dengue control program. We look forward to increase public awareness, widen application of integrated methods of control to other communities. Reduced dependence on chemical control

and increased involvement of the private sector, NGO's and the community as a whole. Strengthened entomological and dengue surveillance including stronger intersectorial and inter agency co-operation.

Dengue Situation in Grenada
Andrew Worme

For the past decade Grenada has been working on strengthening the integrated approach to Vector Control and more specifically in dealing with the problem of *Ae. aegypti* mosquitoes and the threat of dengue transmission. *Ae. aegypti* infestation is widespread throughout all the six parishes on mainland Grenada together with the sister islands of Carricacou and Petit Martinique. However there are a number of communities that continue to be plagued by protracted high vector indices as much as 30%,

These high indices can be attributed to the unplanned development of these communities and the ensuing lack of social infrastructure e.g. public water supply, garbage disposal, etc. There has been some political support for the provision of water to these communities after the Vector Control Media Programs highlighted these problems. However some attitudes have not changed because of the effect of the metering program operated by the utility company and the perceived high cost involved in the water provision. Therefore, some householders continue to store water so as to reduce the wastage, which may occur from direct handling at the point of a tap.

Vector indices in Grenada during 1997 and 1998 are as follows:

Table 9
Vector indices in Grenada during 1997 and 1998

	1997	1998
Grenada		
House Index	12	17
Breteau Index	39	30
Carriacou		
House Index		6

Strategies Used in the Grenada Program.
Biological Control
Biological control continues to be a strong component of our program particularly on the island of Carriacou. There has been tremendous success by this form of intervention as indicated by a sustained low vector house index.
Health Education
This has been one of the major strategies employed by the Vector Control Division in its control program using mass media and in some instances face to face communication. Efforts are continuing to enhance the school health program, an initiative of which PAHO was instrumental in conducting on a pilot basis in many countries. Vector Control is expected to be a major component in the nationally expanded program scheduled to begin in the later part of 1999. Efforts are also continuing to have a curriculum which was developed for the Health and Family Life Education program entitled "Pest and Insect Vectors" adopted or used as a guideline in the

existing health component of the HFLE program functioning in many other countries of the Caribbean.

Community Participation:
In 1997, efforts were made to forge linkages with community groups and NGO's that operate in the country. It was discovered however that many of the community groups were not very active and involvement in Vector Control activities was actually a new area in which to form partnerships. In addition, Vector Control in many instances was in conflict to the focus of many of the community groups. There is need for greater intra and inter sectoral collaboration in Vector Control activities.

Dengue Surveillance:
There is no active surveillance system in place for Dengue in Grenada. Dengue is generally reported from Sentinel Physicians and medical facilities. In 1997 **six** cases were reported and in 1998 the number increased to 8. As of May 1999 seven cases of dengue have been confirmed through the Measles Expanded Program on Immunisation (EPI) which continues to provide monitoring systems in the absence in active surveillance. DEN-2 is the predominant serotype circulating in the country. There were no deaths from dengue in the last decade however dengue continues to threaten the health and well being of our citizens.

Program Cost.
The cost of operating the Vector Control Programs in Grenada range between EC$ 80,000 to 100,000 or the equivalent of US$ 30-38,000 in 1997 and 1998.

Dengue Situation in Guyana

I. Rambajan
Entomological Situation
Ae. aegypti and *Anopheles darlingi* were eradicated from inhabited coastlands of Guyana since 1947, using residual indoor applications of DDT. Georgetown was free from the mosquito since 1946 and Port Georgetown was excluded from the Yellow Fever Endemic area of the Western Hemisphere. Charles 1953 noted the re-infestation of Guyana in 1950. Between 1962-eight *Ae. aegypti* became well established once again with house indices of 15% reported. The distribution of *Ae. aegypti* spread along the coast and into the interior of the country. At present *Ae. aegypti* is present throughout the country with high levels of infestations reported. Table 10 summarises the results of entomological surveillance in 1997-8.

Table 10
***Ae. aegypti* House and Container Indices in the Counties of Demerara, Berbice and Essequibo. 1997-8.**

County	House Index	Container indices by type of container: Tank 1700L	Drum 200 L	Tyres	Drains	Small containers	Flower Vase
C/CST Crabwood Creek, Sping Lands	64.1	39.6	48.2	39.7	0	0	0
East Bank	50.5	25	40.6	52.2	8	18.8	8.3
Demerara Georgetown	42.2	7.6	17.7	25.1	1.1	6	2.2
E'Bo Bartica	32.7	0	24.3	5.3	0	0	0
Berbice New AmsterDam	26	5.7	26.6	17.6	0.8	2.1	5.9
Post Area East Bank	18.3	0	23.1	22.2	0	14.6	0
Ogle	12.2	6.3	11.5	7.1	0	4.6	1.5
Post Area	11.2	0	6.7	9.9	0	0	0
Timehri	10.2	0	13.4	39.5	0	19.6	0.2
Average	**29.7**	**9.4**	**23.6**	**24.3**	**1.1**	**7.3**	**2.0**

Epidemiological Situation

In 1977 -78 51 cases of dengue were reported of which **six** were confirmed. DEN-1 was the serotype circulating. In 1981 51cases reported and serotypes, 2 and 4 were found to be present. There were also sporadic, unconfirmed cases suspected throughout Guyana but these not reported.

In 1998 160 cases were reported of which 33 were confirmed and DEN-1 was reported to be responsible. One unconfirmed case of DHF was noted in from Mahaicony in which the patient recovered.

Factors Responsible for High Indices of *Ae. aegypti*

There are several factors responsible for the resurgence of *Ae. aegypti* in Guyana. With the eradication of malaria from the coastal areas between 1947-1951 and the potential for Yellow Fever being small there were severe cutbacks in the Mosquito Control Services and fieldwork was virtually suspended. With the discovery of Yellow fever cases in 1961, some efforts to control *Ae. aegypti* were undertaken however still a low priority was given to the *Ae. aegypti* Program. Low salaries and allowances and poor promotional opportunities coupled with the severe economic situation in Guyana meant that the control program was poorly supported.

Various social factors also contributed to the conditions that permitted *Ae. aegypti* to become re-established. Over 90% of the population of Guyana is crowded on the coastland areas. Settlement in these areas has been mostly unplanned urbanisation bringing the population together in high-density settlements. Screening of these houses was almost non-existent. Water supply in these areas is precarious and is stored for extended periods in uncovered drums and tanks. Solid waste collection is inadequate resulting in discarded tyres and small containers everywhere.

Environmental Factors are favourable in Guyana due to a high ambient temperature and relative humidity throughout the year, which provides ideal conditions for *Ae. aegypti* and virus transmission.

Dengue Situation in Montserrat
Trevor Howe,

Montserrat is a 39 square mile island located in the Northern Caribbean. However due to volcanic activity since 1995 the occupied land has been reduced to a mere 1/3 of its capacity. Its population have decreased from 11,000 in 1995 to 4,500 in 1999. During this transition period there have been mass movement of people from the unsafe areas during 1995, 1996 and 1997 to the designated safe areas. This created new challenges and environmental health problems, forcing the Environmental Health Department to focus its efforts on shelter management, liquid and solid wasted management.

Vector Control primarily focussed on rodent, roach and fly control as basic sanitation within overcrowded shelters, institutions and residential homes demanded all the available human and other resources necessary to control and prevent associated health problems in an emergency type situation. The *Ae. aegypti* program was put on hold and only complaints reported or observations made by the vector control unit were dealt with, usually within a two day period. This became mandatory as the Department recognised the association between high *Ae. aegypti* mosquito populations and dengue and the fact that a CAREC report indicated that there were cases of dengue and Dengue Haemorrhagic Fever in our neighbouring countries.

With significantly reduced volcanic activity in 1997 and 1998, the Environmental Health Department moved from an emergency type situation to almost normal operations without having a single reported cases of dengue or dengue haemorrhagic fever. It is noteworthy that during that period blood samples from all suspected dengue cases were taken and sent to CAREC for confirmation as we recognised this as an important component in the control of dengue.

Although the *Ae. aegypti* program lost its momentum during the crisis and there were no reported cases during periods mentioned, this occurrence was not due to share luck. Prior to the onset of volcanic activity there was an established system developed for reporting cases of dengue suspected or confirmed. Usually the district or private medical doctor in suspecting a case of dengue would collect a blood sample which would be sent to the laboratory and then to CAREC for confirmation. There is an established understanding by all doctors that a suspected case should be reported immediately to the Environmental Health Department who will then carry out an inspection within a radius of 100 meters of the suspects residence, for evidence of *Ae. aegypti*. Larvae are usually treated with abate and later that evening and early morning, fogging is done to eliminate adult mosquitoes. This procedure is also applied at the place of work of the suspected case.

It is difficult to establish with any degree of certainty the island wide *Aedes* house index due to shift in vector control activities during periods mentioned. However, information gathered over that period for two localities namely Salem and St. Peters showed an average *Aedes* house index

at 12.7%. Although the other localities were never completed it can be assumed that they had similar averages if referenced with complaints received by the Environmental Health Department. In 1998, a mosquito cycle for Salem locality was completed and showed a slight decrease in Aedes House index to 11%. The department considers the situation serious in light of the fact that ***Aedes*** house index was well above acceptable safe levels.

During the period 1997 to 1998, the Environmental Health Department experienced major changes that affected at all levels. Fifty percent (50%) of Public Health Inspectors and 60% of the Vector Control Team left the Department due to the crisis, as many individuals and families could not cope with the uncertainty of the prevailing situation. Staffing levels have not increased and there is difficulty recruiting suitable candidates to replace workers.

With the situation returning to normal, we are presently conducting an island wide *Ae. aegypti* cycle to determine the present *Ae. aegypti* house index. Additionally, the data gathered will be used to establish the most frequently used breeding containers with a view to introduce measures to reduce these sources of breeding.

Our finding although not complete indicate that containers used for storing water, buckets and drums, tyres, vacant and abandoned homes some of which have swimming pools, are sources of *Ae. aegypti* breeding.

The information generated from *Ae. aegypti* forms will assist the Department in improving its strategies to combat the *Ae. aegypti* and Aedes albopictus. Environmental sanitation activities are important in reducing the *Ae. aegypti* populations to acceptable levels. Hence the operation of the New Windward Landfill Site and the Refuse Collection and Disposal regulations recently passed into law gives the Department legal support for our Solid Waste Management.

The addition of two new drinking water supply reservoirs with a capacity of 750 million gallons provides a 24-hour water supply and significantly reduces the need to store water for drinking and domestic purposes.

Public awareness programs using the radio have been useful since the population uses this medium to inform them about the status of the volcano. This provides coverage to a wide cross section of the population. Presently, very little is done at the community and school level. Request form schools or community groups related to vector issues are broad and not specific ***Ae. aegypti*** mosquito campaign.

The Department continues to treat breeding sites with larvicide temephos, and are aware that its proper application in strength is necessary if we are to curb the rate of resistance in the mosquito population. There has been some success in the use of Styrofoam granules but the public does not universally accept it. Efforts to propagate fish for biological treatment was started but most of the fish stock were lost due to ash contamination limiting experimentation in this area.

Last but no least in terms of our strategies there is collaboration and co-operation amongst doctors, district nurses and environmental health officers which provides an active reporting system, which goes a long way in keeping an eye on the dengue situation.

The cost of sustaining and implementing the *Ae. aegypti* program for 1998 was US$37,000

The future of Montserrat and our ability to expand and intensify efforts to reduce *Ae. aegypti* populations to less than 1% of the premises depends to a large extend on what transpires at the Soufriere Hills Volcano since it directly affects our political, economical and social wellbeing.
The prognosis for the future looks satisfactory and our energies will be focussed on intensifying efforts in areas of social participation, environmental sanitation, health education and a greater reliance in physical and biological means of treatment, thereby minimising chemical treatment

This effort hopefully will meet the goal as identified at the Hemispheric Plan to expand and intensify efforts to combat *Ae. aegypti* which is to interrupt dengue transmission in the Americas though a steady decline in areas infested with *Ae. aegypti*".

Dengue Situation in St. Kitts
Oliver Lawrence

Epidemiological Situation
No cases of dengue were reported in St. Kitts. Cases are notified and submitted to the Community Medical Officer CMO to the Environmental Health Department and to the Community Nursing Service for joint investigation

Entomological Situation
Entomological surveillance indicated that *Ae. aegypti* is present at high densities. The house index ranges from 7.2-33.3 and the container index ranges from 2.5-40.

Techniques/strategies used include daily visits to households, source reduction/spot checks, collaboration with collection teams, health education on a one to one basis, health education in schools using the Health and Family Life Education curriculum, involvement of CMC groups and press releases

Cost of program: Approximately US$50,000

Future Prospectives
The future prospective for the control program include the inclusion rural areas in the program, extension of the school based program to all primary schools, creating new social partnership revision of the laws and possibly the licensing of pest control operators.

Dengue Situation in Tobago
J. Lynch-Benjamin

Epidemiological Situation
Before 1997 the incidence of dengue Fever /Dengue haemorrhage Fever in Tobago was not formally documented by the Environmental Health Services Department. It must not be assumed though, that the problem of Dengue had existed in the island prior to that year. This need to

document may have arisen from the number of cases that were being reported to the Department. The need for an informed approach was noted and an Action Plan was developed.

For the management of our Vector Control Program, Tobago is divided into Four Districts, viz: Windward, Central, North and Leeward District. In 1997 there were 21 cases of dengue reported of which eight were confirmed and no deaths were reported. These cases were scattered throughout the Island and distributed in the following districts: Windward District 33%, Central District 19%, North District 9.5% and Leeward District 37%.

In 1998 21 cases were reported of which five were confirmed and one death resulted. The distribution of the cases were Windward District 4.7%, Central District 23.8%, North District 4.7% and Leeward District 66.6%. 1998 showed a definite cluster in the Leeward District where two-thirds of the cases were concentrated. The advent of a death in 1998 took the Department by storm, as incidentally it was also the first reported case for the year.

Reporting Systems

The Department's reporting system was reviewed critically and steps were immediately taken to improve it. Links were established with the Hospital Medical Director, where a daily reporting system was implemented during that period of dengue activity. Links with the Surveillance Nurse were re-established. Linkage with private practitioners was attempted however success was limited. In some cases there is Personal Reporting, where the affected individual would report the illness.

Vector Situation:

The *Ae. aegypti* mosquito is present throughout the island. The indices in some areas were quite high. The high index has plagued the island over the past four to five years and has reached unacceptable levels. Some indices have risen to as much as 25 and over, which is quite a troubling fact.

It should be noted that in 1998, the greatest Dengue activity occurred in the most populated section of the Island. (South-western portion of the Island). Factors that may have contributed to this include: the rapid development in that part of the island including land and building development for residential purposes and hotels, guesthouses, restaurants, etc. for commercial activity. It is important to note that the highest activity in the tourism industry takes place in that part of the island.

Control Situation

The approach to control in 1997 differed to that of 1998. In 1997, control was based only on controlling the aquatic stage of the mosquito without targeting the adults. Even this activity, limited as it was, was plagued with problems of malfunctioning equipment. No ovitrapping was done. Education of the householders has always been stressed and workers are constantly reminded of ~~it's~~ **its** importance.

In 1998, the approach to control was revised. The program can no longer be planned without using the available data. The programs are now planned with the field workers participation. The program now includes the following strategies: repeated cycles in areas where indices were high,

systematic adulticiding after each perifocal intervention, the re-introduction of the use of ovitraps in high-risk areas, intervention of the Public Health Inspector in these areas, lectures to schools, dissemination of information to Churches and other community groups for presentation to their members and placing as a priority education of the householder.

Present Status

At present there is evidence of improvement in some areas. The indices have begun to improve in some of the areas, but in others they have risen. The program is constantly being re-evaluated and oriented based upon information collected. Worker participation is encouraged in formulating the program. Community participation has been incorporated into the Vector Control Program.

Dengue Situation in Trinidad

A.Rahaman

Epidemiological Situation

In 1997 there were 1,779 cases of dengue reported of which 252 were confirmed. There were 104 suspected cases of DHF (19 confirmed) and 14 DHF deaths were suspected of which two were confirmed. Dengue type 1, 2, and 4 were present. The majority of the cases were reported in November and December.

In 1998 there were 2,854 cases of dengue reported (200 confirmed). There were 74 suspected cases of DHF and 23 of these were confirmed. A total of 13 DHF deaths were suspected of which four were confirmed. Dengue type 1 and 2 were present. The majority of the cases were report from July-October. The monthly distribution of the 1,291cases in 1997 and 2,179 cases in 1998 are presented in Figure 4.

Entomological Situation

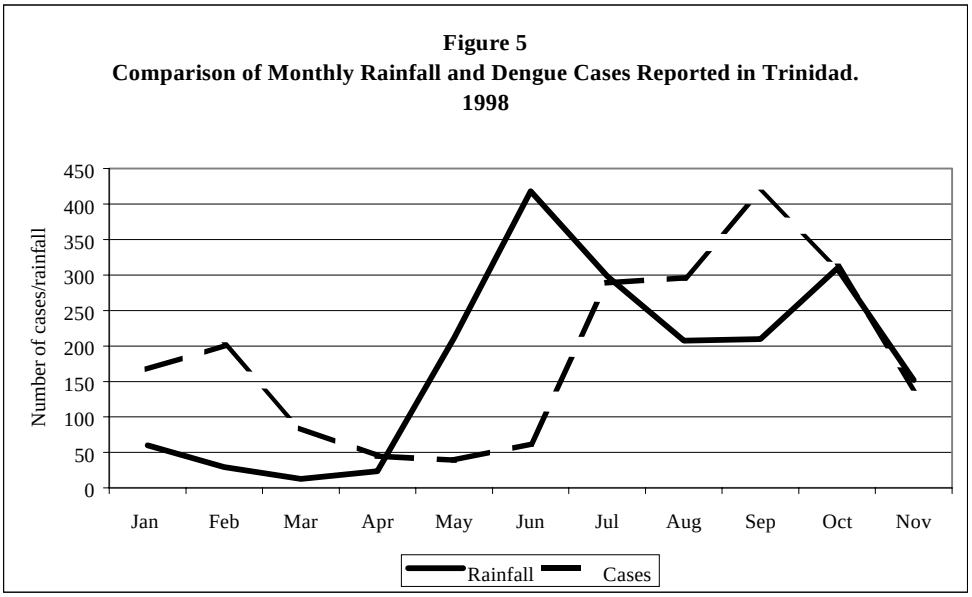
Ae. aegypti is present throughout Trinidad. A comparison of the County *Aedes* (House index) between 1997 and 1998 and the cases of DHF is presented in Table 11.

Table 11
County *Aedes* index and suspected cases of DHF in Trinidad 1997-8

	***Aedes* index**		**Suspected DHF Cases**	
County	**1997**	**1998**	**1997**	**1998**
SGW	9.4	10.4	0	6
SGC	7	7.3	21	5
SGE	6.3	5.5	24	6
SA/D	4	3.9	3	4
CAR	4	2.2	14	14
ViE	6.4			
ViW	10.1	7.1	15	19
STP	8.4	7.9	6	53
N/M	14.1	5.2	4	10
Average	**7.7**	**6.2**		

When the monthly national average *Aedes* index is compared with the monthly rainfall there appears to be little correlation between the two. The monthly *Aedes* index ranged from 4.2-7.2. The correlation between increased rainfall and cases reported in not very strong even when a time delay factor is considered. See Figure 5. When national monthly rainfall was correlated with the monthly cases reported in individual counties a closer correlation was observed between rainfall and cases in the southern counties with rainfall preceding an increase of cases by about a month. In the northern counties the rainfall preceded the cases by 4-5 months. A closer correlation would probably be presented if rainfall for the counties were compared directly with the cases reported for each county.

Figure 5
Comparison of Monthly Rainfall and Dengue Cases Reported in Trinidad. 1998



Dengue Situation in the Turks and Caicos
L. Adams

The Turks and Caicos are a grouping of relatively small islands located at the end of the Bahamas archipelago. It is British Dependent territory made up of the Caicos Islands to the west, and the Turks to the east separated by a deep-water channel. The territory comprises of eight main islands along with many small cays. There are eight inhabited islands, namely, Grand Turks, Providenciales, North Caicos, Middle Caicos, South Caicos, Salt Cay and the privately owned Pine Cay and Parrot Cay. Grand Turk is the territory's administrative seat, and in 1990 it had a population of 3,691. Providenciales is the business centre and has seen exponential population growth in the past few years. The 1990 census put the population of Provo at 4,821.The population for the other islands were put at 200 Salt Cay, 300 in Middle Caicos, 1,300 in North Caicos and 1,200 in South Caicos. These figures are viewed with a high degree of scepticism by many government official and unofficial estimates vary between 20,000-25,000 for the total population with illegal immigrants making up between 5-8,000 of these.

Epidemiological Situation

Dengue fever which is transmitted by the *Ae. aegypti* mosquito has not shown up in the Turks and Caicos since 1993, when there were two cases diagnosed in the islands of South Caicos. After an investigation, it was noticed that these cases might have been imported into the island

from Haiti. There had been no death recorded from the illnesses associated with classical dengue or dengue haemorrhagic fever.

Within the Turks and Caicos any suspected cases of vector borne illness are reported to the Environmental Health Department by medical officers and clinical nurses at the various clinics or hospital. Private clinics do not always report cases although they are advised to do so. Laboratory specimens are sent to CAREC for confirmation.

Entomological Situation

Within the past few years there has been noticed an increase in the *Ae. aegypti* population in some of the islands especially in Providenciales where there has been an increase in the number of illegal immigrant living in settlements. There have been a number of little shantytowns going up around the island without proper sanitation. Water is collected in the various receptacles that can harbour the breeding of *Ae. aegypti* mosquito. Recently the department has stepped up its campaign to try to eradicate the mosquito from the area by having cleanup campaigns and health education discussions with the people in these areas.

In trying to control the mosquito within the islands various strategies are being used. *Gambusia* or guppies are larvivous fish indigenous to the Turks and Caicos Islands. These fish have been used for the past years throughout the Turks and Caicos Islands for mosquito control and their use is being continuously promoted. They are place in both public and private water storage tanks and a program of breeding is being carried out continuously by the environmental health department. This breeding is carried out in ponds (fresh and brackish water) as well as in aquariums. Attempts have been made to acclimatise these fish to various environments. Even though water cistern in the islands are generally well covered to avoid the entry of mosquitoes, fish are still used in about 90% of these cisterns to control mosquito breeding. In Grand Turk the Kiwanis Club has been assisting the environmental health department in promoting the used of *Gambusia* among householders. Temephos is applied in potable water containers that cannot support the *Gambusia*.

With the recent establishment of a water supply distribution system in Providenciales we look forward to a reduction in the *Ae. aegypti* population in some settlements.

Source reduction has also been promoted in the Turks and Caicos Islands especially in the area that has poor sanitation. Since a wide range of refuse can provide breeding sites for the *Ae. aegypti*, an adequate refuse collection system is essential.

As part of the efforts of the Environmental Health Department to control the high incidence of *Ae. aegypti* in the island of Providenciales, a project proposal was submitted to the BDD, which was approved in May of 1991. Phase 1 of the Project provided the department with much needed equipment such as transportation to carry out vector identification and control and also included was other equipment such as ULV fogging machines, and a tipper truck.

Phase 2 included an adulticiding program to control mosquitoes throughout all inhabited Turks and Caicos Islands. The objective of this phase was to provided each of the inhabited islands with the ability to control mosquito borne disease consistent with each island geographic and

logistical limitations, but tailored to suit its particular requirements. This program went on for a few years, however, after the continued resignation of many vector control officers the program did not fully meet its objectives.

In addition to the above program, PAHO provided resources to conduct a national action plan for the implementation of the integrated community base vector control program. The general objective of this plan was to improve the delivery on vector control services in the islands.

During the 1999/2000 financial year the Environmental Health Department has asked for more funds to replace the existing equipment which is not in proper working condition through the wear and tear it has taken during the years. New equipment such as fogging machines, vehicles, sprays pumps etc. will be brought to carry out a proper control program. This equipment will replace old equipment.

Manpower was also a problem in the vector control program. Because of the small salaries provided by government many officers who were properly trained resigned, and the department has been plagued with the same problem to date, however, the environmental health department has asked government to encourage vector control officers to hold on to their jobs, by making them become established staff. This we hope will encourage them to hold on to their jobs because of the better salaries and better benefits. At present there are 14 vector control officers who are presently undergoing training. These officers are divided among the islands.

The Environmental Health Department, therefore look forward to putting together a proper vector control program this year, and hope that all would go well with the staff that exist within the environmental health department in the Turks and Caicos Islands.

Summary of Group Discussion

Group 1: Emergency Plans for Dengue/DHF Outbreaks
Every country should have an emergency plan in place.
The first step would be the formation of a Dengue Action Committee.
This committee should include not only the Ministry of Health but representatives from other sectors ie. Ministries of Education, Agriculture, Public Works, Environment, Housing, Civil Defence Force and NGO's.

<u>Writing of a plan (duty of the committee)</u>
Plan should include:
1. List of all available resources
2. Contact list of suppliers both local and abroad
3. Accurate statistics as to country population, housing, high-risk areas etc.
4. Chain of command should be clear
5. Specific steps to take during all phases of the outbreak

Some risk factors to consider in the preparation of the plan are:
1. The presence of all four dengue serotypes circulating in the region
2. The high population densities of *Ae. aegypti*, the vector of dengue

3. The frequency of occurrence of dengue outbreaks
4. Potential economic impact of dengue eg. on tourism
5. Travel between countries is on the increase and hence the possibility of cases being imported
6. Deficiencies in vector control programs in most of the countries

Countries that already have a plan in place included Puerto Rico and the Bahamas. Each country should decide what constitutes an outbreak. The threshold will differ from country to country

The committee is also responsible for the declaration of the emergency. The committee should be formed and ready for action before the next outbreak, which usually coincides with the rainy season.

Group 2: Specific recommendations for establishing co-operation/collaboration in communities and between countries in the region.

1. Know your mission, write it down, communicate it
2. Act
3. Evaluate whether you are achieving your goals
4. Network in order to boost the efficacy of your dreams

<u>Things that assist in networking</u>
1. A list of resource persons (a who's who directory)
2. Associations
3. Web pages
4. Newsletters, periodical, journals
5. Conferences

Your own evaluation must identify your specific needs in order to achieve your mission. The evaluation should include:
- funding
- staff (specific positions)
- equipment
- training, advice, education (human resource development)
- research
- surveillance
- political will
- skills to elevate the priority of your mission e.g. ability to write reports or proposals
- skills or ability to mobilise others in the community to assist in the achievement of your mission etc.

You then need to identify a possible repository of the resource that will satisfy your need. To help match the list of requirements with the list of resources, each program could list its strengths and publish this, otherwise ask around and you will eventually get referred to the right place. Persistence pays.

To stimulate ideas for bridges building, publish examples of "best practice" or at least small tips on collaboration that has worked for others.

Co-operation by Region
As above but co-ordinated by CAREC and PAHO

A list of Groups

Department of Health	Department of Public Works	Department of the
Environment	Education	Police
Tourism	Youth and Recreation	Customs
Attorney General	Military	Agriculture

Possible Funding Agencies

NGO's	Private Organisations	Service Clubs
Religious Organisations	Regional Organisers - PAHO/CAREC/CDC	

Group 3. Regional needs for Dengue Control - How can PAHO facilitate this?

14) Expanded communication between countries, relevant agencies, sectors
15) Bulletin -output; CAREC entomology unit could facilitate
16) Increase community participation
17) intersectoral collaboration with media
18) Add vector control managers to mailing list - fax alerts, feed back
19) Establishment of a Caribbean Association of Vector Control Managers VCM
20) How to enhance the profile of the VCM
21) Need to emphasise the role of the public health team inclusive of vector control Health Information Unit
22) Central purchasing of insecticides - PAHO (Plan ahead)
23) Revolving fund
24) In discussions of PAHO country plans, vector control is to be included
25) Fax/Telephone/e-mail addresses of all vector control managers are required to promote communication
26) Annual meeting of vector control managers
27) Explore the use of TCDC funds for enhance communication
28) A common approach to the disposal of tyres/derelict vehicles - see MARPOL convention
29) Need to strengthen law enforcement
30) Reward for right behaviour: incentives/prizes for target groups making positive VC activities
31) Training of vector control officers
32) Proficiency test
33) Exchange of experiences - forms
34) Share results between Vector Control Programmes
35) Environmental Health Sanitation - solid waste
36) Environmental Health School curriculum for pest and vector -FLHE
37) Incorporate the help of partners such as NGO's service organisations etc.

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PAHO Regional Dengue Meeting
June 1 – 3, 1999

DAY 1 JUNE 1, 1999

8:30am	Registration	
9:00am	Welcome	Dr. B. Camara for C. J. Hospedales, Director- CAREC
	Greetings	Dr. R. Gusmão PAHO, Washington
9:10am	Introductions	Dr. S.C. Rawlins Dr. C. Frederickson, (Chairpersons)
9:20am	Outline of Purpose of Meeting	Dr. R. Gusmão
9:30am	Lecture: Global Overview of Dengue & Dengue Haemorrhagic Fever	Dr. Bruce Knudsen
9:45am	Lecture: The Current Dengue Situation in the Caribbean Region	Dr. Merle Lewis
10:15am	**C O F F E E B R E A K**	
10:30am	Lecture: The Current Situation of the Dengue Vector in the Caribbean	Dr. S. C. Rawlins
	Discussion	
11:00am	Country Presentations – Part 1- The Status of Dengue & Vector Surveillance Discussion	Participants
12:30pm	**L U N C H**	
1:30pm	Country Presentations – Part 2	Participants
3:30pm	**Discussion**	
4:30pm	The Questionnaire: formation of Working Group and Assignments	
5:00pm	**Adjournment**	
5:30pm	Cocktail Reception	

DAY 2 JUNE 2, 1999

8:30am	Review of Day 1 and Agenda for Day 2	Chairperson
8:45am	Lecture: Insecticide Resistance Patterns of Regional Populations of *Aedes aegypti* – Bioassays	Dr. S.C. Rawlins
9:15am	Lecture: Insecticide Resistance – The Role and Significance of esterases	Dr. Andre Yebakima
9:45am	Community Participation	Renelise Moutenda
10:15am	**C O F F E E B R E A K**	
10:30am	Appropriate Surveillance Tools and Systems for *Aedes aegypti* & *Aedes albopictus*	Dr. Bruce Knudsen
Discussion		
11:15am	Working Groups – Analysis of Questionnaires	

12:30pm	**L U N C H**	
1:30pm	Discussion of the PAHO draft document: " A blue print for action for the next generation: Dengue prevention and control".	Dr. R. Guzmão
2:00pm	Strengthening links for collaboration	Ms. V. Wilson
Discussion		
2:45pm	Pupal Index	Dr. D. Chadee
3:30pm	Presentation of Working Groups	
	Discussion	
4:15pm	Significance of Yellow Fever in Some of our CAREC Member Countries	Dr. Sylvain Aldighieri
	Discussion	
5:00pm	Adjournment	

DAY 3 JUNE 3, 1999

8.30am	Review of Day 2 & Agenda of Day 3	
8.45am	New Breteau Weighted Index & Geographical Information Systems (GIS)- The Martinique Experience	Dr. Andre Yebakima
	Discussion	
9.30am	Vector Control: - A Component of Healthy Tourism	Ms. Yvonne Roberts-White
10.15am	**C O F F E E B R E A K**	
10.30am	Role of Biocontrol Agents for Dengue Prevention	Mr. Marco Suarez
11.00am	The Appropriateness of Large Scale Insecticide Treatments (ground & air)	Dr. S. C. Rawlins
11.30pm	Working Groups –	
	• Emergency plans for Dengue/DHF Outbreaks	
	• Establishing Plans for Co-operation/Collaboration In Communities & b/w Countries in the Region	
	• Regional Needs for Dengue Control : - How can PAHO facilitate this?	
12.15pm	Programa Cubano de Erradicación del *Aedes aegypti*	
12:30pm	**L U N C H**	
1.30pm	Working Groups continued	
2.00pm	Group Reports	
2.45pm	Regional Programmatic Needs: - Discussion & Preparation of a Document	
3.30pm	**Discussion** Strengthening Links b/w Vector Control Units, National Labs and Epidemiology Units	
4.30pm	**Closing**	

Some Comments on the Use of *Aedes aegypti* Indicators.

Christian Frederickson

Variation over Time and Place

The use of indicators such as the house index HI, the container index CI and the Breteau index BI are important components in the evaluation of any control program. It must be realised however that they have their limitations and they are most useful when examined at the local level and at for specific time periods. *Aedes* levels are dynamic and change both over time and between one area and another. This may even occur between areas of close proximity.

Using any of these indicators to generalise for the whole country or for a yearly period does not provide much useful information. It is best to break these indicators down by municipality and within the municipality express the range for each index (ie house index of three (0.5- 15) to reflect the variation that may occur. Although the overall index is low there may be areas within the community that have high indexes and that need attention.

It is also important to indicate when the index was measured. An overall index that takes into consideration months when transmission does not normally occur will depress the index giving a false sense that things are under control. A more accurate indication of the dengue risk potential would be reflected by indicating for example that during a specific month the HI was three (0.0-15) CI four (0-10) and BI five (0-10).

Container Indices

The division of the container index by types of containers is another important tool that provides information that can be used to select methods required for source reduction. If small, unused containers are a problem within a particular area this would suggest a clean up campaign or improvement in garbage collection is required. If large water storage containers are the principal source of *aegypti* then clean up campaigns are going to be less effective. Improving water distribution, enforcing the covering of the containers or focal treatment with a larvicide or larvivorous fish will be more appropriate. If tires are the problem then focal control using a larvicide and clean up campaigns are required. This can be assisted if a small surcharge is placed on the sales of tires to assist in their recycling. This surcharge can be returned when the purchaser returns the old unused tire to a central depot. Having old tires accumulate in a central location can also create another problem so they must be correctly stored and disposed of.

Productivity Indexes

While *Ae. aegypti* indices are general indicators as to the existence of positive containers they do not indicate the productivity and relative importance of these containers. Under the present scheme a pop bottle with **two** larvae is as important as a tire that has 20 larvae and a 200 L drum that has hundreds of larvae. The entomological and epidemiological importance of each of these *Ae. aegypti* sources varies depending both on their relative abundance and on the productivity of the source. The use of the pupal index can quantify the importance of the breeding site and is an important tool that should be used to maximise the information obtained from the field.

The pupal index is defined as the (number of pupae/number of houses inspected) x 100. An alternative method that may be employed may be to rapidly classify the breeding source based upon an estimate of the number of larvae observed in the container. The classes could be :

Class 1 1-10 larvae present
Class 2 >10 but less than 50
Class 3 50 plus larvae present.

With a little practice in the field relative numbers can be easily estimated. While it is known that not all of these larvae will survive to reach adults it will indicate the potential for each type of breeding site.

The extra time taken to collect the additional information regarding productivity and noting the relative abundance of each type of container in the field will be very useful in assessing the risk potential of an area and determining the best long term strategy for control methods to be applied.

Use of Maps in conjunction with Indices.

Detailed maps of municipalities are a vital tool in mosquito control operations. They will indicate at a glance where problems are occurring, what areas need to be surveyed the relation between one section of the municipality with the next. They should be used to not only indicate the results of entomological surveillance but also to indicate the location of cases of dengue whenever possible.

On an operational level indices should be used to differentiate areas and periods when and where problems are occurring. To graphically visualise the variation in indices it important to use detailed up to date large-scale maps of the municipalities. If these are not available use the most recent map available from the municipal office and when field inspections are made constantly improve the maps by carefully drawing in and modifying the map to update it to the current status. A general map can be used as a base map indicating streets and subdivisions of the municipality. This map can be covered with several layers of clear plastic. On each layer of the plastic overlay the results of each entomological survey can be recorded using coloured markers so that areas that need attention can be easily seen and the progression over time can be determined. When dengue cases are marked on the maps clusters of transmission may be observed that require immediate action. A permanent record of the monthly results should also be noted on copies of the maps. Over a period of time and from one year to the next, persistent problem areas can be easily identified and appropriate preventative action taken

Rainfall /temperature Information

Both precipitation and maximum /minimum temperature information can be useful indicators in determining the risk potential in the field. When precipitation is abundant new breeding sites for *Ae. aegypti* are created or reactivated. Remember that *Ae. aegypti* lay their eggs on the inside of containers and when the water level reaches the resting eggs larval emergence is stimulated.

Rainfall may vary considerably from one area to the next and from one side of the island to the other. With this in mind attempts should be made to obtain information as close to the

municipality as possible. The onset of the rainy season will often indicate the emergence of *Ae. aegypti* populations. In areas where the most important breeding sites are stored water containers from intermittent public water supplies rainfall may be less importance as an indicator.

While most areas of the Caribbean experience ideal year round temperatures for *Ae. aegypti* development and virus transmission, seasonal variations may be noted. Higher temperatures promote rapid mosquito development from larva to adult and also virus replication within the mosquito. At lower temperatures the virus will take a few days longer to multiply in the mosquito but this may be crucial if the daily survival of the mosquito is not high. *Ae. aegypti* suffer high daily mortality rates and must live long enough for the virus to replicate before the infected mosquito becomes infectious (i.e. able to transmit the infection to another person). A minor decrease in temperature may be sufficient to prevent transmission or restrict it to shorter periods of time. With this in mind keeping records of the daily maximum /minimum temperatures may assist in determining the risk for transmission.

In Summary

In conclusion it is important to remember that *Ae. aegypti* populations are dynamic and may vary considerable between adjacent areas of the municipality and from month to month. It is important to use accurate and timely collected information as a basis for conducting control strategies. Productivity indices and itemised container indices will assist in determining the areas that require action and will suggest strategies for the most effective control methods. Constant use of maps will improve your knowledge of an area and will assist in planning operational activities. Climatological information should be used to assist in organising control strategies.

Summary of the Caribbean Dengue Situation 1997-98.
Resume of Questionnaire Results

Christian Frederickson

A total of 22 questionnaires were completed by participating countries. Cuba, which presented a verbal report, did not complete the questionnaire therefore data from Cuba is not included in this analysis. The following is a summary of the results of these questionnaires.

Question 2.1 Comparison of cases reported 97-98.
A comparison of the dengue situation in 1997 and 98 indicates that overall there was a two-fold increase in cases reported. This was due to an increase in cases reported in Puerto Rico that in both years was responsible for approximately 60% cases reported in the Caribbean. Jamaica (94x) reported the greatest increase in cases between the two years followed by St. Vincent and the Grenadines (5x), Suriname (4.3x) , St. Kitts/Nevis (3x), Aruba (2.7x), Puerto Rico (2.3x), Dominica (1.8x) and Trinidad and Tobago (1.7x). Belize reported a 2.7 fold reduction in cases followed by Curaçao (2.1x) St. Lucia (1.8x), Guadeloupe (1.4x) and Martinique (1.4x). Six countries (French Guiana, Bahamas, Guyana, Cayman Is., Bermuda and British Virgin Is. reported cases in 1998 but none in 1997.

Question 2.13. Serological Confirmation

Table 1 indicates that when the number of cases reported were low the majority of them could be confirmed serologically. When the number of cases reported became significant, 20-30% of the cases were confirmed serologically. In eight **countries laboratory diagnostic services were less available.**

Table 1
Distribution of Serologically Confirmed cases

No. countries	Total Cases reported	Percent Serologically confirmed
3	<3	100%
2	8	88%
7	160-16,683	21-32%
4	31-2,179	6-13%
4	1-386	0%

Question 2.14 Serological technique used.
IgM ELISA was used in 12 or 57% of the countries to serologically confirm dengue cases.

Question 2.15 DHF cases

In the area surveyed 945 suspected cases of DHF were reported in 1997 and 246 in 1998. Of these 145 were confirmed in 1997 and 83 in 1998. In 1998 French Guiana reported the most suspected cases of DHF (71) followed by Puerto Rico (56) Suriname (52) Martinique (35) Trinidad (19) Dominique (6) and Guyana (1). In 1998 Puerto Rico confirmed the most cases of DHF (56 cases) followed by Suriname (16). See table 2.

Table 2
Cases of Dengue Haemorrhage Fever. 1998.

Country	Suspected	Confirmed
Puerto Rico		56
Suriname	52	16
Trinidad / Tobago	19	6
Dominica	6	2
Guadeloupe		2
French Guiana	77	1

2.16 Mortality due to Dengue

In 1997 30 deaths were attributed to DHF while in 1998 there were 20. In 1997 Trinidad was most affected with 14 suspected deaths (2 confirmed) followed by Martinique (9) Puerto Rico (6) and St. Kitts/Nevis (1). In 1998 Puerto Rico reported 16 suspected deaths due to DHF while Martinique reported three and Suriname one.

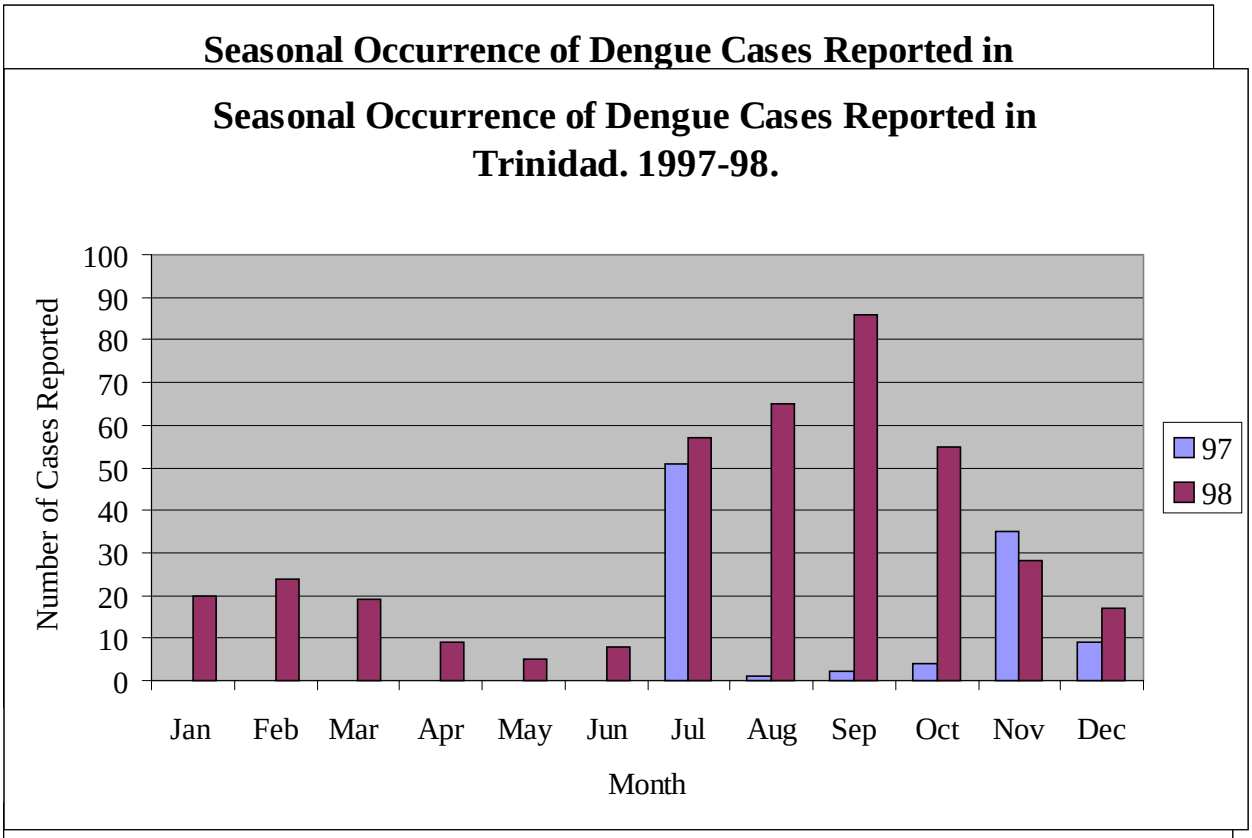
2.1.7 Serotypes

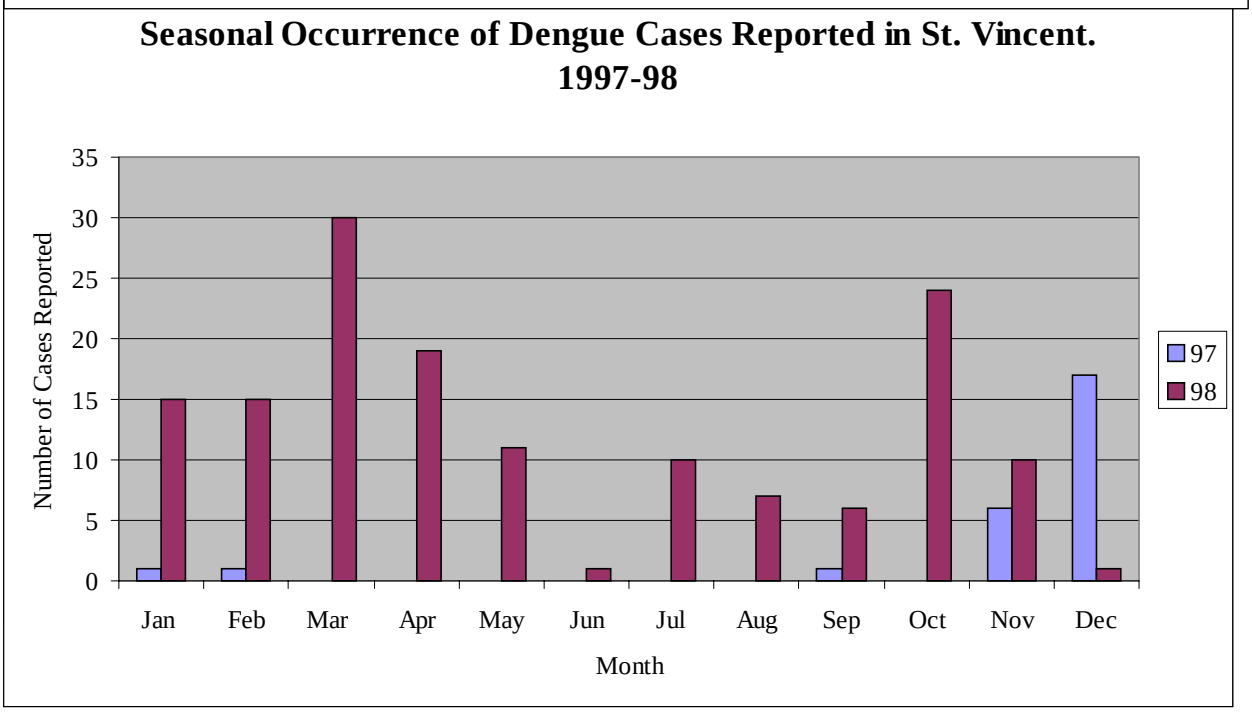
All four serotypes were detected in the Caribbean. Seven countries reported DEN-1, six with dengue type 2 and 3 and two countries DEN-4. Eight countries reported one serotype circulating, three with two serotypes, one with three serotypes and one with all four serotypes. Seven countries did not identify the serotypes present in their country.

Table 3
Dengue Serotypes Reported in the Caribbean. 1998

	Dengue Serotypes Reported				
Country	**1**	**2**	**3**	**4**	**Total**
Puerto Rico	x	x	x	x	4
Guadeloupe	x	x		x	3
Jamaica	x		x		2
Martinique	x	x			2
Trinidad and Tobago	x	x			2
Aruba			x		1
Belize			x		1
Curaçao			x		1
Dominica		x			1
Guyana	x				1
St. Kitts/Nevis			x		1
St. Vincent /Grenadines		x			1
Suriname	x				1
Total	**7**	**6**	**6**	**2**	

2.3 Dealt with the seasonal occurrence of Dengue. Four countries provided sufficient data so that epidemiological curves could be prepared.





2.42 Population at risk

With the population at risk information provided the following incidence figures were determined.

Estimates of the Population at Risk for Dengue Transmission in the Caribbean

	Incidence per 100,000	
COUNTRY	**1997**	**1998**
Puerto Rico	201.6	463.4
Suriname	80.0	346.0
Jamaica	0.6	331.4
St. Vincent and the Grenadines	36.1	180.6
Dominica	22.2	40.3
Curaçao	42.7	20.7
Anguilla	9.4	9.4
St. Kitts/Nevis	2.9	8.8
Aruba	3.3	8.6
Belize	10.8	6.9
Cayman Is	0.0	5.5
British Virgin Islands	0.0	5.1
Martinique	748.1	0.0
St. Lucia	9.4	0.0

Question 2.5 *Aedes albopictus*

Only French Guiana and the Cayman Islands reported *Aedes albopictus* within their territory. In 1998 surveillance for *Ae. albopictus* was conducted in 13 (59%) of the countries and identification of *Aedes* larvae collected from containers occurred in 64%.

Questions 3. Present Situation of the Control Program

Standardised programme regulations with written methods, procedures and techniques in a national document are found in 36% (8) of the countries. Three (13.6%) countries have these documents prepared at the local regional or state level and nine (41%) are without national documents but use manuals and technical documents from different sources.

The national objective of the control program in seven countries is to increase the *Aedes aegypti* control efforts in order to obtain levels of infestations close to zero with the aim of eradication in the future. In nine countries the objectives are to maintain systematic routine stratified control efforts according to epidemiological surveillance. Three countries maintain irregular control efforts that are used only in the case of emergency. In addition Belize reports that they maintain control and surveillance activities in the border areas and Cayman Island indicated that they are maintaining their eradication of *Ae. aegypti* and striving to eradicate *Ae. albopictus.*

Legal support for the Ministry of Health Dengue Control Programme exists in 77% (17) countries. Environmental sanitation is routinely used in 82% (18) of the control programmes and 59% (13) routinely use community participation. A National Commission or Central Technical Advisory Group exists in 31% (7) of the countries surveyed.

Twenty-three percent (5) of the countries have a vertically organised program 45% (10) have a program that is integrated into the general health services and 27% (6) are in the process of integration. In 59 (13) countries there is interaction or co-operation between governmental and non-governmental organisations for the control of dengue.

There has been a restructuring and/or budgetary adjustments or local level operational changes in 59% (13) of the programmes.

- There has been supervisional/ evaluation meetings and periodic technical assistance from the central level with the local levels in 50% (11) countries.
- National research centres participate in the process of the Dengue Control Program in 23% (5) countries.
- In 59% (13) countries there have been training for operational personnel. A total of 15 courses have been offered in the Caribbean in 1998 to train 234 persons in dengue control.

There exists in 68% (15) of the countries, programmes for the permanent elimination of breeding sites in water containers and the management of solid waste which act as sources of mosquitoes.

In urban areas, 81% (17) of the countries have potable water services covering 80-100% of the urban areas. Two countries indicated that the coverage was 50-60%, one country (Bermuda) had only 7% coverage and one country did not answer that question.

76% (16) of the countries reported that 80-100% of the municipalities have adequate garbage collection three reported 55-60% collection, two had 15-20% and one country did not answer that question.

Sixteen countries responded to questions about the sanitary landfill sites found in the municipalities. Of the respondents 56% (9) indicated that 90-100% of the municipalities have adequate sanitary landfill sites, 31% (5) indicated that 55-75% of the municipalities have this facility and two indicate that less than 15% for the municipalities have access to land fills.

Specific programs have been established for the control of public sanitary landfill sites in 59% (13) of the countries.

New or revised rules and regulations been enforced regarding the importation, importation inspection and/or storage of new, used or recycled tires in 14% (3) countries.

4.2 Promotion and Participation of the Community

Nine countries ((41%) report that groups been formed to provide inter-institutional technical assistance for the promotion of dengue control at the local level with the participation of the population. Four (18%) of these have prepared inter-institutional agreements and commitments with the assignment of work groups.

Mass media have been systematically used to inform the public and promote the participation of the community in dengue control activities in 68% (15) countries.

The content of the media message regarding promotion and education of dengue control has been professionally designed with marketing techniques, communication and studies of the community in eight countries (36%)/

The methods used to promote community participation have been evaluated to determine their effectiveness in seven (32%) of the countries.

4.3 Vector control

In 12 countries (55%) they have a specific plan for vector control based upon epidemiological surveillance and stratification for high risk areas.

Control and surveillance actions (with periodic analysis) of the levels of infestation and distribution of *Ae. aegypti* are undertaken with the elaboration of maps of risk areas and readjustment of the measures used for the elimination of *aegypti* breeding sites in 12 (55%) countries.

In 15 (68%) of the countries physical control is used in a systematic fashion to eliminate *aegypti* breeding sites with the participation of the community and or specific personnel. Sixteen countries (73%) use chemical control methods, 14 (64%) use biological control and four (18%) use a combination of these techniques.

4.4 Vector control in Case of emergency

Twelve countries (55%) have a plan of action in place in case of an epidemic of dengue.

4.7 Biological Control

Fish are used on a regular basis fish to control *aegypti* larvae in water storage containers in 50% (11) of the countries however they have been evaluated in only eight (36%). The guppy is used in six (27%) countries and *Gambusia* is used in eight (36%) countries.

4.8 Personnel

In the 22 countries that responded to the questionnaire the total number of supervision staff that are working on vector control activities are 268. There are a total of 13 entomologists, 35 lab technicians and 818 persons involved in spray activities. Approximately half of the vector control staff listed are in Trinidad. The government employs all of the personnel involved dengue control in the Caribbean region.

4.9 Equipment

There are 132 ULV foggers used in the countries surveyed many of which are portable models. In 14 countries more than 75% of the machines are in working order. One country indicated that 22% of their machines were working and in another none were functional. Eleven countries indicate that they have enough vehicles for their foggers. All of the equipment used in the programs is owned by the government and none by the municipalities.

5.0 Epidemiological Surveillance

Only eight (36%) countries report the use of stratified surveillance measures being used for the early detection of dengue cases and epidemics. Sentinel posts are used to detect dengue cases in ten (45%) of the countries.

Dengue is a reportable disease in 17 (77%) of the countries. The same number report that standardised case definitions are used to define suspect cases, confirmed cases and clinical cases of DHF and DSS. An active surveillance system using laboratory diagnosis was reported in 13 (59%) countries with standardised technical and operational regulations for serological and virological surveillance. There are eight laboratories that perform serological diagnosis and two that do virus isolation.

6. Program Expenditures

In 1998 ten of the countries report purchasing their insecticides locally, 14 from foreign companies and four directly from the manufacturer. It should be noted that several countries purchase their materials from more than one source. Seven countries reported their expenditures for supplying water to urban areas. It was estimated that the total cost for all of them was around $18,000,000 US. Ten countries reported their combined expenditures for solid waste management was around 7.3 million US. For eight countries a total of 413,500 US was spent for mass media communication for dengue control. One country reported spending $22,300 US on planning and evaluation of mass media campaigns. One country reported spending 400 US on courses and seminars to promote the evaluation of community participation and one country spent $200,000 US on dengue epidemiological surveillance.

Summary of Information on the Execution of the Caribbean Plan for the Amplification of Control Efforts Against *Aedes aegypti*.

1.-Source of Information

1.1.-Country_____

1.2.- Date questionnaire completed _____

1.3.- Persons completing the Questionnaire , name and position:

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

2.-Epidemiological Situation

2.1.- **Dengue**/ **Yellow Fever** cases and mortality reported in your country.

	1997	**1998**
2.1.1 Total Number of Cases of **Dengue** Reported		
2.1.2 Classic Dengue: Clinical Diagnosis		
2.1.3 Classic Dengue: Serological Confirmation		
2.1.4 Serological techniques used.		
2.15 **Dengue Haemorrhagic Fever** (Suspected) cases (Confirmed)		
2.1.6 Mortality caused by dengue/DHF		
2.1.7 Serotypes circulating		
2.1.8 No. Samples sent to Laboratory		
2.1.9 No. Epidemics of dengue/ DHF		
2.2.0 Confirmed cases of **Yellow Fever**		
2.2.1 Deaths due to Yellow Fever		
2.2.2 No. persons vaccinated against Yellow Fever (Rate : No./100,000)		

2.3 Seasonally Occurrence of Dengue:

Please annex the weekly or monthly reporting of cases of dengue during the past 5-10 years for **several** locations. For example Locality A:_____

Month/Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Jan.											
Feb.											
Mar.											
Apr											
May											
Jun.											
July											
Aug.											
Sept.											
Oct.											
Nov.											
Dec.											

2.4. **Infestations by *Aedes aegypti.***

		Country Total		Area Sampled		Area Infested		Area with *Ae. aegypti* Control Activities	
		1997	1998	1997	1998	1997	1998	1997	1998
2.41	**Area (km2)**								
2.42	**Population**								
2.43	**No.Parishes/ Counties**								
2.44	**No. Houses**								

2.5. ***Aedes albopictus***

	1997	**1998**
2.5.1 Was your country infested with *Aedes albopictus*?	Yes☐No☐	Yes☐No☐
➢ Do you have a surveillance system to detect *albopictus*?	Yes☐No☐	Yes☐No☐

2.5.3 Describe the system _____

➢ Are *Aedes* larvae collected from containers identified using a stereoscope/microscope? Yes☐No☐ Yes☐No☐

3.-Present Situation of Control Program

3.1.- Control Programme Regulations (mark the box that corresponds to your programme) :

☐ Standardised, with written methods, procedures and techniques in a national document.

☐ Standardised, with written methods, procedures and techniques in local, regional or state documents.

☐ Without written regulation. Manuals and technical documents are used from different sources.

3.2.- National Objective of the Control Program (mark the box that corresponds to your programme)**:**

☐ Increase the *Aedes aegypti* control efforts in order to obtain levels of infestations close to zero with the aim of eradication in the future.

☐ Control efforts are systematic, routine, stratified and in agreement with the epidemiological surveillance.

☐ Control efforts are irregular and used only in the case of emergency.

☐ Other:
Describe:_____
_____
_____

3.3.- Institutional Characteristics of the Control Program

	1997	**1998**
3.3.1 Does there exist legal support for the Ministry of Health Dengue Control Programme?	Yes☐ No☐	Yes☐ No☐
3.3.2 Is environmental sanitation routinely used in your country's programme?	Yes☐ No☐	Yes☐ No☐
3.3.3 Is community participation routinely used in your country's programme ?	Yes☐ No☐	Yes☐ No☐
3.3.4 Does a National Commission or Central Technical Advisory Group exist?	Yes☐ No☐	Yes☐ No☐
3.3.5 Does the programme function in a vertically organised manner or is it integrated with the general health services?		
Vertical	Yes☐ No☐	Yes☐ No☐
Integrated	Yes☐ No☐	Yes☐ No☐
In the process of integration	Yes☐ No☐	Yes☐ No☐

3.3.6 Is there interaction/co-operation between governmental and non- governmental organisations for the control of dengue? **1997** Yes ☐ No ☐ **1998** Yes ☐ No ☐

(Please annex a list of institutions that may collaborate in the epidemiology, entomology, control, diagnosis and treatment of dengue/DHF)

3.3.7 Has there been a restructuring and/or budgetary adjustments or local level operational changes in the programme? Yes ☐ No ☐ Yes ☐ No ☐

3.3.8 Have there been supervisional/ evaluation meetings and periodic technical assistance from the central level with the local levels. Yes ☐ No ☐ Yes ☐ No ☐

3.3.9 Do national research centres participate in the process of the Dengue Control Program. (annex a list of investigations.) Yes ☐ No ☐ Yes ☐ No ☐

3.4.0 Has there been training for operational personnel (annex the list of courses, type of courses, course duration) Yes ☐ No ☐ Yes ☐ No ☐

3.4.1 Number of courses, workshops, and internships conducted _____/ _____

3.4.2 Number of persons trained. _____/ _____

4.- Operational Characteristics of the Program

4.1 Environmental Sanitation

4.1.1 Does there exist in your country a program for the permanent elimination of breeding sites in water containers and the management of solid waste which act as sources of mosquitoes ? **1997** Yes ☐ No ☐ **1998** Yes ☐ No ☐

4.1.2 What percent of urban areas receive potable water services? _____%/ _____%

4.1.3 What percent of the parishes/counties have adequate garbage collection? _____%/ _____%

4.1.4 What percent of the parishes/counties have adequate sanitary landfill sites? _____% _____%

4.1.5 Have specific programs been established for the control of public sanitary landfill sites (garbage dumps)? **1997** Yes ☐ No ☐ **1998** Yes ☐ No ☐

4.1.6 Have new or revised rules and regulations been enforced regarding the importation, inspection and/or storage of new, used or recycled tires. Yes ☐ No ☐ Yes ☐ No ☐

4.1.7 How frequently are house inspections made for *Ae aegypti* control?
(interval in weeks) _____/ _____

4.1.8 How frequently are inspections made of key *Ae aegypti* breeding sites (cemeteries, tire repair shops, garbage dumps) (interval in weeks) _____/ _____

4.2 Promotion and Participation of the Community

4.2.1 Have groups been formed to provide inter-institutional technical assistance for the promotion of dengue control at the local level with the participation of the population? **1997** Yes☐No☐ **1998** Yes☐No☐

4.2.2 Have inter-institutional agreements and commitments been prepared with the assignment of work groups in relation with item 4.21? Yes☐No☐ Yes☐No☐

4.2.3 Have the mass media been systematically used to inform the public and promote the participation of the community in dengue control activities. Yes☐No☐ Yes☐No☐

4.2.4 Has the content of the media message regarding promotion and education of dengue control been professionally designed with marketing techniques , communication and studies of the community? **1997** **1998**
Yes☐No☐ Yes☐No☐

4.2.5 Have the methods used to promote community participation been evaluated to determine their effectiveness. Yes☐No☐ Yes☐No☐

4.3 Vector control

4.3.1 Does your country have a specific plan for vector control based upon epidemiological surveillance and stratification for high risk areas. Yes☐No☐ Yes☐No☐

4.3.2 Are control and surveillance actions (with periodic analysis) of the levels of infestation and distribution of *Ae. aegypti* undertaken with the elaboration of maps of risk areas and readjustment of the measuresused for the elimination of *Ae aegypti* breeding sites .
Yes☐No☐ Yes☐No☐

4.3.3 Are any of the following methods used in a systematic fashion to eliminate *Ae aegypti* breeding sites with the participation of the community and or specific personnel?
A. Physical Control ☐ B. Chemical Control ☐ C. Biological Control ☐
D. Combination of the above ☐ Which ones?
Describe:_____
_____
_____

4.4 Vector Control in Case of Emergency

	1997		1998	
Did your country have a plan of action in place in case of an epidemic of dengue?	Yes ☐	No ☐	Yes ☐	No ☐

4.5 Insecticides Used

Insecticide	Brand	Formulation	Concentration	1997		1998	
				Kg/ Litres	Cost (US$)	Kg / Litres	Cost (US$)
Focal Control							
4.5.1 temephos	Abate	G	1%				
4.51.2 *Bti*							
4.51.3 Others:							
Perifocal Control							
4.52.1 malathion							
4.52.2 fenitrothion							
4.52.3 Others:							
Spatial Application							
4.53.1 malathion							
4.53.2 fenitrothion							
4.53.3 lambda-cyhalothrin							
4.53.4 deltamethrin							
4.53.5 Other:							

4.6 Insecticide susceptibility (Laboratory Tests)

	Insecticide	Last year tests conducted	Susceptibility	WHO Tests Or /Other
4.6.1	temephos			
4.6.2	malathion			
4.6.2	deltamethrin			
4.6.3	fenitrothion			
4.6.4	Others (specify)			

Important: Please annex a summary of the results of the last tests.

4.7 Biological Control

4.7.1 Is your country using on a regular basis fish to control *Ae aegypti* larvae in water storage containers?

1997 Yes☐ No☐ **1998** Yes☐ No☐

4.7.2 Have the use of fish been evaluated in your country? Yes☐No☐ Yes☐No☐

4.7.3 What species of fish are being used?_____

Important: Please annex a summary of the results or reports on the use of fish in your country.

4.8 Personnel

How many people do you have working full time on vector control activities?	**1997**	**1998**
Supervisional:	_____/	_____
Entomologists:	_____/	_____
Lab Technicians:	_____/	_____
Spray men:	_____/	_____
Drivers:	_____/	_____

4.8.1 What percent of all the personnel are employed by the government. _____/ _____
_____/ _____

4.9 Equipment

4.9.1 How many ULV foggers are being used in your country?_____/ _____

4.9.2 What percent are functional? _____%/ _____%

4.9.3 Models used (ie Leco 1800, London Aire XL)
_____; _____; _____; _____

4.9.4 Are there sufficient vehicles for each mounted fogger? **1997** **1998**
Yes☐No☐ Yes☐No☐

4.9.4 How many thermal foggers are being used in your country? _____/ _____
Models used (i.e. Swingfog, Black Hawk)
_____; _____; _____; _____

4.9.5 What percent of all the equipment is owned by the government? _____/ _____

4.9.6 Owned and operated by the municipalities? _____/ _____

5.- Epidemiological Surveillance.

5.1. Are stratified surveillance measures being used for the early detection of dengue cases and epidemics? **1997** Yes☐No☐ **1998** Yes☐No☐

6) Case detection:

7) How are cases of dengue reported and what percent are from each source?

Private Clinics ☐_____% Hospitals ☐_____%; Public Clinics☐_____%
Dengue Control Programme ☐_____%; Other : ☐_____% Specify _____

	1997	1998
5.2.2 Are sentinel posts used to detect dengue cases?	Yes☐No☐	Yes☐No☐
5.2.3 How many sentinel posts exist in your country?	_____ /	_____
5.2.4 Is dengue a reportable disease in your country?	Yes☐No☐	Yes☐No☐

8) Are standardised case definitions being used in your country to define the following:

5.3.1 Suspect case	Yes☐No☐	Yes☐No☐
5.3.2 Confirmed case	Yes☐No☐	Yes☐No☐
5.3.3 Definition of clinical case for Dengue Haemorrhagic Fever	Yes☐No☐	Yes☐No☐
5.3.4 Definition of clinical case for Dengue Shock Syndrome	Yes☐No☐	Yes☐No☐

9) Is there an active surveillance system using laboratory diagnosis? Yes☐No☐ Yes☐No☐

10) Have standardised technical and operational regulations for the serological and virological surveillance been established. Yes ☐No☐ Yes☐No☐

5.6 Number of laboratories that perform:

Serological diagnosis :	_____	_____
Virus isolation:	_____	_____

6.- Program Expenditures

6. Expenditures for the *Aedes aegypti* surveillance and control.

6.1What are the annual expenditures for your country's Vector borne Disease Control program and the proportion spent for the control and surveillance of *Aedes aegypti* if it is a separate program .

	1997		1998	
	Total Program Cost US$	***Aedes* Control US$**	**Total Program Cost US$**	***Aedes* Control US$**
6.11 Personnel (Wages & *Per diems*)				
6.12 Transportation				
6.13 Equipment				
6.14 Insecticides				
6.15 Others				
6.16 Total Expenses				
6.17 Health Expenditures for the country				

6.2 Where does your country buy its insecticides? Local companies ☐
Foreign companies ☐ Direct from the Manufacturer ☐

6.3 How much are you paying for each insecticide?

Malathion	$_____per litre
Fenitrothion	$_____per litre
Pyrethroids (specify)	$_____per litre
Abate	$_____per kg
Bti	$_____per litre
Others: (specify)	$_____per litre

6.4 Expenditures for Water and Sanitation:

6.4.1 Estimated expenditure for water supply and storage in urban areas.
1997_____US$ 1998_____US$

6.4.2 Estimated expenditure for collection and disposal of solid waste (garbage):
1997_____US$ 1998_____US$

6.5 Expenditures for mass media communication for dengue control (US$).
1997_____US$ 1998_____US$

6.6 Expenditures for the planning and evaluation of the mass media campaigns (US$).
1997_____US$ 1998_____US$

6.7 Expenditures for courses, seminars and meetings for the promotion and evaluation of the community participation programme:
1997_____US$ 1998_____US$

6.8 Expenditures for epidemiological dengue surveillance:
1997_____US$ 1998_____US$

7. Obstacles and Difficulties Encountered in the Development of an Amplified and Intensified Program for the Control of *Aedes aegypti*

Describe briefly the present situation of your country's programme.
A.-Using as a reference operational, political, economic, legislative or other aspects that influence the present development.
B).- The changes that have been achieved in the last two years.
C).- The perspectives for the biennial 1999-2000.

8. Suggestions for Inter-country and Sub-Regional Collaboration

From your point of view what suggestions do you have to improve the means of communication, exchange of information and technical and operational collaboration between countries in order to carry out the Caribbean Plan for Dengue Control.

Please include as an annex your country's yearly annual report on dengue control efforts.
Questionnaire 99/cfv4
17/02/99

Table 1.

Areas and Populations of Countries Participating the Present Survey (1997).

Country	Population	Area (K^2)	No, Houses
Anguilla	10,663	88	2,619
Aruba	91,361	190	26,112
Bahamas	284,000	13,835	Ø
Belize	223,000	22,965	38,053
Bermuda	64,000	53	Ø
B.V.I.	19,107	344	6,656
Cayman Is.	36,600	259	12,000
Curacao	150,000	472	60,000
Dominica	72,000	789	20,500
French Guiana	114,678	91,000	38,324
Grenada	93,000	344	35,000
Guadeloupe	420,000	1,779	Ø
Guyana	735,000	214,969	165,000
Jamaica	2,553,400	11,424	768,689
Martinique	359,759	1,100	123,317
Puerto Rico	3,600,000	8,960	720,000
St. Kitts	34,000	176	10,074
St. Lucia	149,570	616	Ø
St. Vincent	108,000	389	27,000
Suriname	450,000	142,822	100,000
Tobago	51,247	300	18,000
Trinidad	1,223,753	4,828	341,403
Turks & Caicos	13,000	400	Ø

Ø Data not given

Table 2.
Dengue Cases Reported in Caribbean Countries in 1997/98.

Country	Classical Dengue Cases				Dengue Haemorrhagic Fever				Dengue Serotypes		Deaths	
	1997		1998		1997		1998					
	Suspected	Confirmed	Suspected	Confirmed	Suspected	Confirmed	Suspected	Confirmed	1997	1998	1997	1998
Anguilla	1	0	1	0	0	0	0	0	Ø	Ø	0	0
Aruba	3	0	8	0	Ø	Ø	Ø	Ø	0	3	0	0
Bahamas	0	0	386	Ø	0	0	0	0	0	4	0	0
Belize	24	Ø	9	Ø	0	0	0	0	3	3	0	0
Bermuda	0	0	1	0	0	0	0	0	Ø	Ø	0	0
BVI	0	0	1	1	0	0	0	0	Ø	Ø	0	0
Cayman	0	0	2	2	0	0	0	0	Ø	Ø	0	0
Islands	64	3	31	2	0	0	0	0	3	3	0	0
Curacao	16	6	29	9	4	0	6	2	2	2	0	0
Dominica	Ø	Ø	2265	486	Ø	Ø	77	1	Ø	Ø	0	1
Fr. Guiana												
Grenada	15	1	32	3	0	0	0	0	Ø	Ø	0	0
Guadeloupe	956	315	666	183	Ø	4	Ø	2	1,2	1,2,4	0	0
Guyana	12	0	160	33	0	0	0	0	1	1	0	0
Jamaica	16	3	1509	202	Ø	Ø	Ø	Ø	1	1,3	0	0
Martinique	2690	1295	1949	493	57	Ø	35	Ø	1	1	9	3
Puerto Rico	7259	2372	16,683	5,091	780	32	Ø	56	1,2,4	1,2,3,4	6	16
St. Kitts	1	1	3	3	0	0	0	0	0	3	1	0
St. Lucia	14	2	8	7	Ø	Ø	Ø	Ø	Ø	Ø	0	0
St. Vincent	39	4	196	62	0	0	0	0	1,2	2	0	0
Suriname	360	3	1,557	149	0	0	52	16	Ø	1	0	1
Tobago	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Trinidad	1291	391	2,179	209	104	19	19	6	1,2,4	1,2	14	Ø
Turks & Caicos Is.	0	0	0	0	0	0	0	0	Ø	0	0	0

Ø Data not reported.

Table 3.

Biological Control Agents used in the Anti-Dengue/Anti-*Aedes* Programs

Country	Fish	Bacillus thuringiensis/B. phaericus	Other
Anguilla	✓	x	*Gambusia*/Millions *Poeciliareticulata*
Aruba	✓	✓	*Poeciliareticulata*
Bahamas	✓	x	*Poeciliareticulata*
Belize	x	x	-
Bermuda	✓	✓	*Gambusia*
B.V.I.	✓	✓	*P.reticulata*
Cayman Is.	x	✓	*Gambusia*
Curacao	✓	x	*Gambusia,*
Dominica	✓	x	
French Guiana	N/A	N/A	*Gambusia,P.reticulata*
Grenada	✓	x	*P.reticulata*
Guyana	x	x	*P.reticulata*
Jamaica	x	x	
Martinique	x	x	*P.reticulata*
Puerto Rico	x	x	
St. Kitts	x	x	*P.reticulata*
St. Lucia	✓	x	*Gambusia*
St. Vincent	✓	x	-
Suriname	✓	x	*P.reticulata*
Tobago	x	x	
Trinidad	x	x	
Turks & Caicos Islands	x	x	

4/22 Gambusia 5/11 (45%)
11/22 P. reticulata 8/11 (73%)

Table 4.

Personnel Working Full-Time in Vector Control Activities - 1997

Country[1]	Supervisional	Entomologists	Lab. Technologists	Spraymen	Drivers	Totals	Personnel [2] Per Capita
Anguilla	1	0	0	2	1	4	0.38
Aruba	2	0	0	18	0	20	0.22
Bahamas	4	0	0	9	2	15	0.05
Belize	9	2	6	24	6	47	0.21
Bermuda	2	0	0	2	13	17	0.27
BVI	2	0	0	5	3	10	0.52
Cayman	0	3	2	9	0	14	0.38
Is.	8	1	0	1	6	16	0.11
Curacao	11	0	0	11	1	23	0.32
Dominica	7	0	1	97	9	114	0.99
Fr. Guiana	2	0	0	26	2	30	0.32
Grenada	13	2	1	36	13	65	0.025
Jamaica							
Martiniqu	0	1	2	36	0	39	0.11
e	12	1	3	96	-	112	0.03
Puerto	0	0	0	8	1	9	0.26
Rico	5	0	0	34	-	39	0.26
St. Kitts	5	0	0	24	2	31	0.29
St. Lucia	8	1	1	15	1	26	0.06
St. Vincent							
Suriname							
Tobago	4	0	0	8	4	16	0.31
Trinidad	174	1	17	310	41	543	0.44
Turks & Caicos	1	0	0	12	4	17	1.31

1. No data given: Guyana, Guadeloupe
2. Personnel per 1000 capita

Table 5

Expenditures incurred in Dengue Vector Surveillance and Control in 1997 (US $1000)

Country[1]	Personnel(Wages&P.D.)	Transportation	Equipment	Insecticides	Others	Total	Other Vector Costs
Aruba	444	39	3	30	276	731	
Bahamas	145	7	25	6	-	182	377
Belize	82	90	77	43	-	211	
Bermuda	770	20	7	27	2	825	
B.V.I.	108	5	-	13	.3	127	
Cayman Is.	150	-	-	10	4	164	2,736
Curacao	140	60	5	2.5	5	213	13
Guyana	47	-	-	4	0.8	52	-
Dominica	5	1	3	13	2	25	729
French	3,520	75	20	136	1	3,750	-
Guiana[2]	57	2	-	11	3	73	-.
Grenada							
Martinique	No details given	-	-	-	-	1,600	-
Puerto Rico	1,473	261	207	68	30	2,038	224
St. Kitts	40	4	.2	6	75	50.5	
St. Lucia	112	13	3	28	-	155	
St. Vincent	91	9	-	4	3	107	
Turks & Caicos	40	5	5	5	-	55	65

1. No data: Suriname, Trinidad, Tobago, Anguilla, Jamaica., Guadeloupe
2. Include expenses for other vector control

Table 6.

Expenditures incurred in Dengue Vector Surveillance and Control in Countries per Capita (1997)

Country	Total Expenditure[2]	Expenditure per capita
Aruba	731	8.00
Bahamas	182	0.64
Belize	211	0.95
Bermuda	825	12.89
B.V.I.	127	6.65
Cayman Is.	164	4.48
Curacao	213	1.42
Dominica	52	0.72
Grenada	73	0.78
Guyana	25	0.03
Martinique	1,600	4.45
Puerto Rico	2,038	0.57
St. Kitts	50.5	1.49
St. Lucia	155	1.04
St. Vincent	107	0.99
Turks & Caicos Islands	55	4.23

1. No data supplied by Suriname, Trinidad, Tobago, Anguilla, Jamaica,. Fr. Guiana, Guadeloupe
2. Expenditure in US$ 1000 for *Ae aegypti* control.

Table 7.
Insecticides used against *Aedes*/Dengue in 1997

Country	Larvicide[1] Quantity(Kg)	Cost$	Adulticide[2] Quantity(l)	Cost$	Other Insecticides used
Anguilla	100	N/A[3]	180	N/A	Bti, K-othrine,
Aruba	1825	5220	80	2236	Icon, Decis,BP300
Bahamas	N/A	3,084	12	209	Dursban
Belize	625	2,250	6,200	30,000	
Bermuda	0	0	0	0	
					Bti,Altosid
B.V.I.	454	4,140	68.19	1131	Anti-malariaoil, diesel
CaymanIs.	230	N/A	0	0	Bti, Altosid; Fenthion, naled,
Curacao	800	N/A	912	0	permethrin
Dominica	50	385	0	0	Bti, gas oil;
French Guiana	900	4,400	4,277	30,000	Kerosene. Actellic
					Abateliquid
Grenada	750	3,067	0	0	Malathion(WP)
Guadeloupe	9,700	40,500	11,000	49,500	
Guyana	50	2,675	200	10,800	
Jamaica	394	N/A	0	0	
Martinique	5,400	27,000	0	0	Deltamethrin (Kothrine)
Puerto Rico	682	3,600	8,000	70,560	
St. Kitts	750	5,370	0	0	
St. Lucia	1125	7,450	0	0	Actellic
St. Vincent	158	2,414	125	1498	
Suriname	0	0	0	0	
Tobago	N/A	N/A	N/A	N/A	
Trinidad	27,700	94,919	4,430	17,077	malathion(WP).
Turks & Caicos Islands	2,000	N/A	N/A	N/A	

1. Temephos1%(Abate)
2. Malathion95%,ULV3.Datanotavailable

Table 8.

Country Suggestions for Inter-Country and Sub Regional Collaboration

Country	
Anguilla	
Aruba	Better inter-country communication; central acquisition of insecticides
Bahamas	Need for a regional newsletter and regional meetings
Belize	Need for a regional (PAHO- funded) Anti-Aedes meeting (twice/a)
Bermuda	-
B.V.I.	Formation of a regional professional V.C. association: meetings
Cayman	Use of website; a quarterly dengue (regional) report; meetings
Curacao	Explore the lease of an aircraft for emergency use in sprays in dengue outbreaks
Dominica	To establish a regional web page
French Guiana	-
Grenada	Need co-ordinated (regionally) strategies for V.C.
Guyana	-
Jamaica	-
Martinique	Regular meetings. Exchange information in regional journals
Puerto Rico	Monthly dengue surveillance reports to be prepared and distributed.
St. Kitts	Circulation of quarterly reports & bulletins of outbreaks
St. Lucia	-
St. Vincent	-
Suriname	-
Tobago	-
Trinidad	-
Turks & Caicos Islands	Exchange of V.C. Officers between countries: sharing information.

Table 9.

House Indices of *Aedes aegypti* in the region 1991[1]

Country	Index (%)
Anguilla	26-33
Aruba	Ø
Bahamas	7.14
Belize	0.2-0.4
Bermuda	0
B.V.I.	1-10.4
Cayman Is.	0
Curacao	18.0
Dominica	18.0
French Guiana	Ø
Grenada	6-36
Guadeloupe	19.3
Guyana	60.0
Jamaica	3-25
Martinique	2-62
Puerto Rico	Ø
St. Kitts	0-14.2
St. Lucia	22.0
St. Vincent	0-[1]33.2
Suriname	Ø
Tobago	9.7
Trinidad	2.5-13.2
Turks & Caicos Islands	2.0

1. Ranges or means as reported by Vector Control Units

Ø Data not available

[1] C: Survey Table. SCR

Table 2.4
Total Population of countries and Population at Risk for Dengue

	Population		Population at Risk for Dengue	
COUNTRY	**1997**	**1998**	**1997**	**1998**
Aruba	91,361	93,424	91,361	93,424
Anguilla	10,663	10,663	10,663	10,663
Bahamas	288,000	293,000		
Belize	223,000	130,000	116,000	120,000
Bermuda	64,000	64,000	0	
British Virgin Islands	19,107	19,482		
Cayman Is	36,600	36,600	260	260
Curacao	150,000	150,000	0	0
Puerto Rico	3,771,000	3,800,000		
Dominica	72,000	72,000	751	751
Guadeloupe	420,000	420,000	1,635	
Guyana	735,000	750,000	11,264	11,264
French Guiana	114,678	166,000	41,281	Idem
Jamaica	2,553,400	455,340		
Puerto Rico	3,600,000	3,600,000	8,960	8,960
Martinique	359,579	396,700	1,100	1,100
St. Kitts & Nevis	34,000	34,000	29	29
St. Lucia	149,570	148,000	80	80
St. Vincent & Grenadines	108,000	108,000	363	363
Suriname	450,000	450,000	8,000	8,000

PAN AMERICAN HEALTH ORGANIZATION
Pan American Sanitary Bureau, Regional Office of the
WORLD HEALTH ORGANIZATION

PAHO/HCP/HCT/136/99

A BLUEPRINT FOR ACTION FOR THE NEXT GENERATION: DENGUE PREVENTION AND CONTROL

Communicable Diseases Program
Division of Disease Prevention and Control
Pan American Health Organization

June, 1999

TABLE OF CONTENTS

DENGUE PREVENTION AND CONTROL

The Problem

Dengue is a growing public health problem in the World. Approximately two fifths of the worlds population are at risk, and more than 100 countries have experienced dengue or dengue hemorraghic fever (DHF) outbreaks. The annual incidence of dengue is up to 50 million cases per year, of which 500,000 persons are hospitalized and 20,000 die. Ninety-five percent of all DHF cases are children under 15 years of age.

In the Region of the Americas all four dengue serotypes are circulating, 25 countries have reported cases of DHF, and severe outbreaks have occurred in Cuba and Venezuela. Although sporadic outbreaks occurred around the Caribbean and Venezuela in the 1960s and 1970s, intensive efforts to control *Aedes aegypti* rendered most of North, Central and South American countries free of major outbreaks of epidemic dengue fever for more than 50 years. From 1977 on, however, the spell was broken when Cuba and Jamaica were struck by an epidemic of classic dengue fever. While there were no recorded deaths during the outbreak, more than 500,000 people presented symptoms classic Dengue, including fever, malaise, joint pains, headaches, retro-orbital pain and sporadic skin rashes.[i] Meltzer *et al.* 1998 indicated that the range of DALYs lost per million population to dengue in the Americas is similar to annual losses attributed to any one of the following diseases or disease clusters (primary pertussis, poliomyelitis, measles, tetanus), meningitis, hepatitis or malaria.[ii] The loss is of the same order of magnitude as any of the following: tuberculosis, sexually transmitted diseases (with the exception of HIV), the tropical cluster, including Chagas disease and leishmaniasis, or intestinal helminths.

In the spring and summer of 1981, Havana physicians reported outbreaks of a far more serious illness, with all the classic symptoms, in addition to hemorrhages from the nose and mouth, bleeding under the skin and occasional occurrences of shock and death. With this major announcement, dengue hemorrhagic fever entered the Western Hemisphere.

The number of cases of dengue has increased from 66,011 in 1980 to 717,024 in 1998 (Fig. 1).

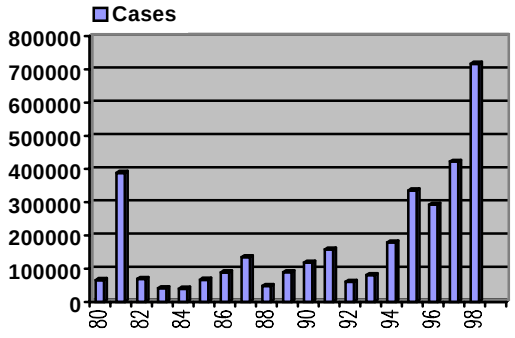


Figure 1. Cases of dengue in the Americas, 1980-1998

By 1998 dengue was endemic in 42 American nations with recent epidemics recorded in Venezuela (1989-90, 1997, 1998), Colombia (1984, 1986, 1989-90), French Guiana (1991), Brazil (1986-87, 1990-91, 1995-96, 1998-99) Puerto Rico (1994), Nicaragua (1994), Central America and Mexico (1995) and Cuba (1997). The number of reported cases of dengue hemorrhagic fever has increased markedly during this period, from 80 cases in 1980 to 11,783 cases in 1997 and 12,414 cases in 1998 (Fig. 2).

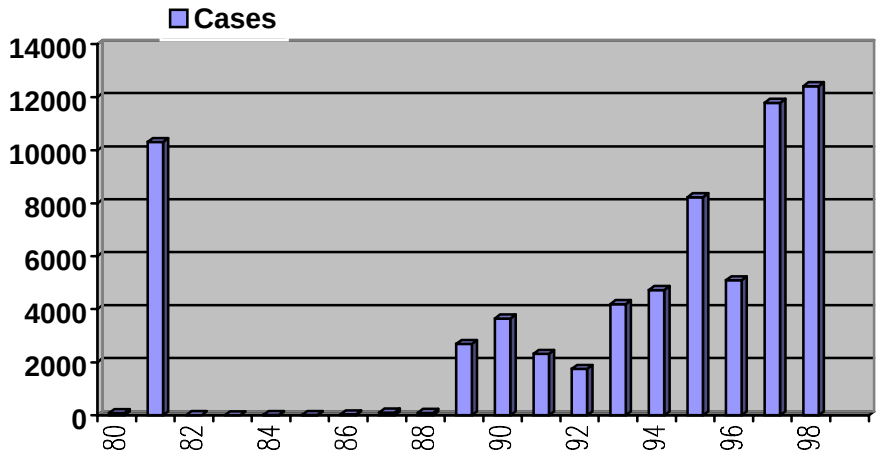


Figure 2. Cases of DHF in the Americas, 1980-1998

It is likely that the magnitude of the dengue/DHF problem in the Americas will continue to expand, because of an alarming increase in the *Aedes aegypti* populations. Rapid unorganized urbanization and the proliferation of slums throughout most of Latin America's cities present an environment of trash and containers ideal for *Aedes* breeding. Since it is unlikely that a vaccine will be available in the foreseeable future, control strategies will have to take on a more integrated approach, incorporating and emphasizing epidemiological stratification of transmission control activities, social communication, health education, and community ownership for prevention and control of dengue.

In 1996, as mandated by its Directing Bodies, the Pan American Health Organization designed a Continental Plan to Expand and Intensify Control of *Aedes aegypti.* The objective of this Plan was to "increase actions to combat *Ae. aegypti*, in order to achieve a close to zero level of infestation, with the aim of eradicating the vector". The cost of the Plan was estimated to be around US$ 1.6 billion per year for all the countries of the Region; its goal is to "interrupt dengue transmission in the Western Hemisphere through a progressive decrease in the presence of *Ae. aegypti* in infested areas".

Ongoing programs in the Region allocate the majority of dengue control funds for vector control. An example of this is the expenditure for 1996. Of the estimated $331.3 million spent by 23 countries in the region, $321.1 million (97.3%) were spent on direct vector control operations, around $8.4 million (2.5%) for social communication, $237,690 (0.07%) for training, and $149,300 (0.05%) for research[iii]. These efforts, and budget distribution, are not enough to change the course *Ae. aegypti* infestation nor of dengue transmission. As may be seen in Annex 1, expenditures for dengue control increased from $331 million in 1996 to more than $671 million in 1997, i.e., over 100%.

At the same time, and in the same countries, the incidence of reported cases of dengue ascended from 285,710 in 1996 to 421,998 cases in 1997, an increase of over 43%. In 1998 there were 717,024 cases reported, however the costs of the programs have not yet been compiled. A reorientation from solely vector control activities has to come about, emphasizing a community based "ownership" strategy with social communication and education as the backbone of the prevention and control actions.

Community ownership of the dengue control program essential requirement for its success and sustainability.

Health Interventions; Lessons Learned:

The control strategies that have worked in the past when the vector was eliminated in most of the Americas no longer are applicable to the reality of the social, demographic, economic and political situation of these countries because of:

- The wide spread demographic changes, resulting in large expansion of marginal urban areas and
- The concentration of rural population in primitive "urban-like" settings.
- The "economic adjustment process" limited the ability of the States to speed up coverage of basic sanitation and water delivery to the population.
- The lack of social acceptability of domestic intervention by official control programs; and
- The high labor costs of the traditional vector control programs
- The health sector reform process in its transition from centralized to decentralized administration has allowed for the dismantling of traditional surveillance and control services before effective community strategies to reduce levels of infestation have yet been developed.

Newly developed programs in place today are failing partially because of:

- **Community participation** in dengue prevention and control was limited to compliance with official demands, never amounting to community ownership;
- **Local Health Services** , now politically and administrative responsible for the prevention and control programs are still not sufficiently established;
- **Household and community** behavior change strategies are either weak or not yet introduced into programs;
- **Water supply and waste management**; coverage severely limited in high risk areas;
- **Sustainability and continuity** of control actions are constantly threatened by competing health and political demands;
- Weak leadership to conduct **intersectoral coordination**;
- **Operational research** on household community strategies has been insufficient t ;

The nature of dengue, with peaks and valleys of outbreaks (Fig. 3 – cases in selected states

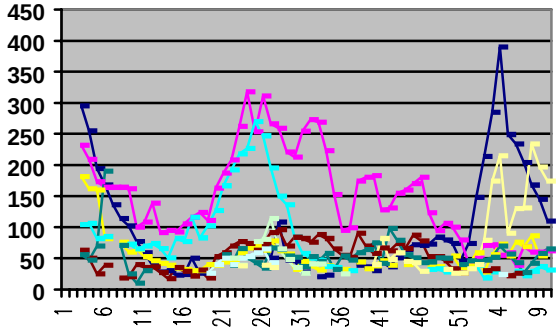


Figure 3. Cases in selected states of Venezuela, 1998-99

of Venezuela by epidemiological week, 1998-9) encourages sporadic non-systematic responses from programs and policy leaders.

Because past programs usually focused on central government vector control actions, there was little or no community control ownership. Traditional and often costly education and mass media programs have increased knowledge levels about dengue among the population, but are not part of a comprehensive behavior change strategies for control of mosquito breeding sites in the household and communities.

In order to be successful, the next generation of dengue prevention and control programs has to incorporate sustained community ownership and control.

Comprehensive behavior change can guarantee sustainable reduction in household infestations of the vector through breeding source reduction and therefore *Aedes aegypti* population reduction.

The New Generation

Locally based control programs can become sustainable, through adaptive changes in behavior, improving their cost effectiveness over time. Effective individual, family and community-based programs are to be designed using local knowledge of domestic arrangement for water and waste management and basic sanitation. They also need knowledge of community organizations and the function of the members within the family. On the basis of this knowledge effective behavior change strategies, applicable to different household and community types can be formulated. These community types can be grouped around a combination of factors such as: availability/accessibility of water and/or electricity, population densities, types of *Aedes aegypti* breeding sites, waste collection, income and education as well as buildings and communal areas usage. Changes in behavior to affect determinant/risk factors can only come about through well-established educational interventions, which are long term actions, and these are to be initiated from the very start of the prevention and control program.

Education programs that bring about behavior change are long term programs and have to be initiated at the onset of the dengue prevention and control program.

Community based strategies have several operative levels: individual, household, community, institutional, policy-making and enforcement. At the individual level, members can become aware of the problem in their particular area, be induced to practice good health behavior that will contribute to personal protection and participate in household and community prevention and control strategies. At the community level, members can participate in activities of *Aedes* source reduction, assigning responsibilities and tasks that will contribute to the improved health of the individuals and households, as fundamental units in a community.

At the community level, activities by local organizations will promote compliance and participation of all households, to insure protection of the community as a whole. Community organizations will promote and support all dengue control activities, and interact with institution and policy-making levels. The institutional level, including private/businesses, municipal governments, health and education agencies, will carry out necessary support activities that are beyond the scope of the communities, household and individuals. At the policy level, the MOH and other central government agencies, in coordination with non governmental organizations and funding agencies, will formulate policy, implement laws, and provide educational and media support to ensure the success of activities at other levels. An important part of the dengue prevention and control programs at this level is that of social communication. The policy level will be responsible for guaranteeing that all the other levels have the necessary materials, supplies and technical support for dengue prevention and control.

Integrated, community-based dengue prevention strategies have proved effective in the past, albeit in small pilot areas and with extensive inputs of technical and financial resources. The challenges facing the region today are to find a way to take community-based dengue prevention strategies to scale, and to sustain them with an appropriate level of resources that can continue to be available over time. Annex 2 lists the key behaviors at the different levels that will promote sustainable dengue control activities.

Economic Rationale:

Currently the endemic countries of the Region, are spending large sums of money (see annex 1) which are increasing every year. From 1996 on, 25 endemic countries have spent US$ 331 million and US$ 671 million in 1997. An evaluation of the needs to extend coverage to all parts of all these 25 countries with the activities they are carrying out today, these countries will need US$ 1.3 billion per year. Combining the difficulties in securing this level of budget for just one program and the fact that so far these programs are not making a significant epidemiological impact, new alternatives to assure results are needed.

Annex 3 provides a rough estimate of cost savings for two countries, based on 70% and 50% reduction of cases through an effective program. Under the assumption that a 100% coverage budget could be secured for Venezuela (US$ 24 million), and for Nicaragua (US$6.0 million). And that these investments could achieve 50 to 70% reductions in the number of cases per year, the net savings to society would amount to a significant rate of return to the investment. This means that Venezuela would save US$ 2.9 to 4.0 million per year and Nicaragua would save US$ 0.9 to1.3 million per year in relation to what these countries are spending today.

A Proposal for Action

Goal

The ultimate goal of the proposal is to have a comprehensive national plan for the control of *Aedes aegypti* and dengue in each affected country. These new plans should break the current imbalance among program components (e.g. educational interactions between program and society vs. institutional activities for vector control carried out by the program). The end result should be a change in strategy: a major effort during the first 4-5 years of implementation of the plan aimed at developing the integration of all levels of the society into the program to achieve a sustainable collective effort thereafter.

Objectives (See also Annex 2)

1. To promote and sensitize individual, families and communities to participate, through ownership and executive partner in dengue prevention and control activities, in order to eliminate *Aedes aegypti* breeding sites in and around the home, the working place and the leisure sites.

2. To promote and reinforce changes in human behavior through health communication and health promotion strategies, which include specific target audiences from the school curricula to mass media participation, among others, to reach most of the population and affect the society as a whole.

3. To promote and strengthen entomological surveillance capability at the local level, to determine *Aedes aegypti* distribution and level of infestation, to detect areas of new infestation, and to support local level societies in taking necessary actions to prevent further spread of the mosquito.

4. To strengthen the epidemiological surveillance system for early detection of dengue cases and rapid implementation of transmission control measures to reduce transmission and prevent the occurrence of epidemics.

Activities

This proposal will be implemented in four stages: preparatory phase, subregional workshops, development of national plans, and resource mobilization

1. Preparatory phase

1.1. Objectives

- Prepare background materials for the workshops (point 2 below) beforehand. These materials will include one or more case studies of successful activities actually implemented in a country or locality of the Americas. Potential case studies include those of Panama (National Plan), Mexico, Cuba, and Peru (effective regional or local program).
- Construct the evidence base to be provided to workshop participants in order to redesign current plans for control of *Aedes aegypti* and dengue, incorporating new elements of social participation, education and communications.
- Design a preliminary model as an alternative to control *Aedes aegypti* and dengue. This model will be presented and analyzed during the subregional workshops.
- Prepare workshop methodology, including a) guidelines for the preparation of a national plan (with detailed actions, required resources and evaluation plan); b) actual workshop methodology, with emphasis in technical matters, management issues, economics, and social communications.

2. Subregional workshops

This stage constitutes the core of the proposal. Four subregional workshops will be conducted as follows:

2.1. Objectives

- Perform a critical analysis of the current model of *Aedes aegypti* and dengue control and a feasibility analysis of current entomological control strategies and pertinent alternatives.
- Propose a new model for *Aedes aegypti* and dengue control based on proven successes of alternative strategies.
- Analyze new elements to include in a national plan for *Aedes aegypti* and dengue control.
- Initiate the preparation of new national plans.

2.2. *Workshop description*

- Four workshops will take place, one each for the Andean Area, Caribbean, Central America and Latin Caribbean, and Southern Cone.

- Participants will include technical individuals representing the ministries of health (3), education (2), sanitation (1), and finance (1), in addition to national experts in social communications (1). Four of these participants per country would be funded from this proposal's resources.

3. Development of national plans

3.1. Description

Following the workshops, it is envisioned that each country will develop its own comprehensive national plan, based on the evidence provided by the workshops and the national dengue situation. The plan should address all aspects of dengue control, i.e., policy, legislation, individual, community and institutional participation, education, and social communication

It is proposed that the national plan be prepared by a national multidisciplinary team including experts in health (3), education (2), finance (1), environmental sanitation (1), social communications (1). This activity will require the support of a management and a technical team that will include a disease control expert, an education/social communications specialist and an economist. Once a final draft is available, each plan would be submitted to PAHO and IDB for review and comments.

4. Resource mobilization

This fourth stage of the proposal is a resource mobilization campaign to obtain financing for the initial expenses of each national plan (e.g. training, materials development, launching), and to secure resources for recurrent costs in each country.

5. Schedule of planned activities

ACTIVITY	MONTH														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Preparatory phase															
Bacground documentation	◄	-	-	-	►										
Workshop preparation			◄	-	-	►									
Subregional workshops*						◄	-	-	-	►					
Workshop 1						■									
Evaluation/revision							■								
Workshop 2								■							
Workshop 3									■						
Workshop 4										■					
Preparation of national plans								◄	-	-	-	-	-	-	►

- One week workshops.

Annex 1

Budget for dengue control programs and number of cases of dengue reported in selected countries in the Americas, by country, 1996 – 1998[iv,v]

	Expenditures[2]		Cases		
Country	**1996**	**1997**	**1996**	**1997**	**1998 (Epidemiological week if not 52)**
Argentina[3]	9,530,004	---	0	1st outbreaks noted	822 (46)
Bolivia[4]	493,055	505,840	52	539	49 (45)
Brazil	254,415,800	606,831,158	175,818	254,109	530,578
Paraguay	2,251,842	2,437,161	0	0	0
Aruba[5]		376,686	17	0	0
Colombia	4,935,772	4,635,580	33,155	24,290	48,855 (29)
Ecuador	5,080,134	2,473,161	5,189	3,871	4,319 (45)
Peru[6]	1,404,474	2,076,042	6,395	1,357	988
Venezuela	534,605	621,247	9,180	33,654	37,586
Costa Rica	3,340,716	2,547,720	2,307	14,267	2,290 (43)
El Salvador	5,265,863	1,088,894	790	423	1,688
Guatemala	1,388,854	3,609,242	3,679	5,385	4,655
Honduras	3,316,135	4,117,880	5,047	11,873	22,218
Mexico	11,667,124	12,031,715	36,538	53,541	23,639
Nicaragua	2,670,111	2,578,111	2,792	3,126	13,592
Anguilla	34,300	24,700	1	0	0
Antigua & Barbuda	477,377	507,052	12	7	4
Barbados	10,000	12,000	130	199[7]	852 (47)
Cuba	23,129,048	23,375,930	0	3,012	0
Dominica	151,080	162,210	3	0	1
Grenada	85,647	103,565	364	22	4
Monserrat	61,485	85,985	3	0	0
Sr. Lucia	621,504	591,504	65	12	1
St.Vincent and the Grenadines	126,988	251,952	190	3	88
Trinidad & Tobago	321,402	318,384	3,983	784	3,120
TOTAL	331,313,320	671,363,719	285,710	410,475	695,349

[2] Expenditures for 1998 are not available at this moment.
[3] Expenditures for 1997 are not available.
[4] Only 20% used in 1996 and 25% in 1997
[5] Figures for 1996 not available.
[6] From: Taller Subregional de Evaluación del Plan Continental de Ampliación e Intensificación del Combate al *Aedes aegypti*. Países Andinos, Aruba y Cuba.
[7] Includes laboratory confirmed cases only.

ANNEX 2

Key Behavior at the Individual/ Family, Local/ Institution and Policy levels.

Level			
Individual / Family	**Community**	**Local/ Institution (includes municipalities)**	**Policy (State/ Central Gov.)**
Correct household water management.	Measures to insure 100% participation in individual/ family goals.	Guarantee of waste disposal (refuse).	MOH dictates policy to insure surveillance and vector control.
Elimination of breeding sites around home. • Useful • Non-useful	Clean up of public common areas.	Elimination of breeding sites in abandoned buildings and construction sites.	Generate adequate legislation to implement behavior compliance
	Guarantee and disseminate education programs and activities to support individual and community behaviors.	Promote incentives for PARTICIPATION at the community level.	Preparation of educational material.
		Surveillance of febrile cases.	Preparation and dissemination of radio and television spots to support community actions and advocacy with policy makers.
		Application of insecticides for vector control in specific situations.	Insure multisectorial participation.
		Local surveillance and feedback to the community organizations (infestation).	Macro surveillance and feedback to the local institutional level (cases).
		Program evaluation.	Provide resources for implementation of activities at all levels.
			Conduct evaluation.

Annex 3

Estimates of potential cost* savings by dengue prevention activities, assuming 70% and 50% reduction in case load, Venezuela and Nicaragua, 1994-1998

Venezuela

	Number of cases			Cost per	Potential Savings	
Year	Reported	Prevented 70% (a)	Prevented 50% (b)	case reported (c)	70% prevented	50% prevented
1994	15,000	10,500	7,500	158.98	1,669,290	1,192,350
1995	32,280	22,596	16,140	158.98	3,592,312	2,565,937
1996	9,982	6,987	4,991	158.98	1,110,793	793,469
1997	33,717	23,602	16,859	158.98	3,752,246	2,680,164
1998	37,586	26,310	18,793	158.98	4,182,764	2,987,711
Total	128,565	89,995	64,283		14,307,405	10,219,632

* All costs in US$.

(a) Assuming 70% of cases are prevented; (b) assuming 50% of cases are prevented.

(c) The cost per case was based on estimated direct costs of US$36 per patient per day, and a 4-day length of hospital stay. Ambulatory care per patient was calculated at $18.3 per patient. In Venezuela, approximately 35.5% of dengue patients are admitted into the hospital. Indirect costs were calculated at $5.00 per 1.7 case per day (patient plus caretaker). Direct health care costs plus indirect cost of lost wages were added to the total amount spent in vector control programs for 1994, only year with complete data available.

Sources of data: See reference 6.

Nicaragua

	Number of cases			Cost per	Potential Savings	
Year	Reported	Prevented 70% (a)	Prevented 50% (b)	case reported (c)	70% prevented	50% prevented
1994	18,674	13,072	9,337	144.35	1,886,914	1,347,796
1995	19,260	13,482	9,630	144.35	1,946,127	1,390,091
1996	2,748	1,924	1,374	144.35	277,672	198,337
1997	2,943	2,060	1,472	144.35	297,375	212,411
1998	13,592	9,514	6,796	144.35	1,373,404	981,003
Total	57,217	40,052	28,609		5,781,492	4,129,637

* All costs in US$.

(a) Assuming 70% of cases are prevented; (b) Assuming 50% of cases are prevented.

c) Based on published data, direct health care costs per patient were estimated at $92.5 (based on 36.5% hospital admission rates). In addition, the same source estimated an indirect cost per case of $23.06. Direct health care costs plus indirect costs were added to the total amount spent in vector control programs for 1994, only year with complete data available.

Sources of data: see reference 7.

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