BLUEPRINT FOR THE NEXT GENERATION:
DENGUE PREVENTION AND CONTROL

Country dengue control programs are predominantly vertical and mostly based on the use of insecticides. Most countries focus on addressing emergency situations, with less emphasis placed on effective, long-term actions. This, along with the decentralization of health services, high incidence of the vector *Aedes aegypti*, and lack of adequate water supply and solid waste management for the population, exacerbate the problem.

This document is presented to the Subcommittee on Planning and Programming because the increase in incidence of the more severe form of the disease, dengue hemorrhagic fever/dengue shocks syndrome (DHF/DSS), has created an alarming situation in the Americas. If immediate action is not taken, DHF will become as endemic in the Americas as it is in Asia, where some countries report hundreds of thousands of cases per year.

In 1995 the Directing Council adopted Resolution CD38.R12 in order to address the magnitude and gravity of the emergence of DHF in the Region and it recommended that Member States strengthen their programs. Few successful steps have been taken since then and the situation is now much more grave.

Some issues for the consideration of the Subcommittee on Planning and Programming to consider are:

- How to effectively build political commitment to prevent and control dengue, including strong intersectoral actions
- Promotion of government and private sector advocacy for higher financial commitment for dengue control
- The role of insecticides in dengue control programs and whether they are used for technical or political reasons
- The importance of community participation, health education, and social communication in dengue control programs with an emphasis on behavioral change
- Source reduction of breeding sites as the means to sustain control over the vector
- The disastrous path we are going down in the face of DHF: how can we prepare for, avert, or revert it?

How can timely dengue case reporting be made uniform throughout the Region to improve information-sharing between neighboring countries?

CONTENTS

1. **Introduction**

The ever-increasing threat of dengue fever (DF), dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS) can be seen throughout the world. More than 100 countries are currently suffering from outbreaks of the disease. The situation in the Americas has become progressively more alarming with an increase in both DF and in the more severe form, DHF, in many countries, with a very high fatality rate. Figure 1 shows the general trend of DF in the Region over the past two decades.

Figure 1. Dengue in the Americas 1980-1999
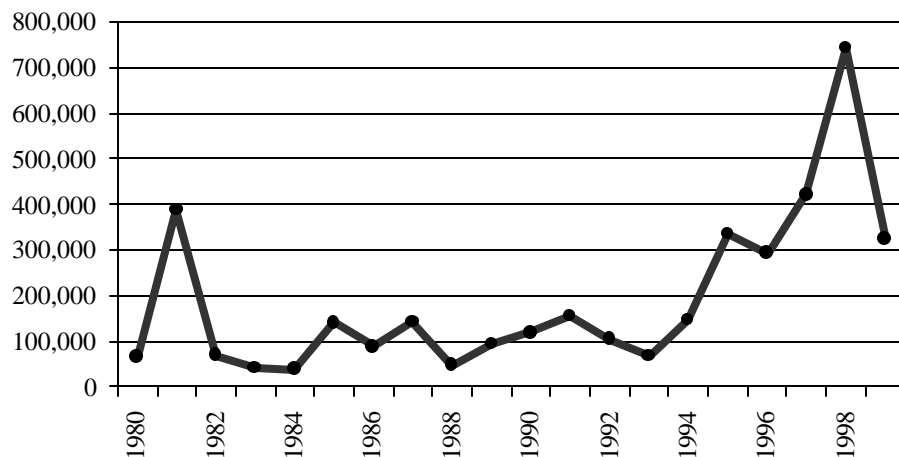
After an epidemic in Cuba in the early 1980s, the number of reported cases for all countries in the Region remained under 200,000 per year until the mid 1990s when a steady increase was observed reaching a maximum report of more than 700,000 cases in 1998.

The reduction in the number of reported cases in 1999 and 2000 does not mean that the situation is getting better. On the contrary, it would not be surprising for the number of clinical cases, in the Region to continue to rise in the years to come. Underreporting of cases, combined with the fact that some countries are only reporting laboratory-confirmed cases, also create a distorted view of the actual situation and is in part responsible for the lower numbers reported in 1999-2000. In fact, during 2000 there were DF epidemics in Ecuador and Paraguay as well as in five Central American countries (Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua). During the first weeks of 2001, epidemics were also reported in northern Peru and Acre State, Brazil.

One of PAHO's major concerns is that the countries of the Americas are now following a similar pattern of dengue hemorrhagic fever to that which occurred in many Asian countries some 20 or 30 years ago. In these countries the once-relatively small number of reported cases of DHF has been rising over the years to the point where some countries are now reporting hundreds of thousands of cases per year. The number of reported cases from 12 Asian countries, (Figure 2), has steadily increased from 1970, and at its peak reached

Fig. 2. Dengue Hemorrhagic Fever in Five Asian Countries
(Indonesia, Malasia, Myanmar, The Phillippines and Thailand)
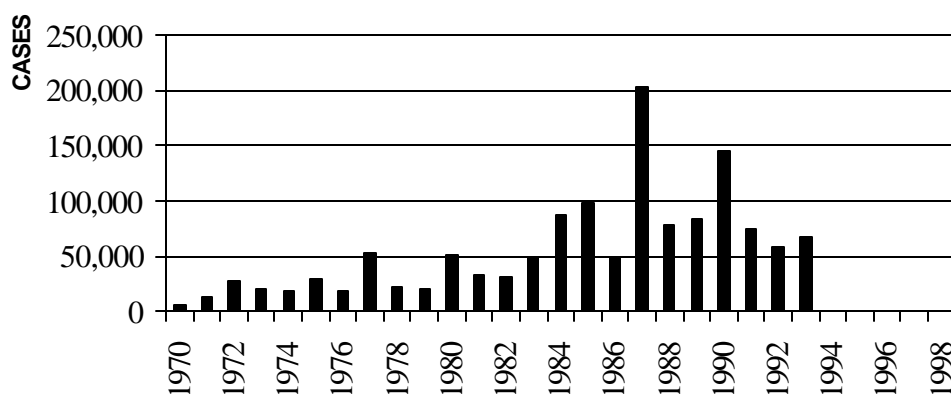
over 550,000 cases per year. Even if some of this increase in the numbers of cases is due to improve surveillance and reporting, there nonetheless is an excessive number of severe cases of the disease. Vietnam alone reported over 350,000 cases of DHF for 1987.

In the Americas reporting on DHF cases is following a trend similar to that of Asia. The first major epidemic occurred in Cuba in 1981, where over 10,000 cases were reported. After that very few cases were reported until 1990. From then on we have seen a steady increase to where over 10,000 cases were reported for 1997 and 1998 (Figure 3).

Figure. 3 Dengue Hemorrhagic Fever in the Americas
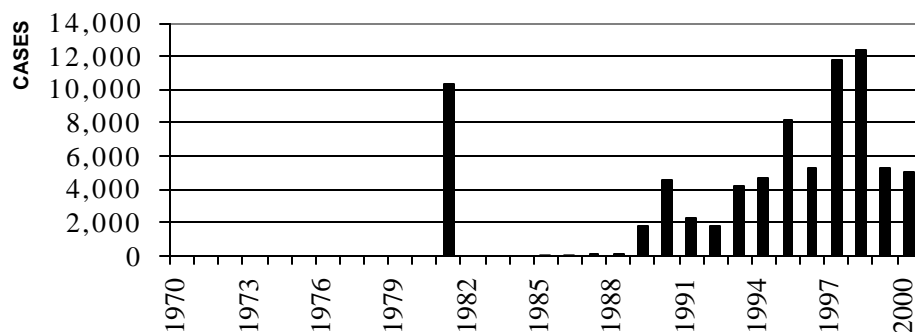
As in the case of Asia, during the past 20 to 30 years, the number of DHF cases reported in the Americas has climbed more than 20-fold. On the other hand, prior to 1980 only 60 cases of DHF had been reported from only five countries. Since then, to the end of 2000, over 75,000 cases of DHF have been reported from 27 countries in the Region.

Fortunately most of the dengue epidemics that we have witnessed in the Americas have been of dengue fever, but overall we are seeing more and more cases of the more severe DHF.

2.   Strategies to Control *Aedes aegypti*

Most of the country programs traditionally have been vertical in nature and have employed methods directed toward the elimination or control of vector breeding sites and the application of insecticides against the adult vector. These have met with some success in Singapore and Cuba, for example, even though these have had periodic setbacks. Vertically organized programs usually are only feasible in countries with a sustained political will and economic commitment to maintain high-cost interventions. Countries lacking this type of commitment usually experience continued failures, meaning that if the vector was successfully controlled in the past, the country usually experiences a reinfestation, either because the mosquito population was not completely eradicated or because surveillance and control programs were subsequently abandoned. These programs usually have also failed to promote adequate government and private sector financial commitment.

Today the Region's dengue control efforts require the development of intersectoral partnerships and support networks, as well as sustainable environmental actions in the areas of urban planning and services such as the provision of basic water and sanitation. These efforts must be buttressed with the active involvement of individuals, households and communities in the care and protection of their physical environment.

3.   Key Issues for Deliberation

In preventing and controlling dengue, as in facing other public health challenges, there is no single, simple, foolproof intervention that will prevent or halt the spread of the disease. The solution instead lies in a series of concomitant actions that may well vary from country to country and even within different areas of the same country, depending on the specific circumstances.

3.1   *Political Commitment*

Political commitment is the first and most essential building block for the development of a successful dengue prevention and control program. It has been said that "each country has the dengue it deserves". While this may be true in many cases, it is unfair in others where unforeseen circumstances have caused epidemics in spite of strong government commitment (such as Santiago de Cuba in 1997). At times success in containing an epidemic has been attributed to various interventions that have been implemented, when in truth the natural history of the epidemic merely has run its course and already infected all available susceptible persons.

All levels of government must be supportive of a dengue prevention and control program from the highest level down to that of the communities and the people they serve. Adequate and rational legislation must be developed and implemented, and government agencies must be willing to improve local water supply, waste water disposal, solid waste management, used tire disposal, and health services and education.

Clearly, countries cannot continue to work in an emergency mode of action, waiting for an epidemic to occur and then quickly mobilizing efforts as if dengue were a fire easily extinguished and then forgotten about. The fact is that as the disease's vector populations increase and the indices escalate, the situation will be exacerbated, and the problem will become more difficult to manage. As the number of epidemics increases over time and as more dengue serotypes circulate and become hyper-endemic in countries, the more serious will be the generalized DHF situation in the Region of the Americas. Therefore, governments need to take an active leadership role to ensure the success of national programs in which all sectors are working in harmony with a common goal.

3.2   *Proposed Intersectoral Actions*

Experience has long proven that effective dengue control is not possible without intersectoral actions and interventions, primarily on the part of government agencies. Even behavioral changes by members of a community are to some extent dependent upon government actions.

Some of the principal areas requiring intersectoral coordination and implementation include:

- Accountability
- Decentralization of dengue programs
- Formal health education at all levels
- Housing construction and improvement
- Legislation
- Solid waste disposal
- Water supply and disposal

How can we reintroduce simple disease prevention and control measures back into the basic educational program curriculum? How can equity be measured and assured in intersectoral actions?

- *Water Supply and Disposal*

One of the major problems of dengue control efforts is the availability of vector breeding places, particularly in water storage tanks. The lack of a constant, permanent supply of water in many parts of the Region largely explains the existence of these tanks. If municipal water authorities could provide sustainable improvements in water supply sources, the need for these containers would be reduced or even discontinued, thereby eliminating one of the principal sources of dengue's propagation.

- *Solid Waste Disposal*

Another primary producer of mosquito breeding sites is the plethora of unusable containers that are discarded by the population in the peri-domiciliary environment. These containers have been the target of massive clean-up campaigns by all dengue programs in the Region. Many times the underlying problem is that there are no systematic refuse removal mechanisms in disease-affected localities, and since community members have no place where they may dispose of these containers properly, they transport them to clandestine or inadequate dumps areas, thereby simply transferring the problem from one locale to another. For this reason, responsible city, municipality, and state agencies need to be incorporated into dengue programs through intersectoral actions that can provide solutions to these breeding sites. In doing this, other benefits such as recycling and improved health, are also brought to the population. Therefore, the question becomes: is it economically viable to invest in trash collection and recycling programs?

- *Decentralization of Dengue Programs*

There is a growing trend toward decentralization of dengue control programs in many countries of the Region. Whether or not it is applicable in all cases should be evaluated. Larger countries may find much benefit in the decentralization of actions while smaller

countries, where geographic distances are shorter, may wish to evaluate the desirability of duplicating efforts if resources are limited. How can we evaluate the relativity of benefits versus drawbacks of decentralization in these cases?

•   *Accountability*

In many cases, dengue prevention and control agencies, as well as government bureaus, have demonstrated insufficient accountability regarding the dengue problem and have been lax in implementing control actions. If intersectoral partnerships were established, along with clear guidelines for each group's responsibilities and accountability, targeted adjustments would be more manageable.

•   *Legislation*

Although legislation exists to regulate various aspects of dengue prevention and control programs and activities, some are not implemented or for some reason cannot be implemented. Means to adjust or create practical legislation must be advocated in order to reduce the disease burden. This includes increasing access to primary health care, particularly for the most marginalized strata of the community; incorporating environmental basic health education at all levels, including the school curriculum; and developing policies to eliminate mosquito breeding sites through periodic removal of trash and other receptacles that attract mosquito populations. How can legislation be developed and/or implemented within a framework that ensures equity?

3.3   *Insecticide Spraying*

Many dengue control programs depend primarily on the use of insecticides yet the role of insecticides is probably one of the most frequently misunderstood aspects of dengue control. The actions undertaken to date in this area have not adequately responded to the threat of the disease, since all forms of the disease are continuing to increase, and epidemics are a constant occurrence. There is a role for insecticides in these programs, but many experts feel these chemicals are not being used judiciously, and their use could be reduced without compromising the integrity of dengue programs.

Insecticide use can be divided into two main approaches: those used against adults (adulticides) and those used against the immature forms (larvicides).

•   *Adulticides*

The purpose of using adulticides is to kill mosquitoes during the adult stage. This is usually done with space-spraying of insecticides. The effect is immediate and short-lasting.

Adulticides last no more than a few minutes and are only effective on the immediate adult population. Many times they are not effective when conditions are less than optimum. In many instances there is strong opposition to their use by the population.

The use of adulticides is recommended only during epidemics in order to eliminate infected female mosquitoes, thus reducing the circulation of the virus in the community. However, if improperly used, adulticides will have little impact on health conditions even if positive short-term political objectives are achieved. The cost of adulticides is very high and non-sustainable.

- *Larvicides*

The purpose of using larvicides is to kill the mosquito during its immature stages in breeding sites that cannot be destroyed. The effects are long-lasting but require some degree of maintenance. The use of larvicides is customary in areas without an adequate and reliable supply of water for drinking, bathing, and household cleaning purposes.

Operationally the presence of the use of larvicides in dengue control is time-consuming and requires a large number of inspectors for monitoring the situation. Resistance to temephos has recently been found in some countries in the Region. Some sectors of the population furthermore are reluctant to open their doors to program personnel who have come to inspect the houses and apply the larvicides.

3.4   *Source Reduction*

Source reduction is defined as the reduction of the breeding source of the vector mosquito; in this sense, it is the most effective method of reducing the density of *Aedes aegypti*. Unfortunately, the prevention and control programs that have carried out these activities in the past, no longer have sufficient personnel to conduct house-by-house inspections today. This problem is compounded by resistance from some homeowners, which weakens the overall impact of source reduction approaches.

3.5   *Role of Community Participation, Health Education, and Social Communication*

Communities include not only the resident population but local industries and enterprises, NGOs, churches, schools, clubs, and other participatory associations.

Since most of the breeding sites of the dengue vector are artificial containers in and around houses, actions by the population may offer the best response to sustained vector control.

When introducing control measures that depend on behavior change and community involvement, some essential social science groundwork must be undertaken with community reference groups. This includes determining beforehand the community's knowledge, attitudes, and practices associated with dengue and mosquito breeding and feeding habits. The feeling of the general public about existing information and social and mass communication sources, other community structures, and government services is also important to disease prevention and control efforts. The knowledge of health care providers, politicians, policymakers, the media and the private sector should also be taken into account. Monitoring and evaluation of behavior change interventions also require regular inputs from skilled social scientists. Behavioral change surveillance indicators have to be defined and developed in order to be incorporated in the control programs along with entomological and epidemiological surveillance.

3.6   *Case Reporting*

Epidemiological surveillance and case reporting are an essential part of prevention and control programs. It is singularly important that all the countries in the Region maintain the most accurate case reporting systems possible. Information relayed to PAHO is sent to all countries so that they may be aware of the situation in neighboring countries.

Case reporting must include clinical cases (probable cases), laboratory-confirmed cases, cases of DHF, and deaths due to DHF/DSS. Some countries do not report clinical cases, giving a misleading impression of the true situation. Clinical cases should be the guide for the prevention and control program. The laboratory confirms the presence of the virus and helps determine the virus serotype that is circulating and the severity of the situation. However, some countries do little, if any, case reporting (Annex A and B).

4.   Final Considerations

Strong and viable dengue prevention and control programs should include the following components:

•   Firm political and financial support with effective intersectoral coordination;

- Selective vector control with an effective social communications program and community participation based on behavioral change;

- Active dengue surveillance based on a strong health information system;

- Emergency mode of action and preparedness for outbreaks and epidemics;

- Training and capacity-building at all levels; and

- Vector control research.

Some of the key elements that programs usually do not possess, or, if they do, need to be strengthened are:

- Epidemiological and entomological surveillance;

- Clearly defined and realistic goals and targets that have measurable indicators;

- Evaluation tools that periodically measure the effectiveness of the vector control interventions that are implemented;

- Issues related to behavioral change strategies in dengue prevention and control;

- Patient care within and outside the formal health sector, including disease diagnosis recognition and proper response (including initial care in the home and knowledge of basic treatment measures);

- Adequate political leadership, particularly in epidemic situations;

- Provisions for social science research focusing on behavior change;

- Proper emergency preparedness and response;

- Awareness of the economic impact of the program's various prevention and control components.

The numerous health benefits accrued through implementation of a strong dengue control program similar to those described in this document make it imperative for countries revisit this issue and seek to address existing vulnerabilities in their national dengue programs.

Annexes

OPERATIONAL DEFINITION OF DENGUE, DENGUE HEMORRHAGIC FEVER AND DENGUE SHOCK SYNDROME CASES, AND CASE REPORTING

As previously stated, it is considered important to standardize case reporting in the Region. In doing so, all member countries will be able to be maintained informed of the situation of the disease at all times.

In order to do this there should be agreement for definitions as well as what should be reported and when it should be reported. Definitions as published in the *Epidemiological Bulletin* Vol. 21, No. 2, 2000 are as follows:

Clinical case of dengue fever

A clinical case of dengue fever is defined as being an acute febrile illness of 2-7 day duration with two or more of the following signs or symptoms:

- Headache
- Retro-orbital pain
- Myalgia
- Arthralgia
- Rash
- Hemorrhagic manifestation
- Leucopenia

Laboratory criteria for diagnosis

Laboratory criteria for diagnosis is defined as one or more of the following:

- Isolation of the dengue virus from serum, plasma, leucocytes, or autopsy samples.

- Demonstration of a four-fold or greater change in reciprocal IgG or IgM antibody titers to one or more dengue virus antigens in paired serum samples by EIA.

- Detection of viral genomic sequences in autopsy tissue, serum or CSF samples by polymerase chain reaction (PCR)

Case classification

Suspected case

A case compatible with the clinical description

Probable case:

A case compatible with the clinical description with one or more of the following:

- Supportive serology (reciprocal hemaglutination-inhibition antibody titre greater than 1280, comparable EIA titre or positive IgM antibody test in late acute or convalescent-phase serum specimen),

- Occurrence at same location and time as other confirmed cases of dengue fever.

Confirmed case

A case compatible with the clinical description, laboratory-confirmed.

Criteria for Dengue Hemorrhagic Fever/Dengue Shock Syndrome

Dengue Hemorrhagic Fever is defined as a probable or confirmed case of dengue and hemorrhagic tendencies evidenced by one or more of the following:

- Positive tourniquet test

- Petechiae, ecchymoses or purpura

- Bleeding: mucosa, gastrointestinal tract, injection sites or other

- Haematemesis or melaena and thrombocytopenia (100,000 cells or less per mm^3) and evidence of plasma leakage due to increased vascular permeability, manifested by one or more of the following:

    - more than 20% rise in average hematocrit for age and sex

    - more than 20% drop in hematocrit following volume eplacement treatment compared to baseline

    - signs of plasma leakage (pleural effusion, ascites, hypoproteinemia).

Dengue Shock Syndrome

It is defined as having all the above criteria, plus evidence of circulatory failure manifested by rapid and weak pulse, and narrow pulse pressure (less than 20 mm Hg) or hypotension for age, cold, clammy skin, and altered mental status.

Frequency of case reporting

It would be convenient if case reporting by the countries were standardized with all countries reporting the same information at relatively the same time to the Pan American Health Organization. When available, this information would allow all the countries in the Region to be knowledgeable about the dengue situation as well as the nature of the circulating viruses.

The information that should be reported would include:

- Probable cases of dengue fever
- Confirmed cases of dengue fever
- Cases of dengue hemorrhagic fever
- Deaths attributed to dengue hemorrhagic fever
- Serotypes identified

Due to the epidemic nature of the disease, the frequency with which this information should be reported is weekly. PAHO, in turn, would have the information available upon request, as well as for reporting to other Member States (through its country offices), on a monthly basis.

REPORTED NUMBER OF CASES* OF DENGUE (D)
AND DENGUE HEMORRHAGIC FEVER (DHF)
IN THE AMERICAS, BY COUNTRY

			Provisional Figures to 31st December 2000				
Country or Subregion	Week[a]	D & DHF[b]	Incidence[c]	Serotype[d]	DHF[e]	Deaths	Population
Argentina	Week 47	1,700	4.59		0	0	37,032
Bolivia	Week 44	73	0.88	Den 1, 2	0	0	8,329
Brazil	Week 51	210,289	123.62	Den 1, 2	40	3	170,115
Colombia	Week 25	10,934	25.84		803	0	42,321
Costa Rica	Week 37	2,313	57.49		0	0	4,023
Cuba	Week 40	--	0.00		0	0	11,201
Dominican Republic	Week 52	3,462	40.75	Den 1, 2, 3, 4	58	6	8,495
Ecuador	Week 37	1,031	166.31	Den 1, 2, 3, 4	0	0	12,646
El Salvador	Week 52	3,248	51.75	Den 2 (Jam)	411	26	6,276
Guatemala	Week 49	8,750	76.86	Den 2	42	9	11,385
Haiti	Week	...	...			0	8,222
Honduras	Week 52	13,795	212.72		296	0	6,485
Mexico	Week 52	2,344	2.37	Den 1, 2, 3	34	0	98,881
Nicaragua	Week 44	6,220	122.59	Den 2-4	507	3	5,074
Panama	Week 52	306	10.71	Den 1, 2, 3, 4	3	0	2,856
Paraguay	Week 47	24,282	441.81	Den 1	0	0	5,496
Peru	Week 45	2,912	11.35	Den 1, 2	0	0	25,662
Puerto Rico	Week 52	2,433	62.88	Den 1,2,3	24	0	3,869
Venezuela	Week 52	21,101	87.30	Den 1, 2, 3, 4	2,186	5	24,170

Country or Subregion	Week[a]	D & DHF[b]	Incidence[c]	Serotype[d]	DHF[e]	Deaths	Population
				English** and French Caribbean			
Anguilla	Week 50	3	37.50		0	0	8
Antigua & Barbuda	Week 52	8	11.94	Den 4	0	0	67
Aruba	Week 25	76	77.55			0	98
Bahamas	Week 52	0	0.00		0	0	307
Barbados	Week 52	744	275.56	Den 1, 3	0	0	270
Belize	Week 50	4	1.66		0	0	241
Bermuda	Week 52	0	0.00		0	0	64
British Virgin Islands	Week 52	3	14.29	Den 2, 3	0	0	21
Cayman Islands	Week 52	0	0.00		0	0	37
Curacao	Week 16	10	4.61	Den 3	0	0	217
Dominica	Week 47	15	21.13	Den 3	0	0	71
French Guiana	Week 35	74	42.53	Den 1, 2, 3	0	0	174
Grenada	Week 51	27	29.03	Den 2	0	0	93
Guadaloupe	Week 35	8	1.75	Den 3	0	0	456
Guyana	Week 35	19	2.21	Den 1,2	0	0	861
Jamaica	Week 49	25	0.97		0	0	2,583
Martinique	Week 35	70	17.72	Den 2, 3	0	0	395
Montserrat	Week 52	9	81.82		0	0	11
St. Kitts/Nevis	Week 40	5	12.82	Den 2	0	0	39
St. Lucia	Week 47	0	0.00		0	0	152
St. Vincent & Grenadines	Week 52	5	4.42		0	0	113
Suriname	Week 39	1073	257.31	Den 1,2	4	0	417
Trinidad & Tobago	Week 46	2,066	159.54	Den 1, 2, 4	49	0	1,295
Turks & Caicos Islands	Week 47	0	0.00		0	0	16
TOTAL		339,437			4,457	52	

*   Confirmed or Suspected

** Figures from the English Caribbean comprise reported cases (suspected and confirmed) and the laboratory confirmed cases (data from CAREC)

[a] Epidemiological week
[b] Cases of Dengue + DHF
[c] Incidence / 100,000 pop. (to date)

- 2 -

Provisional Figures to 31st December 2000							
Country or Subregion	Week[a]	D & DHF[b]	Incidence[c]	Serotype[d]	DHF[e]	Deaths	Population
Source: Country reports to PAHO					[d] *Serotypes circulating*		
-- No cases reported					[e] *Cases of DHF only.*		
... Data not available							