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

Communicable Diseases Program
Division of Disease Prevention and Control
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TABLE OF CONTENTS

THE PROBLEM **2**

HEALTH INTERVENTIONS; LESSONS LEARNED **4**

THE NEW GENERATION **5**

ECONOMIC RATIONALE **6**

A Proposal for Action:

OBJECTIVES 6
ACTIVITIES 7

SCHEDULE OF PLANNED ACTIVITIES **9**

ANNEX 1: BUDGET FOR DENGUE CONTROL PROGRAMS **10**

ANNEX 2: KEY BEHAVIOUR AT INDIVIDUAL, FAMILY, LOCAL/INSTITUTIONAL LEVELS **11**

ANNEX 3: ESTIMATES OF COST SAVINGS **12**

REFERENCES **13**

ACKNOWLEDGEMENTS **13**

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).

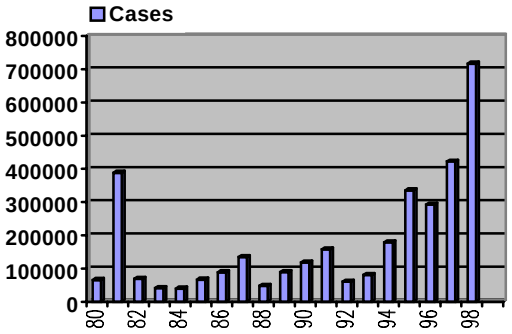

Figure 1. Cases of dengue in the Americas, 1980-1998

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).

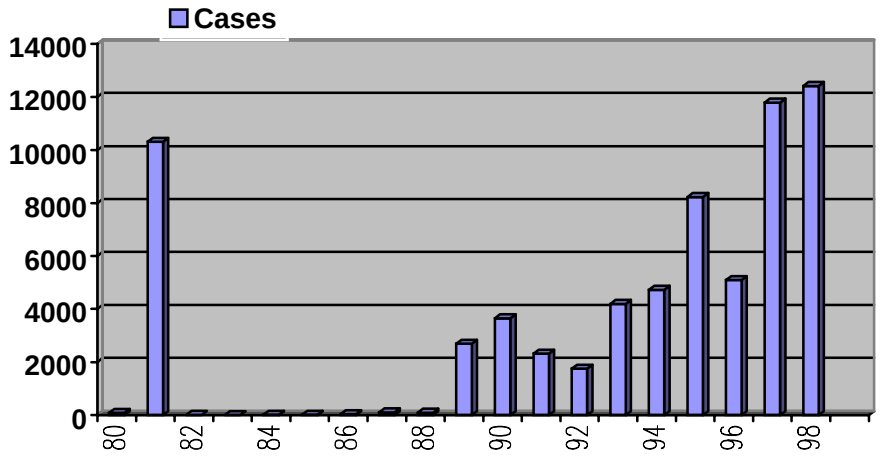

Figure 2. Cases of DHF in the Americas, 1980-1998

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 is an 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

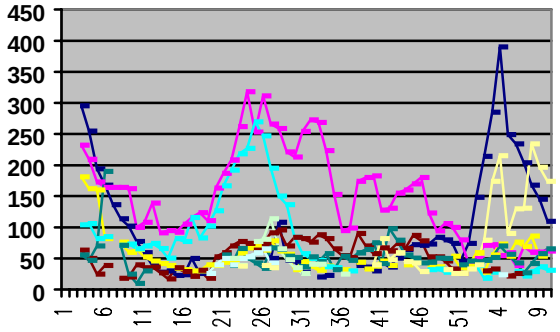

Figure 3. Cases in selected states of Venezuela, 1998-99

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[1]		Cases		
Country	**1996**	**1997**	**1996**	**1997**	**1998 (Epidemiological week if not 52)**
Argentina[2]	9,530,004	---	0	1st outbreaks noted	822 (46)
Bolivia[3]	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[4]		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[5]	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[6]	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

[1] Expenditures for 1998 are not available at this moment.
[2] Expenditures for 1997 are not available.
[3] Only 20% used in 1996 and 25% in 1997
[4] Figures for 1996 not available.
[5] From: Taller Subregional de Evaluación del Plan Continental de Ampliación e Intensificación del Combate al *Aedes aegypti.* Países Andinos, Aruba y Cuba.
[6] 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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[iv] Organizacion Panamericana de la Salud. 1998. Taller Subregional de Evaluación del Plan Continental de Ampliación e Intensificación del Combate al *Aedes aegypti*. Paises Andinos, Aruba y Cuba. OPS/HCP/HCT/126/98 35 pp.

[v] Organizacion Panamericana de la Salud. 1997. Plan Continental de Ampliación e intensificación del Combate al *Aedes aegypti*; Informe de un Grupo de Trabajo: OPS/HCP/HCT/09/97, 43pp.

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