Integrated Management Strategy for Dengue Prevention and Control in the Region of the Americas
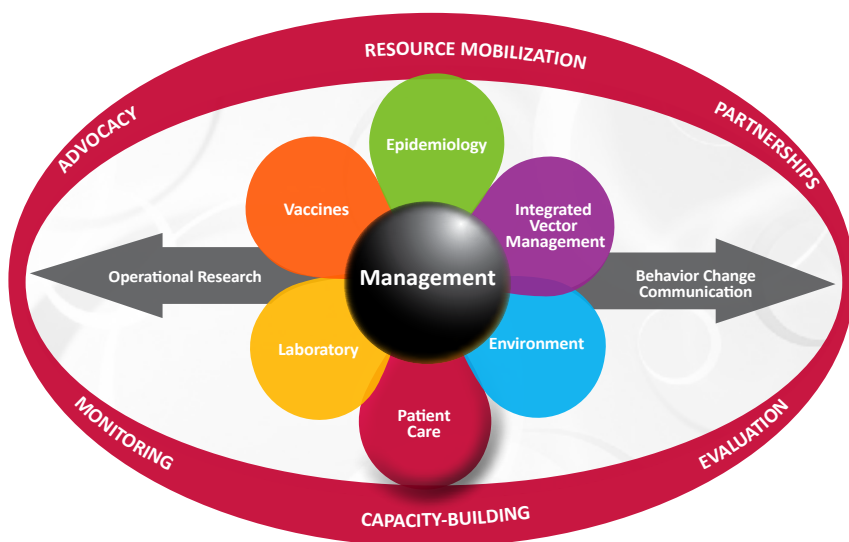
Integrated Management Strategy for Dengue Prevention and Control in the Region of the Americas

Pan American Health Organization

World Health Organization
REGIONAL OFFICE FOR THE Americas

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Of the arboviral diseases present in the countries and territories of the Americas, dengue is the most prevalent and has the greatest negative impact, not only for public health but also in the social, economic, and political spheres. The epidemiological situation of dengue is increasingly complex, and to ensure an adequate prevention and control response, the following elements must be considered: 1) the disease is caused by four distinct viruses, i.e., one may contract dengue four times over one's lifetime, with increasingly greater risk of a severe event after the first infection; 2) there is no specific pharmacological treatment or effective vaccine for this disease; 3) the recent emergence of Zika in the Americas has restricted the use of serological diagnostic methods due to cross-reactivity between anti-dengue and anti-Zika IgM/IgG antibodies, which hinders epidemiological surveillance and laboratory confirmation; 4) the main vector of dengue is *Aedes aegypti*, a mosquito perfectly adapted to domestic life and widely distributed across all countries of the Region (except Canada and mainland Chile); 5) the proliferation of *Aedes aegypti* is facilitated by social and environmental determinants, such as the effects of climate change and globalization, poverty, uncontrolled urbanization, lack of access to drinking water and wastewater treatment, and scarcity of waste collection and disposal services, among others.

Given the need to define a strategy to comprehensively address the various interdependent aspects faced by the countries and territories of the Americas in relation to dengue, the Pan American Health Organization/World Health Organization (PAHO/WHO) and the countries of the Region developed the Integrated Management Strategy for Dengue Prevention and Control in the Region of the Americas (IMS-Dengue) in 2003. Initially, this initiative comprised five components (epidemiology, integrated vector management, social communication, patient care, and laboratory diagnosis); subsequently, an environment component was introduced. Over the course of more than 10 years of progressive implementation and consolidation, IMS-Dengue has been deployed in the field, in different countries and epidemiological settings. It has been improved technically and operationally through various monitoring and evaluation processes, has expanded technical know-how and gained political support, and has been aligned with the WHO Global Strategy for Dengue Prevention and Control, 2012-2020. In 2014, the strategy was revised and newly endorsed by academia, the private sector, PAHO/WHO collaborating centers, countries and territories, and non-governmental organizations, and it has served as the basis and model for the development of a Strategy for Arboviral Disease Prevention and Control (Resolution CD55.R6). IMS-Dengue has provided countries and territories with a robust methodological tool, confirming that it is the best strategy available for the prevention and control of this disease.

PAHO is pleased to present to the countries and territories of the Americas this new 2017 update to the IMS-Dengue strategy, which includes new components, cross-cutting themes, and facilitat-

ing factors for the implementation of IMS-Dengue at the national level. This methodological tool contains the technical elements necessary to address dengue and offers key approaches for an intersectoral and interprogrammatic approach as the fight against dengue is not the sole responsibility of the health sector.

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Methodology

This update to the IMS-Dengue strategy (2017) is based on the IMS-Dengue developed in 2003, which already included epidemiology, integrated vector management, laboratory, patient care, and social communication components. In this update, new components are incorporated (environment, vaccines, and management), and social communication for behavioral change is redefined as a cross-cutting theme, along with operational research.

For the first time, this new update includes implementation-facilitating factors (advocacy, resource mobilization, strategic partnerships, capacity-building, and monitoring and evaluation). The inclusion of these factors are based on recommendations from various monitoring and evaluation processes of IMS-Dengue at the country level, developed by the GT-Dengue International Task Force; the WHO Global Strategy for Dengue Prevention and Control, 2012-2020; and recommendations presented by academia, the private sector, PAHO/ WHO collaborating centers, countries and territories, and non-governmental organizations during a meeting on the latest technical advances in dengue prevention and control in the Region of the Americas (*State of the art in the prevention and control of dengue in the Americas*), held in May 2014 at the PAHO/WHO Headquarters in Washington, DC.

Subsequently, the latest developments were discussed, reviewed, and analyzed with the countries during the IMS-Dengue Regional Meeting held in Santiago del Estero, Argentina, in October 2014. Once consensus on which new elements would be included in the document was established with the countries, the PAHO/WHO technical staff was tasked with consolidating the information and carrying out final revision and editing of the document.

Acknowledgments

Acronyms and Abbreviations

CDC	U.S. Centers for Disease Control and Prevention
CHIK	Chikungunya
CHIKV	Chikungunya virus
COMBI	Communication for behavioral impact
DENV	Dengue virus
EQAP	External Quality Assessment Program
GT-Dengue International	International Dengue Task Force
GT-Dengue National	National Dengue Task Force
IHR	International Health Regulations
IMS-Dengue	Integrated Management Strategy for Dengue Prevention and Control in the Americas
IVM	Integrated vector management
NLC	National Liaison Center
NRL	National Reference Laboratory
PAHO	Pan American Health Organization
RELDA	Arbovirus Diagnosis Laboratory Network of the Americas
USAID	United States Agency for International Development
VBD	Vector-borne diseases
WHO	World Health Organization
WHOCC	WHO Collaborating Center

1 Introduction

The Integrated Management Strategy for Dengue Prevention and Control in the Region of the Americas (IMS-Dengue) updates the methodological working model that the countries of the Region have been deploying and strengthening over the last 10 years. Its integrated and multidisciplinary nature has proven very useful in management at the country level, to prevent and organize national responses to outbreaks, epidemics, and inter-epidemic periods.

IMS-Dengue 2017 is also the result of the experience acquired and the lessons learned since IMS-Dengue was first deployed in 2003, and draws on the best practices developed by the countries. Its purpose is to contribute to a reduction of the social and economic burden caused by dengue in the Americas. The foundations of this material are the various technical documents, strategies, action plans, and resolutions adopted by the countries of the Region, both globally and regionally/subregionally.

This updated methodology, developed within the framework of the PAHO Strategic Plan, will serve as the basis for adjustments to subregional and national strategies and plans. IMS-Dengue is a methodological instrument that seeks to strengthen dengue prevention and control activities more effectively. It is well known that in order to progressively and sustainably reduce the incidence of dengue, the social and environmental determinants of its transmission (poverty, poor health infrastructure, uncontrolled migration, housing problems, etc.) must be addressed.

The process of developing this strategy included situation analysis through face-to-face and virtual meetings for priority-setting, definition of more relevant indicators, and preparation of updated technical documents for comprehensive improvement of surveillance (the new Generic System for the Epidemiologic Surveillance of Dengue) and medical care (*Dengue: Guidelines for Patient Care in the Region of the Americas*, 2nd edition). It also draws on elements observed in the last 10 years, addressed at the *State of the art in the prevention and control of dengue in the Americas* meeting.

IMS-Dengue 2017 proposes a new functional integration model. A systematic review of the different IMS-Dengue components, undertaken during the last five years, led to the incorporation of updates whose practical application has been positive. IMS-Dengue 2017 provides for integrated action on six technical components, two cross-cutting themes, and five facilitating factors as inputs for the prevention and control of dengue in the Americas.

This updated strategy is expected to serve as a basis for country technical teams to make the necessary adjustments to national IMS-Dengue strategies and promote activities to help reduce dengue case-fatality rates by 2020. Integration of these components will increase country capacity for detection and management of dengue cases, and will strengthen development of epidemiological surveillance systems.

2 Background

In 2001, the 43rd PAHO/WHO Directing Council adopted Resolution CD43.R4, urging Member States in the Region to strengthen their health ministries' response to a sustained increase in cases of dengue, and proposed the establishment of a new generation of programs for dengue prevention and control that incorporated community participation and health education.

Operationalization of this political framework required a practical methodological model. Thus, in September 2003, the 44th PAHO/WHO Directing Council approved Resolution CD44. R9, which urged Member States to adopt the integrated dengue prevention and control strategy (IMS-Dengue). This strategy is a methodological tool designed by experts from the ministries of health of various countries, with the collaboration of the PAHO/WHO International Dengue Task Force (GT-Dengue International), which, based on the experience accumulated in the Region, adopted the best existing practices for its different constituent components. Consolidation of the strategy allowed rejection of reactive models, which could only respond to outbreaks, in favor of dengue prevention and control through multidisciplinary and intersectoral interventions, promoting actions on the social and environmental determinants associated with transmission of the disease.

Since its creation in 2003, the IMS-Dengue intervention model has been evolving. In 2003, the model focused on addressing the following components:

- Epidemiology
- Integrated vector management (IVM)
- Laboratory diagnosis
- Patient care
- Social communication

The IMS-Dengue seeks to integrate key areas of action for dengue prevention and control in a horizontal, intersectoral, and interprogrammatic manner. It proposes a shift in focus of national prevention and control responses to involve community groups, especially families, as a means of achieving behavioral change and sustainable actions. Simultaneously, it promotes intersectoral actions on the social and environmental determinants associated with dengue transmission.

GT-Dengue International, in addition to supporting technical work at the country level, has contributed to:

- Implementation and evaluation of national IMS-Dengue strategies;
- Development of national preparedness and outbreak/epidemic response plans;
- Supporting the organization of national dengue outbreak and epidemic responses;
- Training country technical teams in each component of IMS-Dengue, both through country visits and at regional or subregional events.

As of December 31, 2013, four subregions of the Western Hemisphere (Central America, Caribbean, Southern Cone, and Andean Region) and 26 countries and colonial territories had national IMS-Dengue strategies at different stages of implementation. In 2007, at the 27th Pan American Sanitary Conference, PAHO/WHO Resolution CSP27.R15 was adopted, urging Member States to carry out performance evaluations of their national IMS-Dengue strategies with the support of GT-Dengue International. This process began in 2008, and since then, 32 national IMS-Dengue evaluations have been carried out. Some countries, such as Mexico and Brazil, have already completed a second evaluation.

The process of evaluating the implementation of IMS-Dengue in the Region led to important advances in prevention and control in all components, as demonstrated by the quality of national reporting, strengthening of laboratory capacity and enhancement of diagnostic procedures, response to outbreaks, improvements in medical care, and reductions in mortality. Across all components, new tools were implemented and experiences were systematized to allow greater community and intersectoral participation, among other noteworthy aspects. However, after 32 evaluations of national IMS-Dengue strategies, limitations that must be addressed were identified in various components. Some of these are listed in the Annex.

Dengue has increased worldwide and currently affects more than 125 countries. WHO estimates that its incidence has increased 30-fold in the last five decades, with 50 to 100 million cases occurring each year and concomitant circulation of all four serotypes of the dengue virus. In view of this situation, in 2012, WHO presented the Global Strategy for Dengue Prevention and Control, 2012-2020, which sets forth steps to be followed and opportunities for intervention with the objective of reducing dengue mortality by at least 50% and morbidity by at least 25% by 2020.

PAHO, with a view to aligning IMS-Dengue with WHO's 2012-2020 Global Strategy, organized two regional meetings in Santiago del Estero, Argentina, held in October 2013 and November 2014. The national heads of IMS-Dengue of 17 countries and representatives of GT-Dengue International for each IMS component made recommendations that should be taken into account for progress to be made in accordance with the Global Strategy and the characteristics of the Region of the Americas.

As a next step, a regional meeting was proposed to review the implementation status of IMS-Dengue with key extra-sectoral actors—including academia, PAHO/WHO collaborating centers, and industry—and incorporate approved new elements to consolidate regional prevention and control efforts. That meeting, held in May 2014, was a major input for improvement of IMS-Dengue.

3 Dengue. Epidemiology and regional response

3.1 The epidemiological context of dengue in the Americas

Dengue is the most important and common arboviral disease worldwide. It is estimated that 40% of the world's population lives in areas at risk of infection, and that approximately 390 million infections (96 million of them symptomatic) and 20,000 deaths occur each year in more than 125 endemic countries. Of the 30 countries with the highest reported incidence of dengue, 18 (60%) are in the Region of the Americas (WHO, 2012).

The vector. Dengue is spread by *Aedes aegypti,* a mosquito present in all countries and territories of the Americas, except Canada and mainland Chile. However, it should be mentioned that the vector was found in Arica (a northern region of Chile) in April 2015, after more than 50 years with no reports of its presence (Figure 1).

Figure 1. Geographical distribution of *Aedes aegypti* and *Aedes albopictus* in the Americas

Ae. aegypti

Ae. albopictus
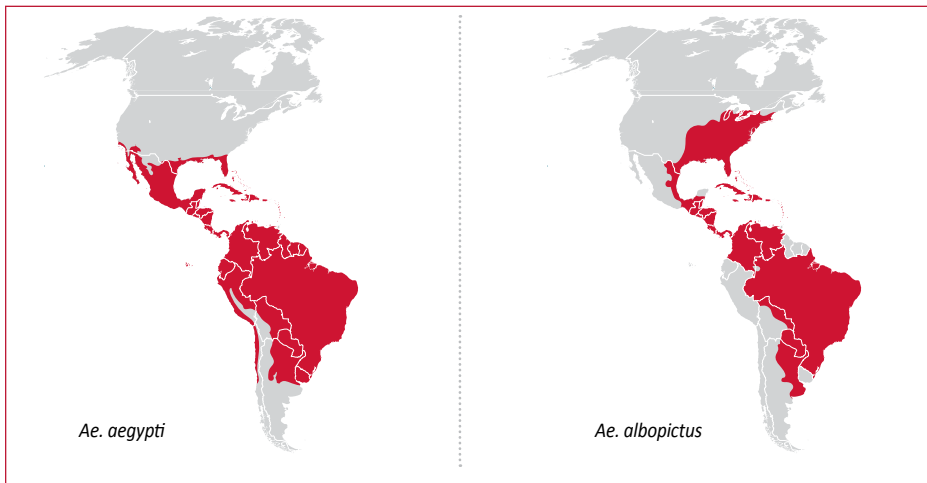
Source: Adapted from *Preparedness and Response for Chikungunya Virus Introduction in the Americas,* 2011.

Serotypes. Dengue is caused by a virus known as the dengue virus (DENV), which has four different serotypes (1, 2, 3, and 4). Any one of these can cause disease. Infection with a specific serotype confers lifelong homologous immunity to this serotype and temporary heterologous immunity against the other three serotypes, which can last six months to two years. The circulation of several serotypes in a single area or territory increases the probability of infection, as well as the risk of epidemics and severe manifestations of dengue in cases of second infec-

tion. The number of countries and territories that report simultaneous circulation of the four serotypes of dengue has risen since 1995, as shown in Figure 2.

Dengue cases. Given the wide distribution of *Aedes aegypti* (Figure 1) and of the DENV serotypes (Figure 2), autochthonous transmission of dengue occurs in all countries and territories, except Canada and mainland Chile. Uruguay had been added to the list of countries in which no dengue transmission occurs, but in February 2016 the country reported cases of dengue after more than 100 years with no documented presence of the disease. During the last four decades, the number of dengue cases in the Americas has increased exponentially. In 1980-1989, 1.54 million cases were recorded; in 1990-1999, 2.95 million cases; and in 2000-2009, 6.78 million cases. Between 2010 and 2017, 12.72 million cases of dengue have been recorded, which indicates a clear upward trend in incidence of this disease in the Americas. This increase reflects not only the spread of the disease, but also the improvement of epidemiological surveillance systems for dengue, demonstrating that more and more countries and territories are not simply recording cases but have better notification systems (Figure 3).

Figure 2. Number of dengue serotypes circulating in the countries and territories of the Americas, 1995-2016
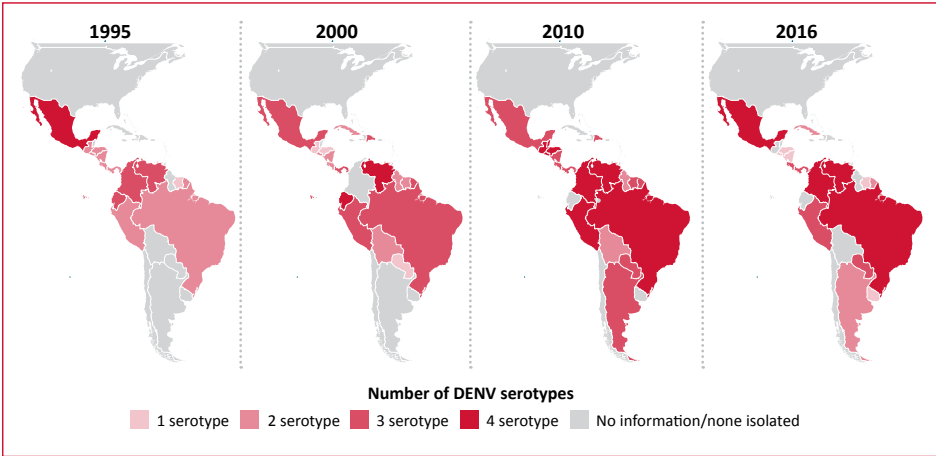
Source: Country epidemiological reports submitted to PAHO/WHO.

Dengue epidemics are cyclical; they occur every three to five years, and each new epidemic usually surpasses the preceding one in number of cases. Since 1980, several dengue epidemics have affected the Americas. Noteworthy ones include the 1981 epidemic, with almost

400,000 reported cases and characterized by the occurrence of dengue hemorrhagic fever, mainly affecting Cuba. The next epidemic to outnumber this one was reported in 1988, with more than 450,000 cases recorded; ten years later, in 1998, another epidemic was reported with almost 740,000 recorded cases of dengue, in turn outnumbering the 1988 epidemic. In 2002, more than one million cases of dengue were reported for the first time in the Americas, a figure that was exceeded seven years later, when 1.1 million and 1.7 million cases were reported in 2009 and 2010, respectively. In 2013, the first dengue epidemic to exceed two million cases was recorded; only two years later, in 2015 and then in 2016, new epidemics exceeding two million cases occurred in the Americas. It bears stressing that the introduction of chikungunya in December 2013 and Zika in August 2015 created new challenges for the epidemiological surveillance of dengue, giving rise to over-reporting that may explain the large number of cases reported as dengue during 2015 and 2016, after such a large epidemic as the one in 2013 (Figure 3).

Figure 3. Number of cases of dengue and of countries/territories reporting dengue in the Americas, 1980-2017
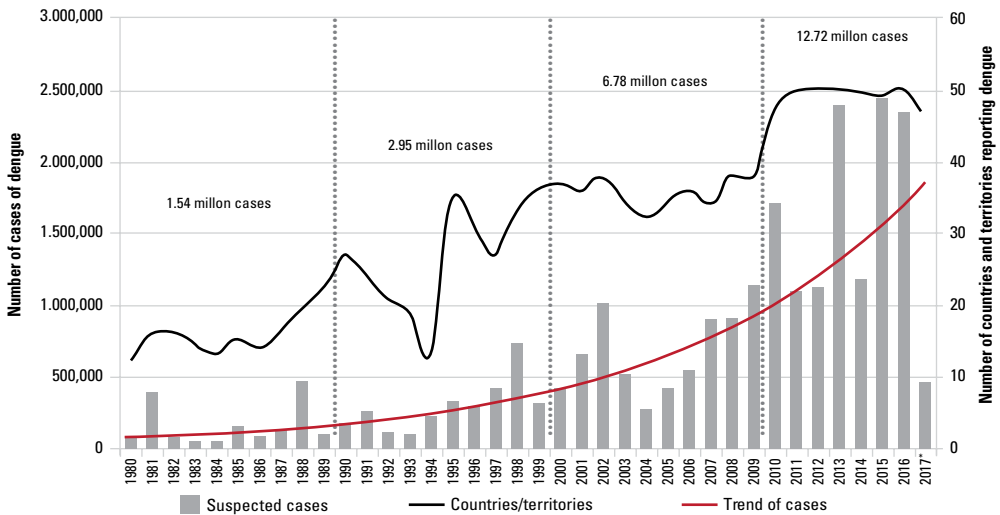
* Preliminary data, epidemiological week 52.
Source: Country epidemiological reports submitted to PAHO/WHO.

Historically, more than 80% of all dengue cases recorded in the Americas have occurred in six countries: Brazil (which, by virtue of its sheer size, records approximately 60% of all cases in the Americas), Mexico, Colombia, Venezuela, Ecuador, and, recently (since 2006), Paraguay.

The remaining 20% of cases are distributed across 44 countries and territories. Figure 4 shows the percent distribution of dengue cases in the Americas.

Figure 4. Percent distribution of dengue cases in the countries of the Americas, 1980-2016
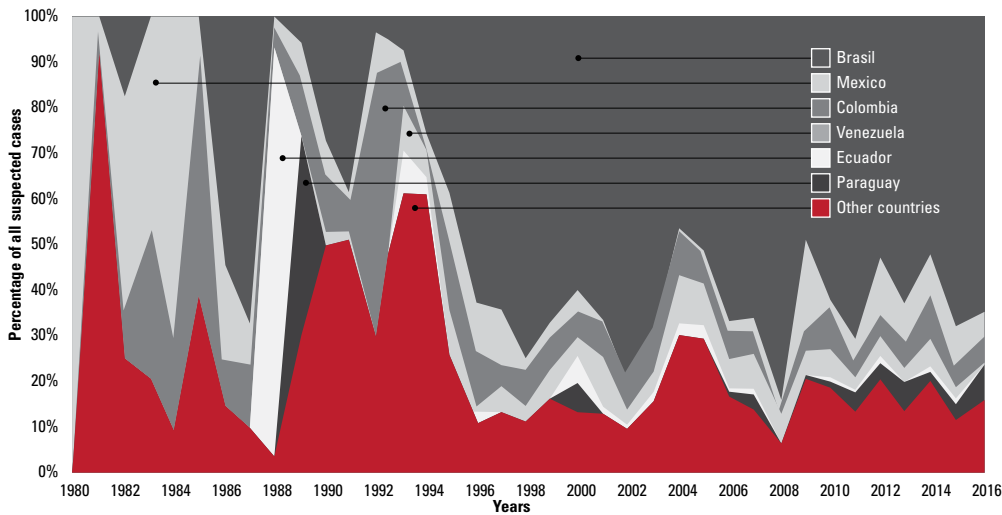
Source: Country epidemiological reports submitted to PAHO/WHO.

Severe cases and deaths. Despite the large number of dengue cases that occur each year, the proportion of severe cases is low (less than 4%), and the case-fatality rate is even lower (<1%). Until 2010, the proportion of severe cases and the case-fatality rate were on an upward trend; however, and unlike the upward trend in the number of cases, the proportion of severe cases and case fatality have since followed a downward trend in the last 6 years. This has occurred after implementation of the new classification of dengue severity (dengue and severe dengue) proposed by WHO in 2009, and the clinical training processes carried out in the countries of the Americas for its use. The new classification focuses on clinical management at the primary care level, in order to prevent progression of the disease to severe dengue and death. The PAHO Strategic Plan 2014-2019 sets targets for the reduction of communicable diseases, among them dengue, which should decrease by at least 30% compared to 2012 (i.e., reach a

rate of 0.049% or lower by 2019). Figure 5 shows the proportion of severe dengue cases and the case-fatality rate between 2000 and 2017.

Figure 5. Proportion of severe cases of dengue and case-fatality rate in the Americas, 2000-2017
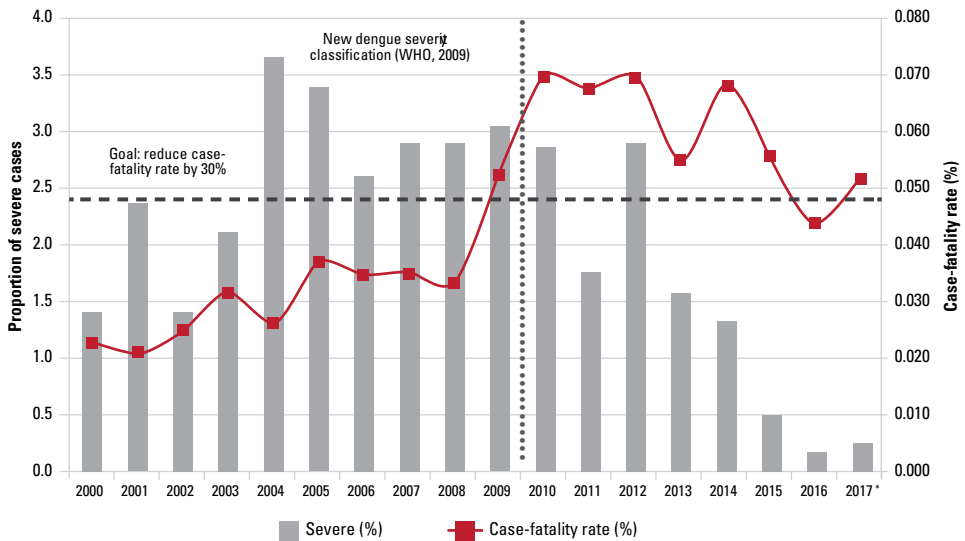
* Preliminary data, epidemiological week 52.
Source: Country epidemiological reports submitted to PAHO/WHO.

As with the total number of dengue cases, an estimated 80% of all dengue deaths in the Americas occur in six countries: Brazil, Colombia, the Dominican Republic, Mexico, Paraguay, and Venezuela. Paraguay was added to the list in 2006. The Dominican Republic was the only country added to the list despite not presenting increased reporting of the number of cases of dengue; however, it ranks third in number of deaths and is the country with the highest case-fatality rate in the Americas. Peru, despite not being among the top six countries with the highest number of dengue deaths in the Region, has recorded an increase in dengue deaths, since 2012, equivalent to half of all deaths occurring in the other countries in this group (Figure 6).

Figure 6. **Percent distribution of dengue deaths in the countries of the Americas, 1980-2016**
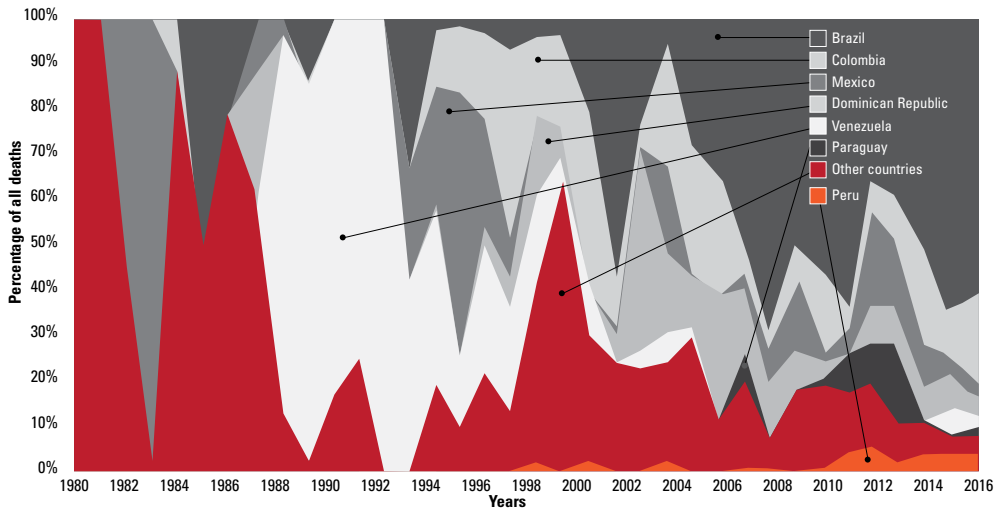
Source: Country epidemiological reports submitted to PAHO/WHO.

Dengue in 2017. As of October 23, 2017, 475,218 cases of dengue had been recorded in the Americas, which represents a 79% reduction compared to the same period of 2016, when 2,243,278 cases were recorded (an unprecedented figure for the Region). The last year with a similar incidence was 2006, with 551,871 cases at year-end. The reduction in number of cases was observed in all countries and territories of the Americas, including Paraguay (98% reduction in probable cases), Brazil (85% reduction), Colombia (77% reduction), Mexico (47% reduction), and Ecuador (18% reduction). Peru (which recorded a dengue epidemic in 2017) and Panama reported an increase in cases. Details on the decline of dengue cases in individual countries and in the Americas overall are shown in Table 1.

The decrease in number of cases in the Americas during 2017 also applies to the number of severe cases as compared with 2016. Overall, there was an 86% reduction in reports of severe cases of dengue, i.e., those that require hospitalization and management in intensive care settings. These cases do not fall through the cracks of surveillance systems. Table 2 summarizes the reduction in severe cases of dengue in some countries of the Region.

Table 1. Reduction in dengue cases in countries of the Americas, 2017 vs. 2016

	Country	Epidemiological week	2016	2017	Proportional difference
1	Paraguay	35	68,185	1,352	-98%
2	Dominican Republic	37	5,991	920	-85%
3	Brazil	35	1,442,208	219,040	-85%
4	Honduras	38	20,320	4,448	-78%
5	Costa Rica	34	15,949	4,254	-73%
6	Bolivia	16	26,643	5,753	-78%
7	Colombia	38	91,124	21,183	-77%
8	El Salvador	37	7,256	2,977	-59%
9	Guatemala	33	5,847	2,280	-61%
10	Mexico	37	77,940	41,555	-47%
11	Ecuador	36	12,852	10,557	-18%
12	Nicaragua	37	68,211	50,508	-26%
13	Peru	36	27,984	72,274	+58%
14	Panama	35	3,332	5,152	+55%
	The Americas	**39**	**2,243,248**	**475,198**	**-79%**

Source: Country epidemiological reports submitted to PAHO/WHO.

Table 2. Reduction in severe dengue cases in countries of the Americas, 2017 vs. 2016

	Country	Epidemiological week	2016	2017	Proportional difference
1	Bolivia	12	34	27	-21%
2	Brazil	35	885	184	-79%
3	Colombia	38	915	222	-76%
4	El Salvador	37	180	2	-99%
5	Mexico	37	2,273	210	-91%
6	Dominican Republic	35	595	57	-90%
	The Americas	**39**	**2,694**	**247**	**-86%**

Source: Country epidemiological reports submitted to PAHO/WHO.

The epidemiological situation of dengue in the Americas is complex and unstable. The disease challenges epidemiological surveillance systems and tests countries' capacity for response, prevention, and control.

3.2 Regional response

Since 2003, IMS-Dengue has constituted the main methodological instrument used by the countries of the Region for dengue prevention and control. Its main contribution focuses on strengthening the management of national programs with necessary, integrated information from each component, facilitating programming and evaluation of preventive actions during inter-epidemic periods and of control activities during epidemics, while always adopting an interprogrammatic approach. IMS-Dengue promotes the establishment of stronger associations to reduce risk factors for dengue transmission, develop an integrated surveillance system, and reduce *Aedes aegypti* populations to control levels. Likewise, it seeks to coordinate better preparedness for DENV detection and identification, through the Arbovirus Diagnosis Laboratory Network of the Americas (RELDA). In addition, the patient care component seeks to optimize case management, emphasizing the detection and monitoring of warning signs, especially in primary care, to prevent severe cases and deaths. It also proposes involvement of families as active and permanent participants in dengue prevention and control. Consequently, integrated action on the IMS-Dengue components is expected to help produce the desired changes of reducing incidence and case-fatality rates.

IMS-Dengue is a dynamic process capable of incorporating new scientific evidence, needed adjustments identified through national IMS-Dengue evaluations, and successful experiences that justify each of its components, including future availability of the dengue vaccine. With the support of GT-Dengue International, national capacities have been strengthened in each of the components. However, the greatest emphasis has been placed on consolidating national responses through an intersectoral and multidisciplinary approach, focused on addressing the social determinants most frequently involved in transmission, and on the technical adequacy of national clinical standards through use of the new dengue severity classification (WHO, 2009). Substantial efforts have also been made towards the establishment of RELDA, with tangible results at the regional and national levels.

GT-Dengue International constitutes the technical arm of the strategy, which works alongside countries to modify existing practices and implement the recommendations generated by

national IMS-Dengue evaluations. National and international GT-Dengue teams then review each adjustment that will have to be made and incorporated into IMS-Dengue.

A first adjustment to IMS-Dengue was made in 2010, as a result of the launch of the new guidelines and clinical classification developed by WHO in 2009, and consisted of adapting these guidelines for the Americas. The new classification became a valuable tool to prevent deaths from dengue by identifying and treating early warning signs. At present, and with the launch of the WHO Global Strategy for Dengue Prevention and Control, 2012-2020, PAHO recognized the importance of harmonizing these two documents; this resulted in a series of meetings between countries and GT-Dengue International in Santiago del Estero (Argentina) in 2013 and 2014, which culminated with the review of the current status of IMS-Dengue implementation in the Americas.

The target for the first period of IMS-Dengue implementation in the Americas (2003-2013) consisted of applying and evaluating IMS-Dengue in 20 countries and territories. That target was reached in 26 countries and territories with national IMS-Dengue; evaluation was completed in 22 countries and territories.

From 2015 to 2019, PAHO's Regional Dengue Program will work with the countries of the Region to reduce dengue mortality by 30%. This target can be achieved by intensifying the search for warning signs and timely treatment, especially in primary care settings. National monitoring systems will also be strengthened by applying the Generic System for the Epidemiologic Surveillance of Dengue, whose two surveillance modalities (national and sentinel) will generate the necessary information for monitoring and evaluation and for the development of new monitoring, prevention, and control strategies, e.g., introduction of the dengue vaccine when it becomes available.

There is also a need to strengthen prevention and control activities, with a focus on improving environmental management as a priority to reduce the risk of vector infestation. It is essential to ensure that families do everything they can in their homes to prevent vector breeding, especially by eliminating the mosquito's physical breeding sites. The involvement of other actors, such as local governments, industry, and other ministries, is also essential. Intervention on these factors will help reduce the population's risk of contracting dengue. However, in the national context, it is necessary to have the political support of the respective governments at

the highest level of decision-making in order to create laws and public policies that will allow sustainable progress in addressing these determinants.

With the appearance of new arboviral diseases in the Region, such as chikungunya and Zika, which also have *Aedes aegypti* as their main vector, interventions to eliminate usual and potential mosquito breeding sites is increasingly necessary.

IMS-Dengue is based on the comprehensive nature of its components—surveillance, laboratory diagnosis, patient care, integrated vector management, environment, and vaccines—and promotes the horizontal coordination of all these components, based on scientific evidence and on the key elements of social communication for behavioral impact. Simultaneously, the new model takes into account all the factors that facilitate the process of permanent strengthening of the strategy. Furthermore, the various outcomes of the strategy and the actions required for its implementation have been placed within a logical framework at all levels: national, subregional, and in the Region as a whole.

4.1 Goal and objectives of IMS-Dengue 2017

Overarching goal:

To reduce the dengue case-fatality rate by at least 30% by 2020 (using 2012 as a baseline).

Specific objectives:

1. To enhance national capacity for the detection and management of all dengue cases in the Region.
2. To strengthen national real-time epidemiological surveillance systems and implement a regional generic system for integrated dengue surveillance.
3. Implement genomic monitoring of the dengue virus.

IMS-Dengue will continue to work on all components and adapt to new tools that may arise, such as the possible availability of a dengue vaccine, use of genetically modified mosquitoes, and other techniques, such as the use of strains of *Wolbachia*, a bacterial species that could reduce transmission of the dengue virus.

4.2 Components of IMS-Dengue 2017

IMS-Dengue will continue to be the methodological model of choice for dengue prevention and control in the Americas. Its integrated and multidisciplinary nature has proven very useful to prevent and organize the response of each country to outbreaks and epidemics, as well as during inter-epidemic periods.

Changes to the current IMS-Dengue management model began with the incorporation of the main technical inputs obtained from the country evaluation process carried out during its implementation. Subsequently, and in line with the WHO Global Strategy for Dengue Pre-

vention and Control, 2012-2020, GT-Dengue and the countries of the Region worked jointly to harmonize the two strategies. Finally, the proposals arising from the *State of the art in the prevention and control of dengue in the Americas* meeting were incorporated. This multidisciplinary meeting, held in early 2014, included the participation of other actors outside the health sector (academia, industry, nongovernmental organizations, government agencies, PAHO/WHO collaborating centers, and the health ministries of several countries, among others) (PAHO/WHO, 2014).

A systematic review of the strategy's components carried out in the last five years made it possible to identify and incorporate new elements, the practical implementation of which has been providing good results.

IMS-Dengue 2017 provides for integrated action among six technical components, two cross-cutting themes, and five facilitating factors for the management of dengue prevention and control in the Americas.

1) **Cross-cutting themes that provide additional information**
   1. Operational research
   2. Communication for behavioral change

2) **Technical components that interact to support management in a coordinated, integrated fashion**
   1. Epidemiology: integrated surveillance and outbreak and epidemic preparedness
   2. Patient care
   3. Laboratory diagnosis
   4. Integrated vector management
   5. Environmental management
   6. Vaccines (preparation for potential availability)

3) **Facilitating factors that will promote implementation of IMS-Dengue**
   1. Advocacy
   2. Resource mobilization
   3. Partnerships
   4. Capacity building
   5. Monitoring and evaluation

The proposed model for the updated IMS-Denguestrategy is summarized in Figure 7.

Figure 7. The Integrated Management Strategy for Dengue Prevention and Control in the Region of the Americas (IMS-Dengue), 2017
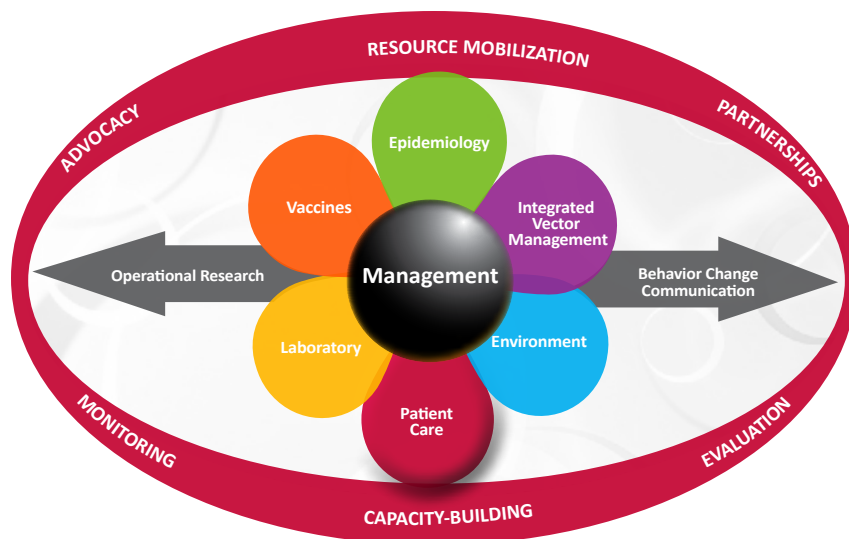
4.3 Cross-cutting themes

The updated IMS-Dengue considers operational research and communication for behavioral change as cross-cutting themes that will gradually generate inputs to facilitate updates to each technical component and provide information to bridge current information gaps. Proper performance of IMS-Dengue is contingent upon producing behavioral changes in authorities and in the population (families), which is why the consolidation of tools such as communication for behavioral impact (COMBI-Dengue) is vitally important.

4.3.1 Operational research

Operational research refers to the generation of knowledge about elements that must be understood in order to solve complex problems which, in practice, perpetuate an existing vulnerability (in this case, contracting severe forms of dengue). Such research is applied to each component of IMS-Dengue, based on the premise that new knowledge can be used to develop more effective tools, which, in turn, will give rise to new or better interventions, strategies, and policies.

Operational research is essential for the discovery, development, and implementation of interventions (PAHO/WHO, 2013) geared to or focused on the settings and conditions in each situation encountered by dengue prevention and control programs (and now, also chikungun-

ya and Zika). Operational research should include research protocols with a multidisciplinary approach, with academia included in formative and investigative roles. Furthermore, national GT-Dengue teams must be encouraged to coordinate with institutions (such as research centers, universities, and nongovernmental organizations) on lines of research and topics of national interest related to dengue, chikungunya, and Zika.

Due to its importance, operational research constitutes a cross-cutting theme for obtaining concrete evidence, such as:
1. systematization of experiences;
2. identification of new tools and techniques;
3. validation of practices and educational materials;
4. measurement of the impact of interventions;
5. assessment of the cost/benefit of interventions.

Participating institutions can thus base their interventions on evidence and improve the actions carried out in each IMS-Dengue component, to achieve more efficient prevention and control.

Although research encompasses all components of the Strategy, three spheres of special interest have been identified:
1. Dengue case management: to improve diagnostic methods, evidence-based patient management criteria, and evaluate the new clinical classification of dengue (WHO, 2009).
2. Vector control: to conceive new strategies for vector control, improve knowledge on how to provide services through integrated approaches (ecological, biological, social, etc.), and innovate on research activities by obtaining support from corporations and social initiatives to enable development of drugs against dengue, health services delivery, community vector control, and "green" technologies, such as mosquito nets for windows and doors made by residents themselves in their own neighborhoods.
3. Outbreak detection and response: to find new ways of compiling scientific data for the detection of warning signs that indicate the emergence of outbreaks and develop indicators and conditions for their detection.

Implementation of operational research requires multidisciplinary teams and funding, which represents an excellent investment opportunity for entrepreneurs who wish to support a cause and for academic sectors willing to collaborate professionally.

4.3.2 Communication for behavioral impact

Behavioral impact refers to changes in individual behavior which result from acquiring knowledge about a subject. It is the stepwise process whereby individuals incorporate change into their daily lives. This also includes interaction with individual values and mores.

To achieve such impact, it is important to analyze in depth the behaviors to be modified; this, in turn, will suggest which means of communication should be used to promote change. In addition, the epidemiological moment (or inter-epidemic interval) during which the corresponding messages will be conveyed should be considered.

Like all technical components of IMS-Dengue, this cross-cutting theme must rely, among other elements, on data available from the other components, as well as on social and anthropological research to identify the target audience and on up-to-date tools to guide implementation and evaluation of achievements.

4.4 Management

Integrated management for dengue prevention and control is for model of planning, organization, conduction, implementation, and monitoring and evaluation, both of structures and of processes and results, which seeks to: 1) characterize the transmission of dengue from an overarching, and multidisciplinary (inter-institutional and cross-sectoral) perspective; and 2) generate feasible responses to achieve the greatest positive impact.

The management component of IMS-Dengue entails decision-making at the following levels.

a. Political: to define the roles and functions of each sector and institution involved in dengue prevention and control responses, based on the information, needs, and recommendations established by the leading or steering institution, which should be from the health sector. This also entails maintaining or facilitating political and financial will at the highest levels.

b. Strategic: to define technical guidelines for the short, medium, and long term, considering the different sociocultural, economic, and epidemiological conditions of each region and country, as well as steering implementation in the national and subnational spheres, promoting functional coordination of the technical components of the strategy to optimize performance through the rational use of available resources, and within an integrated approach framework.

c. Operational: to plan, implement, monitor, and evaluate the interventions established according to plan, in accordance with their levels of resolution, with the different actors involved, and with activities and tasks geared to minimizing the financial and social impact of dengue.

Table 3. Expected results, indicators, data sources for verification, and assumptions

Expected results	Indicators	Data sources for verification	Assumptions
R.1. To adjust and implement national IMS-Dengue strategies on the basis of the regional IMS-Dengue 2017.	1. 20 countries in the Americas have implemented the updated IMS-Dengue. 2. 70% of the municipalities at greatest risk of dengue transmission have implemented the updated IMS-Dengue.	• National IMS-Dengue document. • Country reports. • GT-Dengue International monitoring and evaluation reports.	Political commitment and availability of technical and financial resources from the countries and other sources.

Table 4. Activities, tasks, timeframe for implementation, and responsible parties

Activities	Tasks	Timeframe* for implementation			Responsible party
		S	M	L	
A.1. Update the national IMS-Dengue per the new regional IMS-Dengue 2017.	1. Keep an up-to-date, integrated analysis of the dengue situation for risk stratification.	X	X	X	GT-Dengue National and health surveillance agencies.
	2. Define the objectives and activities of prevention, and control taking into account prioritization/risk targeting.	X			GT-Dengue National.
	3. Define mechanisms for national IMS-Dengue implementation at all levels.	X			IMS-Dengue managers.
	4. Reorient/adapt/adjust the technical, operational, and programmatic capacities of the national and subnational response teams.	X	X		GT-Dengue National, GT-Dengue International.
	5. Devise and deploy a plan for monitoring and evaluation of the implementation of the national IMS-Dengue, adapted to the regional strategy and specificities of each country.	X	X		GT-Dengue National, GT-Dengue International.
	6. Conduct workshops for the adjustment of national IMS-Dengue strategies.	X			GT-Dengue National, GT-Dengue International.

		S	M	L	
A.2. Formalize the establishment and operation of a national, multidisciplinary (inter-institutional and cross-sectoral) dengue task force.	1. Designate a manager in charge of leading and coordinating the technical-scientific and operational aspects of all IMS components.	X			GT-Dengue National proposes; the country's highest authority, extra-sectoral committee, or Health Council decides.
	2. Define the actors and their roles using the legal framework and an approach that addresses the determinants of health.	X			
	3. Define annual working plans for GT-Dengue National, including a plan for follow-up, monitoring and evaluation.	X	X		National task force on arboviral diseases.
	4. Prepare minutes and technical advisories.	X	X	X	
A.3. Keep political decision-makers informed, in a timely manner, of the epidemiological situation of dengue, advances made, and the needs of the national IMS-Dengue.	1. Prepare a management report with relevant technical and operational recommendations for managers or persons in charge at different levels, with emphasis on the municipal or local level.	X	X	X	Persons in charge of the national IMS-Dengue.
	2. Use the management report for accountability of the achieved results to political leaders.		X	X	Highest level of political decision-makers.
	3. Hold management meetings at the regional level for follow-up of national IMS-Dengue strategies.	X		X	GT-Dengue National GT-Dengue International PAHO/WHO.
A.4. Within the national IMS-Dengue, update communication strategies aimed at improving the behavior of the different targeted sectors of the community.	1. Update formative research on behaviors and practices in specific population groups.	X	X		Social scientists, academia, GT-Dengue National and GT-Dengue International research groups.
	2. Establish the behavioral objectives of the different target groups.	X	X		Social scientists, academia, GT-Dengue National and GT-Dengue International research groups.
	3. Define socially and culturally acceptable communication strategies for well-defined groups and with clear behavioral objectives.		X		GT-Dengue National and GT-Dengue International communication groups.
	4. Implement and systematize the communication strategies defined by GT-Dengue.		X	X	GT-Dengue National and operational levels.

*S: short-term (1 year), M: mid-term (2-3 years), L: long-term (4-5 years).
[1] A key aspect of the development of an evidence-based social communication and mobilization strategy. Includes, among other aspects:
- search and review of the scientific literature;
- analysis of entomological indices in key containers, as well as epidemiological, clinical, and laboratory data;
- identification of key social actors;
- qualitative research on health-related beliefs and practices;
- quantitative Knowledge, Attitude, Behavior, and Practices (KABP) surveys;
- surveys to determine use of the media and which types of communication channels are available;
- pre-testing of specific materials, messages, and behaviors.

4.4.1 Epidemiology: integrated surveillance and outbreak and epidemic preparedness

Integrated epidemiological surveillance constitutes one of the basic and essential elements for the management of dengue prevention and control programs at the country level, since an integrated system provides timely information that makes it possible to identify high-risk situations, while facilitating the design of interventions for regular situations and of response to epidemics. This integrated surveillance, which should be part of the national health information system, includes monitoring of a set of key indicators, standardized at the different levels of health management, common to all countries of the Region.

The information from the integrated surveillance system should allow a comprehensive analysis, which provides information on the different components, mainly of IVM, epidemiology, laboratory, and patient care. Permanent monitoring of service quality must also be carried out.

Evaluations of the different IMS-Dengue strategies conducted thus far have confirmed advances related to the information available for calculation of incidence and case-fatality rates, the circulating virus, and data on entomological surveillance, as well as for the development of tools that integrate real-time information. Although, to date, these advances have only been observed in some countries, they constitute an input for definition of the regional proposal of a generic system for integrated epidemiological surveillance of dengue. Despite progress with regard to epidemiological surveillance of dengue in the last ten years, which has made it possible to obtain reliable data on transmission status in more than 40 countries and territories, it is necessary to strengthen systems in the countries, so that these can provide integrated information from all components in a manner amenable to timely analysis to support decision-making. One critical aspect identified in epidemiological surveillance of the Region, among others, is the lack of standardization of operational definitions and risk indicators, which would facilitate stratification, closer identification of disease burden, and comparison of data between countries.

The objectives of the surveillance system are to:
- identify the emergence of outbreaks and epidemics in timely fashion;
- provide data for assessment of social and economic impact on affected communities;
- monitor geographical and time trends of dengue distribution and spread;
- monitor environmental risk factors and, whenever possible, collaborate in the monitoring of other diseases related to water, sanitation, and hygiene, such as chikungunya and Zika; and
- evaluate the effectiveness of dengue prevention and control programs and facilitate planning and resource allocation, based on the lessons learned through program evaluation.

The integrated surveillance system incorporates a new modality: sentinel surveillance, aimed at monitoring viral circulation, the introduction of new serotypes, the presence of the vector, and the characteristics of patients who develop severe forms of the disease, among others. Likewise, the new generic surveillance system is a tool that will facilitate comparisons between countries and strengthen the definition of prevention and control activities. With the arrival of a dengue vaccine, these sentinel areas will also become designed sites for monitoring and evaluation of vaccine impact.

Table 5. Integrated epidemiological surveillance: indicators

Expected results	Indicators	Data sources for verification	Assumptions/risks
R.1. The design of dengue prevention and control activities should be based on information generated by an integrated surveillance system.	1. Number of countries that have deployed an integrated surveillance system for dengue. 2. Number of countries that notify PAHO/WHO on a weekly basis.	• National epidemiological bulletins. • GT-Dengue National and International evaluation reports. • IMS-Dengue progress report from each country.	The national coordination of the IMS-Dengue in each country promotes and uses the outputs of the integrated dengue surveillance system.

Table 6. Integrated epidemiological surveillance: expected results and activities

Expected results	Activities
R.1. The design of dengue prevention and control activities should be based on information generated by an integrated surveillance system.	1. Implement a generic surveillance system integrated into the national surveillance systems. 2. Adapt the national surveillance systems and platforms on the basis of the generic integrated surveillance system. 3. Plan the prevention and control response on the basis of the results of analysis of the information generated by the integrated surveillance system. 4. Monitor and evaluate the integration of information from all components. 5. Conduct operational research for decision-making.

Table 7. Integrated epidemiological surveillance: task and timeframe for implementation

Activities	Tasks	Timeframe* for implementation			Responsible party
		S	M	L	
A.1. Implementation of a surveillance system integrated into the national surveillance systems.	1. Adapt national functional models for surveillance on the basis of the generic integrated regional surveillance system.	X	X		IMS-Dengue managers, GT-Dengue National, GT-Dengue International.
	2. Define areas for the implementation of sentinel surveillance of dengue where appropriate.	X			IMS-Dengue managers, GT-Dengue National.
	3. Review and adjust the integration and complementarity of the sentinel surveillance system with the universal national system.	X	X	X	Country IMS-Dengue managers, GT-Dengue National.
A.2. Adapt national surveillance systems and platforms, using an integrated approach.	1. Carry out workshops to standardize analysis methods (system outputs) and indicators for epidemiological surveillance of dengue, according to the generic regional integrated surveillance system.	X	X		Ministries of Health.
	2. Define the technological requirements of the integrated system, based on each country's national platform and on the regional platform.	X	X	X	IT function, country IMS-Dengue managers.
	3. Establish the system's information outputs and dashboards and incorporate them directly into the Health Information Platform (HIP).		X		Country IMS-Dengue managers.
	4. Strengthen system feedback at all management levels.	X	X	X	Regional dengue program and country IMS-Dengue managers.

		S	M	L	
A.3. Plan the prevention and control response on the basis of the results of analysis of the information generated by the integrated surveillance system.	1. Set up situation rooms at the different spheres of management, including local governments, in case of outbreaks or epidemics.	X	X		Ministries of Health, IMS-Dengue managers, GT-Dengue National.
	2. Devise and standardize risk stratification criteria that can serve as inputs for decision making.	X			IMS-Dengue managers, GT-Dengue National.
	3. Keep the situational diagnosis continuously up to date with information from the integrated surveillance system.	X	X	X	IMS-Dengue managers, GT-Dengue National.
	4. Prepare and disseminate epidemiological alerts in a timely fashion through the National Liaison Center (CNE).	X	X	X	IMS-Dengue managers, GT-Dengue National NLC.
	5. Prepare reports that guide decision-making with participation from the community and local governments.	X	X	X	Ministries of Health.
A.4. Monitor and evaluate the integration of information from all components.	1. Carry out external monitoring and evaluation visits to the countries.	X	X	X	GT-Dengue International.
	2. Carry out monitoring and evaluation visits to the different management levels.	X	X	X	IMS-Dengue managers, GT-Dengue National.
	3. Monitor and evaluate any new tools that are introduced.	X	X	X	IMS-Dengue managers, GT-Dengue National and GT-Dengue International.
A.5. Define lines of research that generate up-to-date knowledge, which will lead to new policies, interventions and strategies.	1. Establish partnerships with academia, research institutes, and funding agencies to evaluate the efficacy of dengue prevention and control programs.		X	X	IMS-Dengue managers, GT-Dengue National and GT-Dengue International, academic partners.
	2. Generate information on the applicability of new surveillance, prevention, and control tools that become available.	X	X	X	Ministries of Health, GT-Dengue National and GT-Dengue International.
	3. Recommend models to quantify the combined effects of vaccination and vector control on dengue transmission.		X	X	IMS-Dengue managers, GT-Dengue National and GT-Dengue International, academia.
	4. Identify communication actions associated with a reduction or interruption of dengue transmission.		X	X	IMS-Dengue managers, GT-Dengue National and GT-Dengue International, academia.

* S: short-term (1 year), M: mid-term (2-3 years), L: long-term (4-5 years).

Outbreak and epidemic preparedness and response. The Plan for Preparedness and Response to Outbreaks and Epidemics is another instrument of IMS-Dengue derived from analysis of recent outbreaks and epidemics, and in which all key actors participate. It presents a series of recommendations that should be properly applied to ensure that lessons learned are taken into account, as well as to ensure early detection of outbreaks or epidemics. As all response processes are complex, clear criteria for inter-institutional involvement and very precise responsibilities must be established to ensure a response that is commensurate with the characteristics of each territory. The Plan is a guidance document, to which any necessary modifications or adjustments may be made, according to the epidemiological scenario at hand, in order to ensure its functionality and operability. It is flexible and can easily be adapted to any geographic setting.

In countries where dengue is endemic, the overall goal of any such plan is to decrease the risk of transmission and to strengthen and sustain control measures to minimize the clinical, social, and economic repercussions of the disease. Monitoring and evaluation systems will be planned and implemented to determine the effects of all interventions.

For dengue emergency response planning, the following 10 areas are considered a priority (adapted from Rigau-Pérez and Clark, 2005):
1. Establish a multisectoral dengue action committee.
2. Formalize an emergency action plan.
3. Intensify integrated disease surveillance.
4. Conduct laboratory diagnostic testing to confirm viral circulation and genotype, if possible.
5. Intensify vector surveillance and control.
6. Protect special populations and reduce the impact of environmental determinants.
7. Ensure proper patient care.
8. Involve the community and relevant groups of dengue control professionals in prevention and control activities.
9. Investigate and systematize the response to each epidemic.
10. Communicate to the media, in accordance with the new scenario, and define the corresponding spokespersons.

In the case of an outbreak, communication and provision of information to the population is essential to reduce domestic breeding sites and ensure that affected people seek timely medical assistance, thus preventing severe forms and deaths from dengue. Messages should focus on the identification of warning signs and the timely search for medical assistance. In addition, communications should make the population aware of the importance of facilitating

interventions in their homes and paying special attention to febrile conditions and the special activities required for vector control, particularly the control of intradomiciliary breeding sites.

A major dengue outbreak may require external support to strengthen the national response. In such events, PAHO/WHO, through the regional program, in coordination with the emergency response plans, and in accordance with the International Health Regulations (2005), will organize the necessary technical cooperation and work together with the affected country to mobilize additional resources and strengthen the response. Several events can justify communication with PAHO/WHO, such as the first confirmation of locally acquired dengue in an area previously free of the disease; the appearance of a new serotype or changes in the disease vector; atypical clinical presentations; or excessively high incidence or case-fatality rates.

Rapid verification, risk assessment and information exchange are crucial for the coordination of response and external support. The technical team of international experts that makes up GT-Dengue International will be mobilized at the request of affected countries to provide support for the key components of IMS-Dengue, or those that need reinforcement in each country, in order to strengthen the national response in a sustainable manner. National and international nongovernmental organizations play an extraordinary role in reaching out to the most disadvantaged populations is recognized. This rapid response can be used as a mechanism to build capacity at the local level, improve preparedness for epidemics, and reduce vulnerability.

In countries where there are vectors present in the absence of circulating DENV, preparedness and response plans should focus on strategies to reduce transmission risks. Any case in which there is clinical suspicion of dengue should be quickly investigated, and laboratory confirmation of the presence of DENV should be pursued. In addition, it is essential to determine if the case is imported or autochthonous (acquired locally). If an autochthonous case is confirmed in an area where DENV transmission has never been recorded, the epidemiological investigation must be expanded to determine the magnitude and extent of the transmission, and an integrated prevention and control response should be planned, involving all actors necessary to interrupt the spread of the disease. The role of fumigation is highly controversial, but it has been proven that, in the aforementioned settings, it is essential to eliminate the adult mosquito and maximize its control. All available integrated response mechanisms should be deployed in such cases.

In countries at risk of introduction of the dengue vector, planning and preparedness activities should focus on entomological surveillance at entry points (seaports, airports, land border outposts), in urban areas providing conditions amenable to the dengue vector, and on educational campaigns aimed at health workers and the community about the risks of dengue and how to participate in prevention actions.

4.4.2 Patient care

Dengue infection has a broad spectrum of clinical manifestations, ranging from asymptomatic infection through mild illness to severe manifestations that can lead to death unless timely and appropriate treatment is provided. Most dengue infections can go unnoticed. After the incubation period, which lasts seven to ten days, disease onset is abrupt, followed by three phases: febrile, critical, and recovery (WHO, 2009). Although the clinical manifestations are complex, their treatment is relatively simple, inexpensive, and very effective in saving lives, provided that appropriate and timely interventions are performed. The key is early recognition of warning signs at the various phases of the disease, which enables a rational approach to case management and good outcomes. This is especially evident in the treatment of lost plasma via oral or intravenous fluids.

Activities in the primary and secondary levels of care (triage and decisions about patient management), which are the first points of contact for patient evaluation, are crucial determinants of clinical outcomes. The identification of warning signs and a well-handled first-line response reduce unnecessary hospitalization, prevent progression to severe dengue, and save lives. Both the timely reporting of dengue cases observed in primary and secondary care services and the use of a standardized case definition are crucial for early response to outbreaks. Referral and counter-referral systems between the different levels of health care must be established, and attempts should be made to provide more comprehensive and coordinated responses to each situation.

Training is a decisive element in all areas of dengue case management, but especially for medical and non-medical personnel involved in the clinical management of dengue at the primary, secondary, and tertiary levels of care. When planning the frequency of such training, factors such as staff turnover and cohorts of newly graduated physicians should be considered. Communication strategies directed at the population should also be defined, to ensure awareness of the warning signs and prompt a timely search for medical attention. This targeting of population groups is a key element in the organization of timely clinical response. Patients and their families should receive information on how to eliminate vector breeding sites in their homes and surroundings, which can be very effective because of high patient receptiveness at the time of care.

Dengue mortality can be reduced significantly through timely and appropriate clinical management. The following technical elements are required to achieve the first objective of the strategy—namely, to reduce the case-fatality rate of dengue by at least 30% by 2020.

Reducing the case-fatality rate by at least 30% (baseline 2012) entails:

- improving the clinical diagnosis and management of dengue cases to prevent deaths. Early clinical detection of cases is key, especially patients who present with warning signs and those with severe dengue;

- improving the treatment capacity of primary and secondary care services, to reduce strain on the tertiary (hospital) services, an element that often prevents the proper management of the severe cases;

- improving the organization of health services during outbreaks/epidemics. In endemic countries, this should include keeping contingency plans up to date and deploying them to prevent dengue deaths;

- capacity-building in the workforce and establishing quality assurance in health services in both the public and private sectors;

- preparing evidence-based training materials and courses on dengue and having a plan in place for continuing education;

- setting the stage for the introduction of dengue vaccines and their repercussions for public health, bearing in mind the challenges of extended implementation;

- during the first week of an outbreak, conducting investigation (including autopsies) to establish the primary cause of the deaths and detect circumstances or errors in care that must be corrected.

Currently, biomarkers are available that allow prediction of which patients are more likely to develop severe dengue; however, the practice of sentinel-site surveillance allows collection of more detailed information in this regard. More research is needed on how to improve the management of plasma loss in patients with comorbidities and during pregnancy and to better understand which host and viral factors are involved in the increased risk of severe infection.

Table 8. Patient care: indicators

Expected results	Indicators	Data sources for verification	Assumptions
R.1. Reduce the dengue case-fatality rate by at least 30%.	1. 90% of physicians and nurses are trained in the diagnosis and management of patients with dengue. 2. 90% of public and private health facilities properly use patient care guidelines and flow charts. 3. 90% of public and private health facilities have contingency plans in place for outbreak and epidemic situations.	• Database of the national epidemiological surveillance systems. • Clinical history audit reports. • Trained staff registries. • Patient care quality audit reports. • Contingency plans (both nationwide and at facilities that provide health services).	• Political support. • Adequate surveillance system. • Availability of human, material, and financial resources. • Access to clinical histories for review. • Availability of up-to-date care guidelines and contingency plans for patients with dengue. • Availability of funding, both internal and external, for training activities.

Table 9. Patient care: expected results and activities

Expected results	Activities
R.1. Reduce the dengue case-fatality rate by at least 30%.	1. Clinical diagnosis, timely management, and adequate monitoring of the dengue patient according to the care guidelines and flow charts recommended by PAHO/WHO. 2. Design of health provider training modules that contain the patient education and community components of IMS-Dengue. 3. Strengthening of the organization of the health services and contingency plans for the clinical management, and, in the event of an outbreak or epidemic, reorganization of services in the different levels of care. 4. Definition of communication strategies to effect behavioral change in health workers, the population, and policymakers. 5. Development of lines of research that generate up-to-date knowledge on new or enhanced tools, which will give rise to new policies, interventions, and strategies.

Table 10. Patient care: tasks and timeframe for imprementation

Activities	Tasks	Timeframe* for implementation			Responsible party
		S	M	L	
A.1. Diagnosis, timely management, and adequate follow-up of dengue patients according to the care guidelines and flow charts recommended by PAHO/WHO.	1. Adjust national guidelines in accordance with the latest PAHO/WHO recommendations (Guidelines, 2nd edition).	X	X		Ministries of Health at the national level.
	2. Training in triage and timely diagnosis, mainly for primary-care and secondary-care personnel.	X	X		Ministries of Health at the national, regional, and local levels.
	3. Application of clinical criteria for dengue management.	X	X	X	Ministries of Health at the national, state/province, and local levels.
	4. Strengthening of the laboratory network at the subnational level.	X	X	X	Primary, secondary, and tertiary care units.
	5. Evaluation of the quality of care provided to patients with severe dengue and to those who have died of dengue.	X	X	X	Case review committees at local and national primary, secondary, and tertiary care facilities.
A.2. Development of training modules for health personnel that contain the patient and community education components of IMS-Dengue.	1. Review and standardization of the case definition and criteria for laboratory diagnosis.	X			GT-Dengue International and National.
	2. Validation and dissemination of the contents of training modules.	X	X		Ministries of Health and GT-Dengue National (patient care component).
	3. Training workshops, including on outbreak response, for health workers in the public and private sectors.	X			Ministries of Health and GT-Dengue National (patient care component).
	4. Annual theoretical and practical courses for health care providers and for medical and nursing students.		X	X	Ministries of Health, universities, and GT-Dengue National (patient care component).
	5. Incorporation of practices by national tertiary referral centers.		X	X	Ministries of Health and GT-Dengue National (patient care component).

Activities	Tasks	Timeframe* for implementation			Responsible party
		S	M	L	
A.3. Strengthening of the organization of health services and contingency plans for clinical management of outbreak scenarios at the different levels of care.	1. Training of health facility managers in management and health services organization.	X	X	X	Ministries of Health and GT-Dengue National.
	2. Definition of tasks and responsible persons at all levels of care.	X	X		Health facility managers.
	3. Review and annual adjustment of the hospital contingency plan.	X	X	X	Ministries of Health and GT-Dengue National.
	4. Train primary-care workers to use the primary care guidelines.				Ministries of Health and GT-Dengue National.
A.4. Definition of a communication strategy aimed at effecting behavioral change in health workers, the population, and decision-makers.	1. Forge partnerships with strategic members who have leadership roles in the fields of media and education.	X	X	X	Ministries of Health, at the national, regional, and local levels.
	2. Strengthen communication with normative entities for implementation of the IMS-Dengue.	X	X	X	Ministries of Health, GT-Dengue International and National.
	3. Support capacity-building in communication for behavioral impact at the ministry of health.	X	X	X	Ministries of Health, GT-Dengue International and National.
	4. Design, production, and distribution of educational material on health care and preventive measures: no self-medication, oral rehydration, and vector control (geared to patients and family members)..		X	X	Ministries of Health and GT-Dengue National.
	5. Strengthen communication in risk and crisis situations related to dengue outbreaks.	X	X	X	Ministries of Health, GT-Dengue International and National.
A.5. Development of lines of research that can generate up-to-date knowledge on new or improved tools, which will give rise to new policies, interventions, and strategies.	1. Clinical characterization of patients with severe dengue and of those who die of dengue.		X	X	Ministries of Health, GT-Dengue International and National, healthcare providers.
	2. Investigate the correlation (of clinical symptoms) between patients with severe dengue and those who died, concerning viral serotype.		X	X	Ministries of Health, GT-Dengue International and National, healthcare providers.
	3. Investigate the correlation between warning signs and deaths from severe dengue.		X	X	Ministries of Health, GT-Dengue International and National, healthcare providers.
	4. Characterization of the clinical behavior of dengue in high-risk groups and according to patient care guidelines.		X	X	Ministries of Health, GT-Dengue International and National, healthcare providers.

* S: short-term (1 year), M: mid-term (2-3 years), L: long-term (4-5 years).

4.4.3 Laboratory

Within IMS-Dengue, the laboratory plays a key role in monitoring of the circulating serotype and its association with outbreaks or epidemics and the emergence of severe cases. The strengthening of PAHO/WHO collaborating centers and national dengue diagnostic reference laboratories, as well as the exchange and technological transfer among them, has constituted a strategic intervention in the Americas, and, to date, has made it possible for more than 20 countries to identify circulating DENV serotype with the CDC technique for identification of the four serotypes through real-time polymerase chain reaction. The Region has prioritized the strengthening of national laboratories and quality management systems to ensure adequate laboratory surveillance, and has thus managed to harmonize its diagnostic algorithms and case classification. In addition, dengue control will depend on the potential results of interdisciplinary research and intervention studies, as well as on technological innovations.

Since 2008, sustained efforts have been made to establish and strengthen the Arbovirus Diagnosis Laboratory Network of the Americas (RELDA), with an emphasis on the need for WHO Collaborating Centers (WHOCCs) to play an active role in implementation of IMS-Dengue, working in a network jointly with national reference laboratories. In 2011, the RELDA statute of operations was prepared and approved, describing RELDA's structure and functions, its goals, objectives, and expected results, and the functions assigned to each laboratory for the control and prevention of dengue and other flaviviral and arboviral diseases, as well as the requirements for effective surveillance by the laboratory.

Initially, a survey of the laboratories was conducted to establish their capacities and limitations for dengue diagnosis. The need to establish a joint quality management system for the WHOCCs and NRLs that integrate the dengue surveillance systems in the region was also addressed. The PAHO website includes information on RELDA, with key information on each of the centers/laboratories, facilities, resources, technical expertise, and research projects.

Another strategic aspect identified by RELDA has been the preparation of strategic reagents and supplies and their exchange among WHOCCs and national reference laboratories, as a way of ensuring the sustainability of RELDA and increasing diagnostic capacity in the Region.

It is essential to know which viruses are circulating in different countries, understand the strengths and weaknesses of the clinical classification of patients with dengue, and investigate the correlates of protection and information on the incidence and burden of disease, including the incidence of sequential infections by different DENV serotypes and other circulating

flaviviruses. It is also of vital importance that high-quality centers of clinical, epidemiological, and laboratory information be supported, and that their operations be evaluated periodically.

The joint circulation of several flaviviruses, vaccination against yellow fever, and the possible introduction of a dengue vaccine in the Region of the Americas pose a highly complex scenario for etiological diagnosis of the disease.

Table 11. Laboratory diagnosis: indicators

Expected results	Indicators	Data sources for verification	Assumptions/risks
R.1. Laboratories for etiological diagnosis of dengue, capable of generating timely, high-quality information to support decision-making.	1. 100% of national reference laboratories in the Americas are members of RELDA. 2. 100% of reference laboratories have serological, virological, and molecular diagnostic capabilities. 3. 100% of reference laboratories have set up a quality system.	• Report of laboratory results, periodic integrated surveillance bulletins, laboratory surveillance systems or other online information systems. • Quality manuals and standardized operational procedures. • Meetings and regional forums for laboratories.	• Commitment of the health authorities. • Adequate provision (in time and form) of equipment, supplies, and reagents, human resources (trained and in sufficient number), adequate infrastructure.

Table 12. Laboratory diagnosis: Expected results and activities

Expected results	Activities
R.1. Laboratories for etiological diagnosis of dengue, capable of generating timely, high-quality information to support decision-making.	1. Strengthen laboratory response capacity in dengue epidemics. 2. Standardize and strengthen the ability of the Region's reference laboratories to diagnose dengue infections. 3. Support mechanisms for information flow among the reference laboratories of the Americas and those of other regions. 4. Strengthen quality management in network laboratories. 5. Develop lines of research.

Table 13. Laboratory diagnosis: tasks and timeframe for implementation

Activities	Tasks	Timeframe* for imple-mentation			Responsible party
		S	M	L	
A.1. Strengthen the response capacity of laboratories to dengue outbreaks and epidemics.	1. Establish criteria for biological sampling for etiologic tests, according to the epidemiological situation.	X	X	X	Country laboratory, epidemiological surveillance, and patient care components.
	2. Arrange for the basic infrastructure, equipment, supply, logistics, and (trained) human resources needs of national reference laboratories and their internal networks.	X	X		Country laboratory and management components.
	3. Promote the implementation of reference techniques for diagnosis (serological, virological, and molecular) of dengue and other arboviruses in national laboratories.	X	X	X	WHOCCs, NRLs, PAHO/WHO (RELDA).
	4. Achieve systematic interaction between laboratories and the epidemiological surveillance, clinical management, and vector management components, to ensure adequate information flow.	X	X	X	IMS-Dengue managers and GT-Dengue National.
A.2. Certify and strengthen the capability of the reference laboratories of the Americas to diagnose dengue.	1. Consolidate the regional WHOCC and strengthen its role as the RELDA Technical Steering Committee.	X	X	X	PAHO/WHO, WHOCCs.
	2. Ensure country participation in RELDA.	X	X	X	PAHO/WHO, WHOCCs, management component.
	3. Promote the establishment, in each country, of a national reference laboratory to handle viral isolation, detection of nucleic acids, antigens, and specific antibodies for dengue and other circulating flaviviruses.	X	X	X	PAHO/WHO, WHOCCs.
	4. Evaluate and harmonize the algorithms for dengue laboratory diagnosis in the Americas, with emphasis on countries' internal networks.	X	X		PAHO/WHO, WHOCCs, NRLs.
	5. Evaluate and transfer new technologies for dengue diagnosis, genomic mapping of circulating viral strains, and differential diagnosis in the countries of the Region, according to the needs detected.	X	X	X	PAHO/WHO, WHOCCs, Ministries of Health, international agencies.
	6. Arrange for the supply of critical nonmarket supplies to support and ensure the continuity of specific and differential diagnosis.	X	X	X	PAHO/WHO, WHOCCs.
	7. Replace the diagnostic methods used in the private sector and promote its participation in the internal networks of each country; offer proficiency testing.	X	X	X	Ministries of Health.

Activities	Tasks	Timeframe* for imple-mentation			Responsible party
		S	M	L	
A.3. Strength-en the information flow mecha-nisms of the laboratory component.	1. Improve the timeliness and flow between information generated by laboratories and the national surveillance system.	X	X	X	IMS-Dengue managers and GT-Dengue National.
	2. Increase communication among collaborat-ing centers and NRLs, and among these and the laboratories of the national networks.	X	X	X	WHOCCs, NRLs.
	3. Publish continuous reviews and updates of the methods and tests proposed for generic integrated surveillance of dengue.		X	X	WHOCCs, NRLs.
A.4. Strength-en quality manage-ment in the reference laboratories of the Americas.	1. Maintain and expand the availability of international proficiency tests for national reference laboratories.	X	X	X	WHOCCs.
	2. Evaluate the operation of internal networks through proficiency audits and tests led by the national reference laboratories.	X	X	X	NRLs.
	3. Strengthen integration and interaction be-tween the laboratory, surveillance, patient care, and integrated vector management components.	X	X	X	Laboratory, surveil-lance, patient care, management, and IVM components.
	4. Evaluate processes to strengthen quality management in the reference laboratories and internal networks of countries.	X	X	X	WHOCCs, NRLs.
	5. Maintain an up-to-date level of capacity-building for dengue diagnosis in national reference laboratories.	X	X	X	WHOCCs, NRLs.
A.5. Develop lines of research that generate state-of-the-art knowledge on new tools, enhance existing ones, and improve surveillance interventions.	1. Study the genetics and virulence of DENV strains circulating in the Americas.	X	X	X	WHOCCs, NRLs, research institutes.
	2. Develop/evaluate methods for: a. Discovering correlates of protection against dengue. b. Distinguishing between natural and vaccine-acquired infection. c. Serological differentiation of the different flaviviruses, especially in secondary infections. d. Rapid diagnosis and correlation with clinical course.	X	X	X	WHOCCs, NRLs, research institutes
	3. Study the circulation of other arboviruses in the Region.	X	X	X	WHOCCs, NRLs.
	4. Characterize the immune response in sequential infections by dengue and other flaviviruses.	X	X	X	WHOCCs, NRLs, research institutes.
	5. Set up international panels to evaluate com-mercial and nonmarket diagnostic methods through multicenter trials.		X	X	WHOCCs, NRLs.

* S: short-term (1 year), M: mid-term (2-3 years), L: long-term (4-5 years).

4.4.4 Integrated vector management (IVM)

IVM is a rational decision-making process that seeks to optimize the use of resources in vector control. Its purpose is to improve effectiveness and achieve sustainability in vector prevention and control activities, which includes the following processes:

- Selection of methods based on knowledge of biology, disease transmission, and morbidity.
- Use of multiple interventions, often combined in synergistic and synchronized fashion.
- Collaboration of the health sector with other public and private sectors related to the environment, whose mandate influences or can influence vector reduction.
- Integration of families and other key partners (education, finance, etc.).
- Establishment of a legal framework to underpin an integrated, intersectoral approach.

Despite the development and implementation of IMS-Dengue in different countries, entomological surveillance remains inadequate and little effective in some. Furthermore, prevention and control actions are not up-to-date or standardized, which prevents synchronized decision-making on various activities. National programs have little interaction with the other components of the IMS-Dengue and with other sectors that could provide effective assistance. In general, vector control has remained limited to insecticide application during epidemic periods, without up-to-date guidelines and with no defined evaluation or monitoring activities to determine the effectiveness of the applied measures. Basic and operational research is limited, which leads to limited development of new control strategies and lack of validation of existing ones. In countries where there is an adequate legal framework, it is often ignored. Due to the evolution of control programs specific to each country (often based on paternalistic conceptions), populations have not been empowered or made aware of their shared responsibilities as key, active players in controlling breeding sites of *Aedes aegypti*, which remains the most dangerous vector in the Americas.

In recent years, personnel are no longer being kept up to date, equipment is not renewed and maintenance of existing equipment is limited or nonexistent, there is no adequate evaluation of the resistance of *Aedes aegypti* to insecticides, and field work receives only limited supervision. In this regard, PAHO/WHO, in collaboration with the CDC and the United States Agency for International Development, among others, is developing a regional proposal for technical recommendations on effective surveillance, prevention, and integrated vector management activities.

Given that the dengue vector is found mainly in dwellings, a strategy must be developed to transfer responsibility and capacity for the control of domiciliary and peridomiciliary breeding sites to individuals and families, in order to ensure that these environments are mosquito-free. The results of the 22 evaluations of national IMS-Dengue strategies and the presence of chikungunya and Zika in the Americas demonstrate the urgent need for effective implementation of IVM. It is paramount that mechanisms be deployed to ensure that all actors comply with the regulatory framework. Basic and operational research in the areas covered by IVM must be expanded to allow validation of existing tools, techniques, and methodologies, to develop new vector control tools, and to strengthen monitoring and evaluation through the standardized use of innovative methodologies as they become available.

Table 14. Integrated vector management: indicatiors

Expected results	Indicators	Data sources for verification	Assumptions
R.1. *Aedes aegypti* breeding sites controlled and population density reduced.	1. House index, Breteau index 2. Proportion of countries that monitor resistance to insecticides.	• Reports of entomological surveys (LIRAa, etc.). • Reports on the deployment of new techniques by countries.	• Political, intra-sectoral, and intersectoral commitment to vector control. • Community participation. • Availability of human resources, equipment, and supplies in adequate quantity and quality. • Effective and validated interventions.

Table 15. Integrated vector management: Expected results and activities

Expected results	Activities
R.1. *Aedes aegypti* breeding sites controlled and population density reduced.	A.1 Strengthen the entomological surveillance system to guide vector control activities. A.2 Empower families and other key actors to ensure their active participation in the control of breeding sites, raising awareness of the epidemiological risk these represent. A.3 Improve the quality and effectiveness of technical vector control activities. A.4 Conduct basic and operational research that can provide feedback for the process and improve decision-making.

Table 16. Integrated vector management: tasks and timeframe for implementation

Activities	Tasks	Timeframe* for implementation			Responsible party
		S	M	L	
A.1. Strengthen the entomological surveillance system to guide vector control activities.	1. Devise mechanisms for integration of entomological surveillance data into the integrated analysis for timely and appropriate decision-making.	X	X	X	IMS-Dengue National managers, GT-Dengue National.
	2. Create or review national IVM guidelines as per the latest PAHO/WHO recommendations.	X	X	X	IMS-Dengue National managers, GT-Dengue National and International.
	3. Develop standardized and reliable methods for vector surveillance.		X	X	IMS-Dengue National managers, GT-Dengue National and International, other partners.
A.2. Empower families and other key actors to ensure their active participation in the control of breeding sites, raising awareness of the epidemiological risk these represent.	1. Coordinate with key actors to determine intersectoral and interdisciplinary strategies to empower the population, families, authorities, and other sectors to carry out the preventive activities of IVM.	X	X	X	IMS-Dengue National managers, GT-Dengue National and International, other partners.
	2. Conduct a diagnosis of behavioral patterns of key actors to guide the communication strategy.	X	X	X	IMS-Dengue National managers, GT-Dengue National and International, other partners.
	3. Devise a mass communication method (COMBI or otherwise) with key indicators of several components to permit monitoring and evaluation of the empowerment of key actors.	X	X	X	IMS-Dengue National managers, GT-Dengue National and International, other partners.
	4. Design and implement, in a sustained manner, communication plans for: a. Achieving the behavioral changes identified in diagnosis. b. Strengthening the role of the community in vector control activities through public awareness campaigns.	X	X	X	IMS-Dengue National managers, GT-Dengue National and International, other partners.

Activities	Tasks	Timeframe* for implementation			Responsible party
		S	M	L	
A.3. Improve the quality and effectiveness of technical vector control activities.	1. Apply adulticides and larvicides, effectively and safely, during outbreaks or epidemics.	X	X	X	Ministry of Health, GT-Dengue National.
	2. Evaluate the quality and impact of vector control interventions with reliable, practical, and standardized methods.	X	X	X	GT-Dengue National.
	3. Improve current control techniques, incorporating new validated tools for physical, biological, or chemical control.	X	X	X	IMS-Dengue National managers, GT-Dengue National.
A.4. Conduct basic and operational research that can provide feedback for the process and improve decision-making.	1. Define a strategy for monitoring and evaluation of resistance and susceptibility to insecticides in vector populations.	X	X	X	Ministry of Health, universities, research centers, PAHO/WHO, other partners.
	2. Promote intersectoral strategic partnerships for basic and operational research within the framework of the IVM.	X	X	X	PAHO/WHO, Ministry of Health, universities, research centers.
	3. Investigate new vector control strategies in order to improve the delivery of dengue-related services through integrated approaches, e.g., ecological, biological, and social.	X	X	X	Ministry of Health, universities, research centers, PAHO/WHO, other partners.
	4. Promote the development of business innovations, coordinated with social initiatives, to support vector prevention and control activities with new tools and approaches.		X	X	Ministry of Health, universities, research centers, PAHO/WHO, other partners.

* S: short-term (1 year), M: mid-term (2-3 years), L: long-term (4-5 years).

4.4.5 Environmental management

Dengue transmission depends on the presence of several social or environmental determinants whose prevention, control, and modification are not the sole responsibility of the health sector. In this regard, both IMS-Dengue and the WHO Global Strategy 2012-2020 emphasize an intersectoral and inter-institutional approach for proper implementation. It is also very important to create a legal framework that allows reduction of the most frequent vector breeding sites, which are caused by construction, inadequate disposal of tires or barrels, domestic water storage tanks, and other domestic containers that serve as breeding sites.

Several legislative experiences to facilitate the elimination of breeding sites have been carried out in the Region. Brazil, Costa Rica, El Salvador, Panama, and Paraguay offer some examples. However, climate change, poor solid waste collection systems, permanent water scarcity requiring water storage, and uncontrolled urbanization are some of the elements for which political support at the highest level is required, in addition to cooperation of the actors, and especially international cooperation.

As already mentioned, it is important not to postpone action to achieve behavioral change in families with regard to eliminating vector breeding sites in their homes, within the framework of environmental sanitation actions carried out by local governments. Multidisciplinary teams need to investigate how to achieve such impact, taking into account the specific features of the local culture and setting. With the support of GT-Dengue International, work will continue to design tools like COMBI-dengue, which can be adopted and adapted by countries.

Table 17. **Environmental management: indicators**

Expected results	Indicators	Data sources for verification	Assumptions
R.1. Implementation of specific cross-sectoral environmental management activities to allow reduction of the entomological risk of dengue transmission.	1. 100% of countries have an officially established cross-sectoral management working group as of 2017. 2. 100% of countries are implementing cross-sectoral plans as of 2017.	• Country reports (participating entities, management and compliance agreements). • Designed plans. • Monitoring and supervision visits.	• Permanent political commitment is available at the highest level. • Actors that can influence environmental management and the reduction of transmission risks are actively involved in the working groups. • A legal framework for environment and health is in place and operational, as are management agreements for the involved institutions.

Table 18. Environmental management: tasks and timeframe for implementation

Activities	Tasks	Timeframe* for implementation			Responsible party
		S	M	L	
A.1. Set up a cross-sectoral group based on mapping of public- and private-sector actors involved environmental management at the national and subnational levels.	1. Identify social actors and establish implementation responsibilities corresponding to their respective spheres of action.	X	X		Ministry of Health, GT-Dengue National and subnational.
	2. Plan and implement cross-sectoral environmental management activities to reduce entomological risk.	X	X	X	GT-Dengue National and subnational.
	3. Conduct an intersectoral regional meeting with those responsible for water, waste management, and housing.	X			Those responsible for the environmental management components at the Ministry of Health and GT-Dengue National.
	4. Monitor and evaluate the activities carried out.	X	X	X	GT-Dengue National and subnational.
A.2. Enforcement of laws and regulations that support environmental management to reduce the vector population and thus prevent dengue.	Implement a program consisting of three basic components: • Safe water management (free of breeding grounds). • Final disposal of waste (tires, plastic, and garbage). • Safe housing (with protection measures to prevent contact between vectors and residents).	X	X	X	GT-Dengue National and subnational.

*S: short-term (1 year), M: mid-term (2-3 years), L: long-term (4-5 years).

4.4.6 Vaccines

This component has been added to the IMS-Dengue (2015) based on the recommendations of the *State of the art* meeting on dengue prevention and control. This meeting analyzed whether, in the medium term, once a dengue vaccine is available, regional and national strategies should require that its introduction be within the framework of the IMS-Dengue (2015), as a future component that will contribute effectively to the achievement of its objectives.

The introduction of a vaccine must take into account the criteria established by WHO, i.e., there must be robust scientific and technical evidence of efficacy. Any vaccine available on the market must be safe, effective, and affordable, and must act against all four dengue serotypes.

Each country must define its own vaccine introduction strategy; however, it is recommended to have the necessary epidemiological information available, as well as relevant scientific evidence, which must include the following factors, among others:
- Burden of disease.
- Review of the national legal framework.
- Modifications required by immunization programs.
- Improvements in the epidemiological information system.
- Operational research.
- Health economics studies.

An agreement was reached not to include this component among the tasks listed here; instead, once any of the vaccines currently under investigation is available, a workshop will be held with country staff from all different areas of the GT-Dengue and with immunization experts, all of whom will design an integrated strategy.

4.5 Facilitating factors

According to *Webster's Third New International Dictionary*, to "facilitate" is to make easier or less difficult; to free from difficulty or impediment; or to lessen the labor of a person or group.

During recent years of IMS-Dengue implementation in the countries of the Region, and as a result of the monitoring and evaluation processes, several factors that facilitated the magnitude and degree of progress achieved were repeatedly detected in each country or territory. These were not considered key technical elements of the IMS-Dengue process; however, they showed up repeatedly in different parts of the document. Later, the WHO Global Strategy for Dengue Prevention, 2012-2020 identified these factors in its operational model as key elements of the implementation process. Finally, during the processes of adjustment and revision of the IMS-Dengue in the Region, these elements were included as facilitating factors that strongly determine the degree of progress that can be achieved in each country or territory.

These factors are:
- advocacy
- resource mobilization
- partnerships
- capacity-building
- monitoring and evaluation

4.5.1 Advocacy

Advocacy consists of multiple actions aimed at promoting certain causes or interceding on their behalf. It plays a decisive role from the outset in the development of integrated manage-

ment strategies for the prevention and control of dengue and other arboviruses. Advocacy entails communication, dissemination, persuasion, and convincing activities that must reach all levels of the community to raise awareness about the importance of IMS-Dengue and opportunities for its success. Initially, advocacy should be focus on national technical resources, i.e., those who will be shown the importance and benefits of functionally implementing this new methodology of work. The decision-making and management levels of the health sector in which IMS-Dengue will be implemented should also be involved, and this should be done with the greatest possible intensity so as to reach other sectors and social areas as well, particularly at the governmental and non-governmental levels, nationally and locally, and in the private sector; however, above all, the population must be the key actor to ensure the sustainability of community-based interventions.

The advocacy process is not an attribute of any one component of IMS-Dengue: it is a communication activity inherent to all components and at the highest management level.

For IMS-Dengue promotion activities to be effective, tools must be in place for persuasive communication to achieve active engagement of national partners in implementation of the strategy, with all the capacity required to have an impact on the disease.

Advocacy activities must be continuous and should be part of our agenda, in order to provide sustainability to implementation of the strategy.

4.5.2 Resource mobilization

Resource mobilization can be defined as the process of seeking different types of support for an organization. It includes both direct financial support and in-kind contributions.

After 10 years of IMS-Dengue implementation in the Americas, it has been demonstrated that the countries that have made the most effort to promote the model and that have also strengthened their preparedness and response to outbreaks and epidemics have achieved reductions in the impact of dengue in terms of conserving resources and saving human lives. The latest example is that of Costa Rica and El Salvador, where thanks to early detection of a higher-than-expected increase in cases, the Preparedness and Response Plan was activated, and national and international resources were deployed to initiate and sustain a response.

It is essential to identify public, private, national, and international actors, who need to receive timely and high-quality integrated information in order to secure resources—through ongoing advocacy—to strengthen national capacities for prevention and response to outbreaks and epidemics.

One of the great historical problems of vector control strategies has been the lack of resources. Currently, only a few programs have the necessary resources to carry out vector surveillance and control activities; even so, in no case are they sufficient to address the complexity of the determinants of transmission. Within the framework of IMS-Dengue, the level of resources needed to improve technical activities in the short and medium term is much greater than is currently available. Vector control experts frequently remark that dengue outbreaks are most often controlled with human and material/financial resources that happen to be left over, rather than with resources that should have been allocated in the first place. To reverse this situation, it is essential that plans be made to provide adequate response in terms of dengue surveillance and control, bearing in mind that the high complexity of addressing the determinants of transmission requires public policies and sustainable development strategies with major investment in the social and environmental spheres.

4.5.3 Partnerships

A strategic partnership is a pact or alliance established by companies, organizations, or other entities to work together so that each can achieve its own objectives. It is a very common model of cooperation in business contexts. The problem of dengue is one of such overwhelming magnitude and technical complexity that the health sector cannot respond effectively by itself. Even if technical strategies developed to perfection were available (if this were possible), no lasting impact could be achieved on many indicators of dengue. Morbidity would be one of these indicators, due to the great adaptability of *Aedes aegypti* to domestic life and the great diversity of safe breeding areas that it has managed to find within houses and their surroundings. As control of the disease is fundamentally dependent on control of the vector, it is essential that robust strategic partnerships be forged to enhance and expand interventions on mosquito breeding sites, which are now purely domestic. Schools, places of work, ministries, churches, and the population in general must be allies in the fight against the dengue vector. To achieve greater impact on physical or chemical control of the mosquito, more specialized measures are needed, such as the use of pesticides, a very complex intervention that requires proper management and control by the health sector.

The response to the problem must be global, not sectoral. To that end, strategic partnerships geared to vector prevention and control are essential .

4.5.4 Capacity-building

Capacity-building consists of training people, organizations, or societies to acquire, strengthen, and maintain the necessary skills that allow them to set and achieve their own goals over time. It focuses on education and training (providing new knowledge and reinforcing existing knowledge), but also on improving access to and full enjoyment of individual rights and freedoms. Permanent strengthening of national capacities is one of the missions of PAHO, but it must also be a

mission for each of the health systems of the Region. The working model of IMS-Dengue requires a that all countries take a proactive attitude to training human resources for each component, not only in specialized, technical aspects, but also to develop the professional ability to relate and integrate scientific thought into other operational and academic areas. All this will enable a better joint response to the disease, with a greater impact on the health of the population.

The integrated vector management component, in particular, has very few new tools available. Research efforts must be redoubled, and technologies or methods that can improve current levels of vector control must be incorporated. There must be a constant search for partnerships with other sectors of academia and research centers or scientific institutions at the highest level, seeking to transcend the menial daily work necessary for vector control through planning efforts that allow more in-depth research to support response, prevention, and control capacities.

4.5.5   Monitoring and evaluation

Monitoring can be defined as the collection, analysis, and systematic use of data to monitor the progress of a program toward its objectives and to guide management decisions. It usually focuses on how, when, and where activities take place, who performs them, and how many people or entities it benefits. Evaluation is the systematic appreciation of an activity, project, program, policy, theme, sector, operational area, or institutional performance. The conclusions, recommendations, and lessons of an evaluation should be used when making future decisions related to the program.

During the early stages of IMS-Dengue implementation in the Region, the monitoring and evaluation process was carefully planned. In the last five years of implementation, 22 countries have received external evaluations, and the logical frameworks of each national IMS-Dengue include the different process and impact indicators to be monitored by national teams and GT-Dengue International.

In current national IMS-Dengue interventions, it is difficult to manage indicators that measure the impact of control are difficult, which are imprecise given the known dynamics of transmission and the diversity of environmental and social determinants; thus, the decision was made to prioritize process indicators and monitor the quality of technical work, which can and should be improved.

All countries must have appropriate national indicators and internal monitoring and evaluation processes in place at subnational levels, regardless of their degree of integration into each component. Levels of responsibility must be well defined to ensure that necessary measures can be taken to permanently foster implementation of programs and activities. GT-Dengue International will continue to carry out comprehensive external evaluations in the countries.

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Annex A. Evaluation of IMS-Dengue implementation in the Region: progress and limitations. Main results of the implementation of IMS-Dengue in the Region

Components	Progress	Limitations
Epidemiology	• Increase in the number of countries that consistently conduct weekly case reporting and monitoring. • Increase national capacity to detect and respond to outbreaks in a timely manner. • Development and improvement of information systems, some in real time (Brazil, Cuba, El Salvador, and Mexico). • Dissemination of information on the epidemiological situation through bulletins published on Ministry of Health websites. • Integration of information from several components in different countries.	• Lack of integration of the information from all components in analysis. • Outdated national surveillance standards. • Surveillance information is not used properly for prevention, response, and control planning. • No automated system for the collection of indicators from all IMS-Dengue components.
Patient care	• PAHO/WHO clinical guidelines for the care of dengue patients adapted for the Americas and available since 2010. • Implementation of the new PAHO/WHO 2010 dengue classification in the countries of Latin America and the Caribbean. • National guidelines for patient management updated with PAHO/WHO recommendations. • Healthcare staff at the hospital level trained in the new clinical guidelines.	• Insufficient dissemination of and training on new guidelines at the primary care level. • Mismanagement of patients with dengue despite availability of documents that strongly recommend clinical investigation of warning signs as predictors of severity.
Laboratory	• Arbovirus Diagnosis Laboratory Network of the Americas (RELDA) established to conduct refresher courses for the staff of 21 national reference laboratories. • Extension of serological diagnosis capabilities through real-time polymerase chain reaction to all RELDA laboratories. • Systematic reporting on viral circulation in the epidemiological bulletins of most RELDA member countries.	• Noncompliance with good laboratory practices for dengue diagnosis has been detected in evaluations. • Lack of standardized criteria and algorithms for definition of confirmed cases. • The genomic map of the region is unknown.

Components	Progress	Limitations
Integrated vector management	• Rapid entomological surveys of the LIRAa type. • Improvement of rapid outbreak response, integrating entomological and epidemiological information. • Implementation of new strategies for tire disposal and recycling (e.g., Ecopontos in Brazil). • Training on the subject of insecticide resistance and stewardship (Argentina, Bolivia, Brazil, Cuba, Panama, Paraguay, etc.).	• Scarce, outdated vector control personnel. • Entomology laboratories severely lacking in human and material resources. • Insufficient monitoring and evaluation of control activities in the field. • Poor surveillance of insecticide resistance in Aedes aegypti. • Little activity and limited financial resources for integrated vector management.
Environmental management	• Implementation of regulations to reduce generation of breeding sites (tires, flowerpots) in several Latin American countries (Bolivia, Brazil, Costa Rica, El Salvador, Paraguay, etc.). • Entry into force, in some countries, of laws that regulate the generation of breeding sites during construction in urban areas (e.g., in Panama). • Municipal ordinances in several countries to punish those who create breeding sites.	• Lack of participation of key actors working on social determinants (water, sanitation, waste collection) related to outbreak prevention and response. • Few public policies aimed at protecting the environment and preventing breeding sites from forming. • Little participation of families and communities in physical control of vector breeding sites within their areas.
Social communication	• Definition of the COMBI-dengue strategy as a tool to promote integrated participation of all key actors in the region, especially families, in home-based interventions. • Systematization of successful experiences and limitations identified during implementation of the COMBI strategy in 15 countries from 2004 to 2011.	• Little emphasis on the distribution of human and financial resources for health promotion. • High turnover of communication (health promotion) personnel, leading to lack of continuity and sustainability of COMBI-dengue plans.

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