# Epidemiological Update
Dengue

23 March 2020

Situation summary

In the Region of the Americas, between epidemiological week (EW) 1 and EW 8[1] of 2020, a total of 560.086 cases of dengue, including 118 deaths. Of the total cases, 137,900 (25%) were laboratory-confirmed and 1,560 (0.3%) were classified as severe dengue. The case-fatality rate was 0.023%.

The number of cases reported until EW 8 of 2020 (560.086) is above the number of cases reported in the same period in 2019 (315,647) and 2018 (74,701) and exceeds the number of cases reported in 2015 epidemic year by 77%. In 2020, the proportion of severe dengue (0.28%) is under the observed in 2019 (0,47%) and 2015 (0,38%). The number of cases reported in the last 10 years, 2010 to 2019 (16,52 million) exceeds the number of cases reported in the period from 2000 to 2009 (6,78 million) by 144% (**Figure 1**).

Figure 1. Distribution of reported dengue cases and proportion of severe dengue cases, by year of report. Region of the Americas, 1999-2020 (up to EW 8 of 2020).
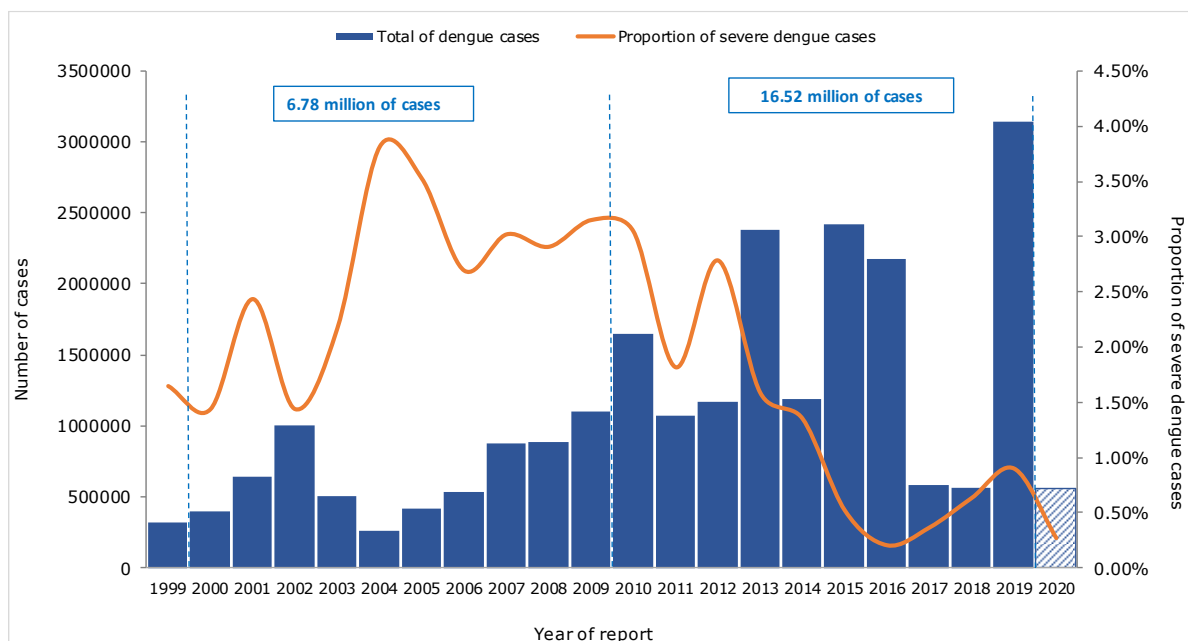
Source: Data entered into the Health Information Platform for the Americas (PLISA, PAHO / WHO) by the Ministries and Institutes of Health of the countries and territories of the Region.
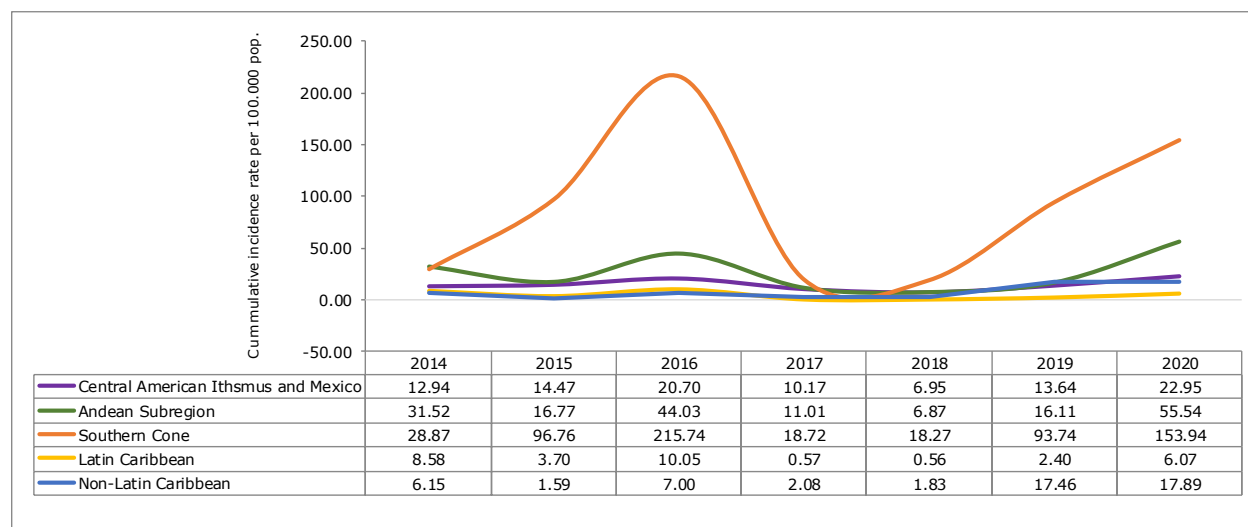
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[1] Data available in the Health Information Platform for the Americas (PLISA, PAHO/WHO), accessed on 13 March 2020. Available at: https://bit.ly/314Snw4

Suggested citation: Pan American Health Organization / World Health Organization. Epidemiological Update: Dengue. 23 March 2020, Washington, D.C. PAHO / WHO. 2020

Between EW 1 and EW 8 of 2020, 27 countries and territories of the Region of the Americas reported an increase in cases at the national level or in some areas of the country compared to 2019. Countries such as Belize, Colombia, Costa Rica, Ecuador, Dominica, the Dominican Republic, Honduras, Mexico, Panamá, and Perú, reported two to three times more cases than the previous year. Other countries and territories, such as Bolivia, Guadeloupe, French Guiana, Martinique, Paraguay, Saint Lucia, Saint Martin, and Suriname reported at least 6 times more dengue cases.

When comparing the cumulative incidence rates by sub-region in 2020 (through EW 8) with the previous epidemic period (2015, through EW 8), the incidence rates exceed those during the previous epidemic cycle for all sub-regions (**Figure 2**).

Figure 2. Incidence rates of reported dengue cases through EW 8, by year and sub-region. Region of the Americas, 2014-2020.

	2014	2015	2016	2017	2018	2019	2020
Central American Ithsmus and Mexico	12.94	14.47	20.70	10.17	6.95	13.64	22.95
Andean Subregion	31.52	16.77	44.03	11.01	6.87	16.11	55.54
Southern Cone	28.87	96.76	215.74	18.72	18.27	93.74	153.94
Latin Caribbean	8.58	3.70	10.05	0.57	0.56	2.40	6.07
Non-Latin Caribbean	6.15	1.59	7.00	2.08	1.83	17.46	17.89

Source: Data entered into the Health Information Platform for the Americas (PLISA, PAHO/WHO) by the Ministries and Institutes of Health of the countries and territories of the Region.

The four dengue virus serotypes (DENV 1, DENV 2, DENV 3, and DENV 4) are present in the Americas. In 2020, co-circulation of all four serotypes was detected in Brazil, Colombia, and Mexico; serotypes DENV 1, DENV 2, and DENV 3 co-circulated in Guatemala and Saint Martin; DENV 1, DENV 2, and DENV 4 co-circulated in Paraguay[2].

In 2020, the five countries in the Americas with the highest incidence rates were Bolivia, Brazil, Belize, Honduras, Colombia, Nicaragua y Peru. (**Table 1**).

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[2] More information on circulating serotypes by country is available at: PAHO/WHO Health Information Platform for the Americas (PLISA): https://bit.ly/314Snw4

Table 1. Incidence rates and number of dengue cases, proportion of severe dengue cases, case-fatality rates, and serotypes, in 8 selected countries of the Region. EW 1 to EW 8 of 2020.

Country	Incidence rate (cases per 100,000 pop.)	Number of cases	Proportion of severe dengue (%)	Case fatality rate (%)	Serotypes reported
Paraguay	1,992.50	137,423	0.07	0.025	1-2-4
Belize	473.00	123.82	0.00	0.000	1-3
Bolivia	350.83	39,349	0.19	0.030	1-2
Nicaragua	212.38	13,348	0.13	0.000	2
Brazil*	156.69	326,697	0.05	0.017	1-2-3-4
Honduras	89.84	7,991	9.30	0.100	1-2
Colombia	103.8	27,710	1.10	0.022	1-2-3-4
Peru	25.25	8,221	0.85	0.134	1-2

*This value refers to the incidence rate of total dengue cases reported in Brazil, in the corresponding period.

Note: To calculate the incidence rates, proportion of severe dengue cases, and case-fatality rates, discarded cases were excluded.
N/A: Not applicable – no data available

Source: Data entered into the Health Information Platform for the Americas (PLISA, PAHO/WHO) by the Ministries and Institutes of Health of the countries and territories of the Region. For Colombia and Honduras, the data was shared by the International Health Regulations (IHR) National Focal Points (NFPs).

The following is a summary of the epidemiological situation for dengue in select countries.

In **Bolivia**, between EW 1 and EW 8 of 2020, 39,349 cases of dengue were reported, including 12 deaths. Of the total reported cases, 7,861 were laboratory-confirmed and 114 were classified as severe dengue (case fatality rate of 0.031%). An increasing trend, over the threshold, was observed during the first weeks of 2020 (**Figure 3**). Of the confirmed cases reported, 80% were in five departments: Santa Cruz (75%), Beni (8%), Chuquisaca (5%), Cochabamba (4%), and Tarija (4%).

As of EW 8 of 2020, the national cumulative incidence rate was 350,83 cases per 100,000 population, representing a 1,113% relative increase compared to the same period in 2019 (28.91 cases per 100,000 population).

The case-fatality rate at the national level in 2020 was 0.030%, which is below that observed in 2019 (0,278%). Deaths were reported in the departments of Beni (2), La Paz (1), and Santa Cruz (9).

As of EW 8 of 2020, DENV 1 and DENV 2 serotypes were reported as circulating.

Figure 3. Dengue cases reported by endemic channels by epidemiological week of report. Bolivia, EW 1 to EW 8 of 2020.
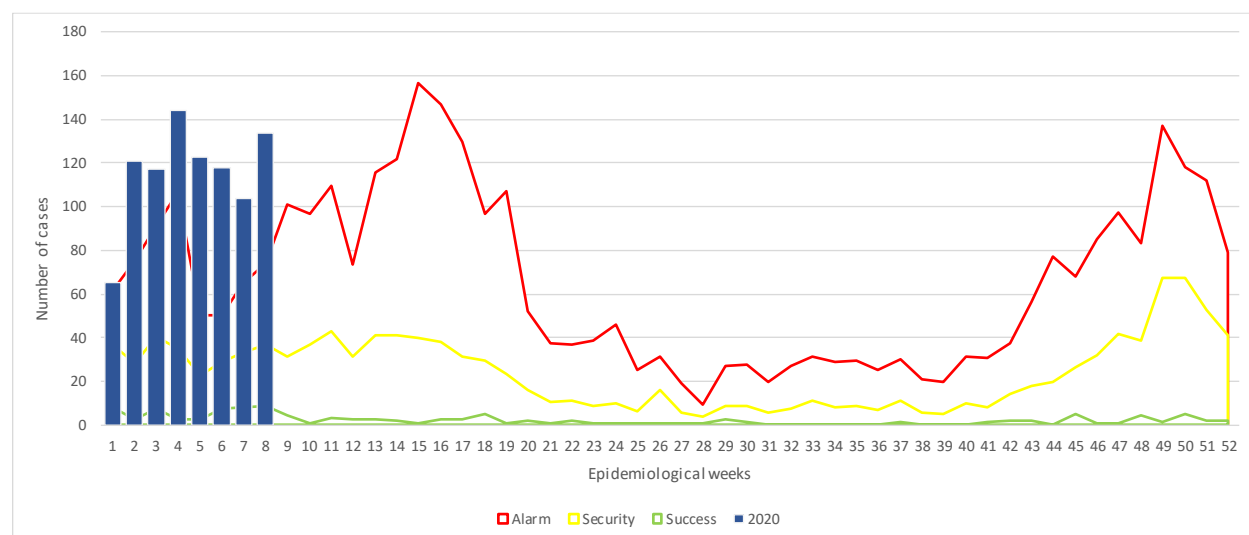
**Source:** Data received from the Bolivia Ministry of Health and reproduced by PAHO/WHO.

In **Brazil**, between EW 1 and EW 9 of 2020, a total of 337,243 cases of dengue were reported, including 58 deaths. Of the total cases, 271,407 cases were probable cases, 120,322 (35.6%) were confirmed by laboratory or clinical-epidemiological criteria. Of the total of confirmed cases, 2.180 were classified as dengue with warning signs and 164 (0.05%) as severe dengue.

In 2020, the cumulative national incidence rate of probable cases was 129.1 cases per 100,000 population. By geographical region, the highest incidence rate was reported in the Central-West (305.0 cases per 100,000 population), followed by the South (274.7 cases per 100,000 population). The federal units with the highest incidence rates were in the North Region: Acre (406.7 cases per 100,000 population) and Roraima (101.5 cases per 100,000 population); in the North East Region: Rio Grande do Norte (58.3 cases per 100,000 population) and Bahia (38.6 cases per 100,000 population); in the Southeast Region: Sao Paulo (193.9 cases per 100,000 population) and Minas Gerais (95.4 cases per 100,000 population); in the South Region: Paraná (711.9 cases per 100,000 population); and in the Central-West Region: Mato Grosso do Sul (728.3 cases per 100,000 population) y Mato Grosso (276.3 cases per 100,000 population). Of the total probable cases reported, 42.3 % were in the Southeast region (**Figure 4**).

The case-fatality rate at the national level in 2020 was 0.02%. Of the total deaths reported in 2020, 28.1% (58 deaths) were confirmed by clinical-epidemiological criteria or laboratory and 148 remain under investigation. The highest case-fatality rates were observed in the North (0.042%) and Central-West (0.032%). By age group, persons aged 80 years and older had the highest case-fatality rate (0.42%), followed by persons aged 70 to 79 years (0.10%).

As of EW 9 of 2020, all four serotypes, DENV 1, DENV 2, DENV 3, and DENV 4 were identified circulating.

Figure 4. Dengue incidence rate distribution by region and epidemiological week. Brazil, EW 1 to EW 9 of 2020.
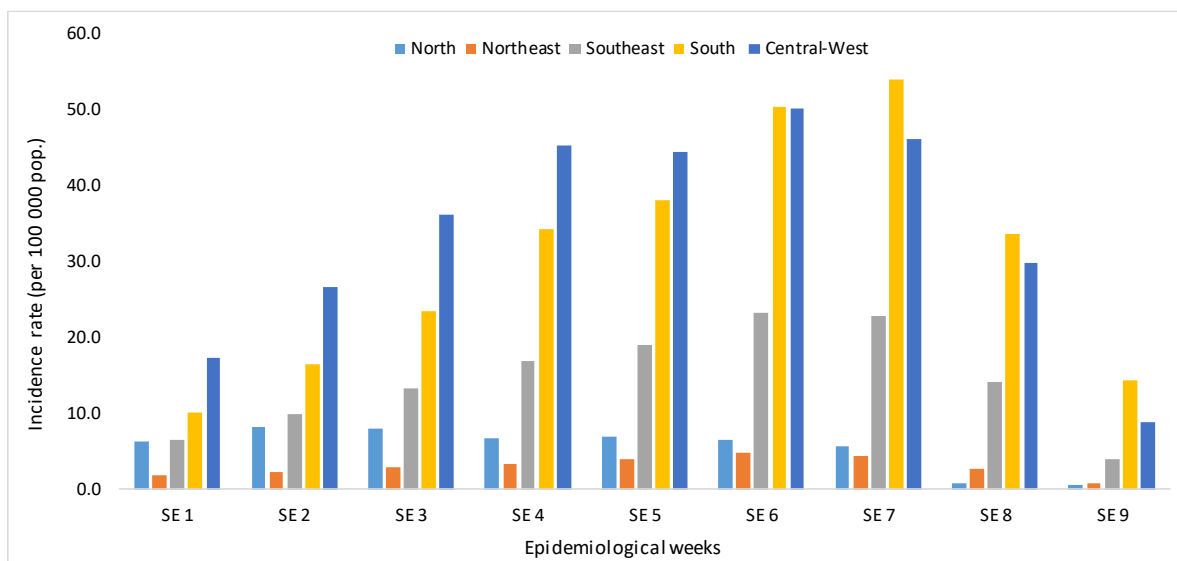
Source: Data published by the Brazil Ministry of Health and reproduced by PAHO/WHO.

In **Chile**, in EW 5 of 2020, a confirmed case of autochthonous dengue fever was reported on Easter Island, has been diagnosed by PCR and serotype 2 (DENV 2) has been identified, this is the first autochthonous case due to this serotype in the insular territory. Laboratory confirmation has been performed at the national reference laboratory of the Chile Institute of Public Health (ISP, per its acronym in Spanish) on 6 February 2020. As of EW 11 of 2020, 4 autochthonous cases of dengue DENV 2 were reported in the Easter Island. Among the 4 cases, 3 are female, age ranges from 25 to 49 years. No travel history reported.

In 2019, a total of 38 dengue cases were reported on Easter Island (28 autochthonous DENV 1 cases, 9 imported cases from Tahiti (4 DENV 1 and 5 DENV 2 cases), and one probable autochthonous DENV 1 case).

In **Colombia**, between EW 1 and EW 8 of 2020, 27,710 cases of dengue were reported, including 6 confirmed deaths. Of the total reported cases, 10,057 (36.3%) were laboratory-confirmed, 14,741 were classified as dengue with warning signs, and 306 (1,1%) as severe dengue. Between EW 8 of 2019 and EW 8 of 2020, an increasing trend above the epidemic threshold was observed, compared with the historical behavior (2013-2019) (**Figure 5**). Of the cases reported, 63.6% were in 7 territory entities: Cali, Cesar, Huila, Meta, Santander, Tolima, and Valle del Cauca.

In 2020, the cumulative national incidence rate was 103.8 cases per 100,000 population, considering the at-risk population[3], representing a 267% relative increase compared to the same period in 2019 (28.2 cases per 100,000 population).

In 2020, 51.7% of the reported cases are male, and children under 5-years-old accounted for 12.8% of the overall cases (3,511) and 14.1% (43) of severe dengue cases.

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[3] Colombian at risk population: 26,689,338 population

5

Of the 36 territorial entities of the country, 14 had incidence rates above the national rate (103.5 cases per 100,000 population). The departments with an incidence rate exceeding 200 cases per 100,000 population were in the following departments in decreasing order: Huila (407.4 cases per 100,000 population), Amazonas (322.0 cases per 100,000 population), Tolima (310.4 cases per 100,000 population), Valle de Cauca (276.9 cases per 100,000 population), Caquetá (234.9 cases per 100,000 population), Vaupés (228.3 cases per 100,000 population), Cundinamarca (222.0 cases per 100,000 population), and Guainía (211.9 cases per 100,000 population).

Of the total of deaths reports (53), 6 were confirmed, 14 were discarded and 33 remain under investigation.

As of EW 8 of 2020, serotypes, DENV 1, DENV 2, DENV 3, and DENV 4 were identified circulating.

Figure 5. Dengue cases reported by endemic channels by epidemiological week of report. Colombia, EW 1 of 2019 to EW 8 of 2020.
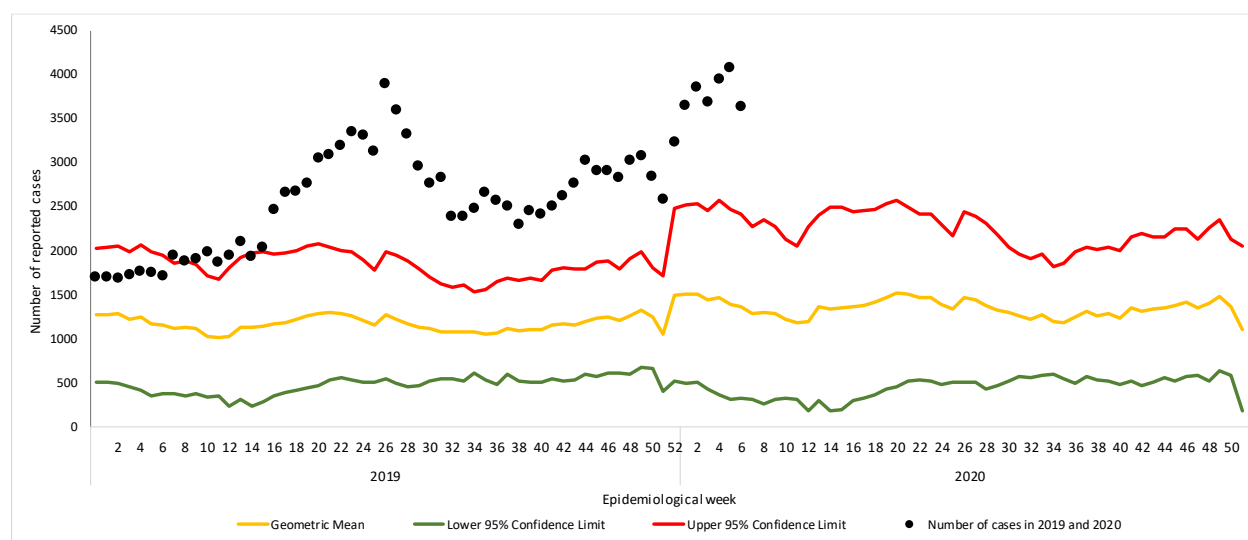

Source: Data published by the Colombia National Institute of Health and reproduced by PAHO/WHO.

In **French Guiana**, between EW 1 of 2019 to EW 8 of 2020, a total of 487 confirmed cases of dengue, with no severe cases or deaths, was reported (**Figure 6**). The most affected communes were Kourou, on the coastline, with 225 confirmed cases, and Maripasoula, in the south-eastern part of French Guiana with 55 confirmed cases.

Since January 2020, DENV 2 serotype has been identified in 63% of the total reported cases.

6

Figure 6. Distribution of suspected and confirmed dengue cases by epidemiological week, French Guiana, EW 1 of 2019 to EW 7 of 2020.
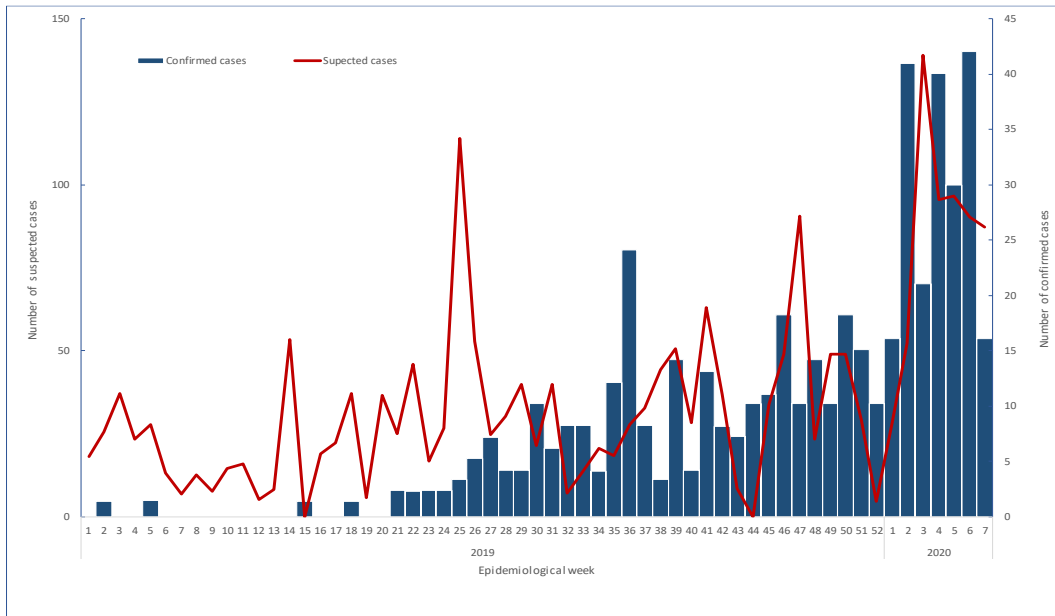
Source: Data published in Le point épidémio, Santé publique France – Cellule Guyane, 20 February 2020 and reproduced by PAHO/WHO

In **Guadeloupe,** between EW 42 of 2019 to EW 7 of 2020, a total of 5,840 cases of dengue, with no severe cases or deaths, were reported. Of these, more than 1,200 were confirmed by laboratory. No severe dengue or deaths were reported. Out of the total of cases, 44% (2,540 cases) were reported since EW 1 of 2020. An increasing trend above the epidemic threshold was observed. (**Figure 7**).

Between EW 3 to EW 8 of 2020, clinically diagnosed cases were reported in 14 of the 24 communes with a sentinel general practitioner (out of a total of 32 communes that make up the archipelago). Most of the cases were reported in the following communes: Basse-Terre, Le Gosier, Le Moule, Petit-Bourg, Petit-Canal, Pointe-Noire, and Saint-François and the isle of Marie-Galante (eastern and central part of the main island).

As of EW 8 of 2020, the cumulative national incidence rate is 387.53 cases per 100,000 population, representing an 806% increase compared to the same period of 2019 (incidence rate of 42.76 per 100,000 population) and exceeded the observed in the 5 last years.

In 2020, DENV 2 serotype was identified.

7

Figure 7. Distribution of suspected dengue cases by epidemiological week, Guadeloupe, EW 35 of 2017 to EW 6 of 2020.
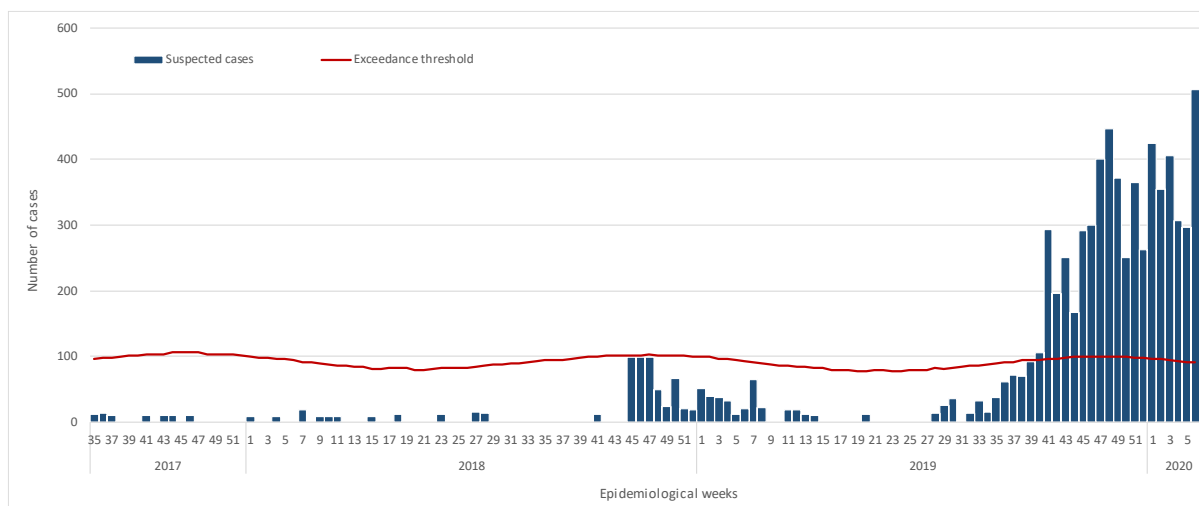
Source: Data published in Le point épidémio, Santé publique France – Cellule Antilles, 20 February 2020 and reproduced by PAHO/WHO

In **Honduras**, between EW 1 and EW 8 of 2020, a total of 7,991 suspected cases of dengue were reported, including 8 laboratory-confirmed deaths, and 9.3% (746 cases) were classified as severe dengue[4].

As of EW 8 of 2020, the cumulative national incidence rate is 89.84 cases per 100,000 population, representing a 167% increase compared to the same period of 2019 (incidence rate of 33.68 per 100,000 population) and exceeded the observed in the 5 last years.

As of EW 8 of 2020, all 20 health regions reported dengue cases. The regions that reported the highest proportion of severe dengue cases were: San Pedro Sula (76%), El Paraiso (12.2%), and (4%).

Of the 15 deaths reported, 8 were laboratory-confirmed, 7 were discarded following laboratory testing. Of the total of confirmed deaths, 75% (6) were among children under 15 years and 75% (6 deaths) were among females. Out of the total of deaths, 87% (7 deaths) were reported in the Metropolitan Central District (50%) and Metropolitan San Pedro Sulas (37%). In 2020, DENV 1 (10%) and DENV 2 (90%) serotypes were identified.

In **Martinique**, between EW 27 of 2019 to EW 7 of 2020, 2,470 suspected cases of dengue and 575 cases confirmed by laboratory, including two severe cases and one death, were reported (**Figure 8**). Out of the total of suspected cases, 47% (1,155) were reported since the beginning of January 2020. Between EW 4 and EW 7 of 2020, confirmed cases were reported in 18 of the 34 communes of the island. The most affected parts of the island are in the South and Central of Martinique.

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[4] In 2019, the high proportion of cases of severe dengue in Honduras is due to the fact that dengue cases with warning signs were included in this clinical classification. In 2020, dengue cases with warning signs are no longer being included under severe dengue.

8

As of EW 8 of 2020, the cumulative national incidence rate is 208.31 cases per 100,000 population, representing a 762% increase compared to the same period of 2019 (incidence rate of 24.16 per 100,000 population) and exceeded the observed in the 5 last years. In 2018, no confirm cases were reported.

In 2020, DENV 2 and DENV 3 serotypes were identified.

Figure 8. Distribution of suspected dengue cases by epidemiological week, Martinique, EW 35 of 2017 to EW 7 of 2020.
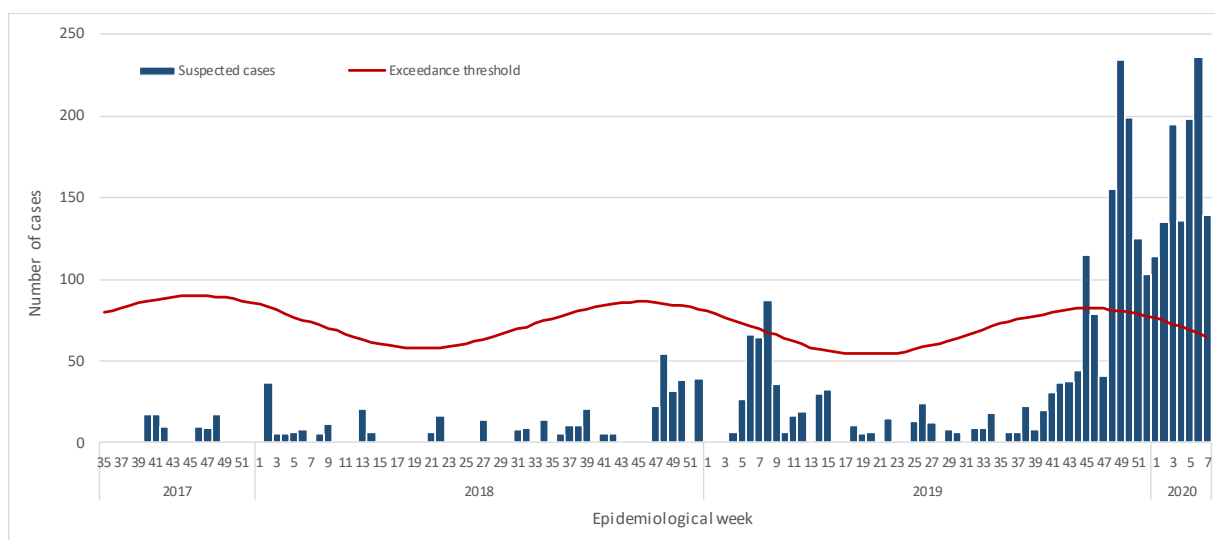
Source: Data published in Le point épidémio, Santé publique France – Cellule Antilles, 20 February 2020 and reproduced by PAHO/WHO

In **Nicaragua**, between EW 1 and EW 8 of 2020, a total of 12,961 suspected cases of dengue were reported (196.5 cases per 100,000 population), of which 459 (3.5%) were confirmed, no deaths were reported. Of the total reported cases, 10 (0.07%) were classified as severe dengue.

By age group, the highest incidence rates were among 1-year-olds (868.4 cases per 100,000 population) and under 1-year-olds (793.5 cases per 100,000 population).

As of EW 8 of 2020, the cumulative national incidence rate is 196.5 cases per 100,000 population, representing a 5.3% increase compared to the same period of 2019 (incidence rate of 186.6 per 100,000 population). The highest incidence rates were reported in the departments of Granada (464.1 cases per 100,000 population), León (412.1 cases per 100,000 population), and Madriz (296.1 cases per 100,000 population).

As of EW 8 of 2020, DENV 2 serotype was identified.

In **Paraguay**, between EW 1 and EW 10 of 2020, a total of 184,434 cases of dengue (confirmed, probable, suspected), including 46 deaths (case fatality rate: 0.030%) were reported. Of the total of reported cases, 1,289 (0.69%) were confirmed by laboratory (RT-PCR) and 18,975 were classified as probable cases, 137 (0.07%) were classified as severe dengue. During the first weeks of 2020, an ascendant trend of reported cases was observed, with a peak in EW 6 of 2020, since the first week of 2020 an increasing trend above the epidemic threshold was observed. Out of the total of confirmed cases by RT-PCR, 60.43% were reported in 2 health regions, Central (42.90%), and Asunción (17.53%).

In 2020, the cumulative national incidence rate is 2,201.55 cases per 100,000 population, above the incidence rate for the same period of 2019 (3.02 cases per 100,000 population).

In 2020, the case fatality rate at national level is 0.030%; in 2019 no deaths were reported. The deaths in 2020 were reported in the departments: Central (26), Asunción (6), Paraguarí (3), Concepción (3), San Pedro (3), Cordillera (2), Presidente Hayes (1), Alto Paraná (1), and Caaguazú (1).

As of EW 10 of 2020, serotypes DENV 1(0.07%), DENV 2 (6.43%) y DENV 4 (93.48%) were identified circulating, with DENV 4 predominating.

In **Peru**, between EW 1 and EW 7 of 2020, 8,221 cases of dengue were reported, including 11 deaths. Of those, 3,929 (47.8%) were laboratory-confirmed, 1,626 were classified as dengue with warning signs, and 70 (0.8%) as severe dengue. As of EW 39 of 2019, an increasing trend of cases was observed. In 2020, 87% of cases were reported from 5 departments: Madre de Dios, Loreto, San Martín, Junín, and Ucayali.

In 2020, the cumulative national incidence rate was 25.20 cases per 100,000 population, above the incidence rate for the same period in 2019 (3.97 cases per 100,000 population).

In 2020, 6 of the 19 departments in the country had incidence rates above the national incidence rate of 25.20 cases per 100,000 population, listed in decreasing order they are: Madre de Dios (1,500.48 cases per 100,000 population), Loreto (249.62 cases per 100,000 population), San Martin (135.28 cases per 100,000 population), Tumbes (109.73 cases per 100,000 population), Ucayali (64.67 cases per 100,000 population), and Junín (28.28 cases per 100,000 population).

As of EW 7 of 2020, the highest incidence rates by age group were among 12 to 17-year-olds (40.84 cases per 100,000 population), 18 to 29-year-olds (31.45 cases per 100,000 population), and children under 11-years (29.53 cases per 100,000 population).

As of EW 7 of 2020, serotypes, DENV 1 and DENV 2 were identified circulating.

In **Saint-Barthélemy**, between EW 49 of 2019 and EW 7 of 2020, a total of 530 suspected cases of dengue, including 20 confirmed cases, and no severe dengue or deaths, were reported. In 2020, the cumulative national incidence rate is 557,78 cases per 100,000 population, no cases were reported in the 2 last years (**Figure 9**).

In 2020, DENV 1, DENV 2, and DENV 3 serotypes were identified.

Figure 9. Distribution of suspected dengue cases by epidemiological week, Saint-Barthélemy, EW 35 of 2017 to EW 6 of 2020.
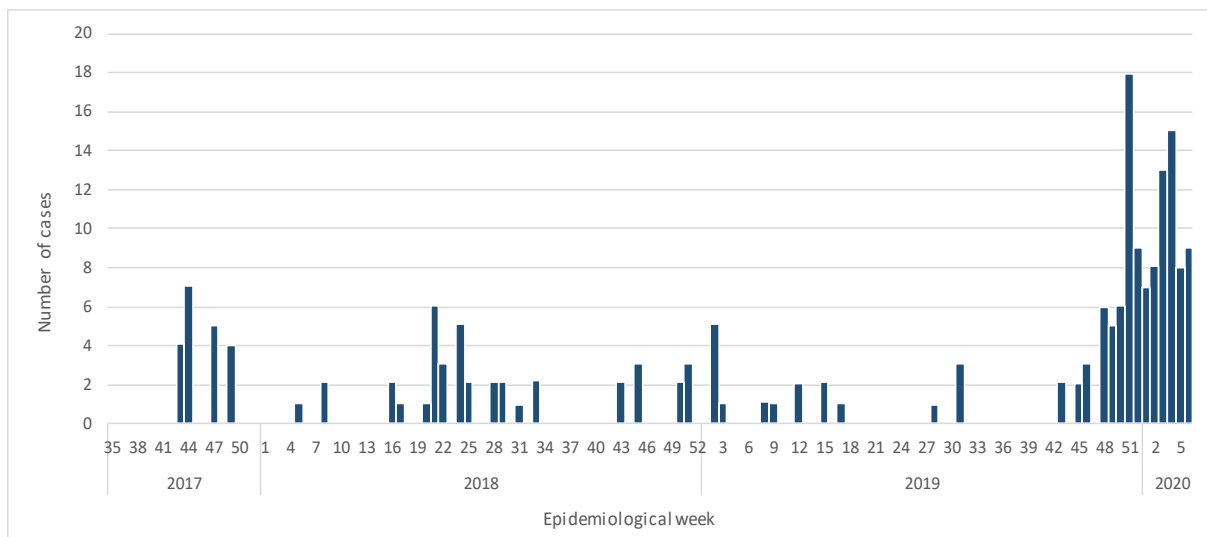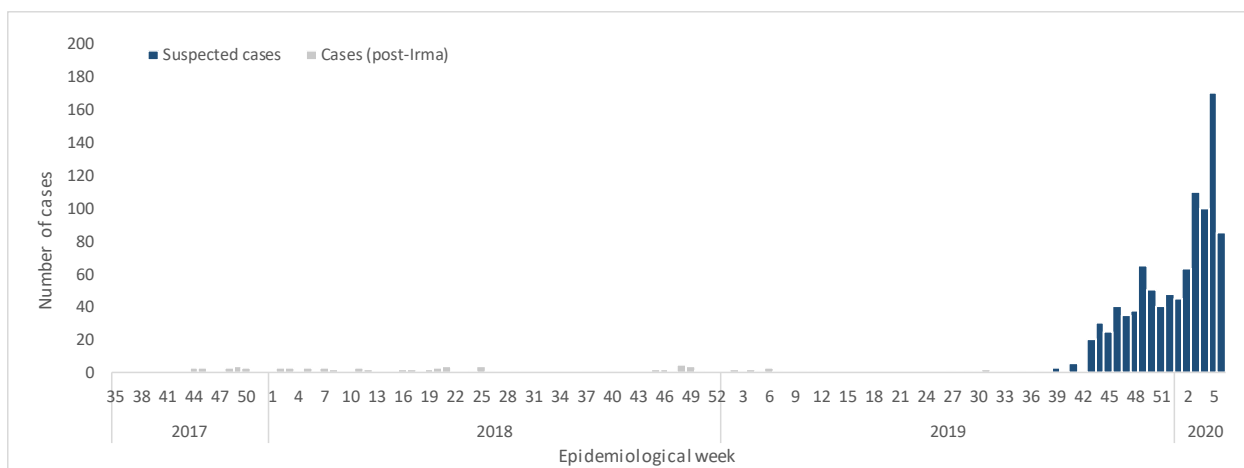

Source: Data published in Le point épidémio, Santé publique France – Cellule Antilles, 20 February 2020 and reproduced by PAHO/WHO

In **Saint-Martin**, between EW 2 and EW 7 of 2020, a total of 530 suspected cases of dengue, including one severe and fatal case, was reported. In 2020, the cumulative national incidence rate is 1,109.38 cases per 100,000 population, representing a 1,675% increase compared to the incidence rate for the same period of 2019 (62.50 per 100,000 population) and exceeding the observed in the 5 last years (**Figure 10**).

In 2020, the serotypes identified are DENV 2, DENV 3, and DENV 1, with the latter predominating.

Figure 10. Distribution of suspected dengue cases by epidemiological week, Saint-Martin, EW 35 of 2017 to EW 6 of 2020.

Source: Data published in Le point épidémio, Santé publique France – Cellule Antilles, 20 February 2020 and reproduced by PAHO/WHO

11

In **Uruguay**, the detection of the first autochthonous dengue case was reported in EW 10 of 2020. The case is a 41-year-old female from the department of Salto, without travel history. Symptoms onset 22 February 2020, with fever, vomiting, and rash on lower limbs and back. On 5 March, the Public Health Laboratories Department confirmed the sample by RT-PCR, the serotype identified was DENV 1. In EW 11 of 2020, the second autochthonous dengue case was reported in a 66-year-old female, mother of the first case, from the department of Salto, with no travel history. Symptoms onset 22 February with fever, headache, vomiting, myalgia, arthralgia, and rash. This case was detected during the convalescent stage of the disease, the sample was processed in the Public Health Laboratories Department and confirmed by IgM and IgG.

These are the first autochthonous dengue cases reported in Uruguay since 2016. In February 2016, an outbreak of dengue cases occurred following 100 years with no autochthonous cases.

Advice to Member States

Given the increase in cases of dengue and severe dengue in several countries and territories in the Region of the Americas, the Pan American Health Organization / World Health Organization (PAHO/WHO) urges Member States to implement inter-sectoral preparedness and response measures for these outbreaks. PAHO/WHO reiterates the recommendations provided to Member States in the 21 November 2018 Epidemiological Alert[5] and the 22 February 2019 Epidemiological Update[6].

The following is a summary of the key recommendations regarding outbreak preparedness and response, case management, laboratory diagnosis, risk communication, and integrated vector management.

Outbreak preparedness and response

As part of outbreak preparedness and response, it is recommended that Member States:

- strengthen disease surveillance, including laboratory diagnosis;

- review emergency plans;

- strengthen and intensify vector surveillance and control;

- ensure that healthcare professionals are properly trained for appropriate clinical diagnosis and clinical management of patients with dengue or other arboviruses, **with a special focus on age groups and at-risk groups with the highest case-fatality rates;**

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[5] Pan American Health Organization / World Health Organization. Epidemiological Update: Dengue. 21 November 2018, Washington, D.C. PAHO / WHO. 2018. Available at: https://bit.ly/2U13MtX
[6] Pan American Health Organization / World Health Organization. Epidemiological Update: Dengue. 22 February 2019, Washington, D.C. PAHO / WHO. 2019. Available at: https://bit.ly/2VUSX1C

- involve the community in prevention and control activities;

- ensure performance of the outbreak response is monitored and systematized, including the establishment of a situation room; and

- adapt risk communication according to the epidemiological scenario.

In countries with presence of the vectors but without dengue virus circulation, preparedness and response plans should focus on strategies to reduce the risk of transmission. Rapid investigation of all clinically suspected cases should be carried out as well as laboratory testing to confirm the presence of the dengue virus.

Situation Room

The situation room is a key tool for informed decision making, wherein information is analyzed through multi-disciplinary teams to support health management. It has a key role in the response to outbreaks and emergencies situations. In the case of dengue, the situation room is typically where key aspects of the inter-sectoral response are tracked, bringing together information from all involved sectors. The activities carried out in the situation room include, but are not limited to:

- Analysis and continuous systematic assessment of the current and prospective situation.

- Integration of epidemiological information, including laboratory diagnosis, vector control, and case management, aimed at:

  o Early detection of cases and outbreaks.

  o Monitoring trends and incidence.

  o Understanding the dynamics of viral circulation.

- Guide and maintain data collection, including data quality control.

- Monitor actions and impact of intervention measures.

- Produce periodic concise, operationally focused situation reports to support coordination of the emergency or outbreak response. The situation report should:

  o Provide a snapshot of the current needs, response, and gaps during outbreaks or emergency situations.

  o Be a tool for mobilizing resources.

- Manage key aspects of logistics for the ongoing prevention and control response.

Case management

While the clinical manifestations of the disease are complex, treatment is relatively simple, inexpensive, and very effective in saving lives if timely and adequate management is provided. Early recognition of warning signs at different stages of the disease is critical in order to provide the necessary health care, and therefore prevent progression to severe disease.

When the clinical diagnosis is suggestive of dengue, chikungunya, or Zika, patients (particularly children), should be managed as a case of dengue and monitored daily to detect warning signs of severe illness, especially during the critical phase of the disease[7].

In cases of dengue without warning signs, patients[8] should receive information about these signs for timely identification of warning signs and for seeking medical assistance.

WARNING SIGNS OF DENGUE
1. Intense abdominal pain or tenderness. 2. Persistent vomiting. 3. Clinical accumulation of liquids. 4. Bleeding from mucous membranes. 5. Lethargy or irritability. 6. Postural hypotension (lipothymia). 7. Hepatomegaly greater than 2 centimeters. 8. Progressive increase in hematocrit.

Clinical management and treatment of patients suspected with dengue should be initiated without waiting for laboratory confirmation of dengue. Initial clinical diagnosis is sufficient to offer timely and adequate medical care and treatment.

Organization of healthcare services and referral of patients

The main objective of the prevention and control measures during dengue outbreaks is to prevent deaths. Consequently, timely and adequate care of patients, as well as strengthening coordination between different health areas and services, should be promoted. If dengue cases increase, the healthcare network should consider expanding healthcare services and ensuring sufficient supplies, equipment, medication, access to clinical tests, and hospital beds; adequate patient monitoring and the use of patient tracking forms should also be ensured.

The **primary level of healthcare** is key in the management of dengue cases, as this is the level in which the first contact with patients occurs and where most cases receive medical attention. Therefore, it is recommended that the primary level of healthcare:

- Have sensitized and trained personnel for the triage of cases upon arrival at the healthcare service. These personnel should provide instructions and guidance to patients and/or family members on how to identify warning signs of dengue and seek the nearest healthcare service as soon as these signs occur.

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[7] PAHO / WHO. Dengue: Guidelines for patient care in the Region of the Americas, 2nd Edition 2016. Available at: https://bit.ly/2U1Pp8t

[8] Or parents or guardians, in the case of children.

14

- Have healthcare personnel trained to observe and detect patients who present with warning or severe signs in waiting, in order to ensure immediate care and reduce waiting time.

- Establish *dengue units* for the management of dengue cases with warning signs.

- Ensure continuous clinical monitoring of patients with specialized medical needs, co-morbidities, pregnant women, concomitant conditions, or persons whose social situation makes it difficult to access the necessary care (such as persons living in remote places, refugees, displaced persons, among others).

- Establish referral and counter-referral systems for severe dengue cases between different healthcare levels. Severe cases of dengue should be referred to a higher-level unit (secondary or tertiary level), after stabilization of the patient and coordination between healthcare units.

- All units of this level should have flowcharts and guidelines for the clinical management of dengue, available to all medical and paramedical personnel, for any necessary consultation during medical attention of patients.

The **secondary** and ***tertiary levels of healthcare*** should be designed for the management of severe cases of dengue. Thus, overwhelming these units is avoided and specific clinical care can be provided to patients requiring highly specialized care.

As part of the organization of the healthcare systems in emergency situations or outbreaks, the following is necessary:

- A group of highly specialized physicians should be established to provide medical guidance on diagnosis and management of dengue cases, mainly to support physicians in remote areas (peripheral areas).

- A hotline for consultation with a trained physician, particularly for healthcare personnel in peripheral areas.

- The healthcare personnel in healthcare units should have access to clinical guidelines and flowcharts for the care of dengue cases.

- Continuous education should be maintained in healthcare units, particularly regarding the management of severe and difficult-to-treat cases as well as the analysis of dengue deaths.

A timely approach, the correct classification of cases, and proper case management are key elements of healthcare to prevent patient deaths due to dengue. A delay in medical care for these cases is often related to the cause of death.

Laboratory diagnosis

Diagnosis and etiological confirmation of dengue infection can be performed through virological assays (viral isolation, detection of genetic material, detection of NS1 protein, or immunohistochemistry) or by serological tests for the detection of IgM antibodies.

Virological diagnosis

- *Molecular detection*: During the first 5 days from the onset of symptoms (acute phase, viremic period), viral RNA from a serum sample can be detected using molecular techniques such as conventional or real-time reverse transcription polymerase chain reaction (RT-PCR). A positive PCR result (with appropriate controls) confirms the diagnosis.

- *Viral isolation*: Can be performed by intracerebral inoculation in mice or in cell culture. However, due to its complexity, this is rarely used as a routine diagnostic test and is recommended only for research or characterization to complement public health surveillance.

- *NS1 Protein*: The nonstructural protein 1 (NS1) of the dengue virus can be detected by ELISA up to 9 days after the onset of symptoms. However, since it is a protein produced at an early stage of infection, it is most likely detected between the first 3 to 5 days after the onset of symptoms.

- *Post-mortem diagnosis*: In fatal cases, it is recommended to take tissue samples (preferably liver, followed by spleen and kidney) in buffered formalin for histopathological and immunohistochemical assay. Additionally, molecular methods (RT-PCR) from fresh tissue samples (taken in dry tube and maintained in refrigeration), or preserved in paraffin, can also be used for the confirmation of fatal cases associated with dengue or to conduct differential diagnosis.

Serological diagnosis

A positive IgM result using the ELISA technique (MAC-ELISA or any other immunoassay) in a sample taken after the fifth day of symptom onset is presumptive of recent dengue infection. A single serum in the acute phase is considered presumptive, so it is recommended that a second sample be taken between one and two weeks after the first sample to demonstrate seroconversion (negative to positive) or an increase up to four times the antibody titer (with one quantitative assay).

Cross-reactivity with other flaviviruses (mainly in secondary infections) should be considered in areas where co-circulation with other flaviviruses (e.g., Zika, yellow fever, St. Louis Encephalitis, etc.) is documented and where there is a likelihood that the population has been previously infected.

Therefore, the detection of antibodies for other flaviviruses (e.g., IgM for Zika) by ELISA should be conducted in parallel. A positive result for dengue IgM in the absence of IgM for Zika (negative) is presumptive of dengue infection, while a negative IgM result for dengue with Zika-positive IgM will be presumptive of infection by the latter. However, a positive result for

16

the two assays only indicates a recent flavivirus infection, and therefore, it will not be possible to confirm an etiologic agent. For this reason, results should be analyzed while also considering the clinical characteristics and the epidemiological history of the case.

Rapid tests

Immunochromatography-based rapid tests have been widely used for the diagnosis of dengue. However, in addition to the challenges observed by cross-reactivity, these types of tests have shown low sensitivity so the negative predictive value is very low, and a negative result will not rule out a case. Due to this, implementation and use of these types of tests for public health purposes should be carefully assessed.

Risk Communication

Risk communication and information to the public is essential during outbreaks to reduce adverse impact, decrease domestic breeding sites, and for affected persons to seek timely medical assistance, and therefore prevent severe cases and deaths from dengue. Communication messages should focus on the identification of warning signs and obtaining timely medical assistance.

In addition, communication campaigns should raise public awareness on the importance of vector control interventions at home, identification of febrile cases, and special measures for vector control, specifically the control of intra- and peri-domiciliary breeding sites, and personal protection.

Entomological surveillance and vector control

Given the high *Aedes aegypti* infestation rates and presence of *Aedes albopictus* in the Region, it is recommended that prevention and control measures be aimed at reducing vector density, with assistance and collaboration of the local populations in adopting these measures.

National authorities should implement prevention and control measures that include the following:

Entomological surveillance

Currently, entomological surveillance is carried out mainly during the immature phase of the vector, both for practical operational reasons and to reduce the risk of virus transmission. However, it can also be done through traps (ovitraps, larvae traps, adult traps) or by capturing adults (aspirators). To make such surveillance more productive and effective, it is recommended:

- That entomological surveillance support communication and social mobilization for the implementation of physical control measures of mosquito breeding sites that individuals and families should carry out in their homes and places of work and study.

17

- Have human resources duly trained to carry out entomological surveillance and vector control in areas of epidemiological and entomological risk defined by the ministries or secretariats of health.

- That technicians at the central and local levels have manuals or guides that indicate, step by step, the methods of sampling the vector in the immature and adult phases.

- That entomological surveillance activities be assigned to institutional technical personnel or experienced operators who are directly and indirectly supervised.

- Vector control programs should ensure that the necessary equipment and supplies for vector surveillance are available (vials, droppers, flashlights, alcohol, worktables, traps, aspirators and office supplies). This is essential to guarantee the quality of the data obtained.

- That entomological surveillance provides updated and detailed information on the evolution of infestation rates and of the most productive containers in support of the planning and implementation of control measures larvicided breeding sites or the physical removal of breeding sites by families.

- That surveillance for the susceptibility or resistance of larvae and adult mosquitoes to the products used in the control be carried out systematically, in accordance with the methods proposed by PAHO / WHO. This is to ensure the effectiveness of products used in larval or adult vector control.

- That exists updated maps of vector distribution, density and graphs on the temporal and spatial evolution of the main entomological indicators evaluated.

- Provide a standardized message on vector surveillance and control measures to the residents of the households visited, which is essential for the application of such measures and the sustainability of the physical elimination of breeding sites.

- Require that during the inspection visit to the home, the technician be accompanied by its owner or someone adult person living in the house. This is for safety reasons and in case an environmental sanitation measure is required, so that it is carried out by the inhabitant of the house. In addition, the technician must convey the message that "vector control in homes and workplaces is the responsibility of the inhabitants and their families" and is not the responsibility of the health sector alone.

Vector control

Larval control

Larval control in tanks or breeding sites that cannot receive physical treatment (elimination or hermetic protection) must rest in the following conditions, which will be carried out by health workers:

- Locations should be stratified into high, medium and low risk categories, according to the epidemiological and entomological criteria established in the country, with the objective of establishing priorities for operations.

- Guarantee stocks of larvicides for use, taking into account that as activities intensify their consumption may increase, therefore, it is necessary to plan well and consider the need to make emergency purchases of larvicides (chemical or biological).

- Use larvicides and doses as recommended by PAHO / WHO, to guarantee safety and efficacy (PQT-VC, 2020).

- Larvicides should be stored in a different environment (warehouse) than other insecticides used in public health, in order to avoid contamination of the former, as larvicides will be applied to water used for human consumption.

- If in specific areas the percentage of containers with larvae or pupae or both is mostly in containers that cannot be eliminated, it will be necessary to strengthen the washing, correct brushing, protection of the containers (hermetic closing) and / or the campaigns of application of larvicides (chemical or biological), where technically recommended. On the other hand, if the percentage of containers that can be disposed of is higher, it is important to coordinate breeding sites elimination campaigns with local authorities and organized groups in those areas.

- It is important to conduct communication and education campaigns for behavioral change aimed to the elimination/protection of vector containers/ breeding sites.

- The message to protect water tanks by covering them hermetically and cleaning them (brushing batteries and barrels) at least once every 6 days is essential, as is the control of other breeding sites present both in homes and in the surrounding areas, as well as places of work and study.

- The information provided to the population should be transmitted sufficiently in advance whenever technical interventions are planned in their community, so that they can organize their support for them.

- Health care services (health units, hospitals, clinics, etc.), schools, universities, and nursing homes should not have vector presence for an area of least 400 meters around these spaces. The managers of these units or premises must have their own personnel trained in the identification and elimination of these entomological risks. Training of these personnel should be coordinated with the vector control program.

- Cemeteries, tire and junkyards must be considered high risk areas and receive special attention are significant sites for the generation of mosquitoes, given their level of productivity and source of constant infestation, they should be considered high risk areas and receive special attention.

Adult vector control

This type of control consists of eliminating the mosquito in its adult phase with the spatial application of insecticides (adulticides) at ultra-low volume (UBV) in cold or thermo-fogging (hot), with portable equipment (backpack type or bazooka) or vehicle-mounted equipment, residual applications can also be used. The function of this approach is to kill infective females, to interrupt or decrease transmission, and for these operations, the following conditions must be met:

- Guarantee reserves of adulticides to be used, considering that as adult control activities intensify, consumption may increase.

- An inventory of portable equipment and vehicle-mounted equipment that are in good working order should be available. Likewise, vehicle operators and drivers must be trained.

- Ensure that the adult insecticide control product application is done in the correct dose and in accordance with the technical standards recommended by PAHO/ WHO (PQT-VC, 2020).

- Vector control programs should make appropriate personal protective equipment (masks, long-sleeved shirts, scarves, ear protectors and caps) available to operational personnel for these activities and monitor their use to ensure worker safety.

- Individual portable equipment for indoor treatment is the most effective in reducing dengue transmission.

- The use of heavy equipment constitutes a highly productive control method, i.e., it can cover large areas in a short time, but is less effective than spraying with portable equipment for indoor spraying. For the insecticide to enter homes more effectively, residents must collaborate by opening windows and doors; to achieve their collaboration, it is recommended to communicate in advance to the population the days, hours, and places that will be fumigated.

- Since adulticidal spraying only affects adult mosquitoes, existing eggs, larvae, and pupae quickly repopulate the site, which can sustain transmission for a short time. Adequate entomo-epidemiological evaluation should guide future treatment.

- Elimination of breeding sites and the combined and simultaneous treatments with larvicide and adulticide are essential to rapidly reduce mosquito density and consequently also virus transmission. This is a necessary emergency measure when transmission occurs, but the most effective measure of prevent and protect of people is to eliminate mosquito breeding sites.

- Fogging with portable equipment must be carried out during the day (indoor application) by a couple of operators and carried out while applications using vehicle-mounted equipment will be carried out during the hours of least vehicle traffic and when the temperature is lower (early morning and late afternoon). Space

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insecticide applications are not recommended in the hottest hours of the day or in rainy weather.

- The mixture preparation should be carried out by trained personnel and carried out just before application. It is not recommended to prepare the mixture to be used for several days (for example, for the week).

- Operators of vehicle-mounted generator equipment must respect the speed rules established for the method used.

- Equipment calibration and proper nozzle size is essential to ensure the correct dose of insecticide is applied; which should be checked regularly.

- Application of adulticide must be accompanied by communication and education campaigns for behavioral change; (control of breeding sites and adults).

- Cleaning and maintenance of the equipment is important and must be carried out daily and according to the manufacturer's instructions so that the equipment can work properly.

Personal prevention measures

Patients infected with the dengue virus are the reservoir of infection for other people. Therefore, public health measures to minimize patient exposure to mosquitoes become imperative to prevent the spread of the virus and thus the disease.

It is necessary to educate the patient, other household members and the affected community about the risk of transmission and ways to minimize this risk by reducing the vector population and contact between the vector and people.

To minimize vector-patient contact it is recommended:

- The patient must rest under mosquito nets, impregnated or not, with insecticide.

- The patient, as well as other members of the household, must wear long sleeves (if there are sick people in the house) to cover the extremities.

- Repellents containing DEET, IR3535 or Icaridin, can be applied to exposed skin or clothing, and their use must be in strict accordance with the instructions on the product label.

- Use wire-mesh / mosquito nets on doors and windows.

These personal prevention measures are also effective in preventing transmission of the virus to healthy people.

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