# Epidemiological Update
# Dengue, chikungunya and Zika

## 10 June 2023

During 2022, several countries in the region registered increases in the number of dengue, Zika, and chikungunya cases compared to those reported in 2021. During the first months of 2023, chikungunya and dengue fever outbreaks of high magnitude were recorded in South America. Before the start of the high season of dengue transmission in Central America and the Caribbean, the Pan American Health Organization / World Health Organization (PAHO/WHO) recommends that Member States review and adjust their preparedness and response plans to face possible outbreaks of dengue and other arboviral diseases in order to avoid deaths and complications from these diseases.

## Situation Summary

In the Region of the Americas, between epidemiological week (EW) 1 and EW 52 of 2022, 3,125,367 cases[1] of arbovirosis were reported. Of the total cases, 2,811,433 (90%) were dengue cases, 273,685 (8.7%) chikungunya cases, and 40,249 (1.3%) Zika cases. In 2023, between epidemiological week (EW) 1 and EW 21, 2,216,405 cases[1] of arboviral infections were reported. Of the total cases, 1,994,088 (90%) were dengue cases, 213,561 (9.6%) chikungunya cases, and 8,756 (0.4%) Zika cases.
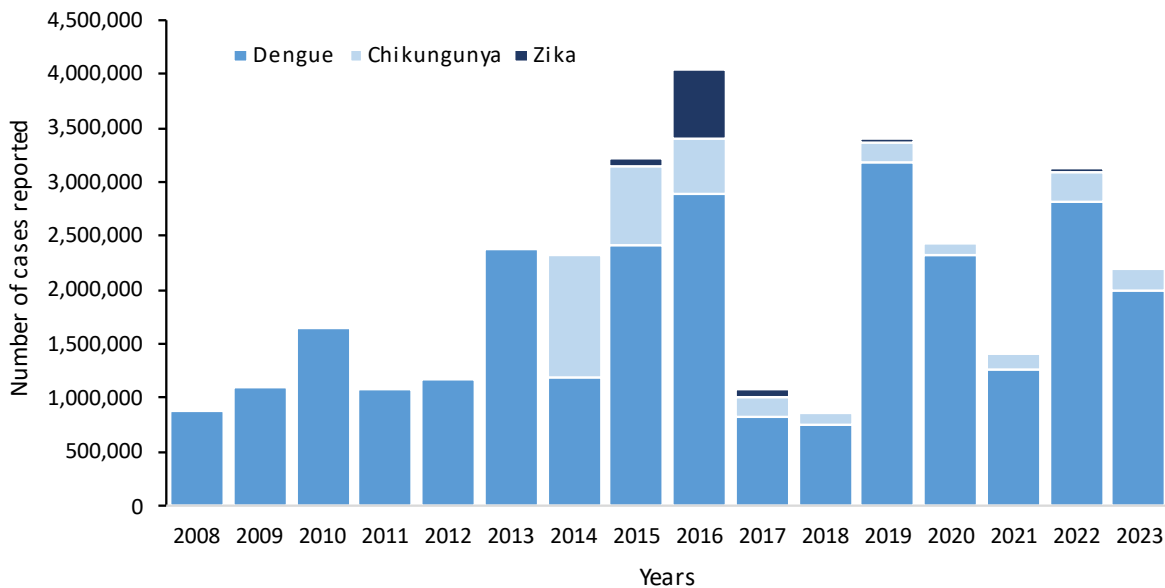
**Figure 1** shows the behavior of dengue, chikungunya and Zika in recent years. Dengue is the arbovirus that causes the highest number of cases in the Region of the Americas, with epidemics that occur cyclically every 3 to 5 years. In 2019, the highest number of historical dengue cases was registered, with more than 3.1 million cases, including 28,203 serious cases and 1,773 deaths. Moreover, is the simultaneous circulation of other arboviral diseases, such as chikungunya and Zika, both transmitted mainly by the same vector, *Aedes aegypti*, which is present in almost all the countries and territories of the Region of the Americas. 2022 was the third year with the highest number of dengue cases, surpassed only by the years 2016 and 2019.

In the Region of the Americas, the number of cases of arboviruses reported in 2022 up to EW 52 (3,125,367 cases), represents an increase of 119% compared to the same period in 2021 (1,425,221 cases). If we compare the cases of arbovirosis notified up to EW 21 of 2023 (2,216,405) with those notified to EW 21 of last year (1,982,243), an increase of 12% is recorded for this year.

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[1] Data available on the Health Information Platform for the Americas (PLISA, PAHO/WHO), accessed 7 June 2023. Available at: https://opendata.paho.org/en

**Figure 1**. Distribution of dengue, chikungunya and Zika cases by year of notification. Region of the Americas, 2008-2023 (until EW 21 of 2023).

Additionally, increase in rainfall is expected for some countries of the Region, especially in Central America and the Caribbean in the second semester of 2023, which, depending on its magnitude and impact on the endemic areas of the aforementioned arboviral diseases, could result in an additional burden of arboviral disease for health systems in the affected areas.

The epidemiological situation of dengue, chikungunya, and Zika in the Region of the Americas is presented below:

# Dengue

Between EW 1 and EW 21 of 2023, a total of 1,994,088 dengue[1] cases were reported in the Region of the Americas, with a cumulative incidence rate of 203 cases per 100,000 inhabitants. The highest cumulative incidence rates were observed in the following Subregions[2]: the Southern Cone with 559 cases per 100,000 inhabitants, the Andean Subregion with 206 cases per 100,000 inhabitants, and the Central American Isthmus and Mexico with 41 cases per 100,000 inhabitants.

Up to EW 21 in 2023, 775,369 (38.9%) were laboratory confirmed and 2,597 (0.13%) were classified as severe dengue of the 1,994,088 dengue cases reported in the Region. The highest number of dengue cases was observed in Brazil with 1,515,460 cases, followed by Bolivia with 126,182 cases and Peru with 115,949 cases. Regarding the number of cases of severe dengue, the highest number of cases was observed in the following countries: Brazil with 654 cases, Bolivia with 558 cases and Colombia with 557 cases. Additionally, in the same period, a total of 738 deaths were reported in the Region (case fatality ratio [CFR]: 0.037%). Keeping the case fatality

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[2] Note: subregions and countries and territories correspond to the divisions described on the Health Information Platform for the Americas (PLISA), available at: https://bit.ly/3lGwSwc. Accessed on 7 June 2023.

rate due to dengue below 0.05% is one of the impact objectives in our Region which highlights the importance of timely diagnosis, early identification of alerts and proper management and treatment of patients, to avoid severe cases and deaths.

**Figure 2**. Dengue cases in 2022, 2023 (up to EW 21) and average of the last 5 years - Region of the Americas.
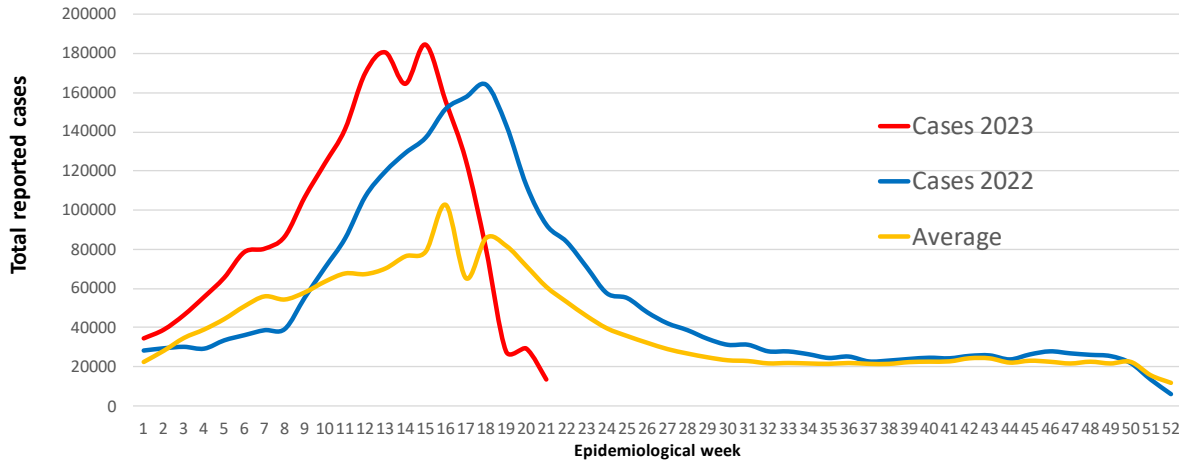


**Source:** Data entered into the Health Information Platform for the Americas (PLISA, PAHO/WHO) by the Ministries and Institutes of Health of the countries and territories of the Region. Available in English at: https://opendata.paho.org/en. Accessed June 7, 2023.

**Figure 3**. Suspected cases and cumulative incidence* of dengue in the most affected countries** in the Region of the Americas, as of EW 21, 2023.
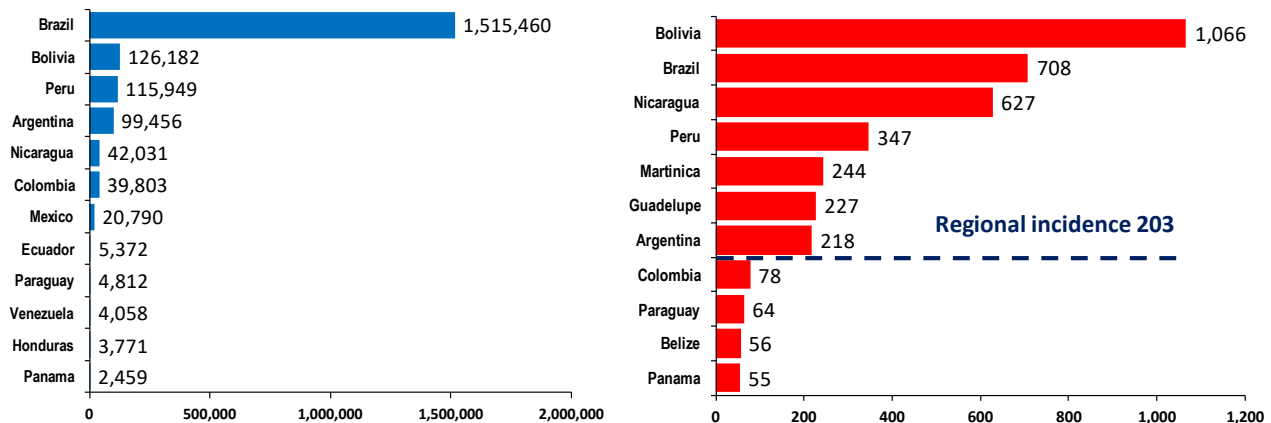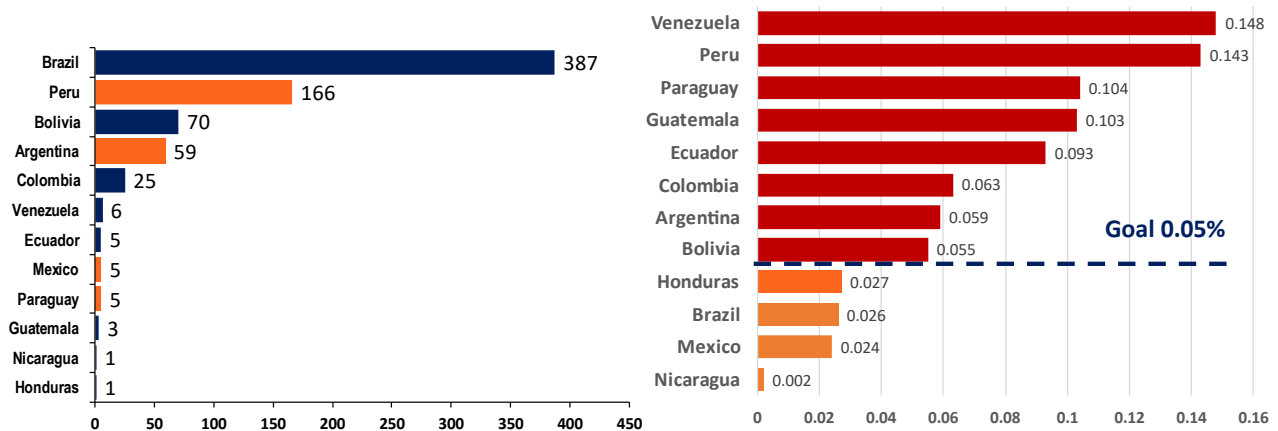


* per 100,000 population
** Countries which reported 99% of cases in the Region of the Americas

**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. Available in English at: https://opendata.paho.org/en. Accessed June 7, 2023.

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**Figure 4**. Deaths and case fatality ratio from dengue in the Region of the Americas, as of EW 21, 2023.

All four dengue virus serotypes (DENV1, DENV2, DENV3, and DENV4) are present in the Region of the Americas. In 2023, up to EW 21, simultaneous circulation of all four serotypes has been detected in Colombia, Costa Rica, Guatemala, Honduras, Mexico and Venezuela; while in Argentina, Panama, Peru and Puerto Rico, DENV1, DENV2 and DENV3[3] serotypes circulate.

Below is a summary of the epidemiological situation of dengue in selected countries in alphabetical order:

### *Argentina*
In 2023 up to EW 20, all 99,456 reported dengue cases were laboratory confirmed. The cases registered up to EW 20 of 2023 are 147 times higher than those reported in the same period of 2022 and 7 times higher compared to the average of the last 5 years (**Figure 5a**). In the same period, a total of 59 deaths were reported (case fatality ratio: 0.059%) (**Figure 5b**)

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[3] More information on the serotypes circulating per country is available on the Health Information Platform for the Americas (PLISA, PAHO/WHO): https://bit.ly/2Pes0li

**Figure 5a**. Dengue cases in 2022, 2023 (up to SE 20) and average of the last 5 years – Argentina
**Figure 5b**. Dengue related deaths and CFR in 2023 (up to EW 20) - Argentina
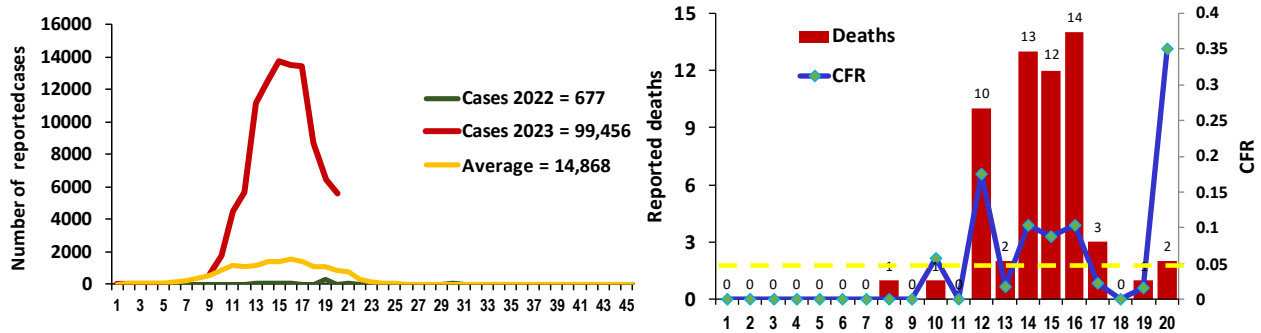


**Source:** Data entered into the Health Information Platform for the Americas (PLISA, PAHO/WHO) by the Ministries and Institutes of Health of the countries and territories of the Region. Available in English at: https://opendata.paho.org/en. Accessed June 7, 2023.

### Brazil

In 2023 up to EW 18, of the 1,515,460 reported dengue cases, 554,542 (36.6%) were laboratory confirmed and 654 (0.04%) were classified as severe dengue. The cases registered up to EW 18 of 2023 are 13% higher than those reported in the same period of 2022 and 73% higher compared to the average of the last 5 years (**Figure 6a**). In the same period, a total of 387 deaths were reported (case fatality ratio: 0.026%). (**Figure 6b**)

**Figure 6a**. Dengue cases in 2022, 2023 (up to SE 18) and average of the last 5 years - Brazil.
**Figure 6b**. Dengue related deaths and CFR in 2023 (up to EW 18) - Brazil.
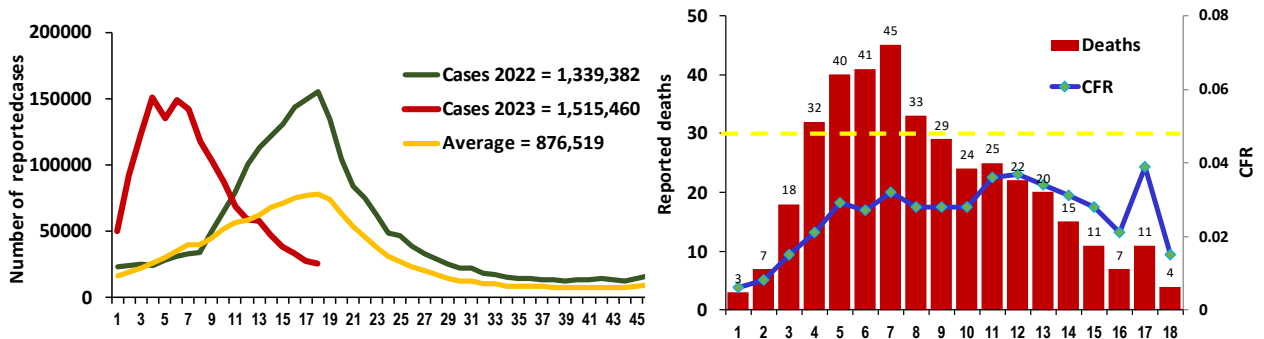


**Source:** Data entered into the Health Information Platform for the Americas (PLISA, PAHO/WHO) by the Ministries and Institutes of Health of the countries and territories of the Region. Available in English at: https://opendata.paho.org/en. Accessed June 7, 2023.

### Bolivia

In 2023 up to EW 18, of the 126,182 reported dengue cases, 21,799 (17.3%) were laboratory confirmed and 558 (0.44%) were classified as severe dengue. The cases registered to EW 18 of 2023 are 19 times higher than those reported in the same period of 2022 and 5 times higher compared to the average of the last 5 years (**Figure 7a**). In the same period, a total of 70 deaths were reported (case fatality ratio: 0.055%). (**Figure 7b**)

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**Figure 7a**. Dengue cases in 2022, 2023 (up to SE 18) and average of the last 5 years - Bolivia.
**Figure 7b**. Dengue related deaths and CFR in 2023 (up to EW 18) - Bolivia.
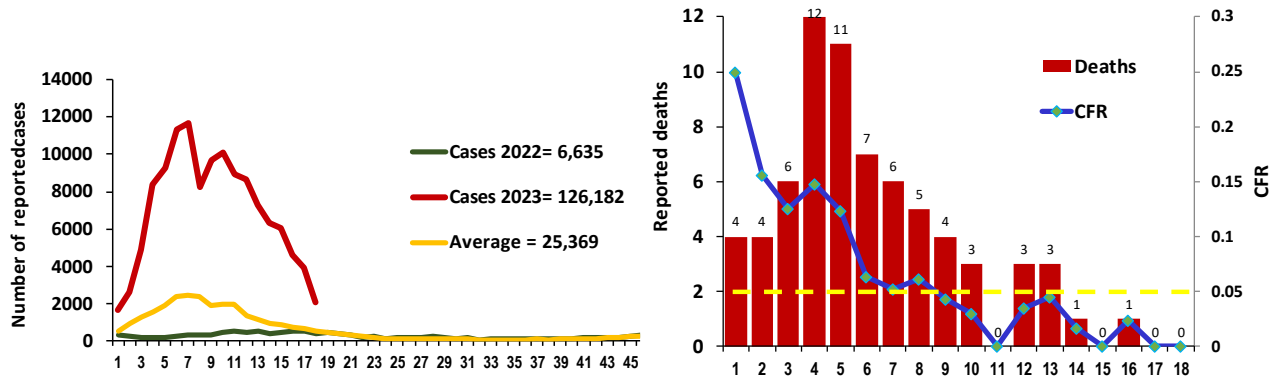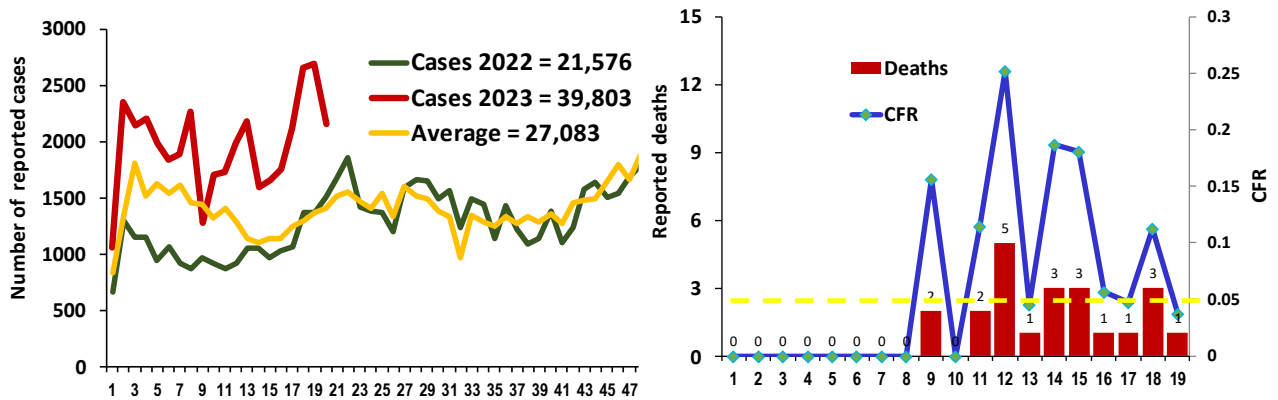


**Source:** Data entered into the Health Information Platform for the Americas (PLISA, PAHO/WHO) by the Ministries and Institutes of Health of the countries and territories of the Region. Available in English at: https://opendata.paho.org/en. Accessed June 7, 2023.

### Colombia

In 2023 up to EW 20, of the 39,803 reported dengue cases, 19,783 (49.7%) were laboratory confirmed and 521 (1.31%) were classified as severe dengue. The cases registered in EW 20 of 2023 are 84% higher than those reported in the same period of 2022 and 47% higher compared to the average of the last 5 years (**Figure 8a**). In the same period, a total of 25 deaths were reported (case fatality ratio: 0.063%). (**Figure 8b**)

**Figure 8a**. Dengue cases in 2022, 2023 (up to SE 20) and average of the last 5 years - Colombia.
**Figure 8b**. Dengue related deaths and CFR in 2023 (up to EW 20) - Colombia.



**Figure:** 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. Available in English at: https://opendata.paho.org/en. Accessed June 7, 2023.

### Peru

In 2023 up to EW 21, of the 115,949 reported dengue cases, 60,178 (51.9%) were laboratory confirmed and 293 (0.25%) were classified as severe dengue. The cases registered to EW 21 of 2023 are 161% higher than those reported in the same period of 2022 and 365% higher compared to the average of the last 5 years (**Figure 9a**). In the same period, a total of 166 deaths were reported (case fatality ratio: 0.143%). (**Figure 9b**)

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Of the total reported cases, 55% were in women. Additionally, 37% of the cases were reported in the 30-59 age group and 22% in the 18-29 age group.

**Figure 9a**. Dengue cases in 2022, 2023 (up to EW 21) and average of the last 5 years - Peru.
**Figure 9b**. Dengue related deaths and CFR in 2023 (up to EW 21) - Peru.



**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. Available in English at: https://opendata.paho.org/en. Accessed June 7, 2023.
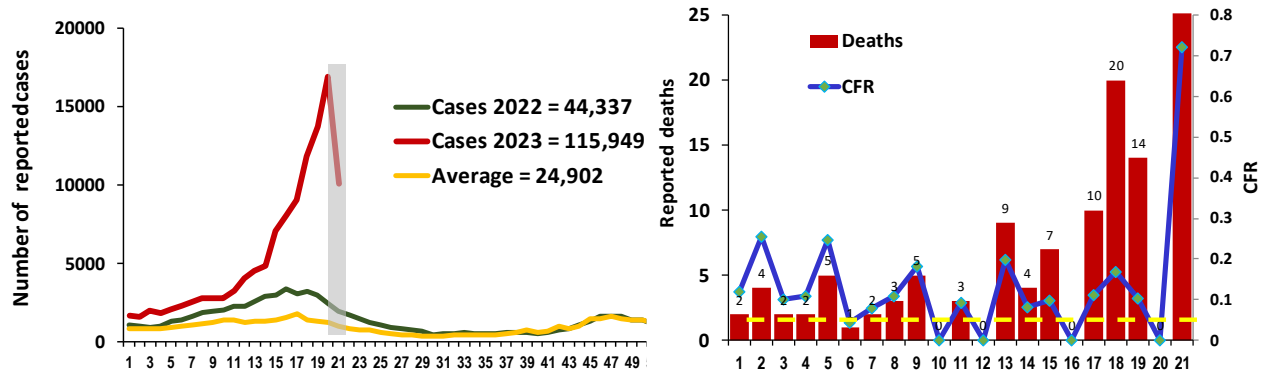
**Figure 10:** Dengue incidence by districts, Peru 2023.

**Cumulative dengue incidence in 2023 (up to EW 21)**

**Dengue incidence as of EW 21 2023**



Per 100,000 pop.
No cases
0.01 – 9.9
10 – 29.9
30 or more
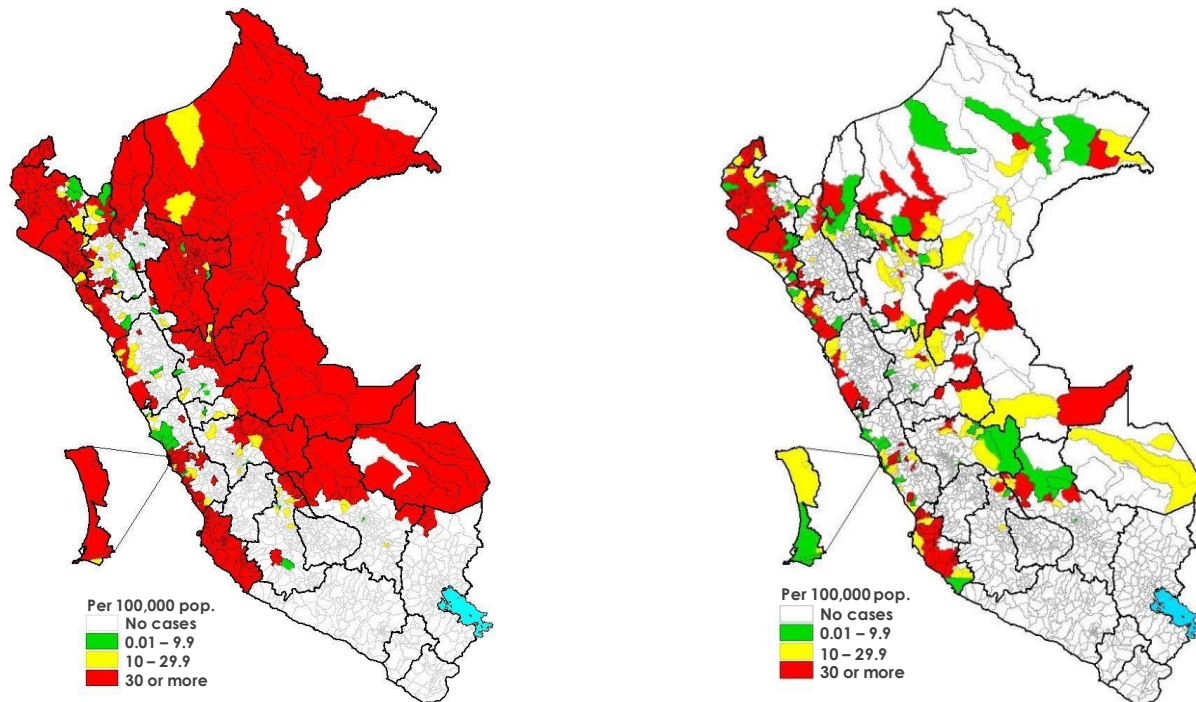
**Source**: Health Situation Room as of EW 21 2023. National Center for Epidemiology, Prevention and Control of Diseases. Ministry of Health. Peru. Available here

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# Chikungunya

Between EW 1 and EW 52 of 2022, a total of 273,685 cases of chikungunya[1], including 87 deaths, were reported in 14 countries and territories of the Region of the Americas; this figure is higher than what was observed during the same period in 2021 (138,358 cases, including 12 deaths). During the same period in 2022, 96.9% of the cases were reported by **Brazil** (265,289 suspected cases of chikungunya).

In 2023, between EW 1 and EW 21, a total of 213,561 cases of chikungunya[1], including 281 deaths, were reported in 13 of the countries and territories of the Region of the Americas; these figures are higher than those observed in during the same period in 2022 (162,836 cases and 49 deaths) (**Figure 11**). For the 2023 period, 98% of the cases were notified by **Brazil** (124,270) and **Paraguay** (85,889).

The cumulative incidence rate in the Region was 22 cases per 100,000 inhabitants. The countries with the highest incidence rates were **Paraguay** with 1,137 reported cases per 100,000 inhabitants, and **Brazil** with 58 cases per 100,000 inhabitants.

**Figure 11**. Distribution of chikungunya cases by epidemiological week of symptom onset. Region of the Americas, 2020 -2022 (until EW 21 of 2023).
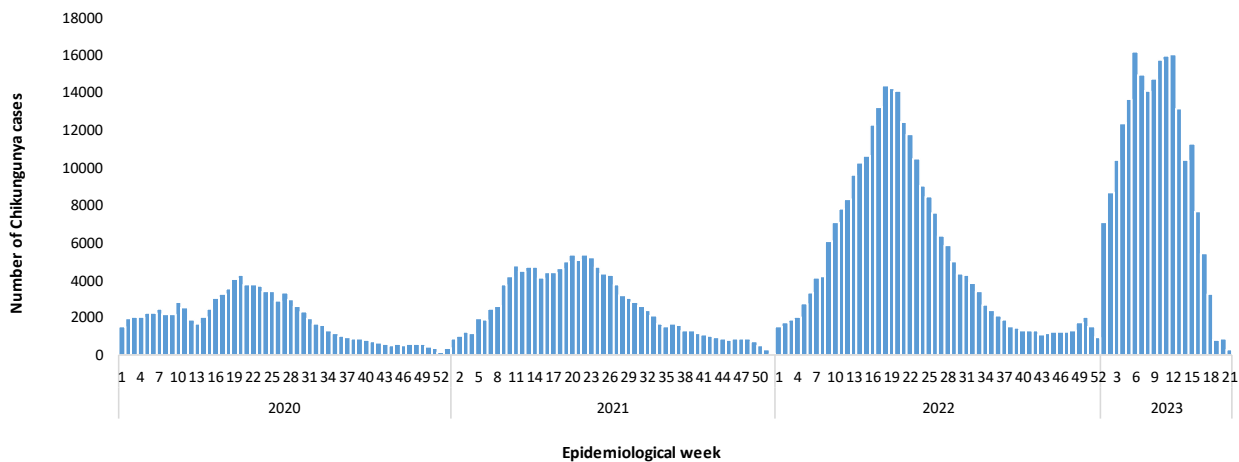


**Source:** Data entered into the Health Information Platform for the Americas (PLISA, PAHO/WHO) by the Ministries and Institutes of Health of the countries and territories of the Region. Detailed information by country is available at: https://bit.ly/3vZjbh9. Accessed June 7, 2023.

### *Paraguay*
Since EW 40 of the year 2022, an increasing trend of reported cases has been observed above the historical threshold, which became more evident during 2023 (**Figure 12**). Between EW 1 and 21 in 2023, 85,889 cases of chikungunya were reported, including 256 deaths[1] (**Figure 13**). The average number of cases reported per week for all of 2023 is 3,862.

**Figure 12**. Distribution of chikungunya cases by epidemiological week of symptom onset. Paraguay, 2022 - 2023 (until EW 21 of 2023).



**Source:** Arbovirosis Situation Room, General Directorate of Health Surveillance, Ministry of Public Health and Social Welfare of Paraguay, consulted on June 7, 2023 and reproduced by PAHO/WHO. Available here.

**Figure 13**. Distribution of deaths from chikungunya by epidemiological week of report. Paraguay, 2020 -2022 (until EW 21 of 2023).
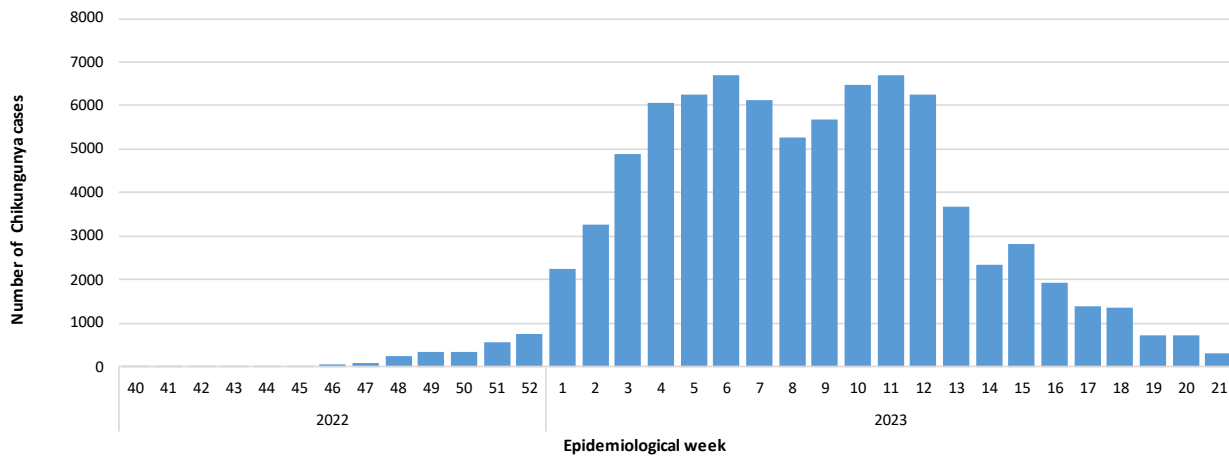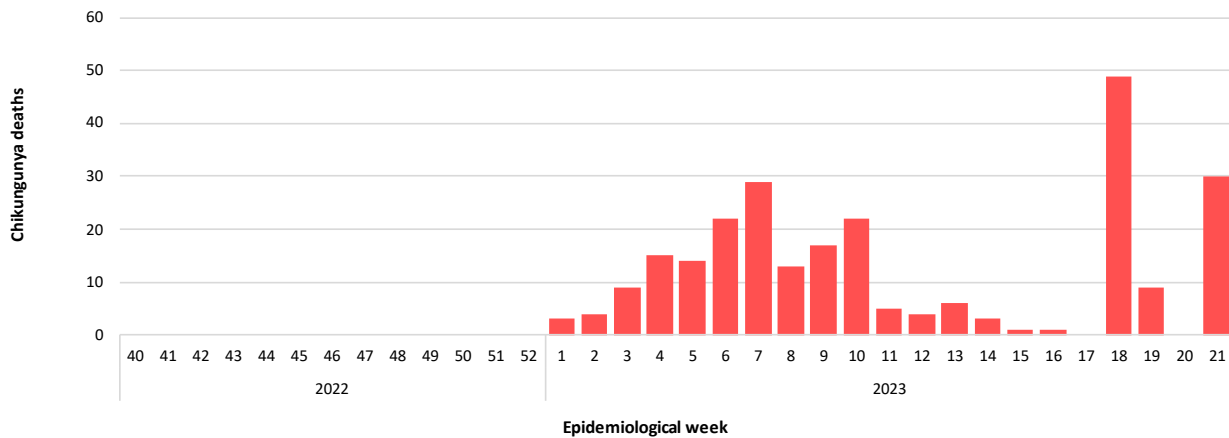


**Source:** Data entered into the Health Information Platform for the Americas (PLISA, PAHO/WHO) by the Ministries and Institutes of Health of the countries and territories of the Region. Detailed information by country is available at: https://opendata.paho.org/en. Accessed June 7, 2023.

# Zika

Between EW 1 and EW 52 of 2022, a total of 406,249 Zika[1] cases, including two deaths (reported in Brazil), were reported in 15 of the countries and territories of the Region of the Americas. These figures are higher than those observed during the same period in 2021 (23,142 cases, including 5 deaths).

In 2023, up to EW 21, 8,758 Zika cases were reported in the Region of the Americas, signifying a 59% reduction compared to the same week in 2022 (21,269 cases). The highest proportion of cases was reported in **Brazil** with 7,352 cases (84%), followed by **Bolivia** with 753 cases (8.6%) and **Belize** with 322 cases (3.7%).

Since its first detection in Brazil in March 2015, local transmission has been confirmed in all countries and territories of the Americas, except for continental Chile, Uruguay, and Canada. In 2016, a total of 651,470 cases were reported after which a significant decline in transmission was observed in the following years (**Figure 14**).

**Figure 14**. Zika cases in 2022, 2023 (up to EW 21) and the last 5-year average – Region of the Americas.
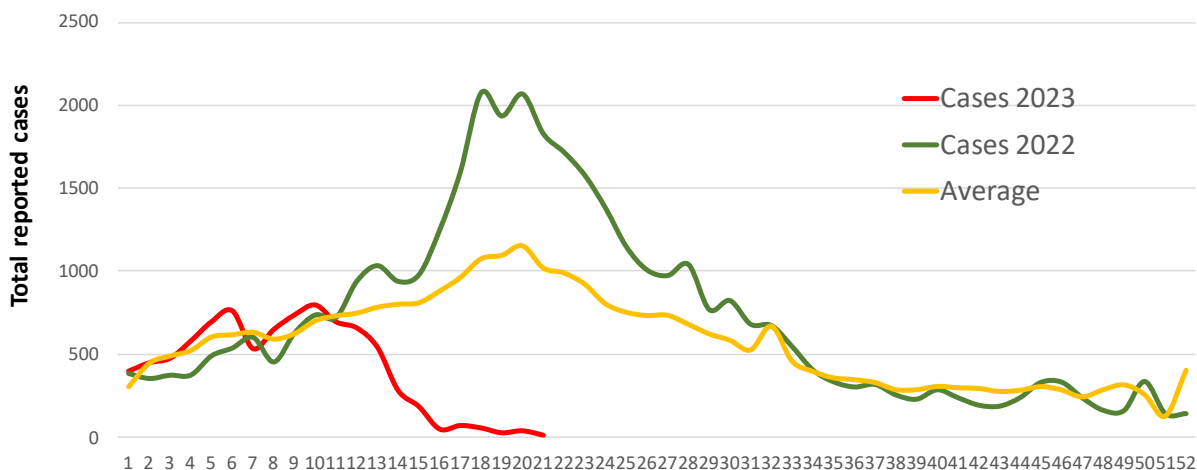


**Source:** Data entered into the Health Information Platform for the Americas (PLISA, PAHO/WHO) by the Ministries and Institutes of Health of the countries and territories of the Region. Detailed information by country is available at: https://bit.ly/3z5aqUM. Accessed June 7, 2023.

# Guidance for national authorities

Given the increase in the number of cases and deaths from dengue and chikungunya in countries of the Southern Hemisphere in the first half of 2023 and the start of high season of arboviruses transmission in the Northern Hemisphere, the Pan American Health Organization / World Health Organization (PAHO/WHO) urges Member States to continue to strengthen surveillance, triage, diagnosis, and timely and adequate treatment of cases of dengue, chikungunya, and other arboviral diseases. Simultaneously, Member States are urged to intensify actions to prepare health care services to facilitate access for patients with these diseases.

PAHO/WHO reminds Member States that the same guidelines published in the Epidemiological Update of June 10, 2020 on dengue and other arboviral diseases, available from https://bit.ly/3oPycno, remain current.

**Adequacy of health care services**

Due to recent increases in the incidence of chikungunya and dengue in some areas of the Region, Member States are encouraged to ensure health care services provide timely and adequate responses to persons at all levels of care.

- Organize in each institution, by levels of care, the screening, patient flow, clinical surveillance, and hospitalization areas.

- Reorganize healthcare services in outbreak/epidemic situations at different levels of patient care.

- Strengthen patient care networks in diagnosis, management, and follow-up of patients with suspected chikungunya in all its phases, including the chronic phase.

**Integrated Surveillance**

PAHO/WHO encourages continued epidemiological surveillance and sharing reports of suspected and confirmed dengue, chikungunya and Zika cases.

Given that the clustering of cases is common in both diseases (dengue and chikungunya), efforts should be made to analyze the spatial distribution of cases to allow a rapid response at the local levels of the most affected areas. Information on dengue and chikungunya hotspots should be consulted for intensive vector control.

Sentinel entomological surveillance assists with assessing changes in the risk of vector-borne diseases and the impact of vector control measures.

**Laboratory confirmation**

It is important to note that the initial diagnosis of CHIKV or DENV infection is clinical, and adequate suspicion can guide the confirmation protocol. However, laboratory results should

always be analyzed in tandem with demographic information and according to the epidemiological context, for surveillance purposes and not for clinical decision-making.

**Chikungunya**. Clinical suspicion of chikungunya virus (CHIKV) infection can be confirmed in the laboratory by virological techniques, including molecular detection by PCR. For detection, the ideal sample is serum collected during the acute phase of infection, preferably in the first 5 days after the onset of symptoms. However, CHIKV usually presents with longer viremias, so a sample may be useful for molecular confirmation4 up to the eighth day from the onset of symptoms[4].

There are different algorithms to perform molecular detection of CHIKV, depending on the epidemiological and clinical context. Thus, in the event of a clinical suspicion compatible with CHIKV infection, it is suggested to start the algorithm with a specific PCR where a positive result confirms the infection; if the result is negative, the detection of other arboviruses, mainly dengue virus (DENV), and Zika virus (ZIKV), or other pathogens that are considered within the differential diagnosis can be continued sequentially (**Figure 15**).

On the other hand, when the clinical suspicion is not clear and the nonspecific symptomatology may be compatible with infection by another arbovirus (or even other pathogens), or syndromic surveillance is performed, a multiple amplification protocol (multiplex) that includes the simultaneous detection of at least 3 of the most likely endemic arboviruses (DENV, CHIKV, and ZIKV) can be efficient (**Figure 16**)

In fatal cases, tissue sampling, mainly liver and spleen, is recommended for molecular detection. These samples are also useful for histopathological analysis to support the diagnosis and better characterize the case.

On the other hand, serological confirmation of chikungunya infection is only possible when paired samples collected at least one week apart (acute phase and convalescent phase) are processed. Seroconversion (negative IgM in the initial sample and positive in the second sample, by ELISA or neutralization) or the increase of at least 4-fold of the antibody titer (with a quantitative methodology), may be useful to confirm the diagnosis. However, it is important to note that serological assays are susceptible to cross-reaction, in the case of CHIKV with other alphaviruses including Mayaro virus. Also, a positive result in a single sample for serological determination is not considered confirmatory since in addition to the possibility of a cross-reaction, IgM can be detected in blood for several months and even years after infection, so a detection may reflect past infection.

In cases with neurologic manifestations (eg, meningoencephalitis), molecular and serologic detection may also be performed on cerebrospinal fluid (CSF) samples. However, this sample should be taken only for clinical indication and not for the specific purpose of identifying the etiologic agent. It is important to note that while a positive CSF molecular test result confirms infection, a negative result does not rule it out.

Additionally, given the similarity of the initial clinical picture of chikungunya with measles and its risk in the Region, it is recommended to also consider the latter as a differential diagnosis[5].

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[4] PAHO/OMS. Recommendations for the detection and laboratory diagnosis of arbovirus infections in the Region of the Americas. 29 August 2022. Available in Spanish from: https://bit.ly/3YtZP1R
[5] PAHO/WHO. Guidance for testing of measles and rubella in the laboratory network of the Region of the Americas. 13 December 2019. Available from: https://bit.ly/3YNnTwx

**Dengue**. Laboratory confirmation of dengue infection is based on virological (RT-PCR, NS1 antigen detection, viral isolation in culture) and serological (IgM detection) tests; however, for the confirmation of cases, priority should be given to virological tests that demonstrate the presence of the virus, its genetic material or its proteins. In general, virological assays for dengue are performed on serum samples taken during the first 5 days after the onset of symptoms (acute phase), although highly sensitive molecular methodologies can detect viral RNA for up to 7 days depending on the viraemia.

On the other hand, serological assays based on the detection of IgM (or IgG) must be carefully analyzed, taking into account the time that antibodies circulate in the blood after an infection, as well as the possibility of cross-reaction with other flaviviruses (including Zika, yellow fever, and others) and non-specific detection. Thus, a single IgM result in a patient only indicates possible recent contact with the virus, but contact may have occurred up to 6 months ago. A second sample taken at least one week apart, processed in parallel with the first and with a quantitative serological assay (PRNT, for example) that can demonstrate seroconversion or increased antibody titer, may be useful to clarify the diagnosis.

In fatal cases, tissue samples (liver, spleen, kidney) should be considered both for the detection of genetic material (RT-PCR) and for histopathological and immunohistochemical study. Taking biopsies in a patient with suspected dengue is completely contraindicated.

Finally, it is important to have a clear laboratory algorithm that allows early detection. Although multiple molecular methodologies (multiplex PCR) are useful when there is no clear clinical suspicion, when faced with a case of dengue that meets the established definitions and where the symptoms are compatible, it is suggested to prioritize protocols for specific detection (singleplex) of the virus.

Since laboratory services are a key component of dengue epidemiological surveillance, dengue virus detection and characterization should be maintained.

**Figure 15**. Sequential algorithm for virological testing in suspected chikungunya cases
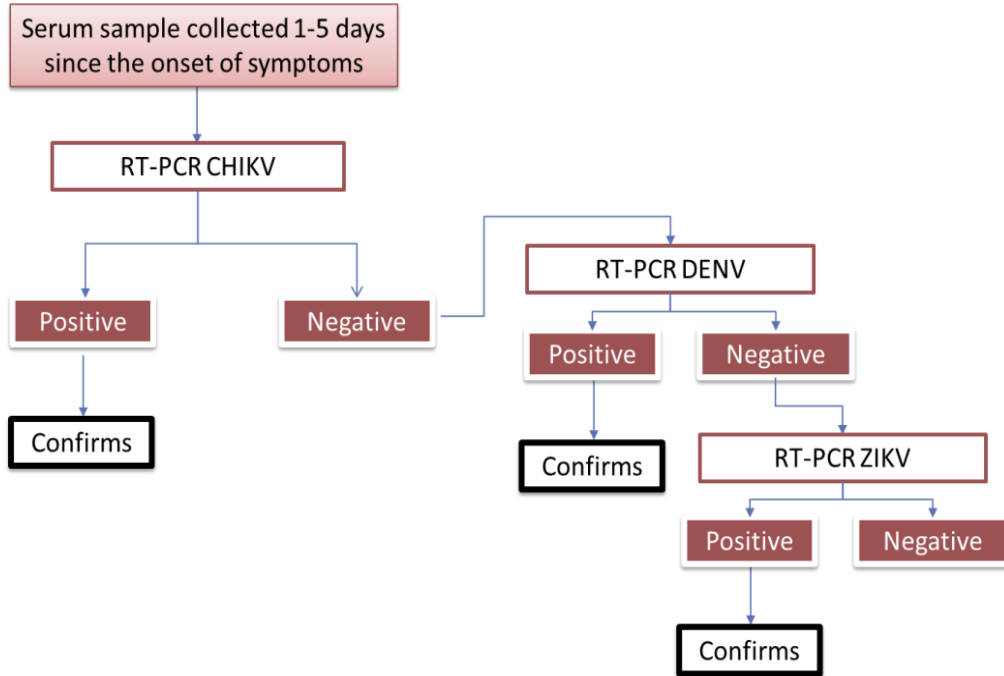


**Source**: PAHO/OMS. Recommendations for the detection and laboratory diagnosis of arbovirus infections in the Region of the Americas. 29 August 2022. Available in Spanish from: https://bit.ly/3YtZP1R

**Figure 16**. Multiplex algorithm for virological testing in suspected chikungunya cases
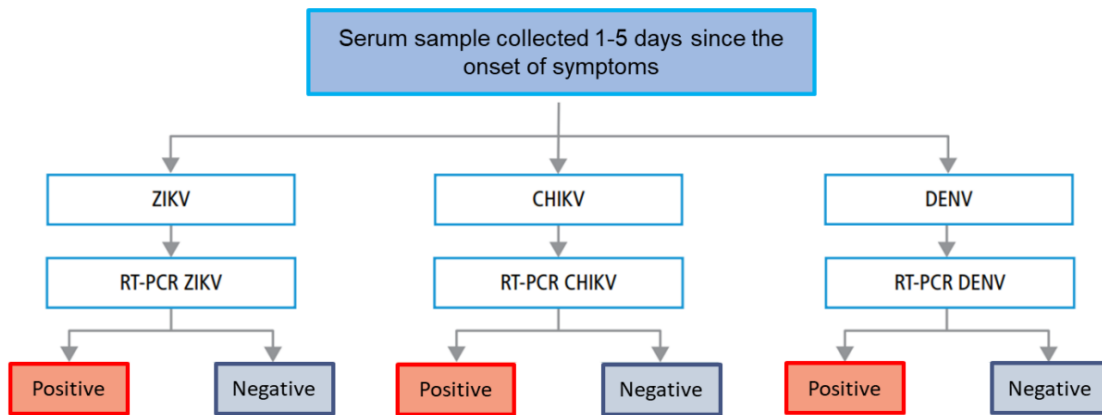


**Source**: PAHO/OMS. Recommendations for the detection and laboratory diagnosis of arbovirus infections in the Region of the Americas. 29 August 2022. Available in Spanish from: https://bit.ly/3YtZP1R

**Case management**

**Chikungunya**. Chikungunya virus disease has a wide range of clinical manifestations, however it is mainly characterized by the onset of fever associated with arthritis or arthralgia[6]. Other common clinical manifestations are headache, muscle pain, rash and pruritus. The duration of clinical manifestations varies from a few days to several months, thus determining the different phases of the disease, acute, post-acute, and chronic. Each of these phases requires specific care and different levels of care. The acute phase lasts up to 2 weeks, the post-acute phase goes from the third week to the third month, and the chronic phase from the fourth month and can last up to years. In most chronic patients, their quality of life worsens during the first years after chikungunya infection. Consequently, considering the high number of recently reported cases, it is recommended to train health personnel at all levels and in all phases of the disease. In particular:

- Train health professionals from service-providing institutions on suspected diagnosis and case management recommendations for chikungunya and other arboviral diseases that are present in the regional epidemiological picture, especially dengue and Zika.

- Train different levels of patient care to prevent and treat the sequelae of the chronic phase of chikungunya.

- Adapt the "Guidelines for the clinical diagnosis and treatment of dengue, chikungunya, and Zika"[7] to national and subnational levels.

- Provide ongoing training workshops for public and private health care personnel on the organization of health services, including outbreak response.

Guide pregnant women, children under 1 year of age, older adults, and people with comorbidities (hypertension, chronic renal failure, diabetes, obesity, heart disease, among others) to immediately go to the nearest health unit at the first suspicion of chikungunya infection due to the risk of presenting serious manifestations or complications of the disease. Likewise, all newborns born to mothers with suspected or confirmed chikungunya (up to 15 days prior to delivery) must be hospitalized.

**Dengue**. Measures to ensure proper clinical management of suspected dengue cases should be a priority.

Capacities must be strengthened at the primary health care level to avoid progression to severe forms and deaths from dengue. Therefore, it is necessary that health workers conduct early clinical diagnosis and recognize serious warning signs in dengue (such as severe and sustained abdominal pain or tenderness of the abdomen, persistent vomiting, clinical fluid accumulation, mucosal bleeding, lethargy, restlessness, liver enlargement > 2 cm below the costal margin, and progressive increase in hematocrit) in order to initiate appropriate management in accordance with the recommendations published in the PAHO clinical guidelines. These

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[6] PAHO/WHO. Chikungunya: case definition, clinical classification, and phases of the disease. Washington, DC. PAHO; 2023. Available in Spanish in: https://www.paho.org/es/documentos/chikunguna-definicion-caso-clasificacion-clinica-fases-enfermedad
[7] PAHO/WHO. Guidelines for the clinical diagnosis and treatment of dengue, chikungunya and Zika. 3 January 2022. Available from: https://bit.ly/3K5oDJl

measures will also help reduce the number of patients that need to be referred to hospitals, thus avoiding the saturation of these facilities and intensive care units.

At the same time, all second and third level hospitals must be prepared to handle serious cases of dengue.

More information on the clinical management of dengue cases is available in the Guidelines for the clinical diagnosis and treatment of dengue, chikungunya, and Zika[8] and in the Tool for the diagnosis and care of patients with suspected arboviral diseases[9], both published by PAHO.

PAHO reiterates the recommendations for technical teams in charge of malaria control, as those also apply to personnel involved in arboviruses care and are available at: https://bit.ly/3ZucrpK.

**Community involvement**

Every effort should be made to gain community support for the prevention of dengue.

Simple Information, Education and Communication (IEC) materials can be disseminated through various media (including social media).

Household members should be encouraged to eliminate both residential and peri-domiciliary sources of mosquito breeding.

Highly productive mosquito breeding sites, such as water storage containers (drums, elevated tanks, clay pots, etc.) must be subject to preventive measures to avoid vector reproduction. Other breeding sites, such as roof gutters and other water-holding containers, should also be cleaned periodically.

Local teams often know how to convey this information more effectively, and in many cases national campaigns and messages are not as effective as local awareness initiatives.

*Aedes* **prevention and control measures**

PAHO/WHO urges Member States to make effective use of available resources to prevent and/or control vector infestation in affected areas and in health care services. This may be achieved through the implementation of integrated vector control strategies in emergencies, which include the following processes:

- Selection of control methods based on knowledge of vector biology, disease transmission, and morbidity.

- Use of multiple interventions, often in combination and synergistically.

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[8] Pan American Health Organization. Guidelines for the clinical diagnosis and treatment of dengue, chikungunya, and Zika. Washington, DC. PAHO; 2022. Available from: https://iris.paho.org/handle/10665.2/55867
[9] Pan American Health Organization. Tool for the diagnosis and care of patients with suspected arboviral diseases. Washington, DC. PAHO; 2017. Available from: https://iris.paho.org/handle/10665.2/33895

- Collaboration of the health care sector with public and private sectors linked to environmental management whose work impacts the reduction of the vector.

- Integration of individuals, families, and other key partners (education, finance, tourism, water and sanitation, and others) in prevention and control activities.

- Strengthening of the legal framework permitting an integrated and intersectoral approach.

Given the high infestation by *Aedes aegypti* and the presence of *Aedes albopictus* in the Region, PAHO/WHO recommends that prevention and control measures aim to reduce the density of the vector and have the acceptance and collaboration of local populations. Prevention and control measures for implementation by national authorities should include the following:

- Strengthen environmental management actions, primarily the elimination of vector breeding sites in households and in common areas (parks, schools, cemeteries, etc.).

- Reorganize solid waste collection services to support breeding site elimination actions in areas of greatest transmission and, if necessary, plan intensive actions in specific areas where regular garbage collection has been interrupted.

- Apply measures for the control[10] of breeding sites using physical, biological and/or chemical methods, while actively involving individuals, families, and the community.

- Define the high-risk transmission areas (risk stratification[11]) and prioritize those with high concentrations of people (schools, terminals, hospitals, health care centers, etc.). In these facilities, the presence of mosquitoes must be eliminated in a diameter of at least 400 meters. It is important to pay special attention to health care units, and to ensure that these are free of the presence of the vector and its breeding sites so that they do not become spreading sources of the virus.

- In areas where active transmission is detected, implementing measures aimed to eliminate infected adult mosquitoes (primarily using insecticides) is suggested in order to stop and cut transmission. This action is of an exceptional nature and is only effective when it is conducted by well-trained personnel under internationally accepted technical guidelines; and when it is carried out simultaneously with the other proposed actions. The main action to interrupt intensive transmission is the elimination of infested adult mosquitoes (active transmission) through indoor spraying by using individual equipment added to the destruction and/or control of vector breeding sites within households.

- An effective modality of adult control that can be used, considering the available operational capacities, is indoor residual spraying, which should be applied selectively to the resting areas of Aedes aegypti, avoiding the contamination of storage containers

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[10] Pan American Health Organization. Methods of entomological surveillance and control of the main vectors in the Americas. Washington, DC: PAHO; 2021. Available in Spanish in: https://iris.paho.org/handle/10665.2/55241
[11] Pan American Health Organization. Technical document for the implementation of interventions based on generic operational scenarios for *Aedes aegypti* control. Washington, D.C.: PAHO; 2019. Available in: https://iris.paho.org/handle/10665.2/51652

of water used for drinking or cooking purposes. This intervention performed in treated areas is effective for a period of up to four-months; it can be used in shelters, homes, health care services, schools, and others. For more information, consult the PAHO Manual for Indoor Residual Spraying in Urban Areas for Aedes aegypti Control[12] and the document on Control of Aedes aegypti in the scenario of simultaneous transmission of COVID-19[13].

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-   Correctly choose the insecticide to be used (following PAHO/WHO recommendations), its formulation, and be aware of which mosquito populations are susceptible to the chosen insecticide[14].

-   Guarantee the proper functioning of fumigation equipment and its maintenance and ensure insecticide reserves.

-   Intensify actions of supervision of the operators' field work (quality control), during both the focal treatment and in the adulticide treatment (fumigation), ensuring compliance with personal protection measures.

**Personal preventive measures**

Patients infected with dengue, chikungunya, and/or Zika virus are the reservoir of infection for others in their households and in the community. It is necessary to communicate to the sick, their families, and the affected community about the risk of transmission and ways to prevent contagion by reducing the vector population and the contact between the vector and people.

To minimize vector-patient contact it is recommended:

-   Patients should rest under mosquito nets, impregnated, or otherwise, with insecticide.

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

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

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

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[12] Pan American Health Organization. Manual for Indoor Residual Spraying in Urban Areas for *Aedes aegypti* Control. Washington, DC: PAHO; 2019. Available from: https://iris.paho.org/handle/10665.2/51637
[13] Pan American Health Organization. Control of *Aedes aegypti* in the scenario of simultaneous transmission of COVID-19. Washington, DC: PAHO; 2020. Available from: https://www.paho.org/en/documents/control-aedes-aegypti-scenario-simultaneous-transmission-covid-19
[14] Pan American Health Organization. Procedures to evaluate the susceptibility to insecticides of the main mosquito vectors of the Americas Washington, DC: PAHO; 2023. Available in Spanish in: http://bitly.ws/HTNA

## Additional resources

- Pan American Health Organization. PLISA Health Information Platform for the Americas, Core Indicators Portal. Washington, DC: PAHO; 2023 [cited 24 March 2023]. Available from: https://bit.ly/3n4FKBs.

- Pan American Health Organization. Recommendations for Laboratory Detection and Diagnosis of Arbovirus Infections in the Region of the Americas. Washington, D.C.: PAHO; 2023. Available in: https://iris.paho.org/handle/10665.2/57555.

- Pan American Health Organization. Measures to ensure the continuity of the response to malaria in the Americas during the COVID-19 pandemic, 24 April 2020. Washington, DC: PAHO; 2020. Available from: https://bit.ly/2UymiMy.

- Pan American Health Organization. Methodology for evaluating national arboviral disease prevention and control strategies in the Americas. Washington, DC. PAHO; 2021. Available from: https://iris.paho.org/handle/10665.2/55745.

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- Pan American Health Organization / World Health Organization. Epidemiological Update on dengue and other arboviral diseases. 10 June 2020. Washington, DC: PAHO/WHO; 2020. Available from: https://www.paho.org/en/documents/epidemiological-update-dengue-and-other-arboviruses-10-june-2020

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