Epidemiological Alert
Yellow fever in the Americas Region

3 February 2025

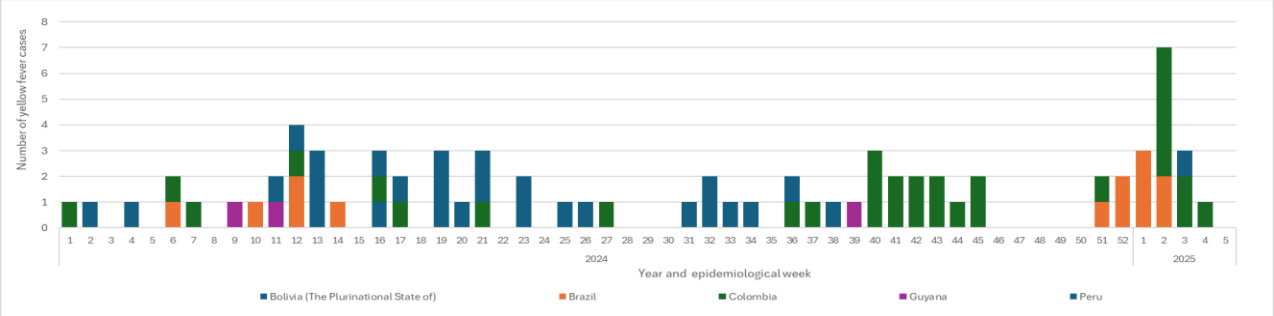
Given the increase in human cases of yellow fever in the last months of 2024 and beginning of 2025 in countries of the Americas Region, the Pan American Health Organization / World Health Organization (PAHO/WHO) calls on Member States with areas at risk to continue their efforts to strengthen surveillance in endemic areas, vaccinate populations at risk, and take the necessary actions to ensure that travelers going to areas where vaccination is recommended are properly informed and protected against yellow fever. In addition, it highlights the need to strengthen clinical management, with emphasis on the detection and timely treatment of severe cases. PAHO/WHO also recommends having reserve doses, in accordance with the availability of vaccines in each country, to guarantee a rapid response to possible outbreaks.

Summary of the situation

In 2024, 61 human cases of yellow fever were confirmed the Americas Region, of which 30 were fatal, distributed among five countries: the Plurinational State of Bolivia, Brazil, Colombia, Guyana, and Peru. Bolivia reported eight cases, including four fatal cases; Brazil, reported eight cases, including four fatal cases; Colombia reported 23 cases, including 13 fatal cases; Guyana reported three cases; and Peru reported 19 cases, including nine fatal cases ***(Figure 1**) (1-6)*

Between epidemiological week (EW) 1 and EW 4 of 2025, 16 confirmed human cases of yellow fever have been reported in three countries in the Region, of which seven have been fatal *(2-4, 6)*. These cases have been reported in: Brazil, with seven cases, including four fatal cases; Colombia with eight cases, including two fatal cases; and Peru with one fatal case *(2–4, 6)*.

Figure 1. Yellow fever cases by country, year, and epidemiological week of symptom onset in the Americas Region*. 2024 and as of EW 4 of 2025.



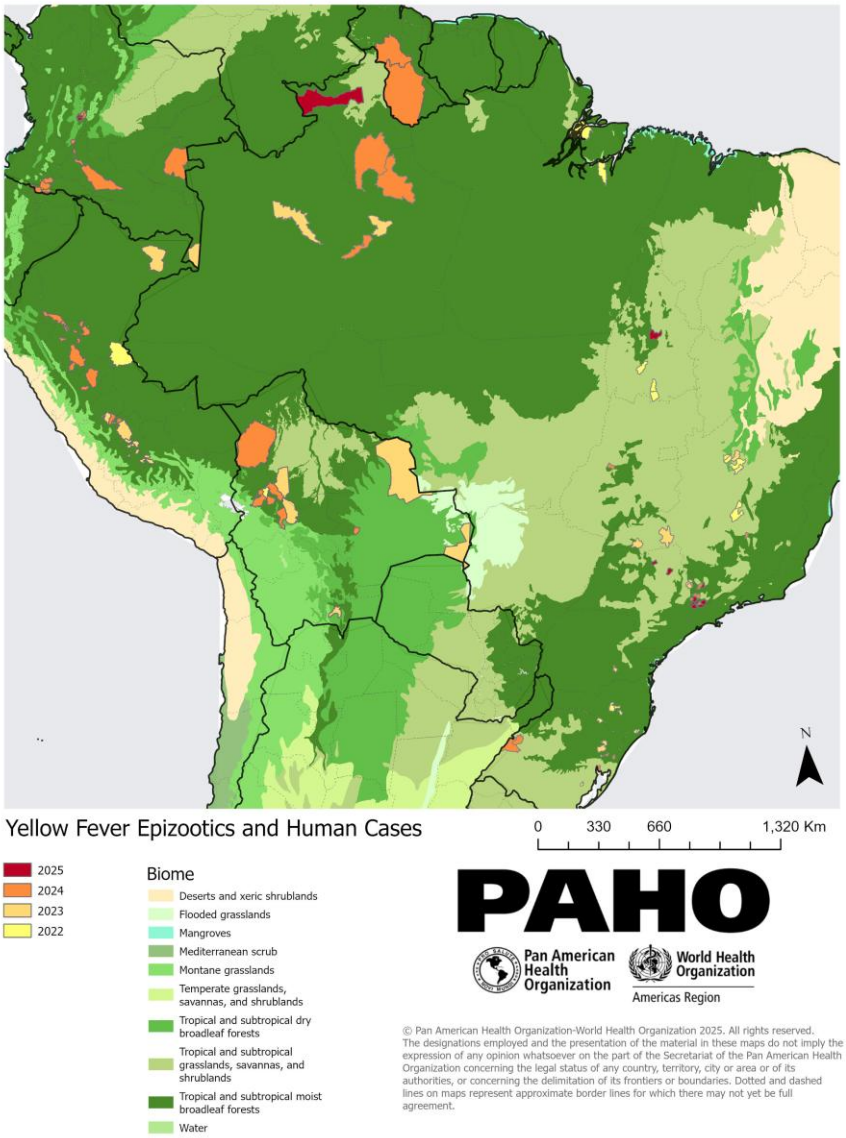
***Note:** Includes only cases for which symptom onset information is available by epidemiological week.

Source: Adapted from data provided by countries or published by Ministries of Health and reproduced by PAHO/WHO *(1, 2, 4-6)*.

Suggested citation: Pan American Health Organization / World Health Organization. Epidemiological Alert. Yellow fever in the Americas Region, 3 February 2025. Washington, D.C.: PAHO/WHO; 2025.

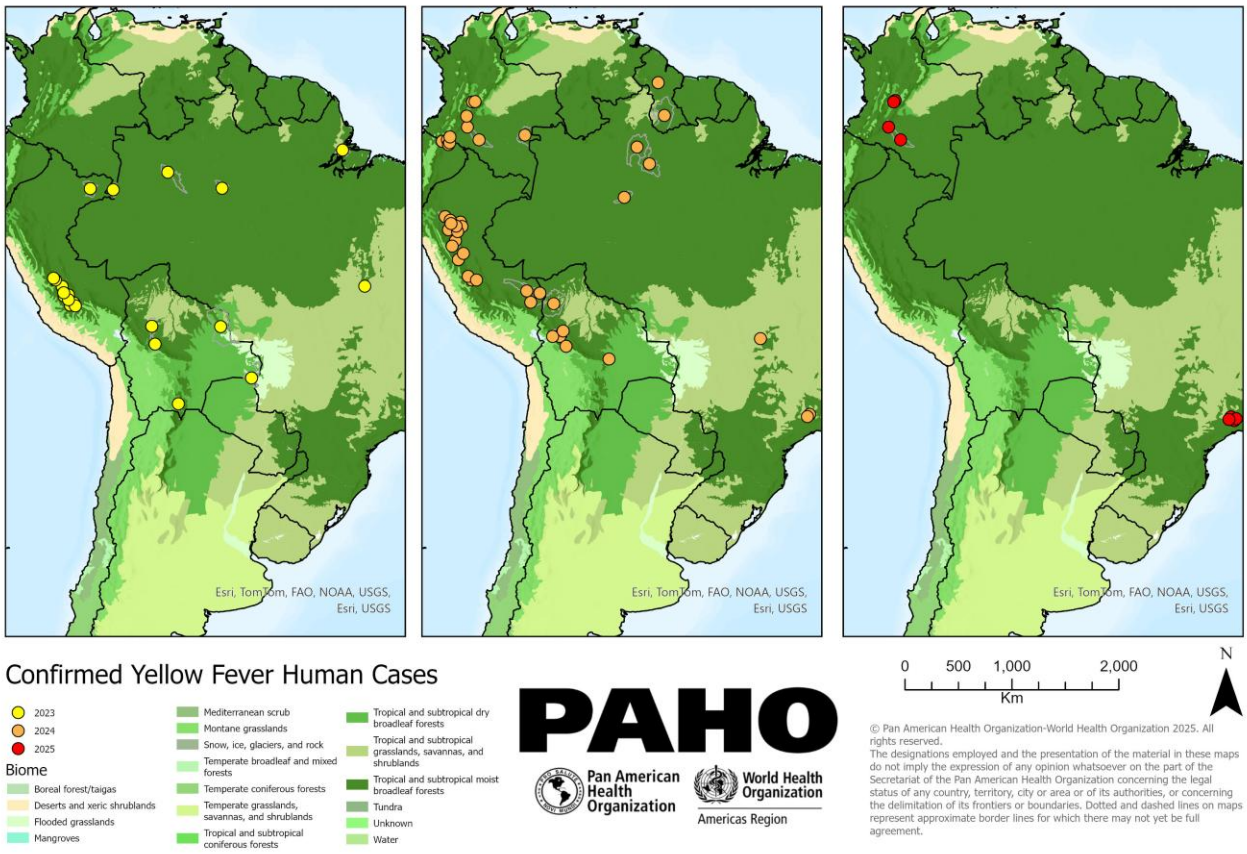
In 2024, yellow fever cases were mainly recorded throughout the Amazon region of Bolivia, Brazil, Colombia, Guyana, and Peru. In 2025, however, cases have been concentrated mainly in the state of São Paulo in Brazil and the department of Tolima, in Colombia, regions outside the Amazon region of both countries (**Figure 2 and Figure 3**)

Figure 2. Municipalities with occurrence of confirmed cases of yellow fever in humans and epizootics* in Bolivia, Brazil, Colombia, Guyana, and Peru, years 2022 to 2025 (as of EW 4).



*Note: Epizootic information only includes data from Brazil.
Source: Adapted from data provided by countries or published by Ministries of Health and reproduced by PAHO/WHO *(1-6)*.

Figure 3. Confirmed human cases of yellow fever by year in the Americas Region, 2023 to 2025 (as of EW 4).



Source: Adapted from data provided by countries or published by Ministries of Health and reproduced by PAHO/WHO *(1-6)*.

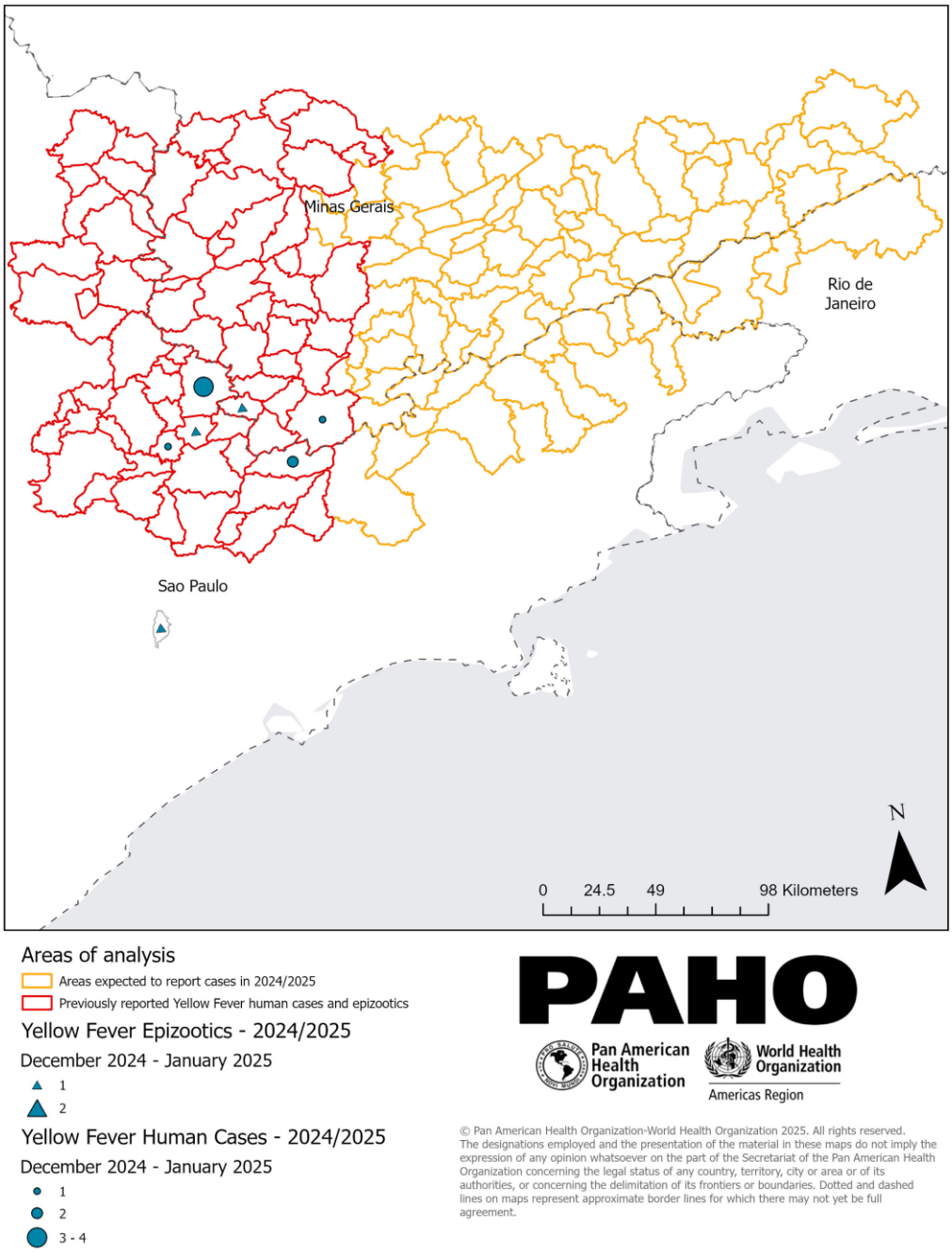
The study and projection model known as the ecological corridor model, developed collaboratively in Brazil, estimated that, for the 2024/2025 seasonal period, there is a possibility of virus spread in the Campinas/São Paulo region, southern Minas Gerais, and Serra da Mantiqueira (**Figure 4**) *(7)*. On the other hand, the combined favorability model indicated that the states with the highest probabilities for the occurrence of yellow fever are, in order of highest to lowest probability, Santa Catarina, Rio Grande do Sul, Paraná, Distrito Federal, Goiás, São Paulo, Mato Grosso do Sul, and Minas Gerais (**Figure 5**[1])*(7)*. If the projections of this model are fulfilled, it is possible that countries such as **Argentina and Paraguay** will also be affected.

It is important to note that the territorial extent of these projections is limited by the available occurrence data and the uncertainties inherent in the modeling. As more updated data become available, it will be possible to adjust the model more accurately.

[1] Detailed information on the methodology of both models is available in Ministério da Saúde Brasil. Secretaria de Vigilância em Saúde e Ambiente - Nota Informativa Nº 35/2024-CGARB/DEDT/SVSA/MS. Brasilia: Saude; 2025. Available from: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/estudos-e-notas-informativas/2024/nota-informativa-no-35-2024.pdf *(7)*.

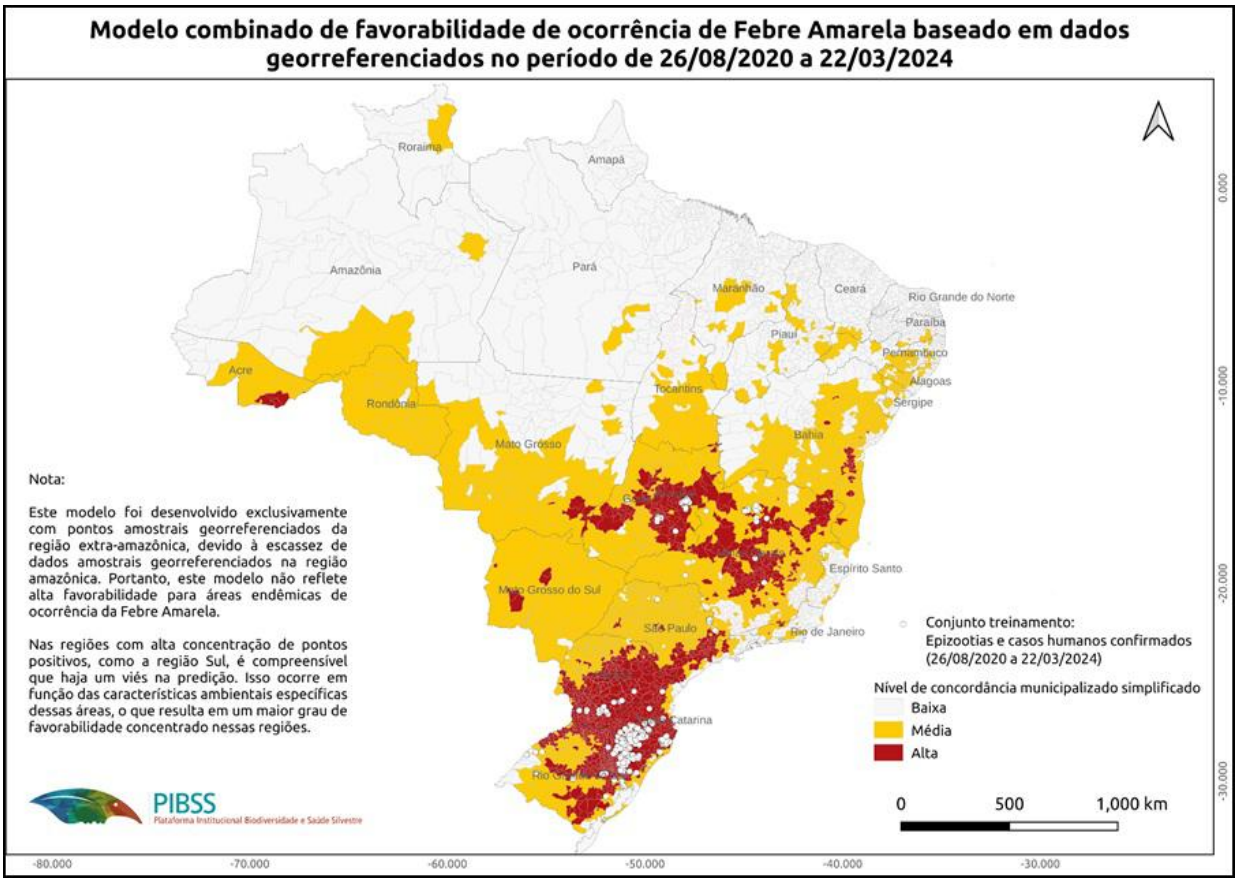
Despite these limitations, these predictive models are an invaluable tool for assessing risk and defining prevention strategies focused on the areas with the highest probability of occurrence

Figure 4. Distribution of the municipalities that are part of the areas of influence of the ecological corridors in 2024, Brazil.



Source: Adapted from Ministério da Saúde Brasil. Secretaria de Vigilância em Saúde e Ambiente - Nota Informativa Nº 35/2024-CGARB/DEDT/SVSA/MS. Brasilia: Saude; 2025. Available from: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/estudos-e-notas-informativas/2024/nota-informativa-no-35-2024.pdf *(7)*.

Figure 5. Combined model of yellow fever occurrence favorability based on geo-referenced data for the period 26 August 2020 and 22 March 2024.



Translation - Note: This model was developed exclusively with georeferenced sampling points from the extra-Amazon region, due to the scarcity of georeferenced sampling data in the Amazon region. Therefore, this model does not reflect high favorability for endemic areas of yellow fever occurrence. In regions with high concentration of hotspots, such as the South, it is understandable that there is a bias in the prediction. This occurs as a function of specific environmental characteristics, resulting in a higher degree of favorability concentrated in these regions.

Translation - Legend: Reference set. Epizootics and confirmed human cases (26/08/2020 to 22/03/2024). Simplified and municipalized level of concordance: low, medium and high.

Source: Ministério da Saúde Brasil. Secretaria de Vigilância em Saúde e Ambiente - Nota Informativa Nº 35/2024-CGARB/DEDT/SVSA/MS. Brasilia: Saude; 2025. Available from: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/estudos-e-notas-informativas/2024/nota-informativa-no-35-2024.pdf.

Following is the epidemiological situation of yellow fever in countries that have reported confirmed cases in 2024 and 2025.

In **Bolivia,** between EW 1 and EW 52 of 2024, eight cases of yellow fever were confirmed (seven laboratory-confirmed and one clinical and epidemiological link), including four fatal cases. The cases correspond to seven males and one female, aged between 14 and 64 years, who initiated symptoms between 20 April and 19 September 2024. Only three of the cases had a history of vaccination against yellow fever and all had a history of exposure to wild and/or wooded areas, due to work activities, among others *(1)*. The probable place of exposure of the cases is the department of La Paz in the municipalities of Caranavi (n= 2 fatal cases), Guanay (n= 1 case),

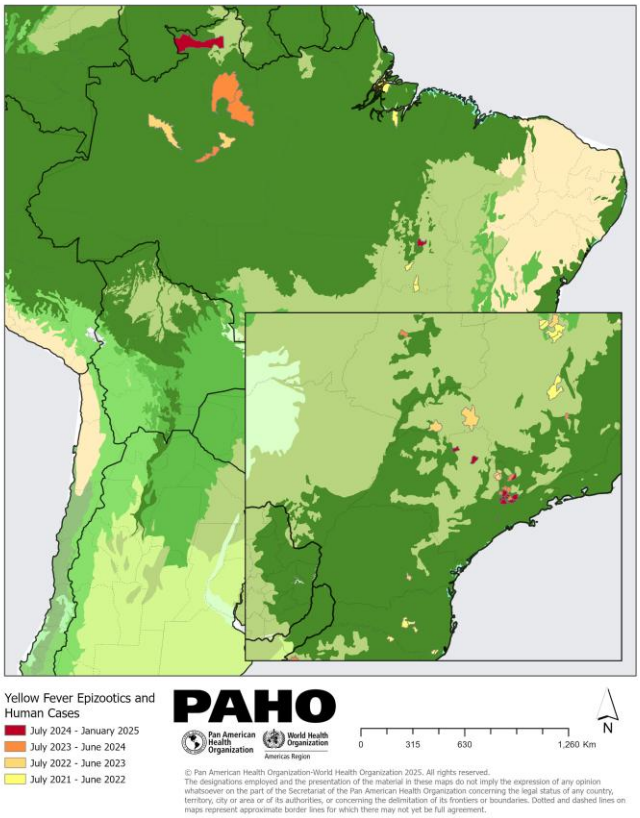
Ixiamas (n= 1 fatal case), Palos Blancos (n= 1 case), and Inquisivi (n= 1 fatal case), and in the department of Santa Cruz, in the municipality of Porongo (n= 2 cases) *(1)*. During 2024, no events involving dead non-human primates (epizootics) were reported (*1)*. In 2025, between EW 1 and EW 4, no confirmed cases of yellow fever were reported in Bolivia *(1)*.

In **Brazil**, between EW 1 and EW 52 of 2024, eight confirmed cases of yellow fever were reported, including four fatal cases. The cases were reported in the states of Amazonas (n= 2 fatal cases), Pará (n=1 case), Minas Gerais (n= 2 cases, including one fatal case) and in the state of São Paulo (n= 3 cases, including one fatal case). The cases corresponded to males, aged between 21 and 73 years, who initiated symptoms between 5 February and 26 December 2024. Only one of the cases had a history of yellow fever vaccination. The cases had probable exposure in the state of Amazonas: Presidente Figueiredo municipality (n= 1 fatal case) and Anori (n= 1 fatal case); the state of Pará: Novo Brasil municipality (n= 1 case), the state of São Paulo: Serra Negra municipality (n= 1 case), Joanópolis (n= 1 case), and Socorro (n= 1 fatal case); and the state of Minas Gerais: Monte Sião municipality (n= 1 fatal case), and Camanducaia (n= 1 case). All cases had a history of exposure in wild and/or wooded areas, due to occupational activities, and were laboratory confirmed by RT-PCR technique *(2, 3, 7)*.

During the beginning of 2025, seven confirmed cases of yellow fever have been reported in Brazil between EW 1 and EW 4, including four fatal cases, all in the state of Sao Paulo. Sixty-two percent of the cases were males, aged between 21 and 73 years. The probable place of exposure of the cases was the municipalities of Socorro (n=4 cases), Tujuti (n=1 case) and Joanópolis (n=2 cases). None of the cases had a history of vaccination against yellow fever. All cases had a history of exposure in wild and/or forested areas, due to work or ecotourism activities, and were laboratory confirmed by RT-PCR *(2, 3, 7)*.

During 2024 (between EW 1 and EW 52), in Brazil, 1,731 events involving dead non-human primates (epizootics) were reported. Of this total, 22 (1.3%) were confirmed for yellow fever by laboratory criteria (n= 19) and by epidemiological link (n= 3), one in the state of Roraima, two in the state of Tocantins, seven in the state of Minas Gerais, and 12 in the state of São Paulo *(2, 3, 7)*. Between EW 1 and EW 4 of 2025, 30 epizootics were reported, of which 16 (53.3%) were confirmed for yellow fever by laboratory criteria (n= 7) and by epidemiological link (n= 9), 15 in the state of São Paulo and one in the state of Minas Gerais (**Figure 6**) *(2, 3, 7)*.

Figure 6. Yellow fever cases in humans and epizootics. Brazil, between July 2021 and January 2025.



Source: Adapted from data provided by countries or published by Ministries of Health and reproduced by PAHO/WHO *(1-6)*.

In **Colombia**, between EW 1 of 2024 and EW 4 of 2025, a total of 31 confirmed cases of yellow fever have been reported, including 15 fatal cases *(4)*.

In 2024, 23 cases of yellow fever were identified, including 13 fatal cases. Seven cases were reported as probable yellow fever and ten were detected as a result of laboratory differential diagnosis of cases with negative results for dengue or suspected leptospirosis and confirmed through RT-PCR and/or immunohistochemistry (in deceased cases). Cases have been reported in six departments, Caquetá (n= 2 cases, including 1 fatal case), Huila (n= 1 fatal case), Nariño (n= 3 cases, including 1 fatal case), Putumayo (n= 4 fatal cases), Tolima (n= 12 cases, including 6 fatal cases), and Vaupés (n= 1 fatal case) *(4)*.The cases correspond to individuals aged between 11 and 89 years, who initiated symptoms between 3 January and 21 December 2024. All cases had a history of exposure in areas at risk for yellow fever, such as wild and wooded areas, in the context of work activities that included agriculture (n= 15 cases), female student in a village (n= 1 case), and stone quarrying (n= 1 case). Of this total, 15 cases had no documented history of yellow fever vaccination *(4)*.

During the beginning of 2025, between EW 1 and EW 4, eight confirmed cases of yellow fever were reported, including two fatal cases. These cases correspond to persons residing in the department of Tolima, in the municipalities of Cunday (n= 5 cases, including one fatal case), Prado (n= 2 cases), and Purificación (n= 1 fatal case). The cases correspond to persons aged

between 28 and 66 years, with symptom onset between 6 and 21 January 2025. All cases had a history of exposure in areas at risk for yellow fever, in the context of work activities that included agriculture, and had no documented history of vaccination against yellow fever *(4)*.

The outbreak recorded in the department of Tolima at the end of 2024 and beginning of 2025 occurred in the rural area adjacent to the southwestern area of the Bosque de Galilea Regional Natural Park in four municipalities identified as high risk *(4)*: Cunday (n= 9 cases), Prado (n= 4 cases), Purificación (n= 3 cases), and Villarrica (n= 5 cases). Of the total number of confirmed cases, 80% were males (n= 16 cases) and 95% were between 25 and 89 years of age, with one case in an 11-year-old female. The date of symptom onset of the cases ranges between 8 September 2024 and 22 January 2025. Eight fatal cases have been reported in this outbreak *(4)*.

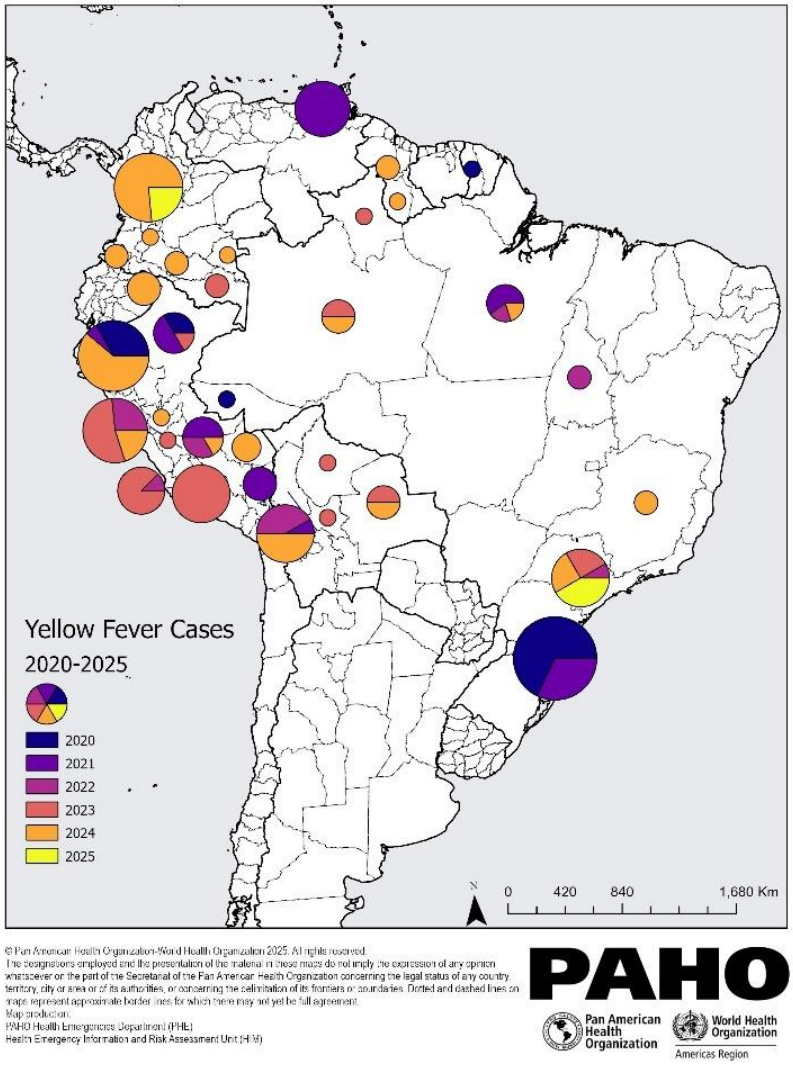
In **Guyana**, between EW 1 and EW 52 of 2024, three laboratory-confirmed cases were identified. The first case was identified in Boa Vista in EW 11, in the state of Roraima, Brazil; and corresponds to a 17-year-old male, resident of the community of Massara, Guyana, 100 kilometers from Lethem, Guyana bordering Bonfim, Roraima, Brazil, with a yellow fever vaccination history of more than ten years. The case works in a rural area of Siparuni (forested area in Region 10 - Upper Demerara-Berbice), harvesting trees and presented onset of symptoms on 29 February 2024. On 12 March, the RT-PCR test confirmed the identification of the sylvatic yellow fever virus by the Central Public Health Laboratory of Roraima. The second case was identified in EW 11, during the process of investigation and testing after the identification of the index case. The case is a 21-year-old female, with a yellow fever vaccination history of more than ten years, resident of Siparuni, in the same logging camp as the first case. She initiated symptoms on 13 March 2024, with a positive result for yellow fever by RT-PCR test on 16 March. The third case was identified in EW 41, corresponding to a 14-year-old male minor, resident of Awareanau village, Region No. 9; the case had a history of vaccination more than ten years ago against yellow fever. On 7 October a serological sample was taken and the presence of yellow fever was confirmed by RT-PCR test. All cases recovered. No confirmed cases have been reported during 2025 in Guyana *(5)*.

In **Peru**, between EW 1 and EW 52 of 2024, 19 cases of yellow fever have been confirmed, including nine fatal cases. Cases were confirmed in the departments of Huánuco, Mariano Damaso Beraún district (n= 1 fatal case); department of Junín, Pichanaqui (n= 2 cases) and Satipo districts (n= 1 fatal case); department of Madre de Dios, Tambopata district (n= 3 cases); department of Ucayali, Padre Abad district (n= 1 case) and in the department of San Martin, districts of Alto Biavo (n= 1 fatal case), El Porvenir (n= 1 fatal case), Shapaja (n= 1 fatal case), Huimbayoc district (n= 1 case), Lamas district (n= 1 fatal case), Pinto recodo district (n= 1 case), Tabalosos district (n= 1 fatal case), Moyobamba district (n= 1 fatal case), Shamboyacu district (n= 1 case), Saposoa district (n= 1 fatal case), and Tocache district (n= 1 case)*(6)*. The 19 confirmed cases are all males between 18 and 83 years of age, who initiated symptoms between 11 January and 1 September 2024. All cases had a history of exposure in wild and/or wooded areas, due to agricultural work activities, and no history of vaccination against yellow fever *(6)*.

During the beginning of 2025, between EW 1 and EW 4, one confirmed fatal case of yellow fever was reported in Peru, in the department of Huánuco, district of Chaglla. The case was a 29-year-old male, with no history of vaccination; symptoms started on 15 January 2025 (EW 3) and died on 22 January. The case had a history of exposure in wild and/or wooded areas, due to agricultural activities, and was laboratory confirmed by RT-PCR technique, with co-infection with leptospirosis *(6)*.

Between 2020 and 2023, all of the above countries had cases of yellow fever in at least one of the years, except Guyana, which identified cases only in 2024 (**Figure 7**).

Figure 7. Yellow fever cases in humans in the Americas Region, between January 2020 and January 2025 (as of EW 4).



Map production:
PAHO Health Emergencies Department (PHE)
Health Emergency Information and Risk Assessment Unit (HIM)

PAHO
Pan American Health Organization
World Health Organization
Americas Region

Source: Adapted from data provided by countries or published by Ministries of Health and reproduced by PAHO/WHO *(1-6)*.

Recommendations for health authorities

In the Americas Region, the risk of yellow fever outbreaks is high. Although immunization remains one of the most effective public health interventions to prevent this disease, most of the cases reported during 2024 did not have a history of yellow fever vaccination.

PAHO/WHO encourages Member States with areas at risk to continue surveillance and vaccination efforts in endemic areas.

It is essential that countries achieve vaccination coverage of at least 95% in populations in at-risk areas, in a homogeneous manner, and that health authorities ensure that they have a strategic reserve inventory that allows them to maintain routine vaccination and, at the same time, respond effectively to possible outbreaks *(8)*.

Epidemiological surveillance

It is recommended that Member States with risk areas for yellow fever implement the following strategies to strengthen surveillance *(9)*:

- Issue epidemiological alerts to municipalities and health services, with emphasis on case definitions. Case notification should be immediate, even if it is a suspected case and regardless of yellow fever vaccination status.
- Conduct an active search for cases with symptoms compatible with the definition of a suspected case and/or with acute febrile icteric syndrome in the areas where cases have occurred, as well as in the surrounding municipalities and places visited by the cases during the 3 to 6 days prior to the onset of the disease.
- Conduct retrospective investigations of death certificates to identify possible cases compatible with the case definition.
- Intensify surveillance actions for epizootics, given that the death of non-human primates can serve as an early warning to identify yellow fever circulation, which would indicate the need to reinforce vaccination actions, especially in areas where human cases and epizootics have not yet been detected. In areas with confirmed transmission, efforts to identify vectors and locally involved primates can provide valuable information to support risk communication, health education and targeted vaccination activities.
- If possible, geo-reference the points of occurrence of non-human primate deaths, and the probable place of exposure of human cases, in order to establish the "ecological corridors" for yellow fever in order to identify the areas of greatest risk in order to anticipate preventive measures and optimize vaccination actions.
- Collaborate with the agricultural sector and involve companies that employ workers in activities involving exposure to forest areas to implement health communication measures. It is recommended to act with the support of community surveillance in the areas considered to be at greatest risk.

Laboratory diagnosis

The diagnosis of yellow fever is made by virological methods (detection of the virus or genetic material in serum or tissue) or by serological tests for the detection of antibodies *(10)*.

Virological diagnosis

- ***Molecular detection:*** During the first 5 days from the onset of symptoms (viremic phase) it is possible to detect viral RNA from serum using molecular techniques, such as conventional or real-time Reverse Transcription-Polymerase Chain Reaction (RT-PCR). Sometimes, viral RNA can be detected for up to 10 days (or more) from the onset of symptoms. For this reason, it is recommended that both PCR and IgM ELISA be performed on samples collected between days 5-10. A positive result (in the presence of adequate controls) on any day of sampling confirms the diagnosis *(10)*.

- ***Post-mortem diagnosis:*** Histopathological study with immunohistochemistry on liver sections is the "gold standard" method for the diagnosis of yellow fever in fatal cases. In addition, molecular methods from fresh or paraffin-preserved tissue samples can also be used for confirmation of cases. Detection can be performed under Biosafety Level 2 (BSL2) containment conditions *(10)*.

Serological diagnosis

Serology (detection of specific antibodies) is useful to make the diagnosis of yellow fever during the post-viremic phase of the disease (i.e., from day 5 from the onset of symptoms) *(10)*.

A positive IgM result by ELISA (mainly IgM capture, MAC-ELISA) or any other immunoassay (indirect immunofluorescence) on a sample taken on or after day 5 of symptom onset is presumptive of recent yellow fever virus infection. Currently, there are no validated commercial kits for IgM detection by ELISA. Therefore, in-house procedures using purified complete antigen can be standardized *(10)*.

Confirmation of a yellow fever case by IgM ELISA will depend on the epidemiological situation and the result of the differential laboratory diagnosis. Thus, in areas with circulation of other flaviviruses (mainly dengue and Zika), the probability of cross-reactivity is higher.

Other serological techniques include detection of IgG by ELISA and of neutralizing antibodies by the plaque reduction neutralization technique (PRNT). IgG ELISA is useful with paired samples (taken at least one week apart), whereas PRNT (90%) can be useful with paired samples, or with a single post-viremic sample as long as the assay includes multiple flaviviruses *(10)*.

A seroconversion (negative result in the first sample and positive in the second), a more than 4-fold increase in antibody titers in paired samples, or detectable yellow fever antibody titers in a post-viremic sample (PRNT 90%) is presumptive of yellow fever infection. Confirmation of a yellow fever case by these techniques will depend on the epidemiological situation and the differential laboratory result, since in areas of co-circulation with other flaviviruses, the possibility of cross-reactivity is greater *(10)*.

Also, in areas where active vaccination campaigns are carried out, the detection of post-vaccination antibodies may occur, so the diagnosis must be carefully interpreted *(10)*.

Interpretation of serology results and differential diagnosis

The cross-reactivity of serological techniques observed mainly in secondary flavivirus infections should be considered in areas where co-circulation of yellow fever virus with other flaviviruses (dengue, St. Louis encephalitis, Zika, and others of the Japanese encephalitis complex) is documented and there is a probability that the population has been previously infected. Also, it should be taken into account that in individuals previously vaccinated against yellow fever, vaccine-induced IgM can be detected for several months or even years *(10)*.

Therefore, it is recommended that the detection of antibodies to other flaviviruses be carried out in parallel and that the results be carefully interpreted taking into account the vaccination history as well as the epidemiological information available *(10)*.

In general, the plaque reduction neutralization technique (PRNT) offers higher specificity than IgM and IgG detection. However, cross-reactivity has also been documented for neutralization assays, so it is also recommended to perform this technique using antigens for several flaviviruses *(10)*.

On the other hand, the differential diagnosis of yellow fever should include other febrile and febrile-icteric syndromes such as dengue, leptospirosis, malaria, viral hepatitis, among others, depending on the epidemiological profile of the affected country or area.

A case of yellow fever will be confirmed by serological techniques only if the differential laboratory diagnosis, taking into account the epidemiological profile of the country, is negative for other flaviviruses.

Post-vaccination immune response

Vaccination induces a relatively low viremia that decreases after 4 to 7 days. Simultaneously, an IgM-type response develops which cannot be differentiated from the IgM response induced by natural infection. Approximately 10 days after vaccination, the person is considered to be protected against a natural infection. Thus, the vaccinal IgM response will be detectable around day 5 onwards with a peak usually occurring two weeks after vaccination. Thereafter, the levels of these antibodies tend to decline. In a significant proportion of vaccinated persons the IgM response can be detected for up to one month after vaccination, and in some cases (mainly travelers), even for up to 3-4 years. On the other hand, the neutralizing antibodies induced by vaccination can be detected for several decades. All in all, the interpretation of serological results in vaccinated persons is complex, particularly those who have been recently vaccinated, so the results should be carefully evaluated *(10)*.

Guidance for laboratory diagnosis in the Americas Region is published in the **Laboratory Diagnosis of Yellow Fever Virus Infection** document dated 9 September 2018 *(10)*.

Clinical management

Yellow fever is a severe viral hemorrhagic disease with an abrupt onset and a lethality of 30-60% in its severe forms *(11)*. It is a dynamic, systemic disease that presents in three well-defined clinical phases: a) infection phase characterized by elevated body temperature, b) remission phase, with the presence of albuminuria, and c) toxemic phase, in which hemorrhagic manifestations and signs of acute liver failure appear, such as jaundice and hepatic encephalopathy *(12)*.

There is currently no specific treatment for yellow fever. Therefore, early detection of suspected or confirmed cases, monitoring of vital signs, life support measures, and management of acute liver failure continue to be the recommended strategies for management *(12)*. Three levels of care should be considered for patient care:

- Basic health units (primary care): management of mild cases or patients without a confirmed diagnosis of the disease, generally those whose symptoms started two or three days before (group A).
- Medium complexity hospitals: patients in the remission phase of the disease, who may be those with a suspicion or diagnosis of yellow fever and whose symptoms began three or four days earlier (group B).
- Intensive care units (ICU): management of severe cases, with hepatic and renal complications (group C).

The following is an outline for the stratified care of patients yellow fever, based on the early identification of warning signs and severity, as well as clinical and laboratory findings, with the objective of ensuring timely, adequate, and supportive management according to the level of care required.

Table 1. Schema for stratified care of patients with yellow fever.

Group	Clinical Condition	Recommended actions
Group A (Primary Care - Infection Phase)	Fever, abdominal pain, nausea, possible mild bleeding, mild to moderate dehydration.	- Oral and intravenous hydration according to water losses. - Initial volumetric expansion of 20 ml/kg if necessary. - Consciousness level monitoring. - Pain and fever management with dipyrone (max. 8 g/day) or paracetamol (max. 2 g/day). - Avoid NSAIDs. -Monitor AST > 5 LSN, platelets < 50,000/mm³ and proteinuria, with close follow-up to detect progression to severe forms. - Re-evaluation in 24 hours to determine evolution and possible reclassification to Group B. - Evaluate whether primary care services have the infrastructure to carry out continuous patient monitoring, and if there is no capacity in primary care, the patient should be sent directly to hospital for monitoring.
Group B (Hospitalization - Remission Phase)	Severe dehydration, persistent vomiting, diarrhea, altered urinary excretion, hemodynamic instability.	- Immediate hospitalization with monitoring of cardiac, renal, hepatic and metabolic parameters. - Second volumetric expansion if necessary. - Initiate vasoactive drugs without delay if hypovolemic shock is present. - Monitor level of consciousness, abdominal pain and onset of severe bleeding.

		- Monitoring AST > 2,000 U/L, serum creatinine > 2.0 mg/dl and RNI > 1.5, with specialized medical support. - Evaluate need for transfer to ICU (Group C).
Group C (Intensive Care Unit - Toxemic Phase)	Acute liver failure (jaundice, alterations in liver function tests), acute renal failure, hepatic encephalopathy, severe bleeding.	- Referral to ICU for specialized management. - Continuous monitoring and advanced supportive care. - Use of vasoactive drugs to maintain hemodynamic stability. - Ventilatory support if necessary. - Dialysis in cases of acute renal failure. - Application of specific protocols according to local availability.

Source: Adapted from Pan American Health Organization. Clinical management of yellow fever in the Region of the Americas. Experiences and recommendations for health services. Washington, D.C.: PAHO; 2023. Available from https://iris.paho.org/handle/10665.2/57318 *(12)*.

The complete recommendations for management are available in the document Clinical Management of Yellow Fever in the Americas Region - Experiences and recommendations for health services, which is available from: https://iris.paho.org/handle/10665.2/57318 *(12)*.

Vaccination

The yellow fever vaccine is safe, affordable, and a single dose is sufficient to confer lifelong immunity and protection, without the need for booster doses *(13)*.

PAHO/WHO reiterates the following recommendations to national authorities *(14)*:

Routine vaccination:

- **Universal vaccination** in children in endemic countries at 12 months of age, administered simultaneously with measles, rubella and mumps (MMR) vaccine or according to the national vaccination schedule of each country.
- Ensure vaccination of all travelers to endemic areas at least **10 days before travel**. Recommendations for international travelers on yellow fever vaccination are available in the International Travel and Health document, which is available from https://www.who.int/publications/i/item/9789241580472 *(15)*.
- **To have a reserve inventory in the country** to maintain routine vaccination and to respond in a timely manner in case of outbreaks.

Preventive or update campaigns:

- Update the **risk assessment and the estimate of the susceptible population**, taking into account changes in ecological factors, migration, vaccination coverage, socioeconomic activities, as well as the risk of urbanization, in order to guide vaccination and control measures.
- Prioritize vaccination in at-risk areas, reaching at **least 95% coverage** in residents of these areas (urban, rural, and jungle), through different strategies to address unvaccinated populations, occupational and professional risk groups, and age groups with suboptimal coverage.

- In countries with yellow fever vaccination for extended age groups, it is suggested to apply the cohort estimation method to identify the susceptible population at higher risk, such as workers in activities involving exposure in jungle/forest areas.
- Since the global supply of yellow fever vaccines has been limited in recent years, it is important to plan ahead for the campaign to ensure vaccine availability.

Vaccination during outbreak response:

- Vaccination in response to outbreaks should consider a careful assessment of the target population based on exposure risk and vaccination history.
- Vaccine stocks should be permanently checked to reduce the possibility of stock-outs in case of outbreaks.
- In case of limited dose availability, the use of "split" doses of yellow fever vaccine (0.1 ml) is recommended, as recommended by the WHO Strategic Advisory Group of Experts (SAGE) and the PAHO Strategic Advisory Group (SAG formerly GTA) *(16, 17)*. Children under two years of age, pregnant women, and persons living with HIV who are eligible for vaccination should receive a standard dose of 0.5 ml. A "split" dose does not meet the requirements of the International Health Regulations as proof of vaccination for international travel.
- It is important to carry out adequate risk communication aimed at health care workers and the general population regarding the term "fractional dose" in order to avoid resistance to vaccination and misinformation.

Precautions and contraindications:

- Age 6 to 9 months, ≥ 60 years, pregnancy and lactation are precautions for vaccination. A risk-benefit analysis is recommended for persons with vaccination precautions.
- The vaccine is contraindicated in:
    a. Children under 6 months of age and not recommended in children 6 to 8 months of age, except in outbreak situations.
    b. Persons with a history of severe hypersensitivity reactions to egg.
    c. Persons with immunodeficiency such as symptomatic HIV or with CD4+ count < 200 cells/ml.

Surveillance of events supposedly attributable to vaccination or immunization (ESAVI):

- Surveillance of *events supposedly attributable to vaccination or immunization* (ESAVI) should be strengthened during the implementation of yellow fever vaccination campaigns, including all the actors involved: National Regulatory Authorities, National Centers for Pharmacovigilance, and those in charge of epidemiological surveillance
- It is essential to train vaccination teams in the precautions and contraindications of yellow fever vaccines and to define a standardized flow for selecting persons to be vaccinated, in order to minimize immunization errors and the risk of ESAVI, e.g., vaccination of immunocompromised persons.
- It is necessary to ensure the conditions for sample collection and processing and interpretation in the process of investigation of severe cases that may correspond to cases of neurotropic or viscerotropic disease. Case investigation should help to meet the

Brighton Collaboration criteria for certainty and should be conducted according to the PAHO ESAVI surveillance manual *(18)*.

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Useful links

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