COUNTRY PROFILE YELLOW FEVER

PARAGUAY

COUNTRY SITUATIONAL ANALYSIS

Paraguay is located in the center of South America. The most populated urban centers are in the east and this is also the area where reactivation of sylvatic yellow fever (YF) transmission cycles is most likely. There have been two outbreaks in the past few decades, with long intervals of epidemic silence between them. These outbreaks were linked to the epidemic waves in southern Brazil and associated with suspected urban transmission events. Dengue has now developed into a primary public health concern, since the reintroduction of *Aedes aegypti*, with both the incidence and geographical distribution rising steadily. Two other arboviruses have also emerged in the last decade: chikungunya and Zika. Their dramatic spread and morbidity highlight the extraordinary capacity of these viruses to invade a mainly susceptible population.

ECOLOGICAL FACTORS AND CLIMATE[1]

Five ecoregions converge in the country:

1) The ***Dry Chaco*** region is a dry ecosystem in the west characterized by high temperatures and low population density.

2) The ***Pantanal*** region in the northwest has floodplains and subtropical wetlands.

3) The ***Alto Paraná Atlantic Forest*** region is a tropical rainforest with a semitropical and humid tropical climate located in the east and extending as far as Brazil and Argentina. This region has suffered great fragmentation as a result of human activity.

4) The ***Humid Chaco*** region in the southeast is characterized by wetlands, estuaries, islands of subtropical forests, and gallery forests, and also extends up to north-central Argentina.

5) The ***Cerrado*** lies to the northeast, as the southern extension of the Brazilian Cerrado, and consists of an amalgam of ecosystems, grasslands, savannas, dry and humid forests.

Forest areas make up 42% of land cover, of which 55% is used for agricultural activities.

Vector distribution and incidence

High levels of vector infested with *Aedes aegypti* were found in Asunción.[3] Entomological surveys to measure *Aedes aegypti* larval infestation in 2021 show high-risk indices (>4%) in 62% of municipalities, alert indices (1%-3%) in 35% of municipalities, while only 3% had satisfactory infestation rates (<1%).

YELLOW FEVER HIGHLIGHTS

EYE strategy risk categorization	High
Routine immunization introduction (year)	2001
Latest official coverage estimates (2021)	52%
Gavi eligibility	No
International Coordinating Group on vaccine provision requests	No
Last disruptive yellow fever outbreak	2008
Yellow fever vaccination proof for entry/exit	Not consistently
Diagnostic capacity	Yes
Fragility, conflict, and violence status	No

DEMOGRAPHICS[2]

Total population	7 044 640
Annual population growth rate	1.3%
Life expectancy	76 years (female) and 74 years (male)
Percentage population living in urban dwellings	56%
Percentage urban population living in slums	18%

1 World Bank Group. Climate Change Knowledge Portal for Development Practitioners and Policy Makers: Paraguay. Washington, DC: World Bank; 2021. Available from: https://climateknowledgeportal.worldbank.org/country/paraguay

2 World Bank Group. Understanding poverty: Open data. Washington, DC: World Bank; 2020. Available from: https://www.worldbank.org/en/understanding-poverty

3 Sanabria E, Rodríguez N, Samudio M, Martínez N, Torales M, Aguayo N. Criaderos de *Aedes aegypti* en la ciudad de Asunción, Paraguay durante los años 2011-2014. Rev public health Parag. 2017;7(1):33–36. Available from: https://doi.org/10.18004/rspp.2017.junio.33-36

EPIDEMIOLOGY

The largest epidemic in the country was recorded in 1937, introduced from Matto Grosso (Brazil). Urban outbreaks were eliminated following the introduction of the vaccine and the implementation of a robust vector control program. A long epidemic silence was interrupted with an outbreak of 9 cases in 1974 along the border with Mato Grosso do Sul (Brazil), with a case fatality rate of 22%. The second outbreak, in 2008, was recorded in rural areas of San Pedro and Caaguazú, and also followed a trend in southeastern Brazil. This included a group of 9 cases in the metropolitan area of Asunción, which raised concerns about the emergence of urban transmission. However, it was not possible to confirm transmission by *Aedes aegypti*. The case fatality rate was 39%. The cases were registered between December and March of that year. Of these, 64% were men, 48% were between 15 and 40 years old (active population), and of these, 46% were farm and livestock workers and 93% had not been vaccinated. The presence of *Aedes aegypti* and other potential vectors throughout the national territory renews the potential risk of the appearance of the disease, which requires strict surveillance and immediate notification. Considering the YF outbreak and the epizootic wave affecting southeastern and southern Brazil, surveillance should be strengthened, as well as investigation of the factors favoring the emergence of cases.

Endemic areas

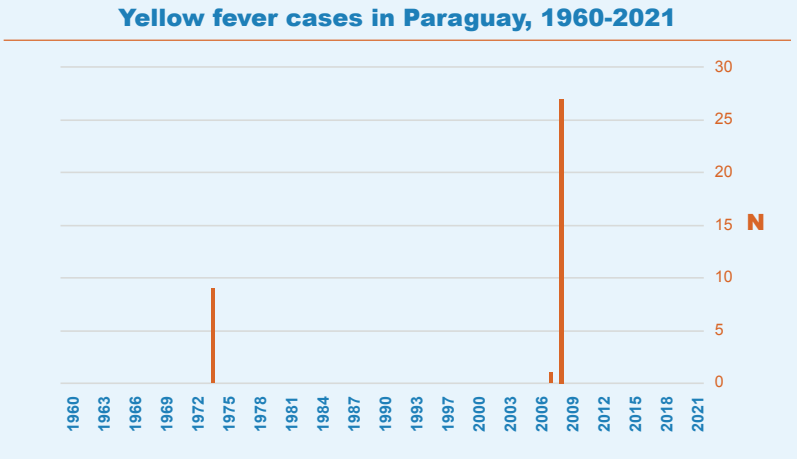
Favorable areas for enzootic transmission are found in the Eastern Region of the country, especially in the departments bordering with Brazil, where sylvatic vectors and susceptible non-human primates live, mainly in the departments of Alto Paraná, Amambay, Canindeyú, Caaguazu, and Concepción.

PAST OUTBREAKS

Year	Number	Region	Comments
1974	9		
2008	28	Departments of Central, Caaguazú, and San Pedro	Case fatality rate: 39%. Cases started to appear in San Pedro, a rural department, linked to the sylvatic cycle of the virus. All cases were young men working or visiting rural areas. Nine cases, including three deaths, occurred in the urban area of the municipality of San Lorenzo, about 15 km from the capital city, Asunción. A total of 1 420 819 vaccine doses were administered in priority districts. Vaccination coverage was 92.9% in San Estanislao, 37.6% in Gauyaibi, 91.6% in Iribucua, 99.4% in Lima, 52.9% in San Lorenzo, and 11% in Cuaguazú.

Trends of previous outbreaks[4]

Over the last 60 years, Paraguay has reported two YF outbreaks to the Pan American Health Organization (PAHO), with a total of 71 cases. Both events occurred within the context of the expanding epidemic waves that originated in southeastern Brazil and also affected Paraguay. These events highlight the extent to which the epidemiological situation in Paraguay is dependent on the epidemiological situation in southern Brazil.



4 Pan American Health Organization. Epidemiological alerts and updates: Yellow fever. Washington, DC: PAHO; n.d. Available from: https://www.paho.org/en/epidemiological-alerts-and-updates

ARBOVIRAL ACTIVITY

Dengue Dengue emerged in Paraguay with a major outbreak in 1989. After 10 years with no cases, the disease re-emerged and continued to increase over .[5]

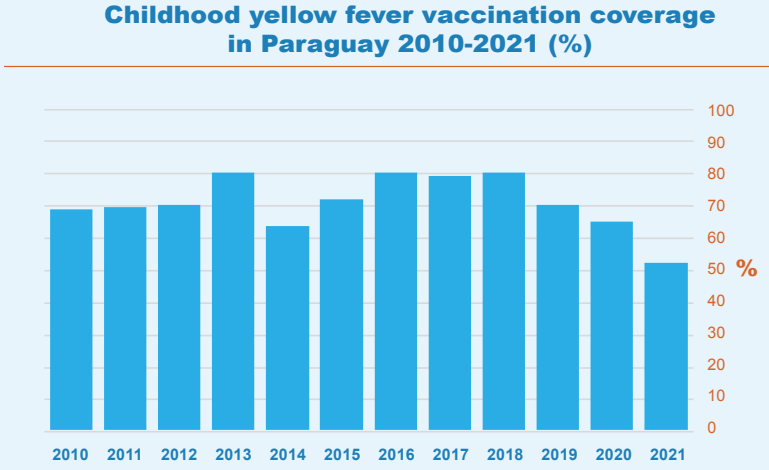
Chikungunya Imported cases were detected in the country in June 2014. In February 2015, the first autochthonous cases were registered and outbreaks continued until 2018. The country has notified PAHO of over 5963 cases.[6]

Zika Zika reached Paraguay in November 2015. The country notified PAHO of 705 suspected cases, 20 confirmed cases, and two congenital syndromes associated with the Zika virus.[7]

YELLOW FEVER VACCINATION

Routine childhood immunization[8]	
Yellow fever vaccine introduced	Yes
Level	National
Year of introduction	2001
Age vaccine is administered (months)	12
Vaccine schedule	Single dose
Integration with first does of measles, mumps, rubella vaccine (MMR-1)	Yes
Gap MMR-1/ yellow fever vaccine to monitor program	Yes

Vaccine coverage[9]



The YF vaccine was introduced into the routine childhood immunization program for high-risk areas in 2001 and this was upgraded in 2006 to nationwide coverage. YF vaccination coverage fluctuated around 70-80%, with decreases following regional vaccine shortages. However, the gap between MMR-1 and YF vaccine is less than 5%. Vaccination coverage rates have fallen again in recent years due to the COVID-19 pandemic.

Vaccination campaigns[10]	
Catch-up campaigns implemented during the last 20 years?	Yes
Preventive mass campaigns implemented during the last 20 years?	Yes
In 2001, vaccination began in populations in high-risk areas, especially in departments close to the border with Brazil. Up to 2005, 294 836 people aged from 1 to 59 years were vaccinated.	
Reactive vaccination campaigns implemented during the last 20 years?	Yes
In response to the 2008 outbreak, 3 635 352 people aged from 1 to 59 years were vaccinated. In addition, health authorities urge the population to report the occurrence of dead monkeys.	
Vaccination in international travelers[11]	Yes
Paraguay offers the YF vaccine to travelers departing for at-risk countries.	
Vaccination in internal travelers (traveling to high-risk areas in the country)[12]	No

5 Pan American Health Organization. Health Information Platform for the Americas (PLISA). Dengue and severe dengue: Cases and deaths for the countries and territories of the Americas. Washington, DC: PAHO; n.d. Available from: https://www3.paho.org/data/index.php/en/mnu-topics/indicadores-dengue-en/dengue-nacional-en/257-dengue-casos-muertes-pais-ano-en.html

6 Pan American Health Organization. Chikungunya. Data and statistics. Cumulative number of confirmed cases of Chikungunya in South America from 2013 to 2017. Washington, DC: PAHO; n.d. Available from: https://www.paho.org/en/topics/chikungunya

7 Pan American Health Organization. Zika: Epidemiological Report. Paraguay. Washington, DC: PAHO; 2017. Available from: https://www3.paho.org/hq/index.php?option=com_content&view=article&id=11599:regional-zika-epidemiological-update-americas&Itemid=41691&lang=en

8 Pan American Health Organization. Comprehensive Family Immunization Unit: Survey for mapping of national policies on yellow fever vaccination and their implementation. Washington, D.C.: PAHO, 2021. Unpublished.

9 Pan American Health Organization. Data compiled from WHO vaccine-preventable diseases: monitoring system reported through the Joint Reporting Form. Washington, DC: PAHO; n.d. Available from: https://immunizationdata.who.int/pages/coverage/yfv.html

10 See Note 8.

11 Ibid.

12 Ibid.

Registration system to record vaccination data[13]	Nominal paper immunization registry system

Vaccine program funding[14]	
Sources of funding	Government
Gaps in funding during the past 5 years	No
Does the country require financial support?	Yes

INTERNATIONAL HEALTH REGULATIONS[15]

Does the country request proof of yellow fever vaccination at points of entry?	Not in all cases
Proof of YF vaccination is requested from travelers from Bolivia (Plurinational State of), Brazil, Peru, and Venezuela (Bolivarian Republic of).	

LABORATORY DIAGNOSTIC CAPACITY[16]		SURVEILLANCE[17]	
Member of the Arbovirus Diagnosis Laboratory Network of the Americas	Yes	National guidelines for surveillance	Yes
National Reference Laboratories	Central Public Health Laboratory	Type of surveillance for human cases	Syndromic and case-based
Reports to PAHO	Yes	Type of YF surveillance for non-human primates	Passive
TESTING CAPACITY FOR YELLOW FEVER		Entomological surveillance	Yes
IgM antibody capture enzyme-linked immunosorbent assay (MAC-ELISA)	Yes	Entomovirological surveillance	No
Plaque reduction neutralization test (PRNT)	No	Case investigation (reactive)	Yes
Reverse transcription polymerase chain reaction (RT-PCR) blood specimens	Yes	**YELLOW FEVER CONTROL STRATEGIES**	
RT-PCR tissue specimens	Yes	Multi-annual immunization plan	Yes
RT-PCR wild type virus versus vaccine	Yes	Risk assessment methodology[18]	Yes
Immunohistochemistry	No	Vector control activities	Yes
Virus isolation	Yes	Diagnosis	Yes
External quality assessment compliance	Yes	Surveillance	Yes
Shortages of diagnostic supplies in the past 5 years	No	Request for proof of YF vaccination at points of entry	Not consistently

POPULATION MOVEMENTS[19]

More than 6000 displaced Venezuelan citizens, refugees, and asylum seekers live in Paraguay.

13 Ibid.
14 Ibid.
15 Ibid.
16 Ibid.
17 Ibid.
18 See Note 8.
19 Office of the United Nations High Commissioner for Refugees (UNHCR). UNHCR Data. Geneva: UNHCR; n.d. Available from: https://www.unhcr.org/en-us/data.html

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