COUNTRY PROFILE YELLOW FEVER

PERU

COUNTRY SITUATIONAL ANALYSIS

Peru is located on the Pacific coast of the central part of South America. Foci of enzootic yellow fever (YF) activity persist in remote and difficult-to-reach jungle areas. Cities located in the highlands (in the Andes or the Sierra) or desert coastal areas are free of transmission. Eighty percent of the Peruvian population is concentrated in the urban centers of the coast. Between 1960 and 2015, more than half of the YF cases reported in the Region were in Peru. For decades, the disease affected the same at-risk populations: migrant workers engaged in agricultural activities and unvaccinated populations moving from non-endemic to endemic regions. This highlights the difficulty in achieving optimal vaccination coverage. Since the reintroduction of *Aedes aegypti*, dengue has also become a major public health problem, with steady increases in both incidence and geographical spread. Two other arboviruses, chikungunya and Zika, have also emerged over the past decade. Their dramatic spread and morbidity highlight the extraordinary capacity of these viruses to invade a mainly susceptible population.

ECOLOGICAL FACTORS AND CLIMATE[1]

Although located in the tropics, Peru has a great diversity of regions and climates that includes deserts, mountains, and tropical rainforests. The following ecoregions converge in the country:

1) The ***Coast*** is a desert region where the main urban centers on the Pacific Ocean are found.

2) The ***Andes*** are highlands that cross the country from north to south with different microclimates depending on the altitude.

3) The ***Amazon*** is a tropical rainforest with a subtropical climate at altitudes 1550 meters above sea level.

The forest makes up 57% of the land cover, with 18% used for agricultural activities.

Vector distribution and incidence

Studies have demonstrated the geographical spread of *Aedes aegypti* into the Peruvian Amazon, driven by human transport networks, and high entomological rates in the main cities.[3,4,5,6]

YELLOW FEVER HIGHLIGHTS	
EYE strategy risk categorization	High
Routine immunization introduction (year)	2004
Latest official coverage estimates (2021)	61%
Gavi eligibility	No
International Coordinating Group on vaccine provision requests	No
Last disruptive yellow fever outbreak	2016-2018
Yellow fever vaccination proof for entry/exit	No
Diagnostic capacity	Yes
Fragility, conflict, and violence status	No

DEMOGRAPHICS[2]	
Total population	32 510 460
Annual population growth rate	1.6%
Life expectancy	80 years (female) and 74 years (male)
Percentage population living in urban dwellings	80%
Percentage urban population living in slums	33%

1 World Bank. Climate Change Knowledge Portal for Development Practitioners and Policy Makers: Peru. Washington (DC): World Bank; 2021. Available from: https://climateknowledgeportal.worldbank.org/country/peru

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

3 Guagliardo SA, Barboza JL, Morrison AC, Astete H, Vazquez-Prokopec G and Kitron U. Patterns of geographic expansion of Aedes aegypti in the Peruvian Amazon. PLoS Negl Trop Dis. 2014;8(8):E3033. Available from. https://doi.org/10.1371/journal.PNTD.0003033

4 Andrade CS, Cáceres AG, Vaquerizo A, Ibáñez-Bernal S and Sulca Cachay L. Reappearance of Aedes aegypti (Diptera: Culicidae) in Lima, Peru. Mem Inst Oswaldo Cruz, Rio de Janeiro. 2001;96(5): 657-658.

5 Schneider JR, Morrison AC, Astete H, Scott TW and Wilson ML. Adult size and distribution of Aedes aegypti (Diptera: Culicidae) associated with larval habitats in Iquitos, Peru. J Med Entomol. 2004;41(4):634-642. Available from: https://doi.org/10.1603/0022-2585-41.4.634

6 Morrison AC, Sihuincha M, Stancil JD, Zamora E, Astete H, Olson JG, et al. Aedes aegypti (Diptera: Culicidae) production from non-residential sites in the Amazonian city of Iquitos, Peru. Ann Trop Med Parasitol. 2006; Suppl. 1:S73-S86. Available from: https://doi.org/10.1179/136485906X105534

EPIDEMIOLOGY

Urban YF epidemics plagued the country until the early 20th century, mainly in the port cities on the north coast of the country. These were controlled with the rollout of the vaccine, and mass vertical vector control campaigns. Since the control of the last outbreak in 1922, only sylvatic-acquired YF occurs in remote endemic areas of the Amazon. These are cyclical with outbreaks at 7- to 10-year intervals. Cases occur throughout the year, with peaks between December and September related to the seasonality of agricultural activities. All patients follow a traditional epidemiological pattern: more than 80% are male, 64% between 15 and 40 years, and up to 10% of cases are children under 15 years. Most cases are persons engaged in agricultural work (mainly coffee and cocoa farming) or forestry. Many are unvaccinated migrant workers coming from the non-endemic highlands (the Andes or the Sierra) or coastal areas (desert).

Endemic areas

The endemic areas are the river basins that cross the Amazon region, toward the east of the Andes mountain range, which include the high mountain forests (Rupa-Rupa), the Yungas, and the low forests. Most of the cases reported are in rural localities that are difficult to access and socioeconomically disadvantaged.

PAST OUTBREAKS[7]

Year	Number	Region	Comments
2003	22	Department of San Martín (municipalities of Pavo, Aucara, and El Zancudo), Madre de Dios, Puno, and Cuzco (municipalities of Echerate and Villacamba).	Reports were isolated cases or small outbreaks. Of the total cases, 86% were men, and of these 64% between 15 and 44 years. The case fatality rate was 59%. Those affected were from the departments of Amazonas, Cajamarca, and Piura arriving in waves of migrant workers for the harvest season, or truck drivers. Vaccination was carried out in the affected areas and nearby areas from which migrant travel.
2004	52	Department of Cuzco (municipality of Echerate), Huánuco (municipalities of Cholón, Daniel Alomia Robles, Huánuco, and José Crespo y Castillo), Junin (municipalities of Junín, Perené, and Pichanaqui), Loreto (Ramón Castilla Municipality), Madre de Dios (municipalities of Huepétuhe, Laberinto, Manú), San Martín (municipalities of Campanilla, La Banda de Shiclayo, Moyobamba, and Nueva Cajamarca).	All cases were men over 15 years of age working in the fields. The case fatality rate was 52%. A preventive mass vaccination campaign was launched (see below).
2009	2	Departments of Loreto and San Martín.	
2016	82	Department of Junin (66% of cases) (cases were reported in 9 of the 25 departments in Peru).	The number of reported cases exceeds the total number of cases reported in the previous 9 years. The case fatality rate was 32%.
2017	7	Departments of Ayacucho (municipalities of Silvia, La Mar, and Llochegua), Cuzco (municipality of Pichari), Huanco (municipality of Luyando), Junin (municipality of Satipo) and San Martín (municipality of Polvora).	The case fatality rate was 42%.
2018	8	Departments of Loreto, Madre de Dios, San Martín, and Ucayali.	The case fatality rate was 60%.

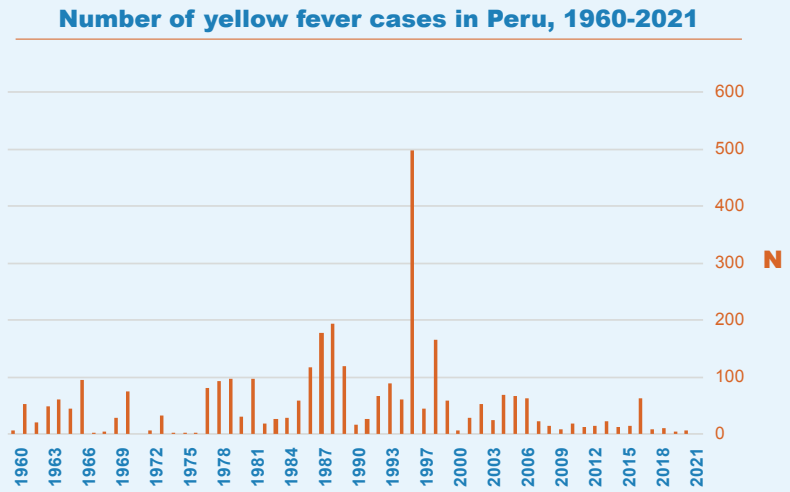
7 Pan American Health Organization. Epidemiological alerts and updates: Yellow fever. Washington, DC: PAHO; n.d. Available from: https://www.paho.org/en/epidemiological-alerts-and-updates

2019	4	Departments of San Martín (municipality of Pólvora), Amazonas (municipality of Nieva), and Junín (municipalities of Vizcatán del Ene and Pichanaqui).	The case fatality rate was 48%.
2020	9	Departments of San Martín (municipalities of Campanilla, Caynarachiand Tarapoto, Saposoa, and Tabalosos) and Loreto (municipalities of Fernando Lores and Trompeteros).	A 15-year-old male with no history of vaccination.
2021	17	Departments of Puno (municipality of Coasa), Loreto (municipalities of Alto Nanay, Teniente César Lopez Rojas y Yurimaguas), Ancash (municipality of Huacchis), San Martín (municipality of Campanilla) and Ucayali.	Of all cases, 56% were confirmed. The case fatality rate was 56%. All cases were men between 18 and 44 years of age with no history of vaccination.

Trends of previous outbreaks[8]

Peru has historically reported the highest number of cases in the Region.

Up to 2015, over 50% of all cases in the Region were in Peru. In the period from 1960 to 2021, it reported 3197 cases and 1333 deaths, with an average mortality of 55% (range 32-100%). The cases usually occur in areas where unvaccinated migrants from non-endemic high Andean regions arrive and then head to areas of virgin forest. Over the past 25 years, the country has managed to reduce the trend of case presentation with vaccination.



ARBOVIRAL ACTIVITY

Dengue. Dengue appeared in Peru in the nineties and its incidence has increased steadily over the years, with cocirculation of serotypes. The country notified PAHO of 494 630 cases between 1989-2021.[9]

Chikungunya. Chikungunya appeared in the country in 2014, and by 2017 had notified PAHO of over 33 117 cases.[10]

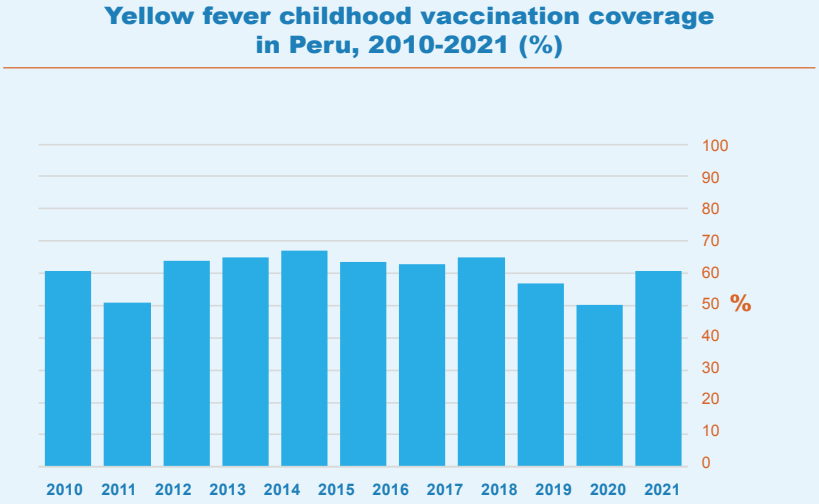
Zika. The first cases of Zika appeared in 2016, with the peak incidence in 2017. By 2021, the country had reported 8106 confirmed cases to PAHO.[11]

8 Ibid.
9 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
10 Pan American Health Organization. Topics: Chikungunya. Number of cases reported. Washington, DC: PAHO; 2018. Available from: https://www.paho.org/en/topics/chikungunya
11 Pan American Health Organization. Zika: PAHO Regional Epidemiological Update (Americas) 25 August 2017. Epidemiological report of Peru. 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#gsc.tab=0

YELLOW FEVER VACCINATION

Routine childhood immunization[12]	
Yellow fever vaccine introduced	Yes
Level	National
Year of introduction	2004
Age vaccine is administered (months)	15
Vaccine schedule	Single dose
Integration with first does of measles, mumps, rubella vaccine (MMR-1)	No
Gap MMR-1/ yellow fever vaccine to monitor program	Yes

Vaccine coverage[13]



The coverage rate of childhood yellow fever vaccination is about 60%.

The gap between MMR-1 and YF coverage ranges from 20% to 45%, ranking among the lowest performance in the Region.

Vaccination campaigns[14]	
Catch-up campaigns implemented during the last 20 years	Yes
Preventive mass campaigns implemented during the last 20 years	Yes
2003-2004	In 2003-2004, a mass vaccination campaign was launched, focusing on non-endemic areas from which migrants leave, with the aim of immunizing the entire population. A post-campaign survey in the Cusco region showed 84% coverage, according to official data, versus 64% coverage in the coverage survey. Logistical and implementation difficulties were reported.[15]
2004-2007	Between 2004 and 2007, the national vaccination campaign began in endemic areas (forest) and in non-endemic areas from which migrants travel (coast and mountains).
Reactive vaccination campaigns implemented during the last 20 years	Yes
Is vaccination provided for international travelers?[16]	Yes
The country offers the vaccine to travelers arriving from or departing for at-risk countries.	
Is vaccination provided for internal travelers (when traveling to high-risk areas in the country)[17]	No
During outbreaks, at access points to areas with high viral activity.	
Registration system to record vaccination data[18]	Electronic immunization registration (EIR) system

Vaccine program funding[19]	
Sources of funding	Government
Gaps in funding during the past 5 years?	No
Does the country require financial support?	Yes

12 Pan American Health Organization. Comprehensive Family Immunization Unit. Survey for mapping of national policies on yellow fever vaccination and their implementation. Washington, DC: PAHO. Unpublished document.
13 World Health Organization. Data compiled from WHO vaccine-preventable diseases: monitoring system reported through the Joint Reporting Form. Geneva: WHO; 2022. Available from: https://immunizationdata.who.int/pages/coverage/yfv.html
14 See note 12.
15 Ibid.
16 Ibid.
17 Ibid.
18 Ibid.
19 Ibid.

INTERNATIONAL HEALTH REGULATIONS[20]

Does the country request proof of YF vaccination at points of entry?	No

Peru does not require proof of YF vaccination at points of entry but recommends it.

LABORATORY DIAGNOSTIC CAPACITY[21]		SURVEILLANCE[22]	
Member of the Arbovirus Diagnosis Laboratory Network of the Americas	Yes	National guidelines for surveillance	Yes
National Reference Laboratories	National Institute of Health	Type of surveillance for human cases	Syndromic-case based
Report to PAHO	Yes	Type of YF surveillance for non-human primates	None
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	No	Risk assessment methodology[23]	Yes
Immunohistochemistry	Yes	Vector control activities	Yes
Virus isolation	Yes	Diagnosis	Yes
External quality assessment compliance	No	Surveillance	Yes
Shortages of diagnostic supplies in the last 5 years	No	Request for proof of YF vaccination at points of entry	No

POPULATION MOVEMENTS[24]

After Colombia, Peru is the most popular destination for the 4 million Venezuelans who, according to United Nations estimates, have fled the economic and political crisis since 2015. More than one million Venezuelans live in Peru and almost 50% have refugee status. The vast majority settle in the coastal cites following internal migration.

The Peruvian population structure has undergone accelerated urbanization in the last five decades, primarily in the coastal regions but also more recently in the forest. This urbanization is expressed in the growing predominance of the urban population (from 35% to 70%). In 1993, just 32 cities were home to more than half the country's population. The priority of the coastal region is reflected in its population growth, which went from 28% to 52%.[25]

20 Ibid.
21 Ibid.
22 Ibid.
23 Ibid.
24 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
25 National Institute of Statistics and Informatics of Peru. Migraciones internas en el Perú. Lima: INEI; 1995. Available from: https://www.inei.gob.pe/media/MenuRecursivo/publicaciones_digitales/Est/Lib0018/n00.htm

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