

Vaccine-preventable diseases (diphtheria, measles, yellow fever, and polio) in the context of the COVID-19 pandemic: implications for the Region of the Americas

15 December 2021

Summary

Date of assessment: 15 December 2021

Overall risk and confidence (based on information available at the time of assessment)

Level of confidence in the available information: **High**

Level of overall risk: **Very High**

Risk Assessment

After more than 22 months of the ongoing COVID-19 pandemic in the Region of the Americas, and COVID-19 cases and deaths have been reported from all 56 countries and territories in the Region of the Americas, health systems are still being challenged and routine immunization activities are still behind in most of countries. The pandemic has affected compliance with the vaccine-preventable diseases (VPDs) surveillance indicators. Furthermore, imposed restrictions on movement as well as concerns due to the pandemic have limited primary healthcare activities, including preventive services such as vaccination, with a consequent decline in the vaccination coverage and an increase of the susceptible population. In addition, the migration phenomena in the Region, the relaxing of public health and social measures, and the impact of COVID-19 on the capacity of the healthcare systems, have led to challenges. Therefore, the occurrence of new outbreaks of VPDs of varying magnitude in the Americas Region cannot be ruled out, and the regional risk remains assessed as **Very High**.

Risk Assessment Questions

Risk Question	Assessment		Risk	Rationale	
	Likelihood	Consequences			
Potential risk for human health?	Regional	Highly likely	Major	Very high	<p><i>Measles</i>: the occurrence of cases in populations with high levels of malnutrition and a lack of adequate healthcare, can result in death among up to 10% of measles cases; the case-fatality rate can be as high as 30% in displaced groups. In the Region of the Americas in the last four years, morbidity has increased in at least 9 countries. In 2021, as of epidemiological week (EW) 49, Brazil, French Guiana, and the United States reported confirmed cases of measles, and currently, Brazil is with ongoing measles virus circulation that can potentially lead to exported cases to other countries within the Region.</p> <p><i>Diphtheria</i> is fatal in 5-10% of cases, with a higher case-fatality rate (CFR) in Latin America, previous outbreaks have shown >20% CFR. In the Region of the Americas, between 2014 and 2020, there was an annual average of 50 confirmed cases in 4 countries within the Region. In 2021, as of EW 49, Brazil, Colombia, Dominican Republic, and Haiti have reported cases. Considering the prolonged transmission of the disease, diphtheria is considered endemic in Haiti. The high migration within the Region can potentially lead to exported cases to other countries with low DPT vaccination coverage.</p> <p><i>Yellow fever</i> is an acute viral disease with a case fatality rate of 20 to 50% among severe human cases. In 2021, three countries in the Region of the Americas (Brazil, Peru, and Venezuela) have reported confirmed yellow fever cases. Indigenous communities and other vulnerable population with sylvatic exposure, that reside in and around the affected sylvatic areas, are particularly at risk.</p> <p><i>Polio</i> is caused by a human enterovirus; approximately 90% of infections are asymptomatic or present with nonspecific fever. Other symptoms could include aseptic meningitis, fever, malaise, headache, nausea, and vomiting. If disease progresses to major illness, severe</p>

					<p>muscle pain and stiffness of the neck and back with flaccid paralysis may occur. In 2020, no confirmed cases were reported; however, low vaccination coverage can potentially lead to cases and outbreaks. Additionally, all countries of the Americas reported a significant reduction in the notification of suspected VPD cases since the beginning of the pandemic, and therefore, increasing the risk of not detecting an outbreak timely.</p> <p>The context of the COVID-19 pandemic has hampered the provision of immunizations and primary healthcare services, and strained resources particularly in healthcare, increasing the risk of non-timely response to an outbreak.</p>
Risk of event spreading?	Regional	Highly likely	Major	Very high	<p>The increase of susceptible population as a result of <i>low vaccination coverage</i> becomes a greater risk of measles, diphtheria, polio, and yellow fever spreading in the Region of the Americas (See vaccination coverage in the context assessment section). In addition, it is likely that the ongoing transmission of measles in Brazil and diphtheria in Haiti and Dominican Republic will continue until adequate vaccination levels are reached and adequate control measures are implemented.</p> <p>Indigenous populations living along the borders of Venezuela, Brazil, and Colombia in particular, as well as the Argentina, Brazil, Bolivia, Paraguay, and Peru borders, are also particularly at-risk due to the difficulty in reaching these populations and due to the limited access to essential health services and immunizations. Among the Caribbean countries, the lack of availability of healthcare workers is a factor which contributes with low coverage and weak VPDs surveillance.</p> <p>The massive migration observed during the last years within the Region and from other Regions, is a challenge for the vaccination field teams and represents a high risk for vulnerable population.</p> <p>The risk of outbreaks due to VPDs and subsequent spread is Very High.</p>
Risk of insufficient prevention and control capacities with available resources?	Regional	Likely	Major	High	<p>In 2021, as of EW 49, a low performance in the surveillance indicators, low vaccination coverages and strained capacity of healthcare services was observed as an impact of COVID-19 pandemic, in addition to limitations in reaching undocumented unvaccinated migrants, as well as local vulnerable unvaccinated populations, has been observed in countries and territories in the Americas. Between 2020 and 2021, a total of 2 countries completed follow-up campaigns against measles and rubella, 3 countries are ongoing and 4 planned to implement campaigns in 2022. PAHO/WHO headquarters has mobilized additional resources to support the campaigns in each of these countries.</p> <p>The risk of insufficient control capacities with available resources is High.</p>

Supporting Information

Hazard assessment

Diphtheria

Diphtheria is an infectious disease caused by the bacterium *Corynebacterium diphtheriae*, which primarily infects the throat and upper airways and produces a toxin affecting other organs. The incubation period for diphtheria is 2-5 days. The disease is spread through direct physical contact or from breathing in aerosolized secretions from coughing or sneezing of infected individuals. The illness has an acute onset, and the main characteristics are sore throat, mild fever and swollen glands in the neck; in severe cases, the toxin may cause myocarditis, renal failure, or peripheral neuropathy. Diphtheria is fatal in 5-10% of cases, with a higher case-fatality rate (CFR) in Latin America, previous outbreaks have shown >20% CFR.

Treatment involves administering diphtheria antitoxin (DAT) as soon as possible after disease onset to neutralize the toxin, as well as early treatment with antibiotics.

Measles

Measles continues to cause death and severe disease in children worldwide being a leading cause of death and disability adjusted life years in developing countries, despite the availability of a safe and effective vaccine. Transmission from person-to-person is airborne, as well as by direct or indirect contact of secretions (nasal, throat) of an infected person. Initial symptoms, which usually appear 7-21 days after infection, include high fever, runny nose, bloodshot eyes, cough, and tiny white spots on the inside of the mouth. Several days later, a rash develops, starting on the face and upper neck and gradually spreads downwards. A patient is infectious 4 days before the start of the rash to 4 days after the appearance of the rash. While there is no specific antiviral treatment for measles, vitamin A is recommended by the WHO for all children infected with measles regardless of their country of residence, as it is associated with reduced morbidity and mortality. Most people recover within 2-3 weeks. In populations with high levels of malnutrition and a lack of adequate healthcare, up to 10% of measles cases result in death; the CFR can be as high as 30% in displaced groups. Among malnourished children and people with greater susceptibility, measles can also cause serious complications, including blindness, encephalitis, severe diarrhea, ear infections, and pneumonia. Serious complications are more common in children under the age of 5, or adults over the age of 30. Women infected while pregnant are also at risk of severe complications and the pregnancy may end in miscarriage or preterm delivery. Measles can be prevented through vaccination with two doses of the measles, mumps, rubella (MMR) vaccine. The goal for immunization coverage for MMR1 and MMR2 doses is 95%.

Yellow fever

Yellow fever (YF) is an acute viral disease transmitted by infected mosquitoes (including *Aedes sp.* and *Haemagogus sp.*). Transmission may be greater in settings that have the presence of *Aedes* mosquitoes (bites during day) and is associated with rapid spread of the disease in urban settings and densely populated areas. While many people who become infected do not experience severe symptoms, a subset will develop severe disease. Following a 3-6-day incubation period, cases develop an “acute” phase of the illness characterized by fever, muscle pain with severe back pain, headache, chills, loss of appetite, and nausea and/or vomiting, which resolves within 3-4 days. Overall, approximately 15% of cases enter a second “toxic” phase within 24 hours of the initial remission, which may include high fever, jaundice with or without abdominal pain and vomiting, hemorrhage, and kidney failure; approximately 20 to 50% of these cases die within 10 to 14 days.

Yellow fever virus circulation in the Region of the Americas is characterized mainly by sylvatic transmission via *Haemagogus* or *Sabethes* vectors in tropical forested environments where the circulation of the virus persists between non-human primates and tree-dwelling mosquitoes. Sylvatic yellow fever reemerges with outbreaks of varying magnitude and extent among unvaccinated people living or working in these risk-areas.

Vaccination is the most important means of preventing the infection. Vaccination against yellow fever provides life-long protection. Vector control strategies are complementary, particularly in urban areas where *Aedes aegypti*-mediated amplification is thought to be the most likely mode of transmission. There is no specific treatment for yellow fever, only supportive care to treat dehydration, respiratory failure, and fever. Associated bacterial infections can be treated with antibiotics. Supportive care may improve outcomes for seriously ill patients, but it is rarely available in poorer areas. Acutely ill patients are recommended to use insecticide-treated bed nets to help avoid further spread through mosquito bites of viremic patients.

Poliovirus

Poliovirus is a human enterovirus and there are three serotypes of poliovirus: type 1, type 2, and type 3; wild poliovirus was the cause of thousands of cases of acute flaccid paralysis (AFP) and deaths for many years; however, after the introduction of the polio vaccines, only serotype 1 of wild poliovirus (WPV1) continues to circulate. The last WPV2 was isolated in 1999 and declared eradicated in 2015; meanwhile, the last WPV3 was isolated in 2012 and declared eradicated in 2019. Immunity to one serotype does not confer immunity to the other two. Polio is spread through the fecal-oral route, entering the body through the mouth and multiplying in the intestine. Infected individuals shed poliovirus into the environment for several weeks, leading to rapid spread in areas of poor sanitation.

The incubation period is usually 7–21 days (range 4–40 days). Infection with poliovirus can cause minor illness with mild symptoms to infections that include the central nervous system and may lead to paralysis. Approximately 90% of infections are asymptomatic or present with nonspecific fever. Other symptoms could include aseptic meningitis, fever, malaise, headache, nausea, and vomiting. If disease progresses to more severe illness, muscle pain and stiffness of the neck and back with flaccid paralysis may occur. The paralysis usually presents asymmetrically, with fever present at onset. Paralysis of respiratory muscles can be life-threatening. Although some improvements in paralysis may occur during convalescence, paralysis still present after 60 days is likely to be permanent.

All cases of AFP among children under 15 years of age must be reported and stool specimens should be collected within 14 days of paralysis onset and tested for viral isolation in cell culture and, if there is any positive isolation, intratypic differentiation for RT-qPCR assays is performed. The assays permit an initial characterization of either Sabin-like or non Sabin-like poliovirus. If there is a suspicion of vaccine-derived poliovirus (VDPV), sequence testing and genetic characterization of the virus is the final confirmatory test that allow the confirmation of Sabin, VDPV or WPV of the three serotypes. The diagnosis of paralytic poliomyelitis is supported by: (i) clinical course, (ii) virological testing, and (iii) residual neurologic deficit 60 days after onset of symptoms.

Two types of vaccines are commercially available for routine immunization: a live, attenuated oral poliovirus vaccine (OPV) and an injectable inactivated poliovirus vaccine (IPV). In rare circumstances adverse events associated with OPV could result in a case of vaccine-associated paralytic poliomyelitis (VAPP), which can occur in vaccinated individuals or their contacts, and the emergence of vaccine-derived polioviruses. The incidence of VAPP has been estimated at 2–4 cases/million births per year in countries using OPV.

The live attenuated viruses in OPV vaccines (Sabin viruses) may, through prolonged replication in an individual or in a community, re-acquire the neurovirulence and transmissibility characteristics of WPV. Through genetic mutations, they may become VDPVs that cause isolated cases or outbreaks of paralytic poliomyelitis. VDPVs are genetically divergent forms of the original Sabin vaccine virus conventionally defined by >1% genetic divergence (or >10 nucleotide [nt] changes) for PV1 and PV3 and >0.6% (or >6 nt changes) for PV2, in the VP1 region of the viral genome. These viruses are further classified into 3 categories: (1) cVDPVs, when evidence of person-to-person transmission in the community exists; (2) immunodeficiency-associated VDPVs (iVDPVs), which are isolated from a person with primary B-cell immunodeficiency or combined immunodeficiency disorders; and (3) ambiguous VDPVs (aVDPVs), which are either clinical isolates from persons with no known immunodeficiency, or sewage isolates of unknown origin.

Exposure assessment

In 2021, until epidemiological week (EW) 49, in the Region of the Americas, a total of 8 different countries/territories have reported confirmed cases due to the following 3 vaccine-preventable diseases (VPDs): diphtheria (4 countries), measles (2 countries and 1 territory) and yellow fever (3 countries).

In 2019, one country has reported the detection of 3 isolates of VDPVs (two VDPV1 and one VDPV3) through environmental surveillance (not genetically linked). Monthly sampling of these sites continues; as of October 2021, no other VDPV has been isolated.

Diphtheria

In 2021 as of 11 November, 4 countries have reported a total of 239 cases of diphtheria, of which 38 were confirmed including 16 deaths, in the Region of the Americas: Brazil (12 cases including one confirmed case), Colombia (7 cases including 1 confirmed case), the Dominican Republic (56 cases including 18 confirmed cases and 12 confirmed deaths), Haiti (164 cases including 18 confirmed cases and 3 confirmed deaths) (6).

Between 2014 and 2020, there was an annual average of 50 confirmed cases within the Region reported to PAHO/WHO each year. However, since December 2014, there has been ongoing transmission in Haiti, where currently the disease is considered endemic (8).

Measles

In 2021 as of 27 November, a total of 7,722 suspected cases have been reported in 20 countries in the Region. Of these, a total of 703 confirmed cases including 2 deaths have been reported from 2 countries and one territory: Brazil (649 cases including 2 deaths), French Guiana (5 cases), and the United States of America (49 cases) (7, 11, 12).

Between 2014 and 2020, there was an annual average of 6,792 confirmed cases within the Region reported to PAHO/WHO each year; 78% of the cases were reported in Brazil. In 2017, an outbreak began in Venezuela, with cases exported to other countries, and in 2018, the number of reported confirmed cases increased to 16,699, with the majority (62%) reported by Brazil, followed by Venezuela (34%) (9). In 2020, a total of 8,726 confirmed cases of measles, including 11 deaths, were reported from 9 countries/territories (8, 12).

Yellow fever

In 2021, as of EW 49, four countries in the Region of the Americas (Bolivia, Brazil, Peru, and Venezuela) have reported confirmed yellow fever cases. In 2020, two countries in the Region of the Americas reported confirmed cases of yellow fever: Brazil and Peru.

In Brazil, a re-emergence of the yellow fever virus has been reported in the extra-Amazonian region of Brazil since 2014. The expansion of the historical area of yellow fever transmission to areas previously considered not at-risk led to two waves of transmission– one during the 2016-2017 seasonal period, with 778 confirmed human cases including 262 deaths, and another during the 2017-2018 seasonal period, with 1,376 confirmed human cases including 483 deaths. As a result, Brazil changed their areas recommended for yellow fever vaccination to include the entire country (8).

In Brazil, during the seasonal period (2020-2021) between July 2020 and April 2021, a total of 290 suspected human cases were reported, of which 8 (3.4%) were confirmed, 47 (16%) are under investigation, and 235 (82%) were discarded. All confirmed cases, which included three fatal cases, were reported in the state of Santa Catarina (8).

In Venezuela, between EW 39 and EW 49 of 2021, a total of 11 confirmed human cases of yellow fever were reported in the state of Monagas, all laboratory confirmed. Of the total, five were asymptomatic and 6 developed signs and symptoms, and the probable site of infection for 10 of the confirmed cases was Maturín Municipality and Punceres Municipality for one confirmed case. Of the confirmed cases, 9 are male with ages ranging from 24 to 82 years old, and 9 had no history of vaccination. To date, no deaths has been reported among the confirmed cases (8, 9).

In Peru, between EW 1 and EW 47 of 2021, a total of 18 probable cases of yellow fever were reported, which is greater than the number of cases reported annually during the past four years (2017-2020) (8, 10).

Poliovirus

In 2019, the detection of 3 VDPVs in environmental samples in Guatemala was notified to PAHO/WHO. One VDVP3 and one VDPV1 were identified through environmental surveillance in samples collected in January and December 2019, respectively, in Aldea Cruz Blanca, San Juan Sacatepéquez Municipality, Guatemala Department. Additionally, one VDPV1 was isolated in Rio Platanitos, Villa Nueva Municipality, which is also in Guatemala Department. These are 3 genetically different vaccine derived polioviruses, unrelated to each other. Poliovirus Outbreak Response Assessment (OBRA) was conducted in July-August 2021. No evidence of VDPV circulation was found, so the three VDPVs can be classified as aVDPV (ambiguous VDPV).

In 2021, the Regional Certification Commission (RCC) certified that the Region of the Americas has been free of WPV for almost 30 years, with the last endemic case of WPV3 occurring in October 1990 in Mexico and the last case of WPV1 occurring in August 1991. In July 2019, the RCC updated the regional risk assessment for polio; the results indicated that 4 countries are at very high risk of having circulation after an importation or emergence of a VDPV (Haiti, Venezuela, Peru, and the Dominican Republic), 6 countries are at high risk, 10 countries/territories are at medium risk, and the remaining 24 are low risk. A new report of the most recent RCC risk assessment will be published in December 2021 (the preliminary information has been provided by the PAHO/WHO immunization unit team).

Context assessment

Vaccination coverage

In 2020, according to WHO and UNICEF estimates of national immunization coverage (WUENIC)¹, vaccination coverage for VPDs has been low within the Region of the Americas.

Diphtheria

In 2020, the third dose diphtheria, tetanus, pertussis (DTP3) vaccination coverage of $\geq 95\%$ had not been achieved in 26 countries/territories in the Region of the Americas, and 14 countries (Argentina, Belize, Bolivia, Brazil, Ecuador, El Salvador, Grenada, Haiti, Mexico, Panama, Paraguay, Peru, Suriname, and Venezuela) had $< 80\%$ coverage for DTP3 (14).

Measles

Between 2019 and 2020, vaccination coverage with the first dose of the measles, mumps, rubella vaccine (MMR1) declined in 27 countries and territories of the Americas Region. The largest declines were observed in 5 countries: Suriname, Venezuela, Panama, Belize, and the Dominican Republic, respectively (**Figure 1**). In 2020, MMR1 coverage of $\geq 95\%$ was not achieved in 27 countries and territories of the Region of the Americas; furthermore, 8 countries (Argentina, Bolivia, Brazil, El Salvador, Haiti, Peru, Suriname, and Venezuela) had MMR1 coverage of $< 80\%$ (7, 14).

Between 2019 and 2020, vaccination coverage with the second dose of the measles, mumps, rubella vaccine (MMR2) decreased in 26 countries and territories of the Americas Region. The largest decreases were observed in 5 countries/territories: El Salvador, San Vincent and the Grenadines, Bermuda, Panama, and Peru, respectively (**Figure 2**). In 2020, MMR2 coverage of $\geq 95\%$ was not achieved in 28 countries and territories of the Region of the Americas; furthermore, 19 countries (Antigua and Barbuda, Argentina, Barbados, Bolivia, Brazil, the Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Haiti, Honduras, Mexico, Panama, Paraguay, Peru, Saint Lucia, Suriname, and Venezuela) had MMR2 coverage of $< 80\%$ (7, 14).

¹ WHO/UNICEF Estimates of National Immunization Coverage. Available at: <https://data.unicef.org/topic/child-health/immunization/>

Yellow fever

Between 2019 and 2020, vaccination coverage with the yellow fever vaccine declined in 9 of the 13 countries and territories with yellow fever endemic areas in the Americas Region. In 2020, yellow fever vaccine coverage of $\geq 95\%$ was not achieved in 11 countries; furthermore, 7 countries (Argentina, Bolivia, Brazil, Ecuador, Panama, Peru, and Suriname) had yellow fever vaccine coverage of $< 80\%$ (14).

Poliovirus

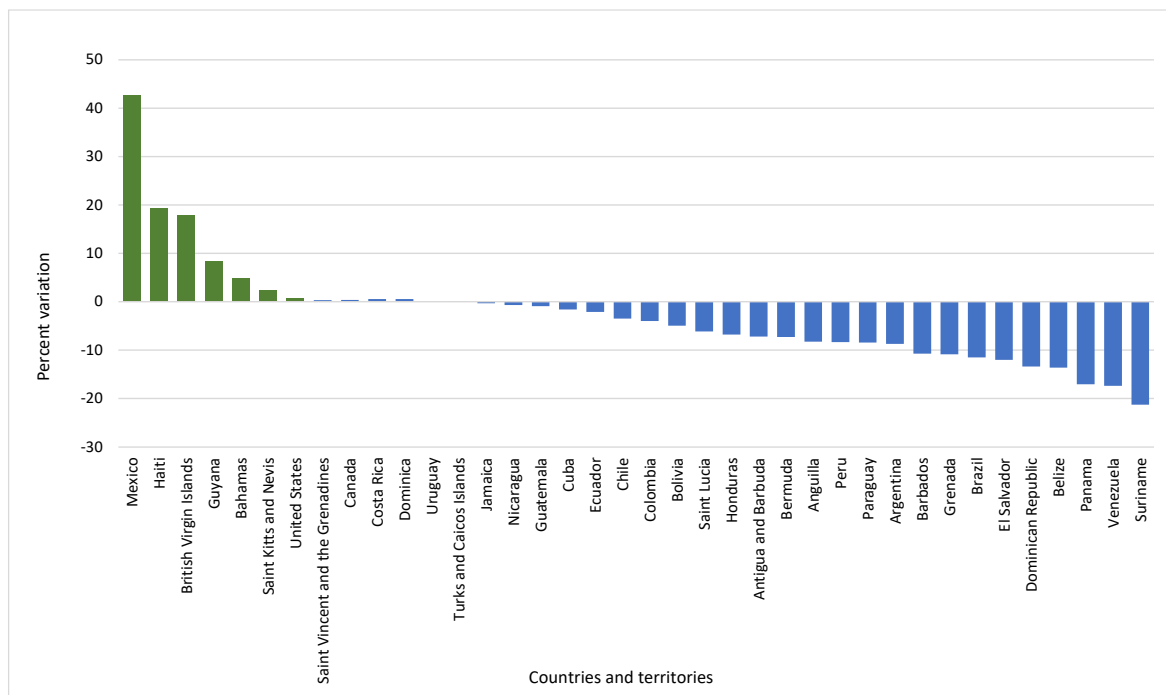
In 2020, vaccination coverage of $\geq 95\%$ with the third dose of the poliovirus vaccine either OPV or IPV (polio3) had not been achieved in 28 countries/territories in the Region of the Americas, and 15 countries (Argentina, Belize, Bolivia, Brazil, Ecuador, El Salvador, Grenada, Haiti, Mexico, Panama, Paraguay, Peru, Suriname, and Venezuela) had $< 80\%$ coverage (14).

As of October 2020, 34 of the 44 countries/territories in the Region use two or more doses of the bivalent oral poliovirus vaccine (bOPV) as part of primary immunization schedules or as booster doses, while 11 countries and territories use only IPV in their immunization schedules: Argentina, Aruba, Bermuda, Canada, Cayman Islands, Chile, Costa Rica, Mexico, Sint Maarten, Uruguay, and the United States. During the same period, there were 10 countries and territories that had not introduced IPV2 into their routine immunization schedules: Bolivia, Curaçao, Dominica, Dominican Republic, Haiti, Nicaragua, Saint Kitts and Nevis, Saint Lucia, Suriname, and Venezuela (29).

Population immunity against type 2 polioviruses continues to decrease, as the cohort of children born after the withdrawal of OPV2 grows, and the potential risk of importation of cVDPV2 increases (29).

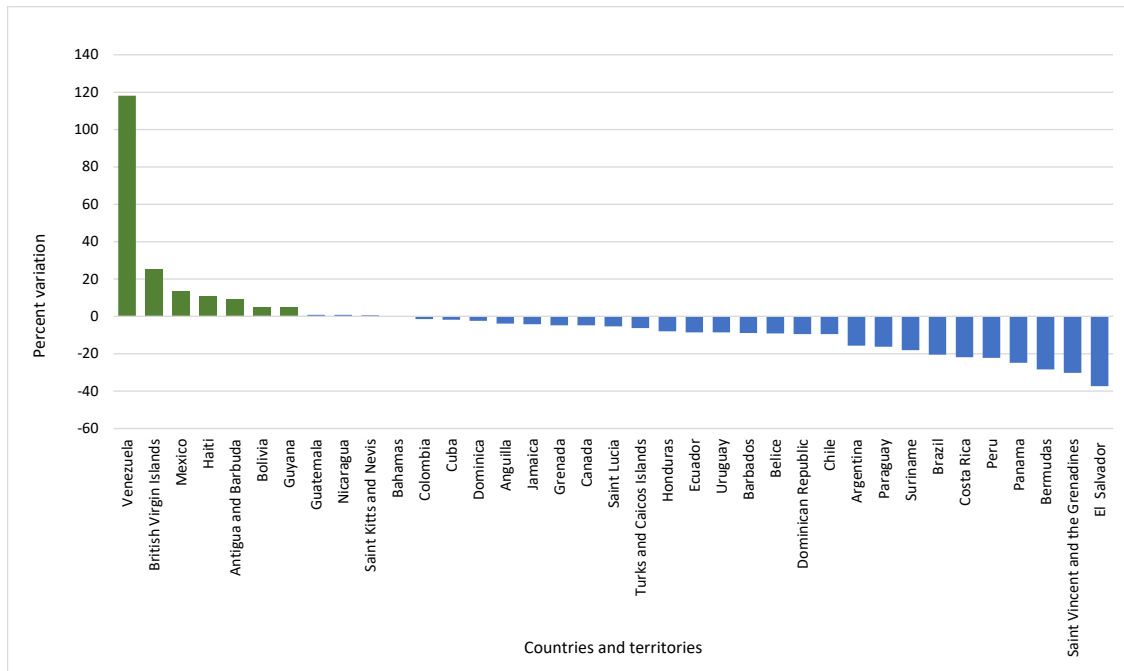
Some countries have repeatedly presented with vaccination coverage of $< 80\%$ in some areas at the subnational level, thereby increasing the risk of transmission of VDPV.

Figure 1. Percent variation in vaccination coverage with the first dose of the measles, mumps, and rubella (MMR1) vaccine. Region of the Americas, 2019-2020.



Source: PAHO/WHO Measles-Rubella-Congenital Rubella Syndrome Weekly Bulletin. Available at: <https://bit.ly/3qcmf68>

Figure 2. Percent variation in vaccination coverage with the second dose of the measles, mumps, rubella (MMR2) vaccine. Region of the Americas, 2019-2020.



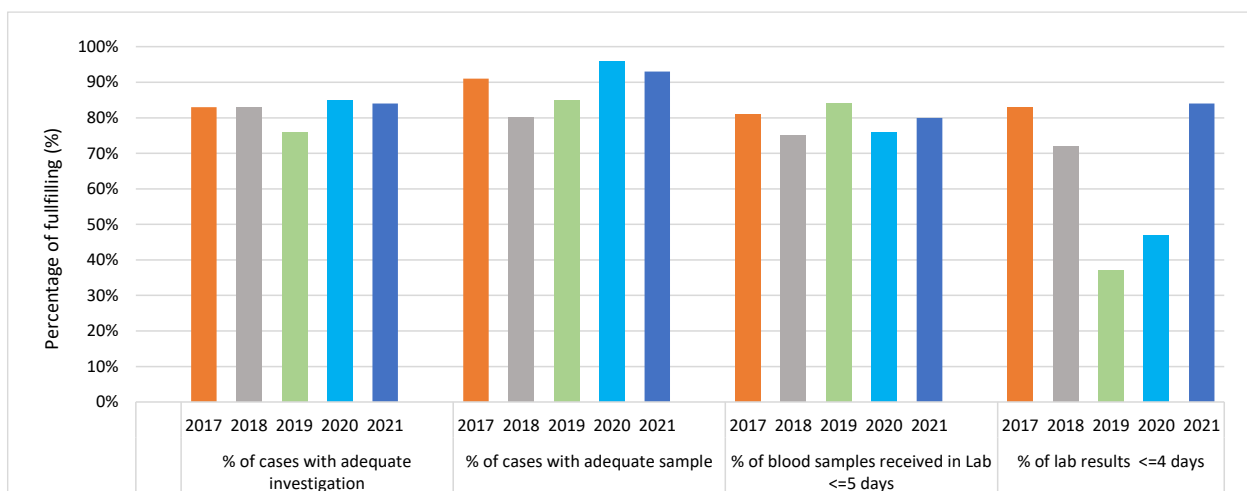
Source: PAHO/WHO Measles-Rubella-Congenital Rubella Syndrome Weekly Bulletin. Available at: <https://bit.ly/3qcmf68>

Surveillance indicators

Indicators of integrated measles/rubella surveillance

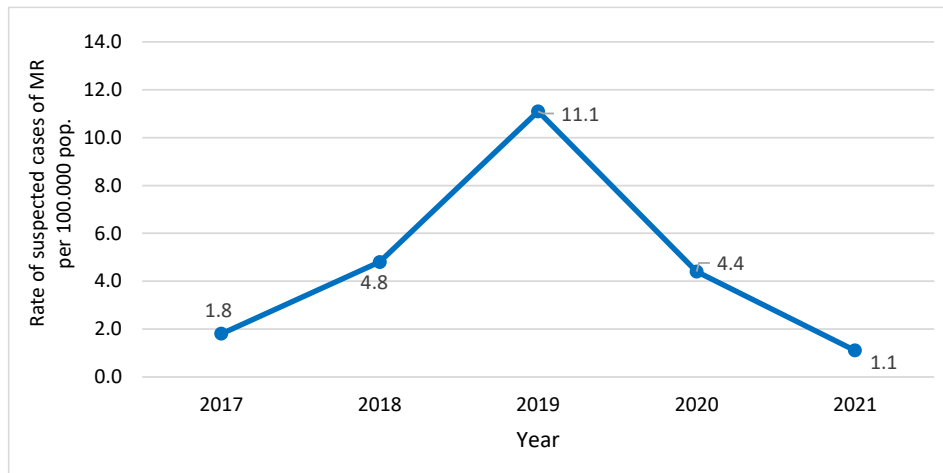
Several factors have contributed to the outbreaks of measles in the Americas occurring between 2017 and 2021, including lack of compliance with 2-dose measles vaccination coverage and now influenced by the COVID-19 pandemic. During the same period, there are gaps in the performance of international indicators for integrated measles/rubella surveillance (**Figures 3 and 4**). Therefore, considering these gaps among the indicators, the low vaccination coverage in many countries, and the wide circulation of viruses in other Regions, the occurrence of new outbreaks of VPDs of varying magnitude in the Americas cannot be ruled out (12).

Figure 3. Distribution of 4 of the 6 international indicators of integrated measles/rubella surveillance. Region of the Americas, 2017 to 2021 (as of EW 47).



Source: PAHO/WHO Weekly bulletin. Measles, Rubella, and Congenital Rubella Syndrome. Available at: <https://www.paho.org/en/measles-rubella-weekly-bulletin>

Figure 4. Rate of Suspected Cases of measles/rubella per 100.000 population. Region of the Americas. 2017 -2021 (as of EW 47).



Source: PAHO/WHO Weekly bulletin. Measles, Rubella, and Congenital Rubella Syndrome. Available at: <https://www.paho.org/en/measles-rubella-weekly-bulletin>

AFP reporting rates

In 2020 and 2021, there has been a significant reduction in the number of reported AFP cases compared to pre-pandemic years. In 2021 as of EW 47, 2 countries (Cuba and Uruguay) have not reported a single case of AFP. Furthermore, during the last 52 weeks (EW 49 of 2020 - EW 47 of 2021), only 2 countries met the goals for all three main indicators (AFP rate, percentage of cases investigated within 48 hours, and percentage of cases with an adequate sample) (13, 25).

In 2020, only four countries (Costa Rica, Cuba, Honduras, and Mexico) met the goals for these three main surveillance indicators (25). Due to the aforementioned factors, there is a risk that a cVDPV event or outbreak will occur and that it will not be detected in a timely manner. In 2021, the expected number of reported AFP cases is 2,219; however, as of EW 43 of 2021, only 968 AFP cases have been reported (13).

One major concern is that countries are not conducting the 60-day follow-up of AFP cases, particularly for cases for which an adequate stool sample was not obtained.

Effects of COVID-19 pandemic on healthcare systems and services

In 2021, all 54 countries/territories in the Region have reported COVID-19 cases and deaths. Although not yet quantifiable, the negative social and economic impact of the COVID-19 pandemic in the short, medium, and long term, at the local, sub-national, national, and global levels, is believed to be unprecedented (25). In addition to the morbidity and mortality directly due to COVID-19 in the Region of the Americas, the pandemic has, in general, also affected the provision of healthcare services, healthcare seeking behaviors, resources, and outbreak response capacity.

Since the beginning of the COVID-19 pandemic, 27 Member States have activated or established health sector emergency administrative structures and measures to strengthen country health systems. However, these function in parallel with the chronic health systems' challenges such as disconnectedness, inequitable access to comprehensive health services, weaknesses related to human resources for health, inequitable access to health technologies, limited capacities for essential public health functions (EPHF), underfunded infection prevention and control (IPC) programs, and limited compliance with IPC practices. These have become a priority for immediate action to rapidly scale up and expand public health and individual health care services to respond to the COVID-19 pandemic, while maintaining other essential services, which is the main challenge (25).

The continuity of essential services provided at the first level of care has been affected in all areas but particularly in peri-urban and rural areas and among indigenous populations. This relates to the already existing deficit of healthcare workers, along with infected healthcare workers and the closure of various primary care facilities in these areas (25).

The main limitations faced by the first level of care include a gap in human resources and a lack of incentives; difficulties in connectivity; shortages of medicines, supplies, medical devices, and personal protective equipment (PPE); and challenges with logistics for conducting case investigation and contact tracing, testing, triage, home care, management of call centers, and teleconsultations. The main reasons for disruption of essential services include cancellation of elective care services (14 of 24 countries, 58%), reallocation of clinical staff to the COVID-19 response (12 of 24 countries, 50%), and patients not presenting (12 of 24 countries, 50%). (25)

Vaccination as an essential health service has also been affected, with a decrease in the demand of vaccination services and the postponement of vaccination campaigns due to the pandemic. Between 2020 and 2021, a total of 2 countries (Chile and Mexico) completed their follow-up campaigns against measles and rubella; 3 countries (Bolivia, Colombia, and Paraguay) are ongoing; and 4 countries (Argentina, Honduras, Dominican Republic, and Venezuela) are planning to implement their campaigns in 2022 (12, 29).

Vulnerable populations and indigenous communities

Special attention should also be placed on specific at-risk groups and notably among ethnic minorities. During the last few years, the migration within the Region of the Americas and from other Regions has increased, due to social, political, and economic crises in countries and territories of the Region of the Americas and other Regions. This migrant phenomena during the last few years, becomes a challenge in vaccination operational activities and considering the increase of mobile vulnerable population.

Of special concern are the Warao people (54,686 in Bolivar State and 41,543 in Delta Amacuro State), and the Yanomami people who live in remote areas of the Amazon jungle along the border of Venezuela and Brazil. Additionally, along the Colombia–Venezuela northern border area (La Guajira Department, Zulia State), there are up to 443,544 Wayu people (2011 Census). According to press reports, the flow of Warao people abandoning their villages and migrating from Venezuela to Brazil, Guyana, and possibly to Suriname, has increased dramatically since mid-2017. The populations in these indigenous communities are especially susceptible to developing diseases because of the limited access to healthcare and vaccinations, and therefore have an increased risk of developing life-threatening complications that could result in fatality. Additionally, cultural and language barriers create a challenge in the implementation of vaccinations and medical treatment.

For diphtheria, the most at-risk populations are the unvaccinated children under 5 years of age, school-age children, healthcare workers, military service personnel, prison communities, and individuals who, by the nature of their occupation, they are in contact with a large number of people on a daily basis.

For measles, unvaccinated young children are at the highest risk of measles and its complications, including death. Any non-immune person (who has not been vaccinated or was vaccinated but did not develop immunity) can become infected. Measles outbreaks can be particularly deadly in indigenous communities with malnutrition and in countries with lack of access to appropriate health services experiencing or recovering from a natural disaster or conflict. Damage to health infrastructure and health services interrupts routine immunization and overcrowding in residential camps greatly increases the risk of infection (3).

Table 1: Capacities and vulnerabilities related to vaccine-preventable diseases (VPDs) in the context of the COVID-19 pandemic for countries/territories within the Region of the Americas, by subregion. December 2021.

Southern Cone Subregion ²
Capacities
<ul style="list-style-type: none"> • One country completed the follow-up campaign against measles and rubella in December 2020, one country has started the campaign against polio, measles and rubella as of November 2021, and one country has planned the campaign against measles and rubella in 2022 (12). • DPT3 vaccination coverage for 2020 was >80% for 2 countries (14). • MMR1 vaccination coverage for 2020 was >80% for 2 countries and ≥95% in 1 of the country (14). • MMR2 vaccination coverage for 2020 was >80% for 2 countries (14). • Polio3 vaccination coverage for 2020 was >80% for 2 of the countries (14).
Vulnerabilities
<ul style="list-style-type: none"> • An active measles outbreak is ongoing in one of the 5 countries in the subregion (7). • In 2021, cases of diphtheria have been reported in one of the countries of the subregion (6). • DPT3 vaccination coverage decreased between 2019 and 2020 in 4 of the 5 countries, ≥95% DPT3 vaccination coverage for 2020 was not achieved in all 5 countries (14). • MMR1 and MMR2 vaccination coverage decreased between 2019 and 2020 in all 5 countries. MMR1 ≥95% vaccination coverage for 2020 was not achieved in 4 of the 5 countries. MMR2 ≥95% vaccination coverage for 2020 was not achieved in all 5 countries (14). • Polio3 vaccination coverage decreased between 2019 and 2020 in all 5 countries, Polio3 ≥95% vaccination coverage for 2020 was not achieved in all 5 countries (14). • In 4 of the 5 countries, the number of AFP cases notified as of EW 43 of 2021 was below the expected estimate (13). • In 2020, MMR vaccination campaigns have been postponed in at least two of the countries of the subregion (29). • Health system and epidemiological surveillance system overwhelmed by the COVID-19 pandemic and other public health events occurring simultaneously (for example: dengue, malaria, amongst others). • Migratory movements and challenges to reach unvaccinated immigrants. • Vulnerable and susceptible populations: unvaccinated migrant children and indigenous populations. • Overcrowding with inadequate sanitation and waste management in temporary and residential shelters and rural and peri-urban areas. • Challenges in the implementation of infection prevention and control measures in overcrowded healthcare settings. • Challenges to maintain the cold chain in rural and peri-urban areas.
Andean Subregion ³
Capacities
<ul style="list-style-type: none"> • One country has started their MMR campaigns in April 2021 and committed to complete in December 2021, one country has started their campaigns against polio and MMR in August 2021 and committed to complete in December 2021, and one country has planned the campaign against polio and MMR in 2022 (12). • MMR1 vaccination coverage for 2020 was >80% in 2 of the 5 countries (14). • MMR2 vaccination coverage for 2020 was >80% in 1 of the 5 countries (14).
Vulnerabilities
<ul style="list-style-type: none"> • One country of the subregion reported cases of diphtheria in 2021 (6). • One country of the subregion reported cases of yellow fever in 2021 (8). • DPT3 vaccination coverage decreased between 2019 and 2020 in all 5 countries, ≥95% DPT3 vaccination coverage for 2020 was not achieved in all 5 countries (14). • MMR1 and MMR2 vaccination coverage decreased between 2019 and 2020 in all 5 countries. MMR1 ≥95% vaccination coverage for 2020 was not achieved in all 5 countries. MMR2 ≥95% vaccination coverage for 2020 was not achieved in all 5 countries (14). • Polio3 vaccination coverage decreased between 2019 and 2020 in all 5 countries, Polio3 ≥95% vaccination coverage for 2020 was not achieved in all 5 countries (14). • For all 5 countries, the number of AFP cases notified as of EW 43 of 2021 was below the expected estimate (13).

² Argentina, Brazil, Chile, Paraguay, and Uruguay.

³ Bolivia, Colombia, Ecuador, Peru, and Venezuela.

- An active measles outbreak is ongoing in one of the bordering countries (7).
- In 2021, cases of diphtheria have been reported in one of the countries of the subregion (6).
- Indigenous communities move along the border between Brazil, Venezuela, and Colombia.
- Health system and epidemiological surveillance system impacted by the COVID-19 pandemic and other public health events occurring simultaneously (for example: dengue, malaria, amongst others).
- Migratory movements and challenges to reach unvaccinated immigrants.
- Vulnerable and susceptible populations: unvaccinated migrant children and indigenous populations.
- Overcrowding with inadequate sanitation and waste management in temporary and residential shelters and rural and peri-urban areas.
- Challenges in the implementation of infection prevention and control measures in overcrowded healthcare settings.
- Challenges to maintain the cold chain in rural and peri-urban areas.
- Two countries postponed their campaigns against Yellow Fever due to the pandemic. No new dates have been set yet.

North America Subregion⁴

Capacities

- DPT3 vaccination coverage for 2020 was $\geq 90\%$ in the 2 countries (14).
- MMR1 vaccination coverage for 2020 was $\geq 90\%$ in the 2 countries (14).
- Polio3 vaccination coverage for 2020 was $>90\%$ in the 2 countries (14).

Vulnerabilities

- MMR2 vaccination coverage decreased between 2019 and 2020 in one of the countries (14).
- Health system and epidemiological surveillance system overwhelmed by the COVID-19 pandemic.
- Migratory movements.

Latin Caribbean Subregion⁵

Capacities

- One country has committed to conduct their MMR follow-up campaigns in 2022 (12).
- MMR1 and MMR2 vaccination coverage for 2020 was $>95\%$ for one of the 2 countries (14).
- DPT3 and Polio3 vaccination coverage for 2020 was $>90\%$ for one of the 2 countries (14).

Vulnerabilities

- In 2021, cases of diphtheria have been reported in one of the countries of the subregion (6).
- For all countries, the number of AFP cases notified as of EW 43 of 2021 was below the expected estimate (13).
- Health system and epidemiological surveillance system overwhelmed by the COVID-19 pandemic and other events occurring simultaneously (for example: dengue).
- Socio-political and economic crisis is ongoing in one of the bordering countries.
- Migratory movements.

Non-Latin Caribbean⁶

Capacities

- DPT3 vaccination coverage for 2020 was $>80\%$ in 9 of the countries/territories (14).
- MMR1 vaccination coverage for 2020 was $>80\%$ in 10 of the countries/territories (14).
- MMR2 vaccination coverage for 2020 was $>80\%$ in 6 countries/territories (14).
- Polio3 vaccination coverage for 2020 was $>80\%$ in 8 countries/territories (14).

Vulnerabilities

- Diphtheria is considered endemic in one of the countries in the subregion (6).
- DPT3 vaccination coverage decreased between 2019 and 2020 in 6 countries (14).
- MMR1 vaccination coverage decreased between 2019 and 2020 in 7 countries. MMR1 $\geq 95\%$ vaccination coverage for 2020 was not achieved in 9 countries (14).
- MMR2 vaccination coverage decreased between 2019 and 2020 in 5 countries. MMR2 $\geq 95\%$ vaccination coverage for 2020 was not achieved in 9 countries (14).
- Polio3 vaccination coverage decreased between 2019 and 2020 in 9 countries, Polio3 $\geq 95\%$ vaccination coverage for 2020 was not achieved in 7 countries (14).
- Health system and epidemiological surveillance system overwhelmed by the COVID-19 pandemic and other public health events occurring simultaneously (for example: dengue).
- Socio-political and economic crisis is ongoing in one of the countries.

⁴ Canada and the United States of America.

⁵ Cuba, Dominican Republic, and Puerto Rico.

⁶ Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Bermuda, Bonaire, Sint Eustatius, and Saba, British Virgin Islands, Cayman Islands, Curacao, Dominica, French Guiana, Grenada, Guadeloupe, Guyana, Haiti, Jamaica, Martinique, Montserrat, Saint Barthélemy, Saint Kitts and Nevis, Saint Lucia, Saint Martin, Saint Vincent and the Grenadines, Sint Maarten, Suriname, Trinidad and Tobago, Turks and Caicos, United States Virgin Islands.

Central American Isthmus and Mexico⁷

Capacities

- One country completed the follow-up campaign against polio and MMR in September 2021 and one country committed to conduct the follow-up campaign against polio and MMR in 2022 (12).
- MMR1 vaccination coverage for 2020 was >80% for 6 of the 8 countries (14).
- In 2 of the countries, the number of AFP cases notified as of EW 43 of 2021 was above the expected estimate (13).

Vulnerabilities

- DPT3 vaccination coverage decreased between 2019 and 2020 in 7 of the 8 countries, ≥95% DPT3 vaccination coverage for 2020 was not achieved in 7 countries (14).
- MMR1 and MMR2 vaccination coverage decreased between 2019 and 2020 in 7 of the 8 countries. MMR1 ≥95% vaccination coverage for 2020 was not achieved in 6 of the 8 countries. MMR2 ≥95% vaccination coverage for 2020 was not achieved in 7 of the 8 countries (14).
- Polio3 vaccination coverage decreased between 2019 and 2020 in 7 countries, Polio3 ≥95% vaccination coverage for 2020 was not achieved in all 8 countries (14).
- In 4 of the countries, the number of AFP cases notified as of EW 43 of 2021 was below the expected estimate (13).
- During the COVID-19 pandemic, measures to drastically limit the flow of incoming international travelers and means of transport or completely prohibit incoming and outgoing flows were not implemented in 2 countries in the subregion (25); this and the increased vulnerable population, could have a potential impact on the importation of disease.

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