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Monitoring progress of maternal and neonatal immunization in Latin America and the Caribbean [☆]



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ABSTRACT

Introduction: The Americas committed to strengthening maternal and neonatal immunization (MNI) through the Pan American Health Organization (PAHO) Regional Immunization Action Plan (RIAP) 2016–20. We describe the progress toward RIAP MNI-related targets and those related to improvement of data quality and information systems; analyze national MNI policies and vaccination coverages; and identify enablers and challenges of monitoring and reporting MNI vaccination coverage in Latin America and the Caribbean (LAC).

Methodology: Descriptive study of national MNI policies, vaccination coverage, and information systems. Sources of information included PAHO–World Health Organization (WHO) / UNICEF Joint Reporting Forms on immunization (JRF) 2013–2019, and other reports.

Results: LAC has met two of three RIAP targets related to MNI (countries with universal hepatitis B birth dose introduction and elimination of maternal and neonatal tetanus) and is on track to meet the other (countries with vaccination of pregnant women). As of 2018, of the 49 countries and territories in LAC, 32 vaccinate pregnant women against influenza and 29 provide tetanus-containing vaccine. Twenty-five countries offer universal hepatitis B birth dose vaccine and 31 offer BCG vaccine. In 2018, regional influenza vaccine coverage among pregnant woman was 75%. Regional coverages for BCG and hepatitis B birth dose (<24 h) vaccines were 93% and 79%, respectively. Countries have exceeded RIAP targets related to the quality of vaccination coverage data and the establishment of electronic immunization registries (EIRs). Challenges in monitoring MNI coverage include estimation of denominators and difficulties disaggregating data by group (e.g., pregnant women versus other groups).

Conclusion: Despite progress in improving MNI in LAC, countries must further strengthen immunization monitoring systems and data quality to better report vaccination coverage among pregnant women and newborns. EIR and MNI information systems must be integrated, such that countries can use accurate data to design more timely and effective vaccination strategies.

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1. Introduction

Maternal and neonatal immunization (MNI)¹ results in decreased morbidity and mortality from vaccine-preventable diseases (VPDs) in pregnant women and their infants [1–3]. In Latin America and the Caribbean (LAC), countries have strengthened MNI through disease elimination efforts (e.g., congenital rubella syndrome and maternal and neonatal tetanus) and through increased uptake of influenza and pertussis vaccines among pregnant women [1,4–6].

As LAC countries transition from vaccination of children to vaccination throughout the life course, MNI has been recognized as a means to provide and integrate maternal immunization services in

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¹ Maternal and neonatal immunization (MNI); vaccine-preventable diseases (VPDs); Latin America and the Caribbean (LAC); hepatitis B birth dose (hepatitis B BD); Bacille Calmette-Guerin (BCG); Pan American Health Organization (PAHO); tetanus-diphtheria (Td); Regional Immunization Action Plan (RIAP); tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap); World Health Organization (WHO); Joint Reporting Form (JRF); PAHO Technical Advisory Group (TAG); and interquartile ranges (IQRs).

primary care and obstetrics and gynecology practices [7–9]. More than 85% of women in LAC receive at least 4 prenatal visits, and antenatal care is considered to be the optimal platform to deliver vaccines to pregnant women [1,7,8]. Vaccination against influenza, tetanus, and pertussis has been recommended during pregnancy because it protects the mother and, through transplacental passage of antibodies, the newborn [1,2]. More than 90% of births in LAC occur in hospitals, and neonates should receive hepatitis B birth dose (BD) and Bacille Calmette-Guerin (BCG) vaccines before hospital discharge [10].

LAC countries have committed to strengthening MNI through the Pan American Health Organization (PAHO) Regional Immunization Action Plan (RIAP) 2016–2020. The RIAP includes strategic objectives related to maintaining achievements in VPD prevention, control, and elimination, reducing infant mortality and maternal mortality, and strengthening immunization services [7]. The plan defines targets related to MNI: increasing the number of countries that offer universal hepatitis B vaccine to newborns, the number of countries that have eliminated neonatal tetanus as a public health problem, and the number of countries that offer influenza, tetanus-diphtheria (Td), and/or tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) vaccines during pregnancy. The RIAP 2016–2020 has two cross-cutting targets relevant to MNI that focus on country activities to improve coverage data quality and to establish electronic immunization registries (EIRs) [7,11].

This manuscript has three objectives. We first aim to describe the progress of the Americas toward achieving RIAP targets related to MNI and data quality and information systems. We then analyze national MNI policies and national and regional vaccination coverages for pregnant women and neonates. We conclude by identifying enablers and challenges in monitoring and reporting vaccination coverage for pregnant women and neonates in LAC. Our findings and lessons learned should be useful to countries in the Americas and other regions seeking to improve monitoring and reporting of MNI programs.

2. Methods

We present a descriptive analysis of the progress of MNI programs during the period of the RIAP 2016–20. We reviewed quantitative and qualitative data for the 49 countries and territories in LAC². The main sources of information are the PAHO–World Health Organization (WHO) / UNICEF Joint Reporting Form (JRF) on immunization, country annual reports submitted between 2016 and 2019 (most countries and territories report data annually about the previous year through the JRF—e.g., in 2019, countries and territories reported 2018 data [12]); unpublished immunization-related country reports; and immunization-related regional guidance and relevant documents. The latter category includes PAHO Core Indicators Health Trends in the Americas, the RIAP 2016–20 progress reports, and PAHO Technical Advisory Group (TAG) on VPD meeting reports [7,10–11,13–19].

For the first objective, we described the progress of the Americas towards MNI-related targets and cross-cutting targets related to activities to improve the quality of vaccination coverage data and to establishing EIRs. We compared the status of each indicator in 2015, as a baseline, to its status in 2018.

For the second objective, we reviewed JRF data on MNI national vaccination policies in 2015, as a baseline before the RIAP 2016–20 period, to data reported by countries in 2019 (2018 data). We also reviewed country administrative coverage levels for influenza, Td, and Tdap vaccines for pregnant women and hepatitis B BD (<24 h and >24 h) and BCG vaccines for neonates.

² Unless otherwise specified, results are presented only for LAC countries and exclude Canada and the United States.

Administrative coverages were calculated by dividing vaccine doses administered (numerator) by the target populations as defined by each country (denominator). We calculated annual regional weighted vaccination coverage for maternal influenza vaccine and for BCG and hepatitis B BD (<24 h and >24 h) vaccines. Coverage rates are expressed as a percentage of the corresponding mid-year population, as reported by countries. LAC aggregated data reflect average values weighted by UN population by age when data are available [20]. To provide a regional trend of maternal influenza vaccination coverage, we calculated medians and interquartile ranges (IQRs) by year. The analysis was conducted in Excel.

3. Results

3.1. Progress of the Americas towards MNI-related and cross-cutting data quality and information systems RIAP targets

The Americas, including Canada and the United States, has met two RIAP MNI-related targets (Table 1). As of 2018, 26 countries have introduced universal hepatitis B BD vaccine (2020 target: 25) and no country or territory has reported rates of neonatal tetanus above 1/1,000 live births (2020 target: 0). The Americas is on track to meet the number of countries that vaccinate pregnant women with influenza and/or tetanus-diphtheria vaccines (2018 data: 34; 2020 target: 35) [13].

Two RIAP targets on data quality and information systems have also been met. As of 2018, 41 countries and territories had implemented activities to improve the quality of vaccination data (2020 target: 25). Nine countries have introduced EIRs, while 19 are working to implement these systems (2020 target: 10) [13]. Most countries use the systems to help monitor MNI coverage levels [7,13].

3.1.1. MNI national policies and vaccination coverage in LAC

Fatality rates for mothers, neonates, and children aged <5 years decreased slightly in LAC from 2015 to 2018 (Table 2).

3.1.2. Vaccination policies and coverage in pregnant women

In 2015, 29 countries and territories in LAC provided seasonal influenza vaccine for pregnant women in their immunization schedules. As of 2018, 32 countries and territories³ offered the vaccine; an estimated 95% of pregnant women in LAC live in countries and territories where influenza vaccine is recommended for pregnant women (Table 3) [12].

In 2015, 20 of 29 (69%) countries with influenza vaccination policies for pregnant women reported maternal influenza coverage rates, compared to 21 of 32 (66%) countries in 2018. Coverage among and within countries varied considerably. In 2015, 12 countries reported coverage >50% and seven reported coverage >75%, compared to 15 and nine, respectively, in 2018 [12].

In 2015, the regional weighted coverage of influenza vaccine among pregnant women was 73%, compared to 75% in 2018. Median coverage by country increased from 55% (IQR 39–80%) in 2015 to 73% (IQR 48–82%) in 2018 [12].

In 2015, 27 countries and territories included tetanus-containing vaccines for pregnant women in their immunization schedules. By 2018, 29 countries and territories⁴ did so. Regional

³ Argentina, Aruba, Bahamas, Belize, Bermuda, Bolivia, Brazil, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Suriname, Trinidad and Tobago, Turks and Caicos, Uruguay, and Venezuela.

⁴ Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Cayman Islands, Chile, Colombia, Costa Rica, Dominican Republic, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Panama, Paraguay, Peru, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Uruguay, and Venezuela.

Table 1

PAHO's Regional Immunization Action Plan 2016–2020: objectives, indicators, and targets related to maternal and neonatal immunization and improvement of data quality and information systems, 2015–2018.

RIAP regional objectives	RIAP regional indicators	2015 ¹	2018 ²	2020 Target ³
General Objectives (GO)	Indicators related to maternal and neonatal immunization			
GO 1.3: Maintain achievements reached in vaccine-preventable disease control	GO 1.3.3: Number of countries and territories that administer hepatitis B vaccine to newborns during the first 24 h	20 ⁴	26	25
GO 2.1: Eliminate neonatal tetanus as a public health problem in all countries	GO 2.1.1: Number of countries and territories with municipalities reporting rates of neonatal tetanus above 1/1,000 live births	1	0	0
GO 4.1: Achieve the expected results proposed by the Post-2015 Development Agenda for reductions in infant mortality and maternal mortality	GO 4.1.1: Number of countries and territories whose immunization schedules include vaccination of pregnant women against influenza and/or with tetanus-diphtheria vaccine, as tracers of maternal vaccination	29	34	35
Strategic Objective (SO)	Indicators related to improvement of data quality and information systems			
SO 4.2: Strengthened immunization services are part of comprehensive, well-run health services	SO 4.2.4: Number of countries and territories that have held activities to improve the quality of their coverage data and that include these activities in their annual action plans	16	41	25
	SO 4.2.5: Number of countries and territories that have a national system for computerized nominal immunization registry	5	19	10

Numbers include Canada and the United States.

¹ Pan American Health Organization. Regional Immunization Action Plan for the Americas: Progress report 2015. Washington, D.C: March 28, 2015. <https://www.paho.org/en/documents/regional-immunization-action-plan-progress-report-2015> (accessed January 9, 2021).

² 57th Directing Council, Pan American Health Organization. Plan of Action on Immunization: Progress report. 71st Session of the Regional Committee of WHO for the Americas. Washington, D.C.: September 30–October 4, 2019. <https://iris.paho.org/bitstream/handle/10665.2/51635/CD57-INF-10-E-e.pdf?sequence=5&isAllowed=y> (accessed January 7, 2021).

³ 54th Directing Council, Pan American Health Organization. Plan of Action on Immunization. 67th Session of the Regional Committee of WHO for the Americas. Washington, D.C: September 28–October 2, 2015. <https://www.paho.org/hq/dmdocuments/2015/CD54-7-e.pdf> (accessed January 7, 2021).

⁴ Ropero Álvarez AM, Pérez-Vilar S, Pacis-Tirso C, Contreras M, El Omeiri N, Ruiz-Matus C, et al. Progress in vaccination towards hepatitis B control and elimination in the Region of the Americas. BMC Public Health 2017;17. <https://doi.org/10.1186/s12889-017-4227-6>.

Table 2

Indicators related to maternal, neonatal, and children health, Latin America and the Caribbean, 2015 and 2018.

	2015	2018
General indicators		
Total population (thousands) ^{1,2}	630,045	651,962
Births (thousands) ^{1,2}	10,916	10,633
Maternal health indicators		
Fertility rate (children per woman) ^{1,2}	2.1	2.0
Maternal mortality ratio (per 100,000) ^{3,4}	60.8	69.5
Antenatal coverage by skilled birth attendants (%) ^{3,4}	85.9	85.1 (2017)
Hospital births (%) ^{3,4}	92.4	92.4 (2017)
Neonate, infant, and children health indicators		
Neonatal mortality rate (per 1,000) ^{2,3}	10.0 (2016)	9.4
Infant mortality rate (per 1,000) ^{1,2}	15.5	15.1
Mortality rate children aged <5 years (per 1,000) ^{1,2}	18.9	18.6

¹ Pan American Health Organization. Basic Indicators 2015: Health Situation in the Americas. Washington D.C.: 2015. <https://www.paho.org/hq/dmdocuments/2015/2015-cha-basic-indicators.pdf> (accessed January 7, 2021).

² Pan American Health Organization. Core Indicators 2018: Health Situation in the Americas. Washington, D.C.: 2018. https://iris.paho.org/bitstream/handle/10665.2/49511/CoreIndicators2018_eng.pdf?sequence=1&isAllowed=y (accessed January 7, 2021).

³ Pan American Health Organization. Core Indicators 2016: Health Situation in the Americas. Washington, D.C.: 2016. <https://iris.paho.org/bitstream/handle/10665.2/31289/CoreIndicators2016-eng.pdf?sequence=1&isAllowed=y> (accessed January 7, 2021).

⁴ Pan American Health Organization. Core Indicators 2019: Health Trends in the Americas. Washington, D.C.: 2019. https://iris.paho.org/bitstream/handle/10665.2/51542/9789275121290_eng.pdf?sequence=6&isAllowed=y (accessed January 7, 2021).

coverage of two or more doses of Td (Td 2) + for pregnant women in LAC was 43% in 2015, 61% in 2016, 38% in 2017, and 42% in 2018.

In 2012, Argentina was the first country in LAC to introduce Tdap for pregnant women. As of 2018, 14 countries⁵ recommended routine Tdap for pregnant women, with Honduras only recommending the vaccine for pertussis outbreaks. Between 2012 and 2018, 12

⁵ Argentina, Bahamas, Bermuda, Brazil, Cayman Islands, Chile, Colombia, Costa Rica, El Salvador, Mexico, Panama, Paraguay, Peru, and Uruguay.

countries intermittently reported Tdap coverage levels for pregnant women (Fig. 1). Coverages varied significantly. Tdap coverage for pregnant women in Mexico, for example, fluctuated from 52% in 2015 to 96% in 2016 to 60% in 2018 [12].

3.1.3. Process for monitoring and reporting vaccination coverage in pregnant women

Calculating the numerator for maternal influenza vaccine coverage requires that countries disaggregate data on pregnant women from other influenza high-risk groups, record pregnancy status of patients in information systems, and register doses administered to pregnant women in the routine program at public and private health facilities and during outreach activities such as campaigns [4,18].

LAC countries have varied policies for Td and Tdap vaccines that complicate reporting of coverage. Many countries have introduced Tdap for pregnant women and boosters for other groups, such as adolescents or adults, but do not disaggregate coverage by group. Examples include countries that recommend Td and Tdap for pregnant women and report coverage for only one vaccine; countries that recommend Tdap for pregnant women and Td for those that require completion of the schedule and report coverage for both vaccines; and countries with policy recommendations on Td and/or Tdap in pregnant women that do not report vaccination coverage. In addition, the JRF form does not include standardized reporting requirements for maternal Td or Tdap vaccination coverage.

3.1.4. Vaccination policies and coverage in neonates

As of 2018, 25 countries and territories⁶ in LAC have introduced universal hepatitis B vaccine for neonates in the first 24 h of life, compared to 20 in 2015. Two other countries⁷ provide targeted hep-

⁶ Argentina, Belize, Brazil, British Virgin Islands, Cayman Islands, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Honduras, Mexico, Montserrat, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, and Venezuela. In 2019, Anguilla, Chile, Guyana, and Turks and Caicos Islands introduced universal hepatitis B vaccine for neonates; in 2020, Curacao introduced the vaccine.

⁷ Bermuda and Uruguay.

Table 3
Influenza vaccination policy and coverage levels among pregnant women, Latin America and the Caribbean, 2015–2018.¹

Regional indicators	2015	2016	2017	2018
Countries with influenza vaccine recommendation for pregnant women	29	30	30	32
Countries reporting influenza vaccination coverage in pregnant women	20	23	19	21
Median vaccination coverage by country (25–75% IQR)	55% (39–80%)	61% (27–72%)	59% (23–77%)	73% (48–82%)
Weighted vaccination coverage in LAC	73%	71%	59%	75%
Country or territory	2015	2016	2017	2018
Argentina	99%	100% ²	100% ²	72%
Aruba	NA ³	ND	ND	ND
Bahamas	ND	ND	ND	ND
Belize	ND	12%	8%	48%
Bermuda	19%	6%	9%	16%
Bolivia	49%	69%	84%	87%
Brazil	83%	80%	79%	81%
Cayman Islands	ND	ND	ND	ND
Chile	72%	69%	71%	90%
Colombia	72%	60%	60%	69%
Costa Rica	ND	82%	72%	73%
Cuba	100% ³	98%	79%	88%
Dominica	11%	61%	ND	ND
Dominican Republic	83%	13%	19%	87%
Ecuador	55%	63%	55%	67%
El Salvador	72%	73%	82%	78%
Grenada	ND	ND	ND	ND
Guatemala	41%	89%	23%	ND
Honduras	94%	62%	78%	82%
Jamaica	ND	ND	ND	ND
Mexico	95%	93%	62%	81%
Nicaragua	77%	30%	51%	91%
Panama	51%	57%	58%	64%
Paraguay	ND	ND	ND	28%
Peru	36%	26%	ND	38%
Saint Kitts and Nevis	NA	NA	NA	2%
Saint Lucia	1%	5%	ND	73%
Suriname	ND	ND	ND	ND
Trinidad and Tobago	ND	15%	ND	ND
Turks and Caicos	NA	NA	NA	ND
Uruguay	29%	36%	23%	25%
Venezuela	41%	50%	10%	ND

¹ Pan American Health Organization. PAHO-WHO/UNICEF Joint Reporting Form (JRF) on immunization. Washington D.C.: 2016–2019. https://www.paho.org/hq/index.php?option=com_content&view=article&id=2043:data-statistics-immunization&Itemid=2032&lang=en (accessed December 6, 2020).

² Coverages reported as “100%” reflect rates >100%.

³ ND = No data; NA = Not applicable (i.e., vaccine not yet introduced); IQR = interquartile range.

atitis B BD only to neonates of hepatitis B surface antigen-positive mothers. Approximately 95% of the birth cohort of LAC lives in an area where the vaccine is offered. In 2018, 22 countries reported vaccination coverage of timely hepatitis B BD (administered during the first 24 h of life). Of the 22 countries reporting hepatitis B BD <24 h coverage, 21 reported coverage >24 h, with 16 of these reporting no difference in coverage levels. Regional coverage of timely hepatitis B BD (<24 h) in LAC declined from 87% in 2015 to 79% based on 2018 data (Table 3) [12].

As of 2018, 31 countries and territories⁸ reported including BCG vaccine in their national schedules and all reported vaccination coverage in infants. Of these, five had coverages below 85% (Table 4). Regional BCG coverage levels ranged from 97% in 2015 to 93% in 2018 [12].

We observed a 14% difference between timely hepatitis B BD (<24 h) and BCG vaccination rates at the regional level (Table 3). Although birth-dose hepatitis B and BCG vaccine can be co-administered, 18 of 19 countries reported lower coverage for hepatitis B timely birth dose, with a median difference of 11% and an average difference of 16%. Repeating the analysis with late hepatitis B BD vaccine showed that 17 of 21 countries had lower coverage

with Hepatitis B, with a median difference of 4% and an average difference of 9% [12].

3.1.5. Process for monitoring and reporting vaccination coverage in neonates

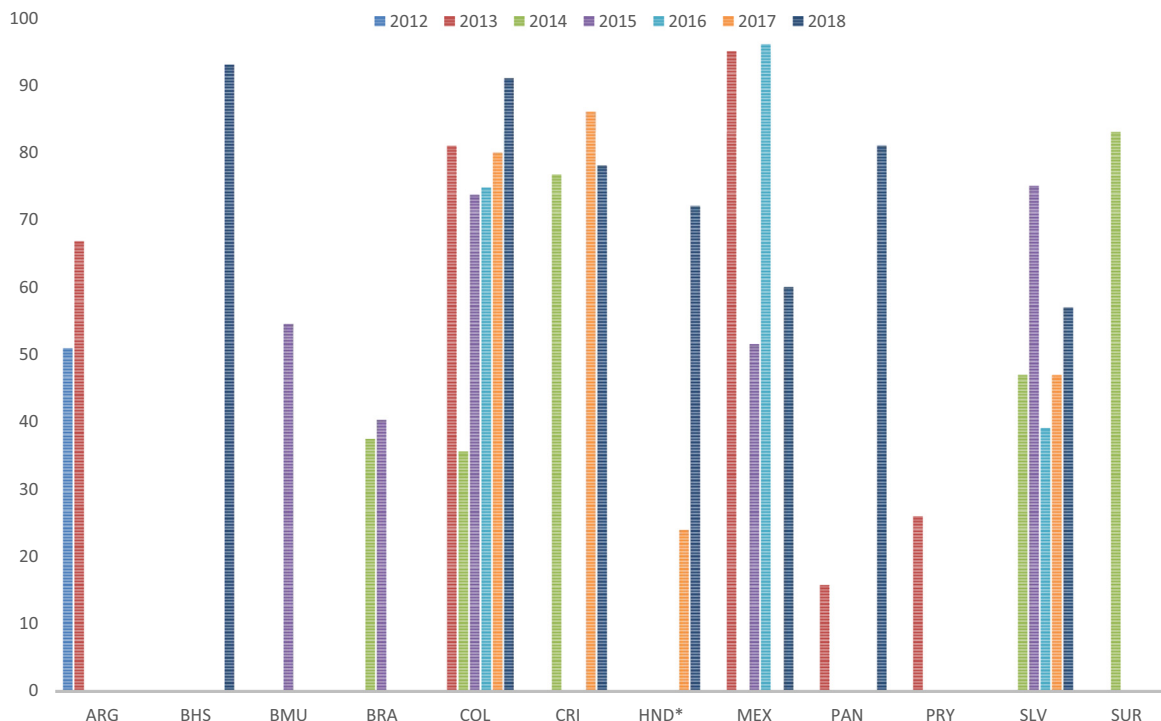
Not all healthcare facilities have the personnel needed to register vaccines doses given in delivery rooms, making it difficult to monitor timeliness of hepatitis B BD vaccine at the national level.

In LAC, most reported BCG coverage does not distinguish between doses given at birth and those given after the perinatal period but before age 1 year. Consequently, it is impossible to evaluate simultaneity of BCG and hepatitis B BD vaccine administration. Reporting definitions between hepatitis B BD and BCG coverage are also different. Reporting of BCG coverage includes doses given to infants aged <1 year, while hepatitis B BD coverage includes only doses given before the start of routine hepatitis B vaccination. Finally, many countries recently introduced hepatitis B BD vaccine and may still be building the infrastructure needed for vaccine administration [21].

4. Discussion

Our study is the first to describe monitoring and reporting of vaccination coverage among pregnant women and neonates in the Americas. The Region has already achieved two of three goals for MNI established by the RIAP 2016–20, with only one more

⁸ Anguilla, Argentina, Belize, Bolivia, Brazil, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Montserrat, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Turks and Caicos, Uruguay, and Venezuela.



ARG=Argentina; BHS=Bahamas; BMU=Bermuda; BRA=Brazil; COL=Colombia; CRI=Costa Rica; HND=Honduras; MEX=Mexico; PAN=Panama; PRY=Paraguay; SLV = El Salvador; SUR=Suriname

Source: 2013-19 PAHO-WHO/UNICEF joint reporting form (JRF) on immunization (2012 – 2018 data).

* Honduras: Only in case of pertussis outbreaks

Fig. 1. Countries reporting maternal Tdap vaccine coverage in the Americas, 2012–2018. ARG = Argentina; BHS = Bahamas; BMU = Bermuda; BRA = Brazil; COL = Colombia; CRI = Costa Rica; HND = Honduras; MEX = Mexico; PAN = Panama; PRY = Paraguay; SLV = El Salvador; SUR = Suriname Source: Honduras: Only in case of pertussis outbreaks. Source: Pan American Health Organization. PAHO-WHO/UNICEF Joint Reporting Form (JRF) on immunization. Washington D.C.: 2013-2019. https://www.paho.org/hq/index.php?option=com_content&view=article&id=2043:data-statisticsimmunization&Itemid=2032&lang=en (accessed January 9, 2021).

country needed to meet the third goal of having 35 countries that provide influenza or tetanus-containing vaccine to pregnant women. Countries have exceeded RIAP targets related to the quality of vaccination coverage data and the establishment of EIR systems [13].

Despite this progress, we found differences between the coverage of vaccines recommended for pregnant women and variability within a country over time. These results should be considered in the context of larger challenges facing routine immunization programs in LAC. Regional infant DTP3-containing vaccine coverage declined from 92% in 2010 to 85% in 2019 [12]. Potential causes include stockouts, challenges estimating denominators, rising vaccine hesitancy, limited resources for operational activities due to increased procurement costs, and difficult sociopolitical situations [11,22]. While LAC countries understand the need to maintain high coverage of infant vaccines, they have also been tasked with introducing new vaccines and adopting a model of vaccination throughout the life cycle, including the vaccination of pregnant women [8,9,11,23]. As stated in the 2030 Immunization Agenda, countries are working toward “a world where everyone, everywhere, at every age fully benefits from vaccines for good health and well-being” [8]. That LAC countries have adopted policies recommending vaccination of pregnant women and neonates shows commitment to the principle of MNI, even if there are non-homogeneous coverages among pregnant women and neonates and weaknesses in coverage monitoring and reporting systems [1]. The next step is for countries to identify problems and develop specific action plans to address these barriers.

Some previously described barriers that affect vaccine uptake among pregnant women in LAC include lack of access to prenatal care [10], limited training of prenatal care service providers about vaccines recommended during pregnancy [2,21], and acceptance of vaccines by pregnant women due to safety concerns and lack of knowledge [24]. We identified challenges related to monitoring maternal influenza and tetanus-containing (Td and Tdap) vaccination coverage, including difficulties tracking and reporting vaccinated women during campaigns and in the routine program, limitations in integrating reporting in private health facilities, and, in some cases, lack of pregnancy status as a field in immunization registries [1,24]. One of the main issues has been estimating denominators. Defining the denominator to calculate influenza vaccination coverage for pregnant women is particularly challenging, as it requires knowledge of the annual birth cohort and because influenza vaccine is only provided during specific months of the year due to the disease’s seasonality [18,24]. Countries use different definitions and sources to calculate denominators, with some countries relying on outdated census data [24,25]. Although the JRF includes a standardized reporting requirement for influenza vaccination coverage for pregnant women, LAC countries have not been reporting data for each year. Reported coverages have also varied widely by year, thereby affecting the regional weighted coverage. PAHO has provided guidance to be adapted in each country or territory [18] (Fig. 2).

In terms of reporting, the lack of standardized approach in the JRF for maternal Tdap is another barrier. In 2019, the PAHO TAG

Table 4
BCG and Hepatitis B birth dose vaccination coverage, Latin America and the Caribbean, 2015–2018.

Latin America and the Caribbean	2015	2016	2017	2018
BCG coverage	97%	94%	94%	93%
Hep B coverage <24h	87%	75%	74%	79%
Hep B coverage >24h	ND	92%	82%	88%
National data	Hep B <24h (2018)	Hep B >24h (2018)	BCG (2018)	Difference between Hep B <24h and Hep B >24h (2018)
Anguilla	NA	ND	89%	NA
Argentina	82%	82%	93%	0%
Belize	55%	95%	99%	40%
Bolivia	NA	NA	90%	NA
Brazil	87%	93%	98%	6%
British Virgin Islands	98%	98%	NA	0%
Cayman Islands	ND	83%	82%	ND
Chile	NA	NA	96%	NA
Colombia	77%	87%	89%	10%
Costa Rica	90%	93%	92%	3%
Cuba	100%	100%	100%	0%
Dominica	46%	46%	95%	0%
Dominican Republic	80%	80%	100%	0%
Ecuador	70%	70%	90%	0%
El Salvador	77%	77%	81%	0%
Grenada	95%	95%	NA	0%
Guatemala	48%	ND	88%	ND
Guyana	NA	NA	100%	NA
Haiti	NA	NA	76%	NA
Honduras	82%	82%	93%	0%
Jamaica	NA	NA	93%	NA
Mexico	ND	99%	96%	ND
Montserrat	96%	96%	100%	0%
Nicaragua	NA	NA	100%	NA
Panama	85%	85%	100%	0%
Paraguay	ND	76%	79%	ND
Peru	73%	73%	81%	0%
Saint Kitts and Nevis	96%	96%	97%	0%
Saint Lucia	95%	95%	100%	0%
Saint Vincent and the Grenadines	97%	97%	100%	0%
Suriname	79%	79%	NA	0%
Turks and Caicos	ND	ND	100%	ND
Uruguay	NA	NA	98%	NA
Venezuela	55%	59%	92%	4%

¹ Pan American Health Organization. PAHO-WHO/UNICEF Joint Reporting Form (JRF) on immunization. Washington D.C.: 2013–2019. https://www.paho.org/hq/index.php?option=com_content&view=article&id=2043:data-statisticsimmunization%26Itemid=2032%26lang=en (accessed January 9, 2021).

²Coverages reported as “100%” reflect rates >100%.

³ND = No data; NA = Not applicable (i.e., vaccine not yet introduced); Hep B = hepatitis B vaccine.

encouraged countries to begin monitoring and reporting Tdap coverage levels for pregnant women in a similar way that has been used with influenza vaccination [11].

The number of countries with vaccines for neonates in their national immunization schedules has increased. The Americas has met the 90% third-dose Hepatitis B for infants established by the WHO and significantly reduced hepatitis B mother-to-child-transmission, but several barriers, such as insufficient infrastructure, have limited hepatitis B BD vaccine uptake [21,26,27]. Countries must institutionalize hepatitis B vaccine administration to newborns in all facilities where births take place and make monovalent vaccine available in delivery rooms [1,2]. Similarly, they must ensure that all communities have access to neonatal vaccines, which may require the design of new vaccination delivery strategies in hard-to-reach areas and in homes of women who do not give birth in hospitals [17,26,27].

While LAC countries have established administration of the hepatitis B vaccine in the first day of life as an indicator of program performance and have issued guidance that hepatitis B vaccine given after the first day of life still offers protection against perinatal transmission, especially if administered in the first 7 days of life, our comparison of hepatitis B BD <24 and >24 h coverage suggests that this is not common practice [1,28]. Countries must modify their information systems to track and register vaccination against hepatitis B in the first day of life and monitor differences between

doses administered within 24 h of birth and those given afterwards [1,21]. In addition, while coadministration of hepatitis B BD and BCG vaccines is recommended, coverage differences have been observed [29,30]. Countries should monitor BCG administration within 24 h and add simultaneity of BCG and hepatitis BD vaccine administration as a tracer of program performance [1]. This may help to avoid missed opportunities for vaccination, which have been observed to occur more frequently for hepatitis B BD vaccine than for BCG [31].

Underlying the aforementioned barriers is the need to integrate and provide vaccination services in maternal and neonatal health services and systems, such that immunization is considered as a key component of the mother's health during pregnancy and the neonate's health in the first days of life [1,8,9]. While countries continue to implement nominal EIRs to monitor childhood vaccination, some cannot routinely collect vaccination data for pregnant women and neonates [32]. Moving towards immunization throughout the life course means that countries must adapt their information systems to register nominal data about immunization of these groups. EIRs may also allow interoperability with other systems and establish links between pregnant women and the neonate that will help to prevent missed opportunities for vaccination [32]. Lastly, countries should take advantage of the benefits of existing EIRs, including timely reporting, geographical analysis, and alerts for vaccination when providing other health services to pregnant

Estimating the denominator of pregnant women

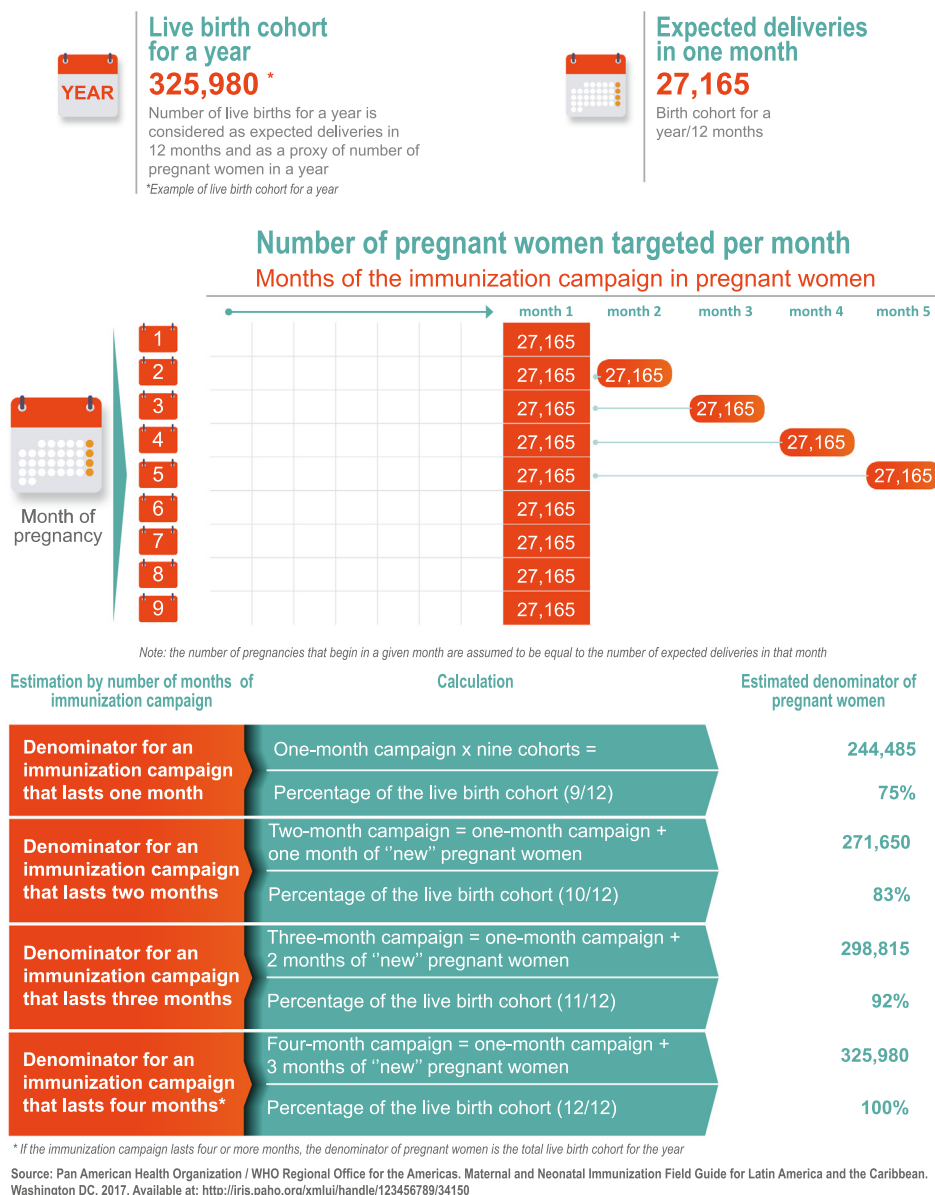


Fig. 2. Estimating the denominator of pregnant women. Source: Pan American Health Organization. Maternal and Neonatal Immunization Field Guide for Latin America and the Caribbean. Washington, D.C.: 2017. <https://iris.paho.org/handle/10665.2/34150> (accessed December 6, 2020).

women and neonates [32]. Lastly, countries should use all features of existing EIRs, such as alerts for vaccination, when providing other health services to pregnant women and neonates [11]. These efforts will all also be critical to documenting the impact of vaccination of pregnant women in the Region [1,11].

The amount of information on vaccines administered to specific populations (e.g., pregnant women) has increased at all administrative levels. The transition to the eJRF, an online platform, to report vaccination coverage offers an opportunity to improve how immunization data are collected and analyzed at the regional and global levels [25]. To this end, countries must define data collection standards, encourage triangulation among different data sources to answer specific questions, conduct periodic evaluations of immunization registries, and be prepared to supply additional evidence as needed [11,25,33]. Improving data quality throughout the cycle—from identification of needs to data collection, analysis,

and interpretation—should facilitate the use of evidence to inform policy decisions about vaccines in the pipeline for pregnant women and neonates [11].

Lessons learned from the RIAP period may inform targets for the future RIAP and the Immunization Agenda 2030 and improve national and regional immunization information systems. At the national level, our recommendations for strengthening coverage monitoring and reporting systems should be considered in the context of competing priorities such as the COVID-19 pandemic [34]. The pandemic has stressed health systems in the Americas, and vaccination coverages in 2020 and 2021 may decrease due to the diversion of resources [34,35]. At the same time, PAHO has provided guidance on immunization during the pandemic, and countries have re-committed to providing immunization as an essential service and are preparing for vaccine deployment to all people [34–37].

Our study has several limitations. The analysis relies on data reported by countries to PAHO. Vaccination coverages for pregnant women and neonates are only reported at the national level; sub-national coverage differences for those groups likely exist and limit our analysis and the ability of countries to detect and address immunization barriers at the local level. Vaccination coverages reported through the JRF form are also based on administrative data and do not necessarily include survey data. Administrative vaccination coverage levels provided by countries are subject to limitations, such as inclusion of migrant populations (numerators) or outdated census data (denominators) [25]. Finally, there is variable consistency of MNI data reported through the JRF, limiting our ability to draw conclusions about coverage trends at the national and regional levels.

5. Conclusion

LAC has made substantial progress in improving MNI programs. For MNI to realize its potential, countries must implement better practices to monitor and report coverage among pregnant women and newborns. The implementation of the eJRF offers an opportunity to systematize the reporting and regional analysis of MNI data. The success of MNI further depends on the continued integration of health programs (e.g. harmonization with antenatal and perinatal care) and on leveraging interoperability between EIRs and maternal and neonatal information systems, such that countries can design timely and effective strategies to increase vaccine uptake among pregnant women and neonates.

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7. Contributors

MVG, AV, AMR, and MC conceived of the study. MV, AV, MC, and CP conducted an initial analysis of the data, with subsequent input from all authors. SPT drafted the manuscript; MVG, AV, and MC gave substantive input; all other authors provided feedback.

8. Data statement MNI

The vast majority of data presented come from publicly available resources such as the PAHO–World Health Organization (WHO) / UNICEF Joint Reporting Form (JRF) on immunization and the PAHO Technical Advisory Group (TAG) on VPDs meeting reports. We have cited these data sources in the manuscript wherever possible. No personal data are included.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Dr. Trumbo reports a personal fee from the Pan American Health Organization for consulting to analyze MNI coverages and policies in LAC. The authors otherwise report no conflicts of interest.

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