

Status of Vaccine Coverage In Venezuelan Children, A Country With A Complex Humanitarian Crisis

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Abstract

In Venezuela, PAHO has reported an increase in vaccine-preventable diseases since 2016. The goal of this work was to assess vaccination coverage in children hospitalized in the Department of Pediatrics at the Hospital Universitario de Caracas (HUC).

Methods: A descriptive cross-sectional study included 0 to 12 years old children hospitalized in HUC admitted between January 2015 and December 2019, and verified immunization scheme. The patient data were compared with the schedule of the Ministry of Health of Venezuela and analyzed by comparing immunization coverage by year of patient hospitalization and patient age.

Results: A total of 2903 patients were surveyed, corresponding to 53.2% male, 37.4% infants. A coverage level above 95% was found only for BCG. Comparing vaccination coverage with the vaccination schedule vs year of patient hospitalization, it was observed a mean decrease in vaccine coverage of 21.5% in 2019 relative to 2015 ($p = 0.0000$). Vaccination rates in children under one year old were lower than in children older than 6 years for all vaccines ($p = 0.0000$)

Conclusions: There is a decline in vaccination coverage in 2019 in relation to previous years, being the most affected children less than one year old

Background

Vaccination has been one of the measures with the greatest impact on public health in the last half century, not only for its effectiveness but also for its profitability, greatly contributing to two-thirds reduction in child mortality between 1990 and 2015 (1, 2). However, there is a gap between the potential use of this practice and its actual contribution to child survival (2). According to the World Health Organization (WHO), by 2017 the global rate of vaccination coverage was 86%. They calculated that global vaccination coverage could be improved to prevent 1.5 million deaths, and estimated that there are still 19.5 million infants worldwide who do not receive basic vaccinations, with children in developing countries being the most affected (3).

In developing countries, low vaccination rates are multifactorial (1). Factors that interfere with vaccination coverage can be grouped in four areas: i) immunization system, i.e. structure for vaccine distribution (e.g. limited funding for routine immunization services, barriers to access to primary care); ii) parental knowledge and attitudes about vaccination programs; iii) communication and information (2, 4–8); and iv) family characteristics, including poverty, rurality, extremes of maternal age, multiple childbirths, low maternal education, family size and lack of knowledge about vaccine-preventable diseases (2, 4, 5, 8).

The Expanded Program on Immunization (EPI) was established in 1974 as an initiative of the WHO / Pan American Health Organization (PAHO) to improve the availability of vaccines worldwide, with the aim of ensuring that all children have access to and receive basic immunizations (1, 7). Systematic vaccination programs have allowed the eradication of smallpox, the interruption of transmission of polio and control of tetanus, diphtheria, rubella and invasive bacterial infection by *Haemophilus influenzae type B* and *Streptococcus pneumoniae* (7).

In the EPI, monitoring and evaluation are key tools that contribute to the effective and efficient implementation of actions, since they serve to periodically verify that the work is being developed according to the plan, to identify causes of failure to meet targets and to take timely and appropriate steps to correct the deviations. (9)

Vaccination coverage measures the proportion of children who have received the vaccines according to the scheme for their age and are therefore protected (9). The minimum percentage needed to achieve herd immunity varies by disease from 75–95% (2, 7).

Coverage reported in 2015 in Venezuela in the Annual Report of the Ministerio del Poder Popular para la Salud (MPPS) were: oral polio 91%, hepatitis B 91%, pentavalent: 91%, MMR 97%, yellow fever 92%, 87% BCG, rotavirus 88%, TT-TD pregnant: 38% (10).

According to the report of PAHO's Executive Committee (included on the agenda of the Session 162), "PAHO's Response to Maintaining an Effective Technical Cooperation Agenda in Venezuela and Neighboring Member States", the burden of disease in Venezuela has become more complex and extended and diverse, affecting in particular fragile and vulnerable population. Emerging diseases have not been properly addressed, allowing the re-emergence of infectious diseases in epidemics spread of infectious diseases preventable by vaccination which had been controlled, revealing the inefficiency of epidemiological surveillance and the weakness of the national immunization program (11). The case of the measles epidemic, reemerging disease with indigenous cases since the first week of July 2017 is highlighted in the document, signaling the failure of mass vaccination campaigns. This results in an important setback which impacts Venezuela and the entire American Continent, which loses the recognition of being free of endemic transmission of the disease, reached since 2016 (11).

The purpose of this study is to evaluate vaccination coverage and its evolution from 2015 until 2018 in pediatric patients attending the University Hospital of Caracas.

Methods

A descriptive cross-sectional study of vaccination coverage in pediatric patients, which were included all children hospitalized in Pediatric and Medical Pediatric Infectious Hospital Universitario de Caracas (HUC) aged between 1 day and 11 years, 11 months and 29 days, in the period January 2015-December 2019, whose immunization scheme could be assessed by their immunization card. For each patient, demographic data, immunization schedule and year of hospitalization in the HUC were recorded.

Immunization coverage was supposed when a child was correctly and fully vaccinated, following the Venezuelan national immunization schedule established by the Ministry of Popular Power for Health (MPPS) (12), which includes:

- Newborn: a single dose of BCG (Bacillus Calmette-Guérin)
- Under 1 year old: 3 doses of pentavalent vaccine (tetanus toxoid, diphtheria toxoid, *Bordetella pertussis*, *Haemophilus influenzae type B*, hepatitis B), 2 doses of rotavirus vaccine, two doses of pneumococcal vaccine, 3 doses of polio vaccine and two doses of seasonal influenza vaccine. Since July 2017 a dose of viral bivalent vaccine (measles and rubella MR) was included, as ordered by the MPPS in order to control the epidemic of measles in Venezuela for that year
- 1 to 5 years: two doses of viral trivalent vaccine (MMR: measles, rubella and mumps), reinforcing Pneumococcal a yellow fever vaccine, pentavalent vaccine booster, polio vaccine booster, annual influenza vaccine.
- Older than 6 years: DT vaccine booster (tetanus and diphtheria toxoid), annual influenza vaccine

All patients whose immunization schedule could not be verified were excluded from the study.

For evaluation of vaccine coverage 3 groups were considered in response to vaccination cycles. First, patients under 12 months old (basic immunization); a second group involves patients between 12 months and 6 years old, when the reinforcement of different vaccines must be. The third included patients older than 6 years, which should already have the basic immunization scheme and reinforcements for the different vaccines considered in the study.

Data were collected through the database of the Pediatric Department of HUC created for collection of egress data of pediatric patients, approved by the ethics committee HUC of 2015, and which was developed using the application Google Drive Forms. The data was analyzed descriptively by frequency and percentages for the qualitative data, and mean and standard deviation for quantitative data; Chi-square was evaluated for comparison the vaccine coverage according to age groups, year of patient egress and the combination of patient age groups vs year of hospitalization; a cutoff value for significance of $p < 0.05$ was established. For statistical data processing the software Epiinfo 7.2 was used.

Results

From January 2015 to December 2019 a total of 3235 patients were registered, meeting the criteria for entry and egress a total of 2903 patients; 332 patients were excluded because they did not have complete data of the immunizations. 1545 (53.2%) were male. Group under 12 months old corresponded to 37.4% (n = 1085 patients); the group between 12 months and 6 years old included 38.2% (n = 1109). The social class Graffar V (extreme poverty) was the most frequent 75.6% (n = 2195). (Table 1).

Table 1
Sample characterization

Demographic characteristics	n	%
Sex		
Female	1358	46,8%
Male	1545	53,2%
Age group		
< 6 months	757	26,1%
6 to 11 months 29 days	328	11,3%
12 months to 6 years	1109	38,2%
> 6 years	709	24,4%
Graffar		
I	2	0,1%
II	10	0,3%
III	125	4,3%
IV	571	19,7%
V	2195	75,6%
Hospitalization year		
2015	644	22,2%
2016	634	21,8%
2017	695	23,9%
2018	547	18,8%
2019	383	13,2%
TOTAL	2903	100.0

The vaccine with largest general coverage level was BCG (Bacille Calmette-Guérin) with 94.9% (n = 2745) followed by polio 81.8% (n = 2028). The vaccines with lowest coverage were influenza 17.7% (n = 332) and pneumococcal conjugate with 14.6% coverage (n = 332) (Table 2).

Table 2
Vaccination coverage as type of vaccine

Vaccine	Complete		Incomplete		Total	
	n	%	n	%	n	%
BCG	2745	94,9%	148	5,1%	2893	100,0%
Polio	2028	81,8%	451	18,2%	2479	100,0%
Pentavalent	1808	75,8%	576	24,2%	2384	100,0%
Rotavirus	1726	71,9%	676	28,1%	2402	100,0%
Pneumococcus	332	14,6%	1948	85,4%	2280	100,0%
Influenza	332	17,7%	1545	82,3%	1877	100,0%
MMR	1346	75,1%	447	24,9%	1793	100,0%
Yellow fever	1028	61,8%	635	38,2%	1663	100,0%

Assessing vaccination coverage considering the year of hospitalization of the patient, a decline in coverage is evident from 2015 to 2019 in all vaccines (between 6 and 52%), being statistically significant in all cases (p = 0.0000). The largest coverage decline was observed for the case of rotavirus vaccination, which drop from 87.9% (n = 510) in 2015 to 35.7% (n = 100) in 2019 (p = 0.0000). The least significant decline was

observed for the BCG coverage, from 99.1% (n = 637) in 2015 to 92.8% (n = 349) for the year 2019. Pentavalent, MMR and pneumococcal vaccines experienced a decline of 20.3%, 16.1% and 16.2% from 2015 to 2019 (Table 3).

Table 3
Vaccination coverage and year hospitalization of patient

Vaccine	2015		2016		2017		2018		2019		p	Chi2
	n	%	n	%	n	%	n	%	n	%		
BCG	637	99.10%	605	95.70%	656	94.40%	498	91.00%	349	92.8%	0.0000	44.3916
Polio	518	87.4%	448	85.2%	503	86.3%	344	75.4%	215	67.0%	0.0000	83.9357
Pentavalent	461	80.2%	404	80.0%	437	79.7%	319	71.9%	187	59.9%	0.0000	62.1557
Rotavirus	510	87.9%	434	83.8%	425	73.5%	257	57.6%	100	35.7%	0.0000	336.8869
Pneumococcus	120	21.5%	93	19.6%	60	11.5%	43	10.0%	16	5.4%	0.0000	62.2331
Influenza	138	28.5%	91	23.6%	68	16.8%	17	4.8%	18	7.4%	0.0000	106.6313
MMR	346	77.2%	307	83.0%	323	80.8%	215	67.0%	155	61.0%	0.0000	58.3705
Yellow fever	294	66.2%	252	75.0%	246	69.3%	130	43.2%	106	46.7%	0.0000	103.0292

Regarding the different age groups, the group under 12 months old had lower coverage in all vaccines than other groups, with 87.4% (n = 939), coverage for BCG compared with 99.0% (n = 1098) for children 1 to 6 years of age and 99.9% (n = 708) for children older than 6 years (p = 0.0000). For polio vaccine coverage was 58.3% (n = 396) for children under 1 year old, while for children aged 1 to 6 years and older than 6 was 88.0% (n = 965) and 94.9% (n = 667) respectively (p = 0.0000). The greatest difference between age groups was observed in the case of rotavirus vaccine: while the coverage was 39.3% (n = 251) for the group under one year, it was 91.4% (n = 634) for children older than 6 years (p = 0.0000) (Table 4).

Table 4
Patient age vs immunization coverage

Vaccine	< 1 year		≥ 1 to 6 years		≥ 6 years		P	Chi2
	n	%	n	%	n	%		
BCG	939	87.4%	1098	99.0%	708	99.9%	0.0000	200.7531
Polio	396	58.3%	965	88.0%	667	94.9%	0.0000	360.3340
Pentavalent	334	53.4%	864	80.9%	610	88.4%	0.0000	182.1056
Rotavirus	251	39.3%	841	78.6%	634	91.4%	0.0000	488.0485
Pneumococcus	61	10.0%	116	11.6%	155	23.3%	0.0000	58.5141
Influenza	15*	6.2%*	170	17.3%	147	22.7%	0.0000	33.2324
MMR	30*	31.3%*	729	71.6%	587	86.5%	0.0000	151.9962
* 6 months to 11 months 29 days old								

By correlating the age group with the year of hospitalization and vaccination coverage it can be observed that the age group under 1 year old had the largest drop in immunization coverage when comparing the years 2015 through 2019; the largest decline was observed for the rotavirus vaccine, with 69.2% coverage decrease between 2015 and 2019 (p = 0.0000). (Table 5)

Table 5
Vaccination coverage by year of hospitalization and patient age

	2015	2016	2017	2018	2019	P	Chi2
	%	%	%	%	%		
Under 1 year							
BCG	97.1%	89.6%	85.6%	81.9%	84.2%	0.0001	24.5656
Polio	74.8%	66.9%	56.1%	48.0%	43.6%	0.0000	34.5134
Pentavalent	73.3%	64.4%	47.1%	46.81%	30.9%	0.0000	49.6378
Rotavirus	76.5%	62.9%	30.5%	12.1%	7.3%	0.0000	185.7668
Pneumococcus	26.7%	15.3%	2.9%	2.2%	3.5%	0.0000	61.7479
Influenza*	23.10%	8.3%	4.0%	0.0	0.0%	0.0000	27.0094
MR *	0.0	0.0	10.3%	18.10%	14.0%	ND	ND
1 year to 6 years							
BCG	99.7%	99.6%	99.6%	97.0%	98.6%	0.0236	11.2761
Polio	89.4%	88.2%	97.2%	83.0%	75.0%	0.0000	47.8885
Pentavalent	80.4%	81.4%	90.5%	46.81%	67.1%	0.0000	32.2985
Rotavirus	90.3%	89.6%	85.7%	67.9%	35.0%	0.0000	198.8064
Pneumococcus	17.1%	14.4%	8.3%	9.8	4.6%	0.0009	18.6351
Influenza	29.1%	20.0%	16.4%	5.4%	7.1%	0.0000	55.0644
MMR	74.0%	75.2%	76.3%	61.0%	67.7%	0.0035	15.6807
Over 6 years							
BCG	100.0%	100.0%	100.0%	100.0%	98.8%	0.1006	7.764
Polio	92.9%	98.1%	97.7%	98.2%	82.5%	0.0000	35.4147
Pentavalent	84.4%	91.6%	90.5%	91.67%	82.1%	0.0551	9.2551
Rotavirus	91.8%	94.8%	94.2%	97.3%	68.0%	0.0000	60.8297
Pneumococcus	24.7%	30.0%	24.0%	20.8%	9.1%	0.0108	13.0939
Influenza	28.7%	33.1%	21.8%	6.7%	11.8%	0.0000	33.331
MMR	82.1%	93.6%	90.6%	85.1%	75.6%	0.0005	19.8696
* 6 to 11 months 29 days old							

Immunization decline above 30% was observed for other vaccines. The only exception was for the MR vaccine, which wasn't administered the years 2015 and 2016 for children under 12 months old because there was no measles epidemic in those years. Importantly, in 2019 no children less than 1 year was vaccinated against influenza, and only 3.5% received the pneumococcal vaccine (Table 5).

A significant coverage decline is observed for the group 1 to 6 years old, with the largest decline between 2015 and 2019 in the cases of rotavirus (55.4%) and influenza (22%) ($p = 0.0000$). Significantly, the MMR (measles, rubella, mumps) coverage dropped by 6.3% between 2015 and 2019 ($p = 0.0035$). (Table 5).

For the group older than 6 years, significant drop in vaccination coverage was only observed for the case of rotavirus 23.8% and influenza 16.8% ($p = 0.0000$). (Table 5)

Discussion

Immunization is an essential component of the human right to health, and is the responsibility of individuals, communities and governments. It is estimated that vaccination prevents 2.5 million deaths each year. Children immunized and protected from the threat of diseases preventable

by vaccination have the opportunity to develop and more likely to reach their full potential. These advantages are further reinforced by vaccination of adolescents and adults. As part of an intervention plan to prevent and control diseases, vaccines and immunization are an essential investment in the future of a country and even of the world (13).

Vaccination is one of the most beneficial strategies in public health. Scientific, technological and social advances offer great opportunities to expand basic vaccination schedules. (3).

Maximizing the impact of vaccination on public health requires a number of conditions. Among these factors are the need to generate more preventive awareness among the population, the imperative to ensure political support for the healthcare sector in terms of allocation of financial resources for the introduction of new vaccines, and the need to counteract the effect of the anti-vaccine groups (3).

By 2010 WHO established the general goals of the decade 2011–2020: 1. To get a polio-free world 2.- To meet vaccination coverage targets in all countries, regions and communities, 3.- To develop and introduce new and improved vaccines and technologies 4.- To overcome the number 4 Millennium Development Goal on reducing child mortality. If these specific immunization goals were achieved, hundreds of millions of cases and millions of future deaths would be avoided by the end of 2020, and thousands of millions of dollars of productivity would be earned, and immunization would help to achieve the target of the 4th Millennium Development Goal by reducing child mortality (13).

In May 2017, Health Ministers of 194 countries adopted a new resolution to strengthen vaccination in order to achieve the objectives of the Global Vaccine Action Plan. In this resolution, countries are encouraged to show leadership and more robust governance over national immunization programs, to strengthen monitoring and surveillance in order to ensure the use of updated data to guide strategic decisions, to optimize program's performance and impact of immunization. In addition, it is recommended to expand immunization services beyond infancy, to mobilize internal funds and to strengthen international cooperation to achieve the objectives of the Global Vaccine Action Plan (3).

It is estimated that in 2016, 19.5 million infants worldwide were outside the scope of routine immunization services, like the third dose of the triple bacterian (DTP3). About 60% of them live in 10 countries: Angola, Brazil, Ethiopia, India, Indonesia, Iraq, Nigeria, Pakistan, Democratic Republic of Congo and South Africa (3).

Monitoring data at the national level is critical to assist countries prioritizing and tailoring vaccination strategies and operational plans to fill immunization gaps, and to get people all the shots which can save their lives (3).

According to the latest Pan American Health Organization (PAHO) report on immunization coverage in Venezuela, 2017 vaccination coverage was 100% for BCG, 66% for DTP (3rd dose), 79% for polio (3rd dose), 95% for MMR, and 18% for rotavirus (14, 15).

In the present study it was observed a low coverage for all vaccines in 2019 – a situation already evidenced by WHO in 2017–. An average decrease in vaccine coverage of 21.5% from 2015 to 2019 was verified. The smallest decline in coverage was for the BCG vaccine which only decreased by 6.3%. On the contrary, a significant decline in coverage in the years evaluated was found for the other vaccines, being the more important coverage decline for the rotavirus vaccine (52.2%) followed by influenza, where the drop was 21.1%. These deficits are exacerbated when they are analyzed by age group. The worst case is for children under one year old: coverage for rotavirus dropped 69.2%, and influenza vaccine reaches 0% coverage in the studied population. The coverage drop was less marked for children aged 1 to 6 years, although there was also a significant drop in rotavirus and influenza vaccination rate. In children older than 6 years, significant differences were found in terms of vaccination coverage, except for the case of BCG and Pentavalent vaccine.

Even though pneumococcal vaccine was included in 2013 in the EPI in Venezuela, and began to be implemented in May 2014, a very low coverage of this vaccine is observed. Only 16% of patients had access to full immunization schedule, and a coverage drop of 16.1% is found between 2015 and 2019. This drop is more accentuated for the group of children under 1 year old: in this age group coverage was only 3.5% in 2019.

The scenario just described contrasts with studies in other countries in the region, where it is evidenced lower coverage for children older than 6 years old. For instance, in 2016 Carne Saperas Pérez (7) evaluated vaccination coverage by age group in a municipality of Apartado, Colombia, evidencing correct coverage of hepatitis B and BCG in newborns, with figures ca. 100%. However, as age increases, declining immunization coverage is observed, being for pentavalent in children older than 1 year of 90.7%, 90.15% polio, MMR 88.86%, yellow fever figures critical booster vaccination coverage of DTP and MMR at 5 years of age, which differs from our study, where better vaccination coverage was observed in children aged 12 months to 6 years and in critical figures in children under 12 months old. (7)

In its report of 2017, the Roundtable for Poverty Reduction (Peru) assessed vaccination coverage for full compliance with the basic vaccination schedule in children under 3 years. They found an increase in the overall vaccination coverage from 55.7% in 2014, to 69.4% in 2015 (up 13 percentage points increment) for children under 1 year old –where timely vaccination is a reflection of the quality of care–. The increase in coverage continues in 2016, reaching levels of 74.0% (up 5 percentage points). In the first half of 2017 75.5% coverage (16) was reached.

Decline in vaccination coverage is influenced by several factors, one of the most important being vaccine availability. According to Venezuela's 2017 EPI report, produced and published by PAHO / WHO, vaccine shortages in Venezuela have increased from 2012 to 2017, with shortages reported in 2012 for hepatitis B and polio vaccines, while in 2017 shortages of pneumococcal conjugate, DTP, yellow fever, hepatitis B, Hib, Influenza, IPV, oral polio and rotavirus vaccines are reported (15). This would explain the decrease in compliance with the recommended immunization schemes observed in the present work, when comparing data of 2015 and 2019.

Low vaccination coverage have caused the rise in previously eradicated diseases as measles and diphtheria. In Venezuela, between epidemiological week 26th of 2017 and the 52th of 2018, 9,116 suspected cases of measles were reported (1,307 in 2017 and 7809 in 2018) of which 6,202 were confirmed (727 in 2017 and 5,475 in 2018). The cumulative incidence rate in the country from 2017 to 2019 is 19.6 cases per 100,000 inhabitants (17); despite this epidemic, it was observed a decline in coverage against measles in the years studied, dropping to 61% coverage for 2019.

There is also an epidemic of diphtheria in Venezuela that started in July 2016 and which is still active in March 2019. 2,512 suspected cases of diphtheria have been registered up to the 2nd epidemiological week of the year 2019, of which 1,559 were confirmed, with 270 deaths (18). However, a decrease in diphtheria's vaccine coverage was evidenced in the present study. We found a decrease in pentavalent coverage of 80.2% for 2015 and 59.9% for 2019, this decrease being more pronounced in children under 1 year old, for whom coverage for 2019 was 30.6%.

Immunizations represent, after clean, safe water, the most effective way of preventing infectious diseases, one of the most outstanding public health achievements in child health. Hence, the importance of knowing their application cannot be overestimated; systematic vaccinations, particularly at ages in greater risk, will dramatically decrease the incidence of infectious diseases.

The main limitation of the study was to obtain from parents the information on the immunization schedule that many of them did not know the information and lost the vaccination record of their children.

Conclusions

Even though vaccination has been one of the most important measures of intervention in reducing child mortality over the past 40 years, our findings determine the absence of optimum vaccination coverage in patients enrolled in the present study.

It is necessary to strengthen preventive medicine; the EPI has to be well implemented to be able to prevent outbreaks of vaccine-preventable diseases, which contrasts with Venezuela's current situation.

Low vaccination rates suggest that the goal of eliminating measles and diphtheria is likely to remain elusive, unless greater efforts to improve vaccination coverage are made

As vaccination is less expensive than the burden of diseases, it is essential (and cost-beneficial) to strengthen the national immunization program.

Abbreviations

PAHO
Pan American Health Organization
HUC
Hospital Universitario de Caracas
WHO
World Health Organization
EPI
Expanded Program of Immunization
MPPS
Ministry of Popular Power for Health (Ministerio del Poder Popular para la Salud)

Declarations

Ethics approval: The study was approved by the Ethics Committee of the Hospital Universitario de Caracas on February 2, 2015, CBE N° 03/2015 signed for doctor Claudio Urosa Bioethics Committee Coordinator.

Consent to participate: informed consent was given in writing by the parent or guardian for all children participating in the study

Consent for publication: Not applicable

Availability of data and materials: the datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests

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Authors' contributions

TD: study direction, perform study design, analyzed the patient data and write the manuscript

IM: Perform study design and analyzed the patient data and write the manuscript

AS, MJR, JG, RT and MS: collected, analyzed and interpreted the patient data

BR and AT: analyzed data, write and revised the manuscript.

All authors read and approved the final manuscript.

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References

1. Black R, Laxminarayan R, Temmerman M, Walker N. Reproductive, Maternal, Newborn, and Child Health. Volume 2. Third Edition. Washington The World Bank, 2016. p. 187.
2. De Oliveira M, Zangiacomi E, Yazlle J. Factors associated With children vaccination coverage in children under 5 years in Angola. *Rev Saúde Public.* 2014;48(6):906–15.
3. Vaccination coverage [Internet] World Health Organization. 2018. [Cited 22 March 2018] Available in <http://www.who.int/mediacentre/factsheets/fs378/es/>.
4. Wanjala S. Determinants of Immunization coverage in Kenya. [Final dissertation on the Internet]. [Nairobi]: University of Nairobi; 2014. [Cited November 2014]. Available in <http://erepository.uonbi.ac.ke/>.
5. Shemwell S, Peratikos M, Gonzalez L, Renom- Lloncs M, Boon A, Martinho S, et al. Determinants of full vaccination status in children aged 12–23 months in Gurué and Milanpe districts, Mozambique: results of a population -based cross- sectional survey. *Int Health.* 2017;9:234–42.
6. Dunn A, Black C, Arnold J, Brodine S, Waalen J, Binkin N. Childhood Vaccination Coverage Rates Among Military Dependents in the United States. *PEDIATRICS.* 2015;135(5):e1156 e1148-.
7. Saperas C. Diagnostic Technical Report on the status of immunization coverage in children under 5 years. [Internet]. Apartado Antioquia Department, Colombia. [Cited February 2016]. Available in: <https://ddd.uab.cat/pub/trerecpro/2016/149148/>.
8. Figueiredo A, Jhonston L, Smith D, Agarwal S, Larson M, Jones N. Forecasted trends in vaccination coverage and socioeconomic factors correlations With global time - series analysis over 30 years. *Glob Health Lancet.* 2016;4:e726-35.
9. Tregnaghi M, Sosa A, editors. Manual vaccines in Latin America [monograph on the Internet]. Latin American Society of Pediatric Infectious Diseases SLIPE; 2014 [Cited 24 February 2019] Available: <https://www.vaxeen.com/files/Manual%20de%20Vacunas%20-%20Edici%C3%B3n%202014%20-%20SLIPE.pdf>.
10. Ministry of Popular Power for Health. Report and Accounts 2015 Caracas [Internet]. Popular Ministry for Health, 2015: 112. [Cited 24 February 2019] Available: <https://es.scribd.com/doc/302207521/Memoria-del-Ministerio-de-Salud-2015>.
11. Venezuelan Observatory of Health. The complex emergency suffered by Venezuela and the performance of the Pan American Health Organization [Internet] Center for Development Studies Central University of Venezuela [Cited February 24, 2019] Available: <https://www.ovsalud.org/noticias/2018/emergencia-venezuela-organizacion-panamericana-salud/>.
12. Carrizo J, Drummond T, Betancourt A, Izaguirre J, Perez, Figueroa D, Rísquez A, Levy J. E. Sileo immunization schedule for children and adolescents in July 2018. *Sociedad Venezolana de Puericultura y Pediatría.* [Internet] Venezuelan Society Childcare and Pediatrics [Cited September 18, 2018] Available: <http://www.svpediatrica.org/secciones/publicaciones/esquema-de-inmunizacion/>.
13. WHO Global Action Plan on vaccines [Internet] World Health Organization. 2013 [Cited February 28, 2019] Available: https://apps.who.int/iris/bitstream/handle/10665/85398/9789243504988_spa.pdf;jsessionid=C73986AA1585B930F91C9E9F2591F09F?sequence=1.

14. WHO Vaccine Coverage [Internet] World Health Organization [Cited February 28, 2019] Available: <https://www.who.int/es/news-room/factsheets/detail/immunization-coverage>.
15. PAHO / WHO
PAHO / WHO. Country Report EPI, Venezuela, 2017 [Internet] Pan American Health Organization 2018. [Cited February 28, 2019] Available: https://www.paho.org/hq/index.php?option=com_docman&view=download&category_slug=perfiles-paises-im-1809&alias=4803-venezuela-perfil-pais-803&Itemid=270&lang=es.
16. Roundtable for Poverty Reduction. Status of vaccine coverage for children under 3 years.-the first half 2017 [Internet] Monitoring Team concerted Health Policy. Sub Group "Immunization in children under 5 years" Report No. 2-2017-SC / MCLCP [Cited 28de February 2019] Available:
<https://www.mesadeconcertacion.org.pe/sites/default/files/archivos/2017/documentos/09/reportevacunasgtsalud240817vrev6.pdf>.
17. Pan American Health Organization / World Health Organization. Epidemiological update: measles. March 4, 2019 [Internet] Washington, DC: Pan American Health Organization 2019. [Cited 13 March 2019] Available: https://www.paho.org/hq/index.php?option=com_docman&view=download&category_slug=2019-3&alias=47909-4-de-marzo-de-2019-sarampion-actualizacion-epidemiologica&Itemid=270&lang=es.
18. Pan American Health Organization / World Health Organization. Epidemiological update: Diphtheria. January 22, 2019 [Internet] Washington, DC: Pan American Health Organization 2019. [Cited 13 March 2019] Available: https://www.paho.org/hq/index.php?option=com_docman&view=download&category_slug=2019-3&alias=47971-8-de-marzo-de-2019-difteria-actualizacion-epidemiologica&Itemid=270&lang=es.

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