Epidemiological Report

Immunization Division

Historic Series 2010 – 2021

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DOI: https://doi.org/10.57148/bepa.2022.v.19.37900
VOL. 20 • **Nº** 219 • **YEAR** 2023 • **ISSN** 1806-4272

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INTRODUCTION

The State Immunization Program (SIP) has completed 55 years since its establishment in 1968. Since then, the challenges have been to maintain high and homogeneous vaccination coverage (VC) to maintain the control and elimination of vaccine-preventable diseases in the country. state of São Paulo (SSP). SIP is part of a large-scale national vaccination policy, based on universality, equity, fighting diseases considered neglected, inducing technological and scientific development, and directing public resources.

The good performance of the attributions assumed by the federal, state, and municipal levels, properly articulated, and supported by the principles and guidelines of the Unified Health System (SUS), is a requirement for achieving the goals of the vaccination policy. The significant role of the National Immunization Program (NIP) is highlighted, which, since 1973, has been leading Brazil in the technical directions of actions aimed at vaccination, in addition to providing immunobiologicals and inputs for the prevention of vaccine-preventable diseases.

Past achievements, such as the certification of an area free from the circulation of wild poliovirus and rubella virus, drive the challenges arise in the present. For example, the measles' elimination of, the maintenance of the elimination of wild and vaccine-derived poliovirus and the recent confrontation of the SARS-CoV-2 pandemic, with the application of an exponential number of doses of vaccines against covid-19.

In addition to the impact on the epidemiological scenario of vaccine-preventable diseases, the large-scale vaccination action implies the need to advance in the identification of the risks of using immunobiological through specific systems for monitoring their safety, such as the Epidemiological Surveillance System of Post-Vaccination Adverse Events and Immunization Errors (SSPVAEIE), implemented by the NIP with São Paulo as a participant. It is worth mentioning that the state was a pioneer in monitoring the safety of immunobiologicals administered in its territory by implementing in 1984 the Epidemiological Surveillance of Adverse Post-Vaccination Events.

Currently, SIP reaches about 4,700 public vaccine rooms and provides 19 immunization agents for all age groups and vulnerable groups with special health conditions. In addition, it also guarantees serums and immunoglobulins to SUS, providing four other vaccines for the national vaccination campaign against covid-19.

The epidemiological surveillance (ES) structure of São Paulo has 27 regional units, which are the epidemiological surveillance groups (ESG). These, in addition to the ES actions of diseases, events and injuries of interest in public health, also participate in the logistics of conservation and distribution of vaccines.

The SSP has a central warehouse for immunobiologicals, which is the Distribution and Logistics Center "Prof. Edmundo Juarez" (CDL), with storage capacity at positive and negative temperatures. The CDL is responsible for quality control and monitoring of the storage environment, as recommended by current legislation, in all logistical processes, including the delivery of the immunobiological to the destination.

To guaranteeing the quality of available vaccines to the population, SIP has invested in the acquisition of new equipment, for the physical and structural adaptation and readjustment of the entire state cold chain. In addition, it promotes frequent updates to train personnel in this area, through virtual and face-to-face meetings.

The increase in the number of immunobiologicals on the SIP list has had an impact on the structure of the cold chain in recent years, especially with the introduction of vaccines against covid-19 (SARS-CoV-2) from different producing laboratories, even demanding the adoption of new logistical distribution strategies. Even so, the arrival in large quantities of these immunizers, which require different storage temperatures, ended up overloading the cold chain at state and municipal levels. New equipment to keep part of these vaccines at ultra-low temperatures was acquired/rented and installed, mainly at the State Cold Network Center, as well as at strategic points in the regional network. These same adjustments in the logistics and conservation structure of immunobiologicals also occurred in most municipalities.

Concerning the adjustments in this logistics, which involves all levels of health management (federal, state and municipal), the Strategic Input Information System (SIIS) was used and the flows and deadlines for the management of immunobiologicals grids were defined. The decentralization of the SIIS in the SSP began gradually, starting in October 2020. For this purpose, it was necessary to register the entities and train the users of the system. The training took place in groups, first formed by members of the ESG, from the capital of São Paulo and from the Reference Centers for Special Immunobiologicals (RCSI), followed by the other municipalities in the state.

The Immunization Division consolidates the requests for immunobiologicals received from the ESG and performs a thorough analysis considering the target group, the vaccination schedule and the special situations defined in the technical standard of the SIP, in addition to other criteria such as monthly average, stocks available at the state and regional levels, future delivery schedules, outbreak situations and/or health emergencies. After authorization of the orders made by the ESG, the CDL prepares the supply, separation, and distribution notes of vaccines, always maintaining quality control and temperature monitoring as recommended by the manufacturer and current legislation, in all processes until delivery to the destination, currently made by a logistics company.

Monthly, the São Paulo program requests the amount of immunobiologicals needed from the Inputs Center of the Department of Immunization and Communicable Diseases of the Health Surveillance Secretariat of the Ministry of Health (DEIDT/SVS/MS) through the SIIS, in agreement with the NIPI. Information systems are an important basis for the SIP, as they capture information on applied doses, movement of used vials, notification of temperature changes to which immunobiologicals are exposed, post-vaccination adverse events and immunization errors.

To collect data regarding vaccination activities individually at the local level, in 2016 the process of implementing the NIP Information System (NIPIS) started in all municipalities of São Paulo. It was a milestone in São Paulo vaccination, as the previously consolidated data became individualized, allowing the registration of the history of vaccines applied and analysis by residence.

The new guideline of the Ministry of Health adopted, at the end of 2019, the e-SUS APS – Vaccination Module, a new system of the Secretariat of Primary Health Care, (SPHC/MS) that also formalizes the individualized record of the doses applied in the primary care units, maintaining hospitals, maternities, and private clinics in NIPIS. Municipalities could adopt their own systems since interoperability with official systems is guaranteed. Validated data are uploaded to the national SIPNI database and made available in the applied dose reports (reflecting the VC), VC homogeneity and dropout rate. Through password access, health establishments can check the list of vaccinated persons and their respective schedules.

Data on the movement of immunobiologicals by public health establishment are entered monthly in NIPIS. Physical or technical losses, transfers, previous and current available and unavailable balance are information filled in monthly by the health unit.

Another process inherent to SIPI concerns the conservation of immunobiologicals. Due to their composition, most require storage between 2°C to 8°C, to maintain the quality, safety, and effectiveness of the product. When the vaccines in the calendar are subjected to temperature outside the recommended limit, the change must be notified on a specific form and forwarded to the Immunization Division for evaluation and management. Occurrences involving the covid-19 vaccines are notified by municipalities in the RedCap System, with evaluation and conduct given by the National Institute of Quality in Health (NIQH).

Among the numerous vaccination rooms in São Paulo, ten are Reference Centers for Special Immunobiologicals inserted in state hospitals and contracted by the São Paulo government, two of which are in the process of becoming official. In compliance with the principles and guidelines of the SUS, the objective of these RCSI is to facilitate the population's access, those with congenital or acquired immunodeficiency and other conditions of morbidity or exposure to risk situations,

to special immunobiologicals for disease prevention; and ensure mechanisms for investigation, monitoring and elucidation of serious and/or unusual adverse events temporally associated with the application of vaccines.

Since its programmatic beginnings, the SIP has had, throughout its 55 years, the collaboration of specialists in immunization, and, since 1987, the Office of the Secretary of Health has had the technical assistance of the Permanent Commission for Advisory on Immunizations (PCAI). In these 36 years, PCAI has participated in several processes, from the elaboration of the technical standard of the immunization program to support for specific demands, such as epidemics and outbreaks, discussion of adverse events and the introduction of new immunobiologicals in the SIP, among others. The current commission is consolidated in SES-SP by Resolution SS-56/2006, being composed by the coordination of the Disease Control Coordination (DCC), by the directors of the Epidemiological Surveillance Center "Prof. Alexandre Vranjac" (CVE), including the Immunization Division. The PCAI also includes a representative of the Council of Municipal Health Secretaries (Cosems), members of the academy and professionals of recognized technical-scientific knowledge (Resolution SS-70/2021). Its current members are listed in Resolution SS-74/2021.

ANALYSIS OF VACCINATION COVERAGES

The 1970s, 1980s and 1990s showed a sustained growth of VC, with the expansion of access to vaccination due to the increasing availability of new immunizers in the official calendar and the increase in vaccine rooms. Between the 2000s and mid-2010s, there was a plateau in which VC remained at high rates. In the SSP, as of 2016, a reduction in coverage and homogeneity was identified. The same happened with the VCs in Brazil, which since 2015 have already pointed to a fall.

There is an intense discussion about the reasons for this reduction, whose core is the risk of reintroduction of vaccine-preventable childhood diseases and the maintenance of reliability and adherence of the SUS user population to immunization programs. The situation is complex, and many factors may be contributing to this drop in coverage.

a) Record of administered doses:

- period of adaptations/adjustments in the transition of information systems;
- specific training period on the registration of immunobiologicals, according to the particularities of the vaccination schedule;
- difficulties of interoperability between the own systems of some municipalities and the official NIP system; and

- simultaneous application of several doses of different immunobiologicals in the same child, which can promote registration failures and, therefore, under-registration.

b) Denominator database for calculating VC (population estimate used may not be adequate).

c) Missed vaccination opportunities:

- health team not fully engaged in encouraging vaccination, when the child attends the unit;
- precariousness in carrying out the active search for absentees; and
- late age to start vaccination schedules.

d) Human resources in the units:

- insufficient nursing staff to adequately and safely carry out vaccination activities;
- high turnover of professionals and, consequently, in vaccine rooms, leading to difficulties in the quality of information recording; and
- complexity of the program, which requires continuous technical training.

e) Inherent to the population:

- beliefs in alternative health practices and false contraindications;
- efficient control of vaccine-preventable diseases, which promotes a false sense of security (perception of risk) and discourages the search for vaccination;
- fear of adverse events;
- dissemination of misinformation/false information through social networks and other media, which can result in the loss of credibility of vaccines; and
- lack of knowledge of the immunizers that are part of the vaccination schedule.

f) Discontinuity in the supply of some immunobiologicals, related to the insufficient transfer of vaccines by the Ministry of Health to meet routine demand.

g) Access barriers:

- reduction in the number and opening hours of vaccination rooms, difficulties in scheduling specific ones;
- operating rooms only during business hours and insertion of parents/guardians into the job market; and
- type of bond with the unit and the health team.

h) Lack of assertive and comprehensive communication campaigns: denialism, disinformation, and *fake news*.

i) Current pandemic context.

Most likely, this list of probable reasons that would explain the reduction in VC is incomplete and, therefore, requires further investigation of other influences, such as social, economic, and behavioral issues.

We highlight here a little more of the changes that occurred in the information systems used as an important part of the VC analyses. Until 2015, they were evaluated by doses applied for each vaccine in the basic calendar on a consolidated basis. That same year, training sessions were started throughout the SSP with a view to implementing, in 2016, the National Immunization Program Information System to assess coverage. Now, with the capture of nominally applied doses, as well as the entry of individual data and by origin, the NIPIS started to allow the registration of the history of vaccines, the monitoring and adjustments of the vaccination schedule and the location of the person to be immunized, through their registration data.

A survey carried out in 2018 indicated that the system was implemented in 75% of the existing vaccine rooms available in the territory of São Paulo. It is worth clarifying that, despite this advance in implementation, the NIPIS needed constant adaptations and training of teams to appropriate its use. Thus, at the end of 2019, a new information system was implemented, the e-SUS APS – Vaccination Module, officially adopted in vaccine rooms belonging to primary health care. Recently, another survey carried out by the SIP pointed out that at least 53% of the cities in São Paulo use the e-SUS APS to record the doses applied; another portion uses systems developed by the municipalities themselves.

Table 1 shows the CVs and the homogeneity of each vaccine made available by the São Paulo State Immunization Program, from 2010 to 2021. We chose to detail the data, with the description of each immunizer, its particularities, and milestones.

Table 1. VC and homogeneity according to vaccines and year, SSP, 2010 to 2021.*

VACCINES		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021*
BCG	COB	101.6	103.7	104.0	103.7	103.5	102.2	94.3	100.9	101.3	83.8	67.7	62.9
	HOMO	56.0	56.0	54.4	51.6	52.9	51.5	42.5	51.3	64.8	52.4	27.1	18.3
HEPATITIS B	COB	-	-	-	-	91.8	92.5	89.8	91.8	90.3	77.5	53.4	52.8
	HOMO	-	-	-	-	21.9	20.8	19.1	23.7	36.7	33.0	11.2	9.3
POLIOMYELITIS (OPV/VIP)**	COB	96.6	100.3	96.4	99.0	95.7	99.7	83.8	87.7	92.6	86.6	82.1	73.6
	HOMO	72.2	77.1	66.2	69.1	64.8	71.2	44.0	49.0	56.7	39.1	36.9	23.1
PENTAVALENT	COB	-	-	-	97.2	95.5	98.4	88.5	87.2	91.6	72.1	89.6	73.6
	HOMO	-	-	-	61.7	65.1	69.8	54.1	48.2	55.5	23.6	49.1	22.6
PNEUMOCOCCAL 10 V	COB	42.0	86.6	89.5	95.8	100.6	99.9	93.6	95.9	96.0	89.8	84.4	75.9
	HOMO	2.2	42.8	47.8	56.3	74.6	71.3	59.2	60.8	60.5	46.5	39.2	26.2
ROTAVIRUS	COB	89.2	94.0	91.6	97.5	93.8	97.0	90.3	90.8	92.6	87.2	81.6	73.7
	HOMO	67.0	77.5	68.4	77.4	76.4	76.7	63.1	64.8	67.9	53.8	46.4	32.4
MENINGOCOCCAL C	COB	-	122.1	98.7	102.2	97.4	98.6	90.4	89.7	88.9	87.9	82.6	73.8
	HOMO	-	95.5	66.0	74.0	70.4	65.9	55.5	51.3	50.4	47.0	36.7	24.8
YELLOW FEVER	COB	-	-	-	-	-	-	-	-	60.2	72.3	69.1	65.7
	HOMO	-	-	-	-	-	-	-	-	36.3	28.5	24.2	18.0
SCR D1	COB	94.9	100.3	99.5	103.4	105.0	97.9	93.0	86.7	91.5	91.8	85.3	75.9
	HOMO	61.2	66.4	69.0	76.4	74.9	60.8	61.7	42.5	54.7	55.5	45.0	30.4
SCR D2	COB	-	-	-	75.7	95.9	92.4	77.7	83.4	81.8	82.5	67.1	62.3
	HOMO	-	-	-	33.2	74.1	61.6	34.4	30.1	34.0	29.8	18.6	11.3
HEPATITIS A	COB	-	-	-	-	67.8	102.4	63.4	76.1	83.6	86.3	80.5	72.6
	HOMO	-	-	-	-	20.2	77.4	19.1	32.2	35.5	34.7	35.2	20.8

Source: National Immunization Program Information System. *Data updated on March 27, 2023, subject to revision. **OPV vaccine until 2015 and VIP from 2016.

There are two ways to calculate the homogeneity of VC. One determines the proportion of assessed territorial units that reached the recommended CV. It is desirable that they all reach a number, however, as an indicator to measure and identify the areas of greatest risk, it was agreed that, in the vaccination routine, at least 70% of the territorial units reach the coverage established for a given immunizer. In vaccination campaigns, other homogeneity indices were defined, reaching around 80%.

The year 2020 was totally impacted by the current pandemic, including regarding immunization actions, despite the SIP having recommended to municipalities to keep vaccine rooms open to meet routine demand, even in the worst period of occurrence of covid-19 cases. If, on the one hand, the pandemia resulted in a greater reach of the immunizer against influenza (inactivated), leading the state to administer 18 million doses, on the other hand, it had an unfavorable impact on daily vaccination.

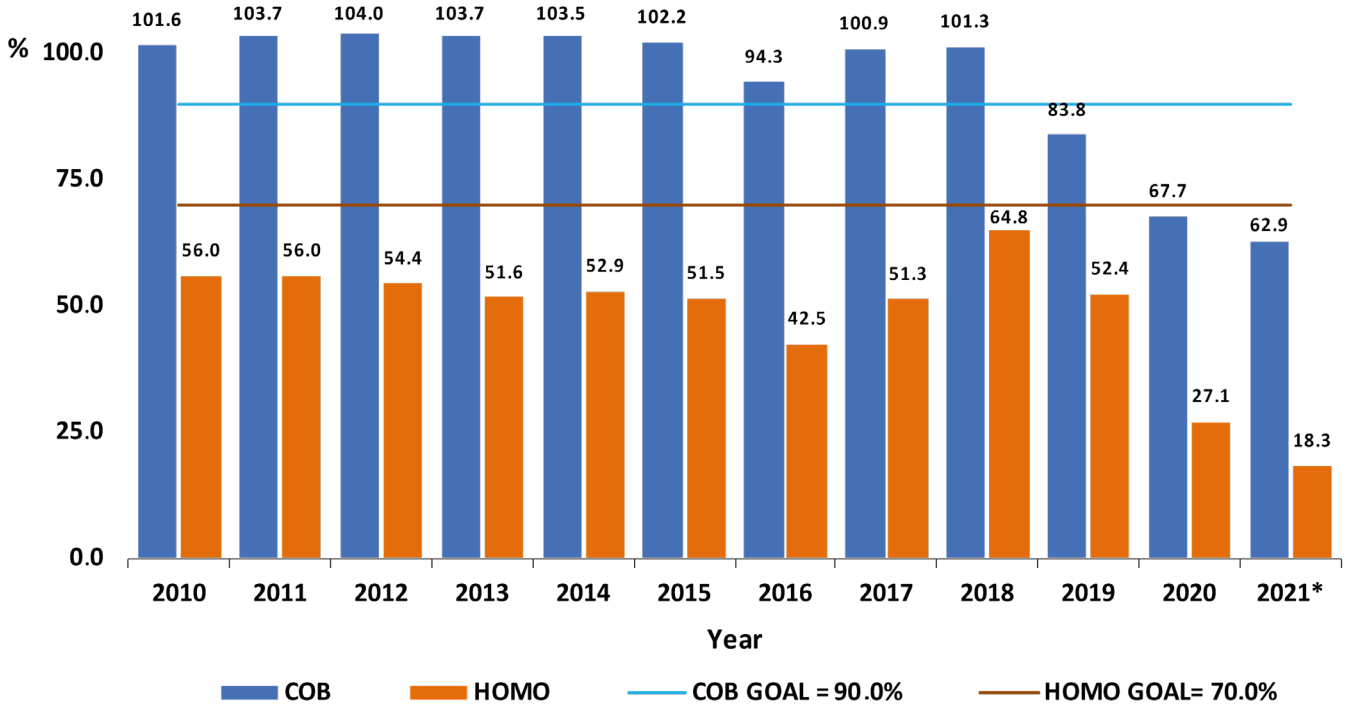
The pandemic generated concern about the risk of exposure to the new coronavirus, which affected the demand for vaccination services and, consequently, led to a drop in the coverage of most immunizers in the vaccine calendar. Due to increased social distancing measures to mitigate the transmission of the virus, several countries have recorded a substantial reduction in CVs in children, especially those under 2 years of age.

In 2021, the milestone was the immunization against covid-19, starting in January, with exponential numbers of doses applied throughout the year, and, also, intense targeting of health services to care for the pandemic. The priority focus given to SARS-CoV-2 containment actions may have impacted immunization actions against other vaccine-preventable diseases. The impact of the pandemic disease had an impact on the coverage of all routine vaccines.

To better detail the CV and homogeneity, there are graphs, tables and figures that express the situation of the basic immunization schedule in the SSP (Appendix I).

A single dose at birth, the BCG vaccine (against severe forms of tuberculosis, miliary and tuberculous meningitis) reached the coverage target (90%) for nine consecutive years, as seen in Graph 1. In 2019, the range was 83 .8%, still close to the target, while in 2020 and 2021 there was a significant drop, with the VC below 70% (67.7% and 62.9%, respectively). The homogeneity target (70%) was not reached in any of the years, remaining close to 50%, with a more relevant drop in 2016 (42.5%) and in the pandemic periods of 2020 (27.1%) and 2021 (18.3%).

Graph 1. Coverage and homogeneity of the BCG vaccine in children under 1 year of age, according to year. SSP, 2010 to 2021.*



Source: National Immunization Program Information System. *Data updated on March 27, 2023, subject to revision.

It is worth mentioning that most vaccination spaces are in hospitals and maternity wards, with a view to their use at birth. Small municipalities without a hospital structure, however, had CV impaired and, thus, contributed to its increase in neighboring cities, references for deliveries until the year 2015, with the consolidated record. The nominal system allowed this correction from 2016 onwards, when coverage started to be analyzed with data by residence.

It is also noteworthy that the implementation of the nominal system had direct repercussions on the BCG records of newborns in maternity hospitals, although this vaccination can also occur in basic health units. In an analysis carried out by the Immunization Division regarding the doses applied in 2019 and 2020, a lack of data entry was identified in several establishments, such as maternity hospitals and hospitals, compared to the numbers by place of birth, made available by the Strategic Information Center in Health Surveillance (SICHS) of the CCD/SES-SP, and the total doses applied in these same municipalities.

Table 2 shows the number and percentage of municipalities in São Paulo allocated by VC clusters, being < 50%, ≥ 50% to < 75%, ≥ 75% to < 90% and ≥ 90%, in a total of 645. Excluding the years 2016, 2020 and 2021, more than 50% of the cities reached the vaccination target in the other years. In 2016, there was a significant increase in the number of municipalities with coverage below 50%. In the pandemic years 2020 and 2021, the number of cities that previously reached the target had a strong reduction.

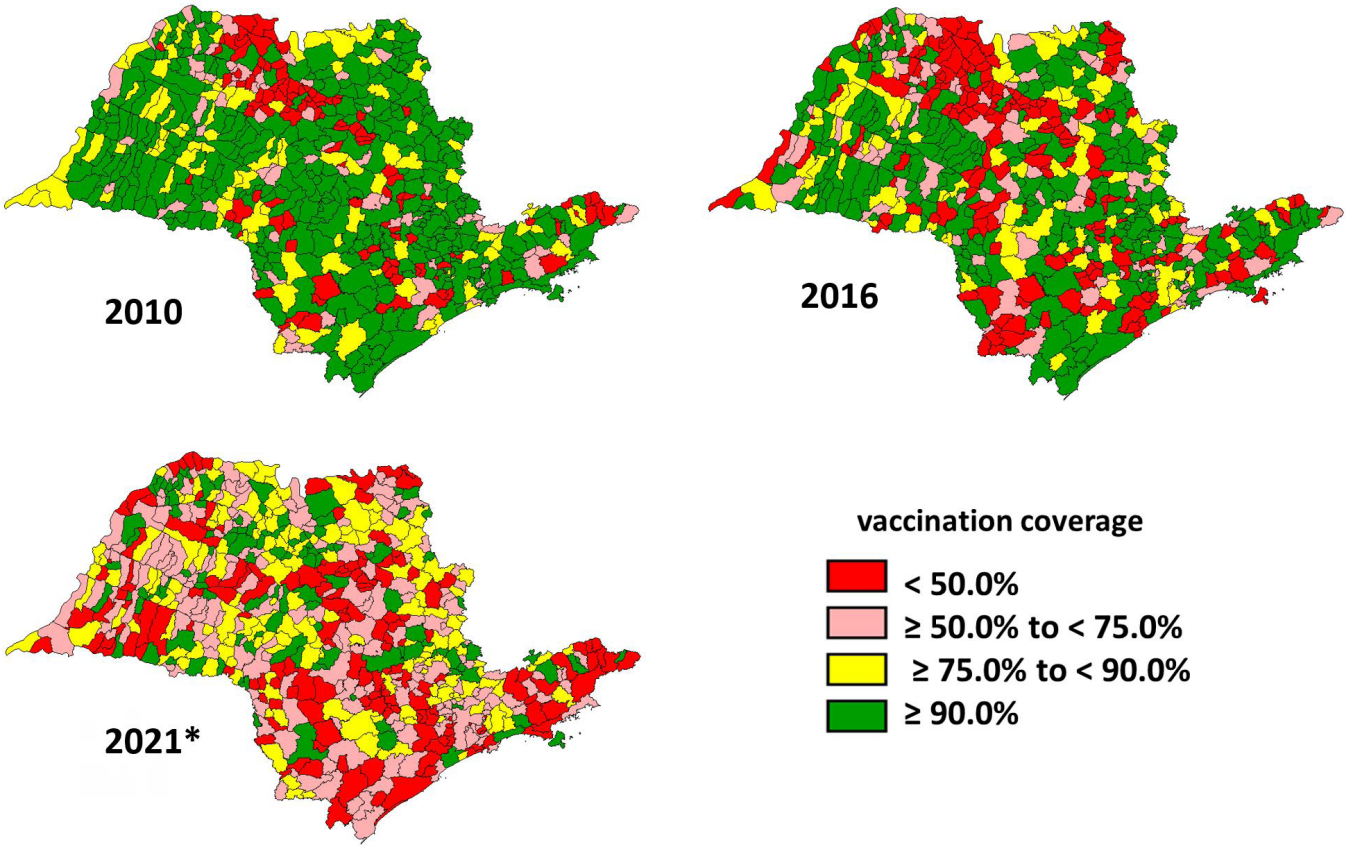
Table 2. Number and proportion of municipalities by year and coverage of the BCG vaccine in children under 1 year of age. SSP, 2010 to 2021.*

YEAR	VACCINATION COVERAGE								TOTAL
	< 50.0%		≥ 50.0% to < 75.0%		≥ 75.0% to < 90.0%		≥ 90.0%		
	Nº	%	Nº	%	Nº	%	Nº	%	Nº
2010	113	17.5	68	10.5	103	16.0	361	56.0	645
2011	129	20.0	55	8.5	100	15.5	361	56.0	645
2012	129	20.0	68	10.5	97	15.0	351	54.4	645
2013	134	20.8	67	10.4	111	17.2	333	51.6	645
2014	144	22.3	62	9.6	98	15.2	341	52.9	645
2015	144	22.3	90	14.0	79	12.2	332	51.5	645
2016	189	29.3	88	13.6	94	14.6	274	42.5	645
2017	140	21.7	70	10.9	104	16.1	331	51.3	645
2018	45	7.0	101	15.7	81	12.6	418	64.8	645
2019	38	5.9	105	16.3	164	25.4	338	52.4	645
2020	168	26.0	147	22.8	155	24.0	175	27.1	645
2021*	168	26.0	197	30.5	162	25.1	118	18.3	645

Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

Figure 1 presents the BCG CVs by spatial distribution of the municipalities in São Paulo in 2010, 2016 and 2021, according to the legend that groups them by scope of coverage percentage and by color, to facilitate the observation of the evolution in the years in which question. The gradual change in the figures is evident, demonstrating the increase in the number of cities that did not reach the goal and of susceptible areas/pockets, with greater risk/vulnerability for the return of severe cases of tuberculosis.

Figure 1. Spatial distribution of BCG VC in children under 1 year of age. SSP, 2010, 2016 and 2021.*

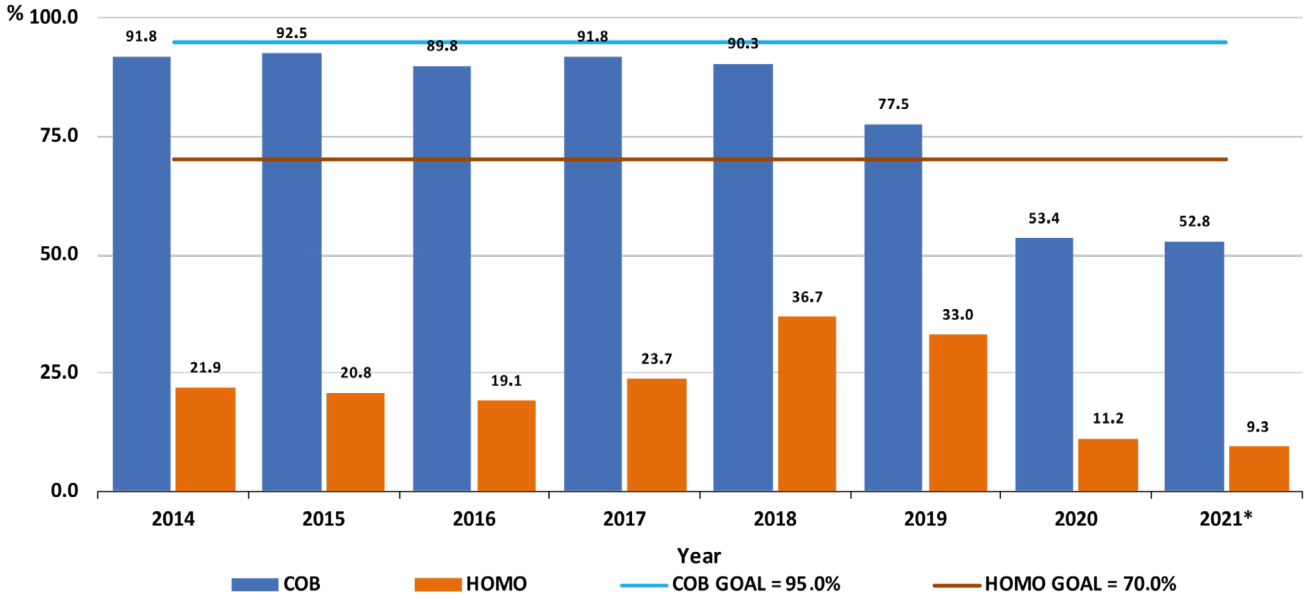


Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

The hepatitis B vaccine (recombinant) was implemented in September 1998 for children under 1 year of age. In 2005, with the publication of Resolution SS-39, vaccination against hepatitis B was instituted in the first 12 hours of all live births in the SSP. The objective of the measure: prevention of vertical transmission, in the case of a newborn of an HBsAg+ mother. Therefore, early administration of hepatitis B vaccine (recombinant), as well as specific human immunoglobulin, is essential.

The analysis of coverage data, which began in 2014 due to the unavailability of information referring to previous years, with a target of a VC of 95%. Graph 2 shows that in eight years of analysis this goal was not reached, with a drop in coverage from 2019 onwards (77.5%), with greater expression in pandemic years (53.4% and 52.8%).

Graph 2. Hepatitis B (recombinant) VC and homogeneity administered up to 30 days of age, by year, SSP, 2014 to 2021*.



Source: National Immunization Program Information System. *Data updated on March 27, 2023, subject to revision.

The homogeneity goal (70%) was not achieved in any of the years mentioned here, remaining well below expectations, with a slight increase in 2018 and 2019, respectively, 36.7% and 33%. In the pandemic phases, the distance from the goal was accentuated. As in the case of BCG, the hepatitis B vaccine (recombinant) is also available in hospitals and maternity hospitals with a view to its use at birth, ideally in the first 12 hours of life, and can be administered until the thirtieth day. Therefore, the population of small municipalities without a hospital structure is vaccinated in cities referred for childbirth, harming the local CV until 2015, when the new system corrected the information by residence, starting in 2016.

The implementation of the nominal registry also had an impact on the CVs of hepatitis B in the newborn in maternity wards and hospitals, where a lack of data entry on the immunizer was identified, as observed in the BCG. This finding was based on an analysis that compared birth data by location provided by SICHS/CCD/SES-SP.

Table 3 shows the number and percentage of municipalities in São Paulo allocated by VC clusters, being < 50%, ≥ 50% to < 75%, ≥ 75% to < 95% and ≥ 95%, in a total of 645. In the first six years of this analysis, the number of cities that reached the CV target ranged from 20.8% to 36.7%, with an even greater reduction in the pandemic years of 2020 and 2021 (11.2% and 9.3 %, respectively). Most cities are allocated in the group of VC < 50%, with the highest expression in 2015 (60.8%) and the lowest in 2019 (19.8%). In the pandemic, the increase in the number of cities with coverage below 50% was evident, confirming the difficult scenario for routine vaccination.

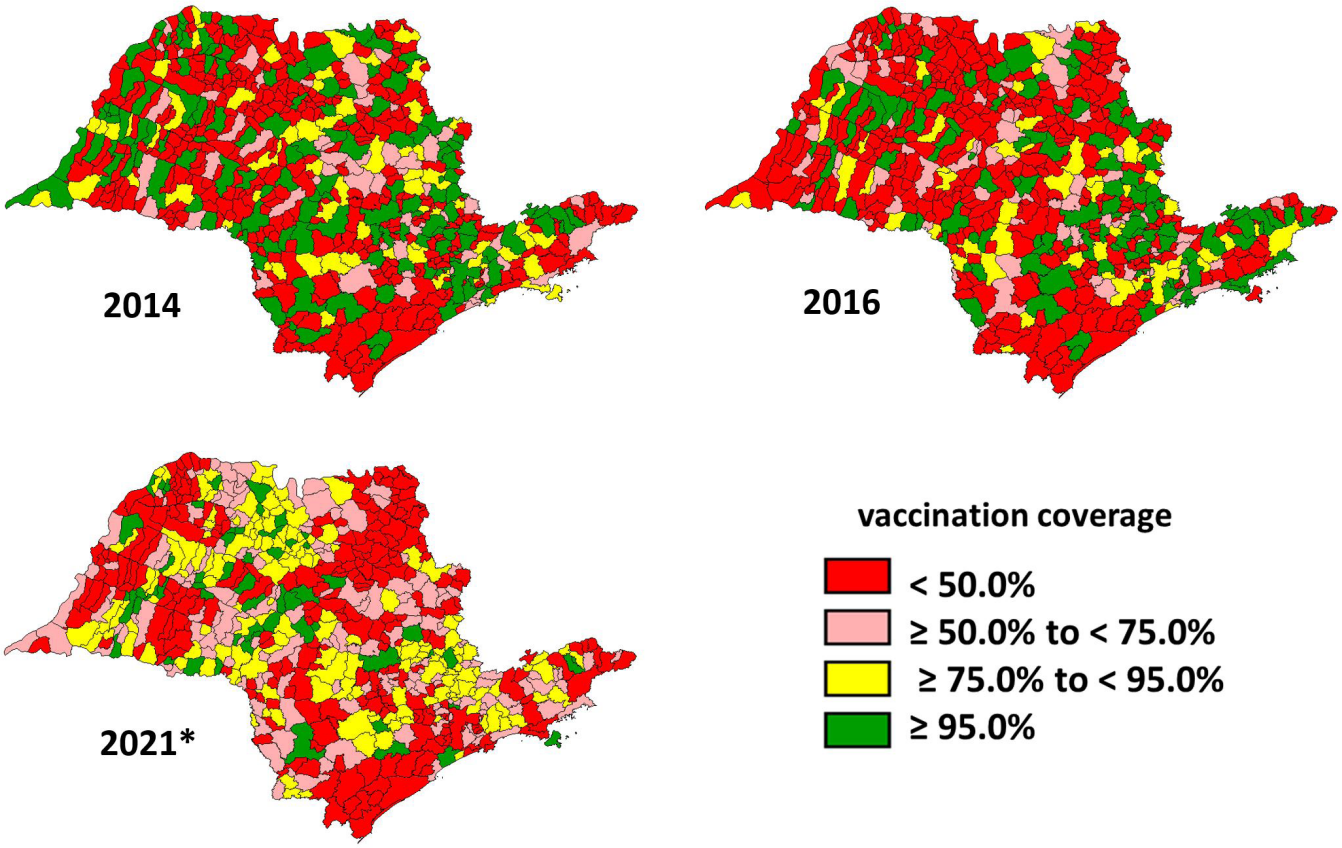
Table 3. Number and proportion of municipalities by year and coverage of hepatitis B vaccine (recombinant) administered up to 30 days of age, SSP, 2014 to 2021.*

YEAR	VACCINATION COVERAGE								TOTAL
	< 50.0%		≥ 50.0% to < 75.0%		≥ 75.0% to < 95.0%		≥ 95.0%		
	Nº	%	Nº	%	Nº	%	Nº	%	Nº
2014	380	58.9	57	8.8	67	10.4	141	21.9	645
2015	392	60.8	59	9.1	60	9.3	134	20.8	645
2016	386	59.8	82	12.7	54	8.4	123	19.1	645
2017	313	48.5	95	14.7	84	13.0	153	23.7	645
2018	162	25.1	115	17.8	131	20.3	237	36.7	645
2019	128	19.8	127	19.7	177	27.4	213	33.0	645
2020	251	38.9	142	22.0	180	27.9	72	11.2	645
2021*	258	40.0	165	25.6	162	25.1	60	9.3	645

Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

Figure 2 shows the coverage of the hepatitis B vaccine (recombinant) by spatial distribution of the municipalities in the territory of São Paulo, in the years 2014, 2016 and 2021, according to the legend that groups the cities by coverage percentage and by color, to facilitate the observation of its evolution in the period in question. The figures corresponding to 2014 and 2016 have a very similar configuration, with many locations with CV < 50% and in 2021. Despite being a pandemic period, it is possible to observe an increase in municipalities with coverage between ≥ 50 to < 75%. The scenario in all years was of lack of vaccine protection at an opportune time.

Figure 2. Spatial distribution of hepatitis B (recombinant) vaccination coverage administered up to 30 days of age, SSP, 2014, 2016 and 2021.*



Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

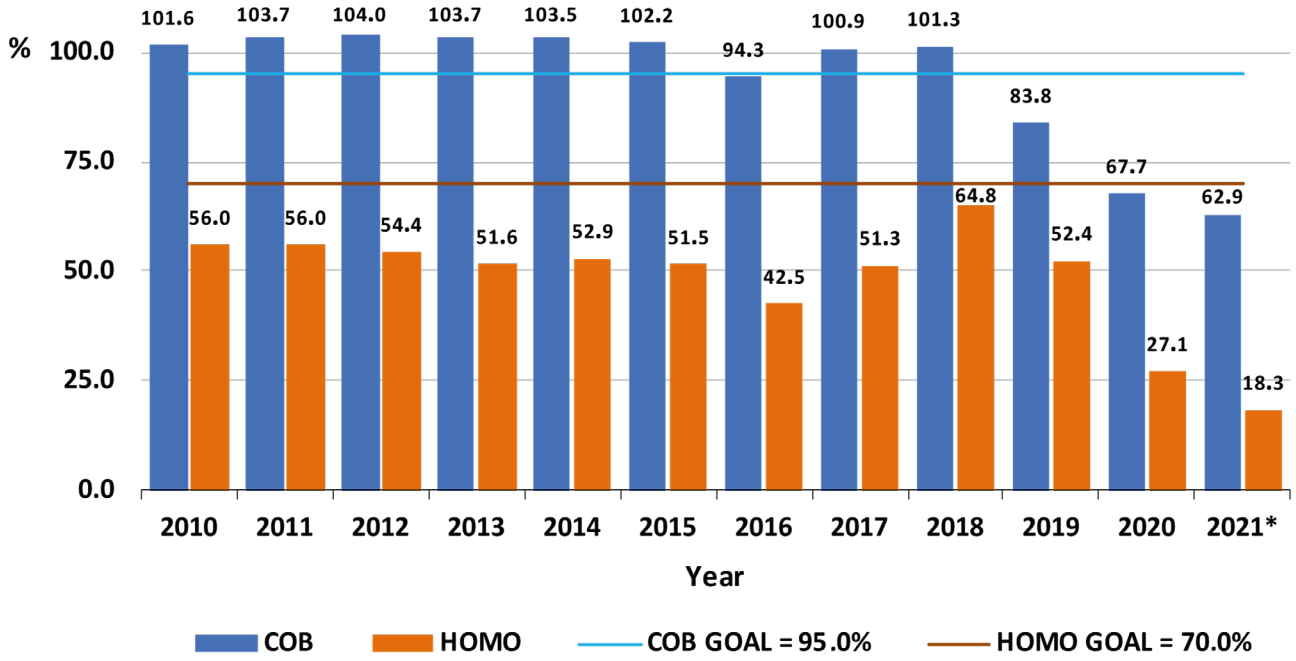
To follow the official schedule, there are vaccines administered at 2 months of age. Against poliomyelitis the 1, 2 and 3 (attenuated) or OPV, was used for decades, of oral use, with a basic vaccination schedule at 2, 4 and 6 months with two boosters, at 15 months and 4 years. As of August 2012, it began to be replaced by the polio vaccine 1, 2 and 3 (inactivated), also known as VIP, in a scheme called VIP/OPV. In it, the first dose is VIP, applied at 2 months and the second at 4; the third dose, with OPV, at 6 months. In 2016, the VIP vaccine was adopted as a basic regimen.

In Brazil, trivalent OPV was distributed to states until November 30, 2015, with the recommendation to use it until March 31, 2016. After that date, it would be collected and incinerated. In April 2016, bivalent OPV began to be administered in boosters.

The VC calculation is based on the third dose applied to children under 1 year of age. It has a target of 95% VC and 70% homogeneity. Graph 3 shows the result of VCs in a historical series of 11 years, starting in 2010. The goal was reached in 2015 and since 2016 coverage has fallen to 83.8%, with an increase in 2018 (92.6%) and a new decrease since 2019, moving away from the goal

completely in the pandemic period (82.1% and 73.6%, respectively, in 2020 and 2021). Homogeneity was reached or very close to it in the first six years of this important historical moment, dropping significantly in 2016 (44%) and not returning to acceptable levels.

Graph 3. Poliomyelitis VC and homogeneity (third dose), in children under 1 year of age, second year, SSP, 2010 to 2021.*



Source: National Immunization Program Information System. *Data updated on March 27, 2023, subject to revision.
NOTE: VIP introduction in August/2012. As a third dose, from 2016.

Table 4 shows that, in the historical series in question, the cities were mainly allocated in the VC groups from ≥ 75.0% to < 95.0% and ≥ 95.0%, confirming a greater number of cities with higher VC. Since 2016, however, there has been an increase in cities with coverage < 50% and ≥ 50.0% to < 75.0%, and a reduction in those with high coverage (≥ 95.0%).

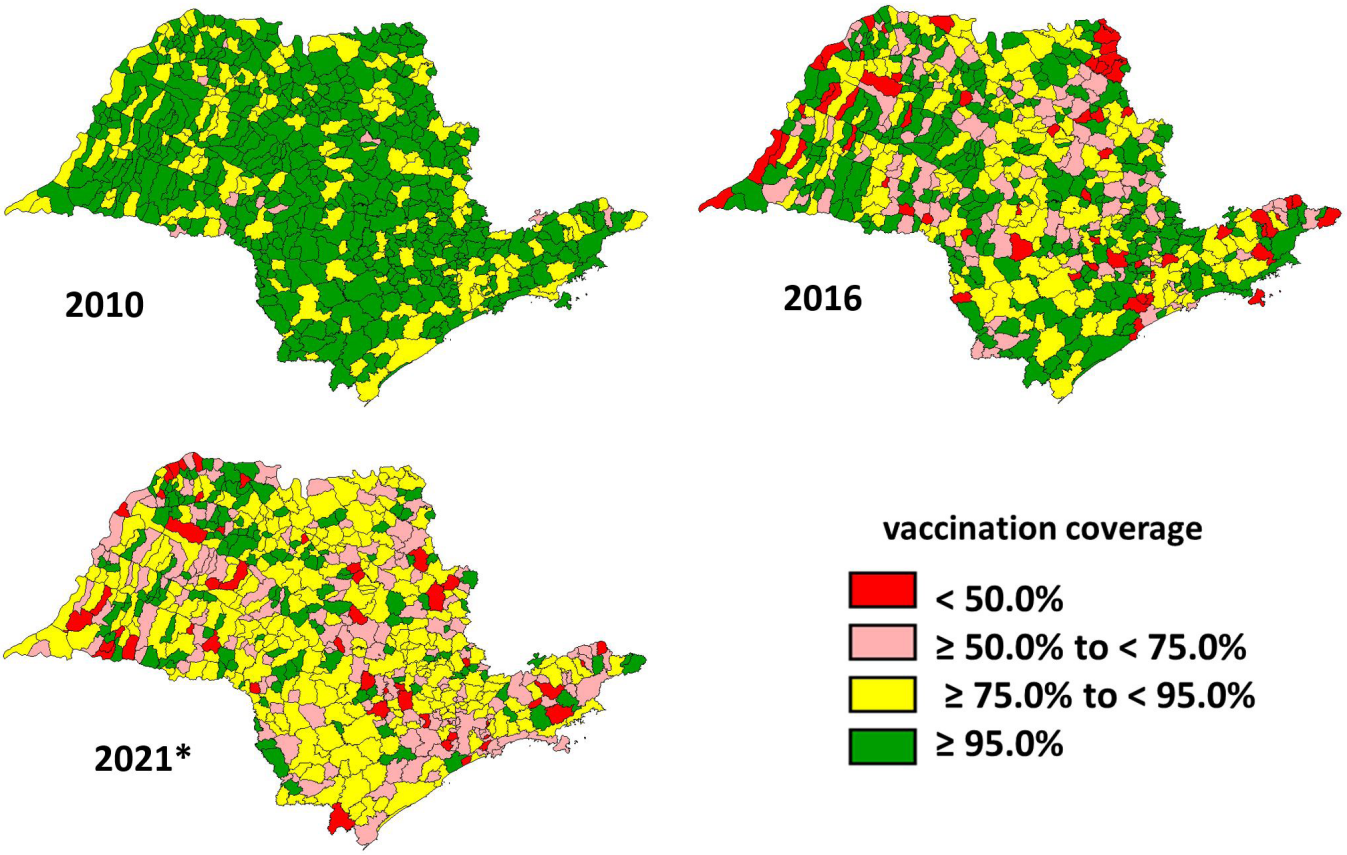
Table 4. Number and proportion of municipalities by year and coverage of poliomyelitis vaccine (third dose), in children under 1 year of age, SSP, 2010 to 2021.*

YEAR	VACCINATION COVERAGE								TOTAL
	< 50.0%		≥ 50.0% to < 75.0%		≥ 75.0% to < 95.0%		≥ 95.0%		
	Nº	%	Nº	%	Nº	%	Nº	%	Nº
2010	0	0.0	10	1.6	169	26.2	466	72.2	645
2011	1	0.2	21	3.3	126	19.5	497	77.1	645
2012	2	0.3	28	4.3	188	29.1	427	66.2	645
2013	3	0.5	35	5.4	161	25.0	446	69.1	645
2014	2	0.3	26	4.0	199	30.9	418	64.8	645
2015	4	0.6	30	4.7	152	23.6	459	71.2	645
2016	60	9.3	106	16.4	195	30.2	284	44.0	645
2017	6	0.9	84	13.0	239	37.1	316	49.0	645
2018	9	1.4	54	8.4	216	33.5	366	56.7	645
2019	11	1.7	89	13.8	293	45.4	252	39.1	645
2020	33	5.1	130	20.2	244	37.8	238	36.9	645
2021*	48	7.4	163	25.3	285	44.2	149	23.1	645

Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.
NOTE: VIP introduction in August/2012. As a third dose from 2016.

Figure 3 highlights the appropriate scenario of VC against poliomyelitis in 2010 and a drop from 2016, which is sharply accentuated in the pandemic year 2021, confirming the number of municipalities (44.2%) with coverage between ≥ 75% and < 95%.

Figure 3. Spatial distribution of coverage of the VIP vaccine (third dose), against poliomyelitis, in children under 1 year of age, SSP, 2010, 2016 and 2021.*



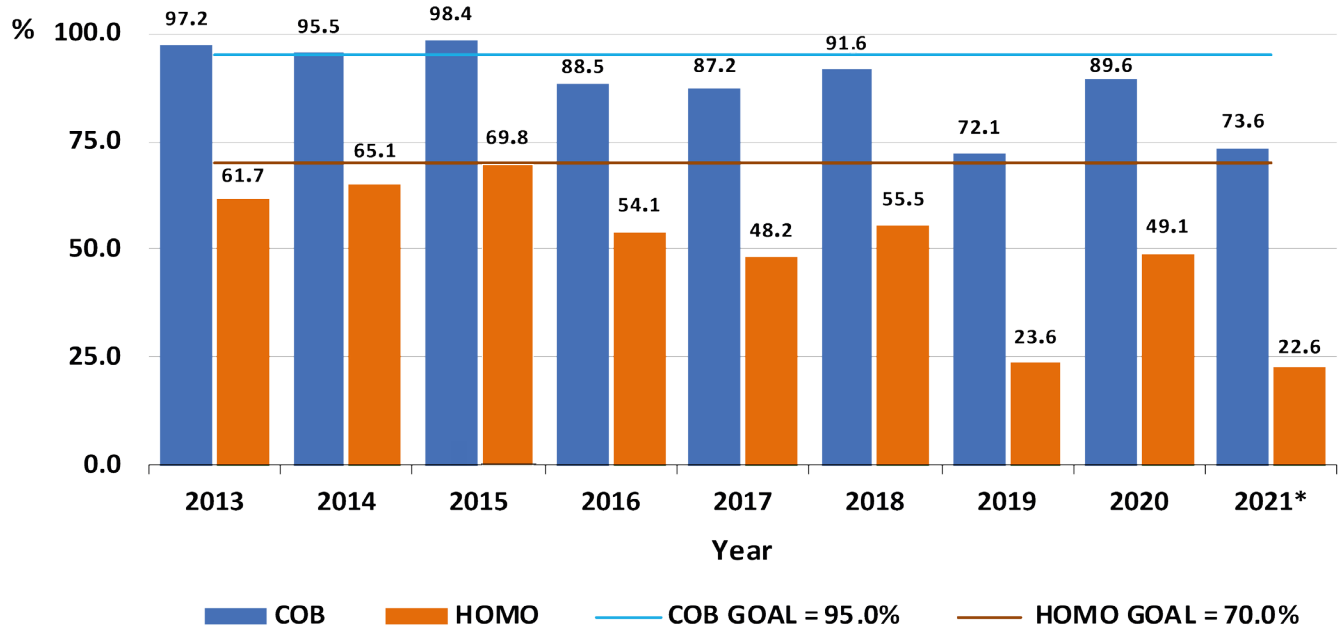
ource: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision. S
NOTE: VIP introduction in August/2012. As a third dose from 2016.

It is also important to highlight the elimination of the wild poliomyelitis virus in the SSP in 1988, when the last case of São Paulo was described in the municipality of Teodoro Sampaio, while in Brazil it was in 1989. In 1994, the Brazilian territory was certified by the Pan American Health Organization (PAHO) as a wild poliovirus-free area, along with other countries in the Americas. However, as there is still circulation of wild poliovirus and the vaccine derivative in nations of the world, the risk of imported cases remains. Thus, the reduction in VC in the SSP since 2016, with the accumulation of susceptibles thereafter, points to an urgent need for the resumption of better conditions and results, due to the risk of reintroduction of poliomyelitis in our environment.

Along with VIP, the schedule recommends the simultaneous administration of the adsorbed diphtheria, tetanus, pertussis, hepatitis B (recombinant) and *Haemophilus influenzae* b, also known as pentavalent, for parenteral use (intramuscular - IM), with a basic vaccination schedule at 2, 4 and 6 months of age. Its use started in August 2012, having as predecessors the tetravalent vaccines (adopted in 2002) and triple bacterial vaccines (in use since the early 1950s).

The calculation of the VC of the pentavalent falls on the third dose in children under 1 year of age. The CV and homogeneity targets are 95% and 70%, respectively. As with most immunizers in the calendar, in 2016 the pentavalent coverage started to decrease (Graph 4), initially still with CV close to the target, with a more expressive drop in 2019 and 2021. It is important to note that in 2019 there was a shortage of this vaccine, which also had an impact on coverage. The homogeneity not achieved at that time had a relevant drop from 2016 and another in 2019, due to shortages.

Graph 4. Coverage and homogeneity of the pentavalent vaccine (third dose), in children under 1 year of age, second year, SSP, 2013 to 2021.*



Source: National Immunization Program Information System. *Data updated on March 27, 2023, subject to revision.

Table 5 shows that, in the historical series, the municipalities were mainly allocated in the CV groupings from ≥ 75.0% to < 95.0% and ≥ 95.0%, confirming a greater number of cities with coverage above 75%. As with the VIP vaccine, also with the pentavalent vaccine there was an increase in locations with coverage < 50% and ≥ 50.0% to < 75.0% and a reduction in those with high coverage (≥ 95.0%). It is worth noting that in 2019 there was a reduction in the number of municipalities that previously occupied the VC group ≥ 95%, with a significant increase in cities with coverage between ≥ 50.0% and < 75.0%. That year, there was a significant shortage of pentavalent vaccine and a resurgence of measles in the SSP.

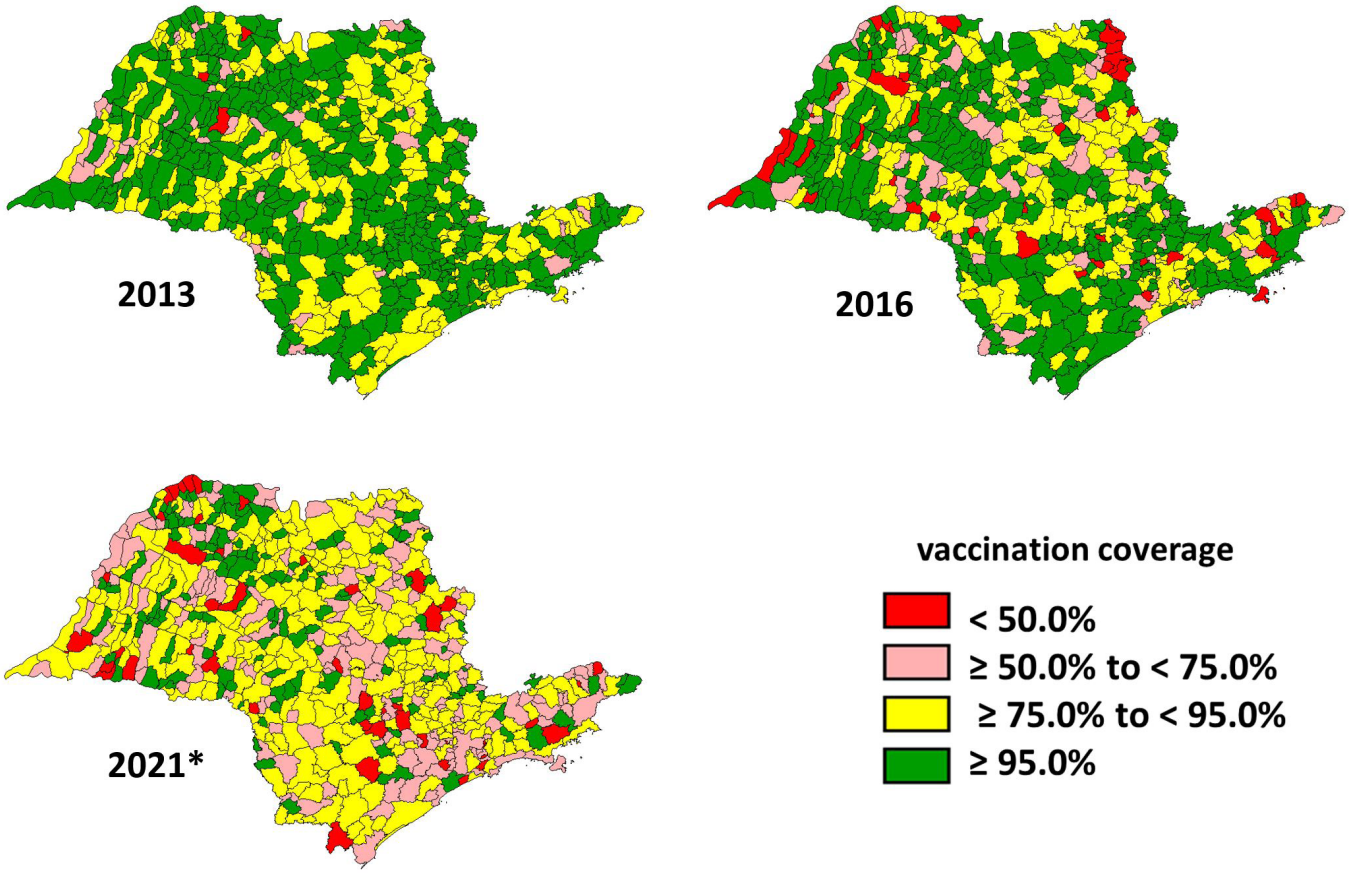
Table 5. Number and proportion of municipalities by year and coverage of the pentavalent vaccine (third dose), in children under 1 year of age, SSP, 2013 to 2021.*

YEAR	VACCINATION COVERAGE								TOTAL
	< 50.0%		≥ 50.0% to < 75.0%		≥ 75.0% to < 95.0%		≥ 95.0%		
	Nº	%	Nº	%	Nº	%	Nº	%	Nº
2013	3	0.5	42	6.5	202	31.3	398	61.7	645
2014	3	0.5	28	4.3	194	30.1	420	65.1	645
2015	4	0.6	39	6.0	152	23.6	450	69.8	645
2016	43	6.7	67	10.4	186	28.8	349	54.1	645
2017	11	1.7	71	11.0	252	39.1	311	48.2	645
2018	10	1.6	57	8.8	220	34.1	358	55.5	645
2019	31	4.8	248	38.4	214	33.2	152	23.6	645
2020	31	4.8	92	14.3	205	31.8	317	49.1	645
2021*	45	7.0	164	25.4	290	45.0	146	22.6	645

Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

Figure 4 shows that most municipalities (61.7%) had adequate coverage for the pentavalent vaccine in 2013 and a drop from 2016, which was strongly accentuated in the pandemic year 2021, confirming the number of cities (45, 0%) with VC between ≥ 75% and < 95%.

Figure 4. Spatial distribution of pentavalent VC (third dose), in children under 1 year of age, SSP, 2013, 2016 and 2021*.



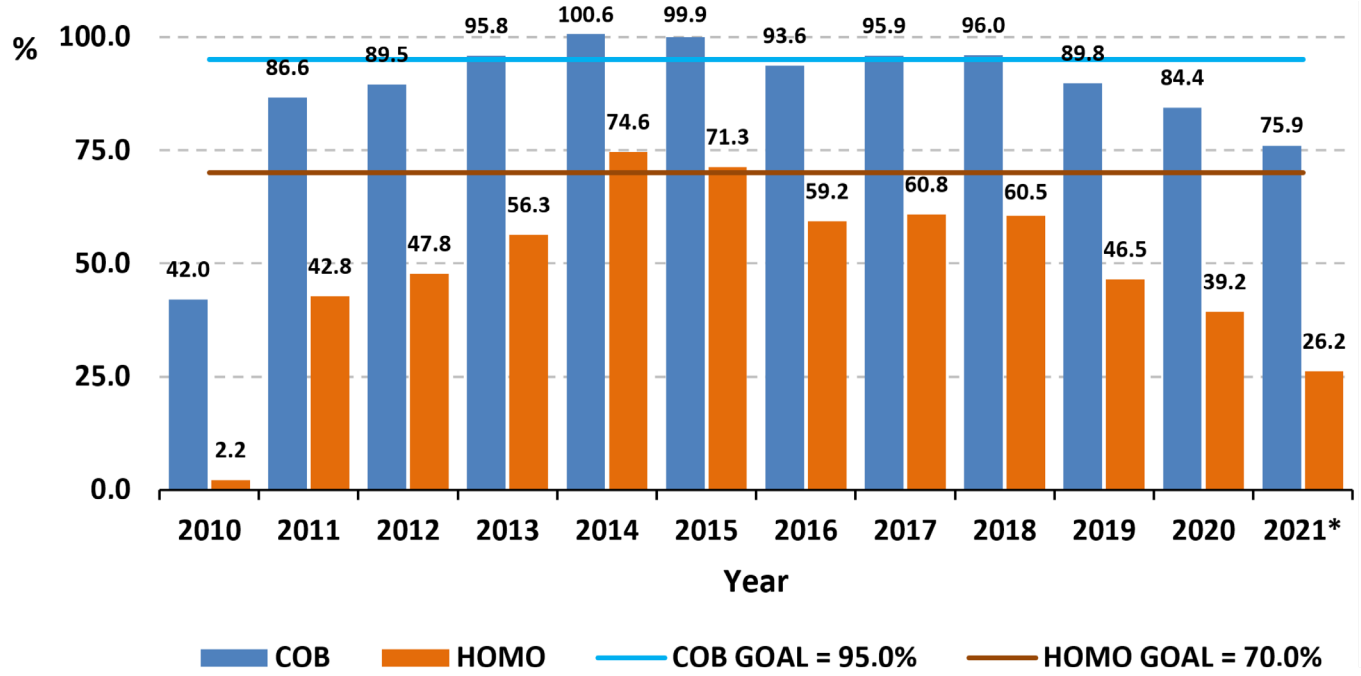
Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

The 10-valent pneumococcal vaccine (conjugate) was incorporated into the children's calendar in March 2010, initially to be administered at 3, 5 and 7 months of age, with a booster at 15.

On December 3, 2013, Resolution SS nº 129 was published, approving the vaccination schedule for the SIP. At that moment, there was a change in the Pneumococcal 10-valent (conjugated) schedule, which was now indicated at 2, 4 and 6 months, maintaining the booster at 15. In January 2016, a new change in the schedule changed the primary schedule to 2 and 4 months and booster at 12. Currently, the SIP recommends a two-dose vaccination schedule at 2 and 4 months of age and booster at 12.

The calculation of 10-valent pneumococcal (conjugated) coverage is based on the second dose in children under 1 year of age. This vaccine has a target CV of 95% and 70% homogeneity. Graph 5 shows the result of coverage from 2010 to 2021. In the first year of the history series, the implementation of vaccination did not cause intense adherence, being expanded in the following year (2011). The coverage target was achieved in the period between 2013 and 2015 and in 2017 and 2019.

Graph 5. Coverage and homogeneity of 10-valent pneumococcal vaccine (conjugate) in children under 1 year of age, second year, ESP, 2010 to 2021.*



Source: National Immunization Program Information System. *Data updated on March 27, 2023, subject to revision.

Coverage was below the target in 2011 (86.6%), 2012 (89.5%), 2016 (93.6%) and 2019 (89.8%), completely distancing itself from it in pandemic years (84 .4% and 75.9%, respectively 2020 and 2021). It is worth remembering that in 2016 there was a change in the primary regimen to two doses, and its application at 2 and 4 months of age is recommended. Thus, the CV to be evaluated at the end of the primary regimen, that is, in the second dose, administered at 4 months. The homogeneity target was reached only in 2014 and 2015, occurring away from the target in the pandemic years (2020 and 2021).

Table 6 shows the number and percentage of municipalities in São Paulo allocated by VC clusters, being < 50%, ≥ 50% to < 75%, ≥ 75% to < 95% and ≥ 95%, in a total of 645. It is evident that they are mainly in the CV clusters from ≥ 75.0% to < 95.0% and ≥ 95.0%, confirming a greater number of cities with higher coverage. However, in 2016, 2020 and 2021 there was an increase in the number of municipalities with coverage < 50%. The same occurred in 2020 and 2021, when there was also an increase in cities with CV between ≥ 50.0% to < 75.0% and a reduction in those with high coverage (≥ 95.0%).

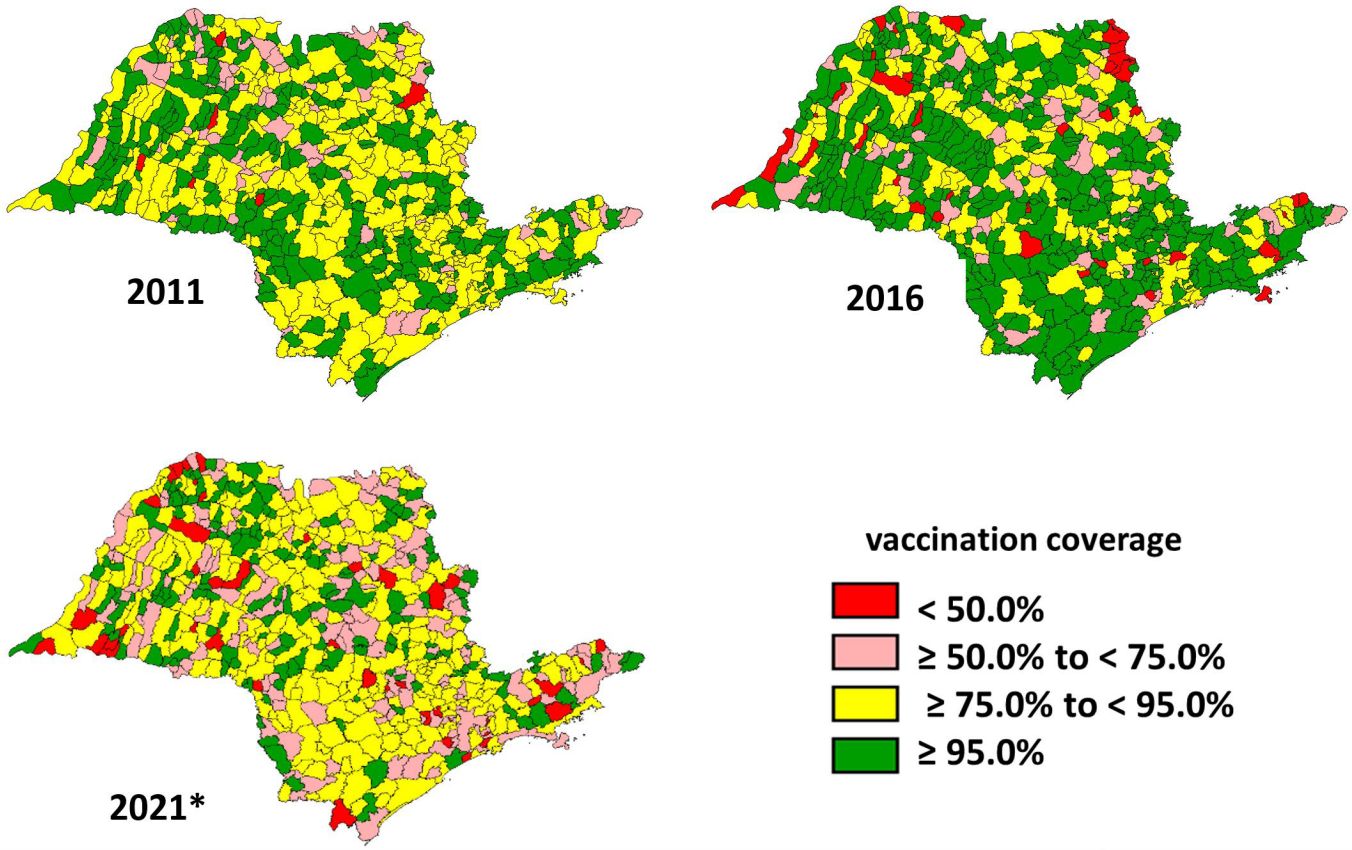
Table 6. Number and proportion of municipalities by year and coverage of 10-valent pneumococcal vaccine (conjugate) in children under 1 year of age, SSP, 2010 to 2021.*

YEAR	VACCINATION COVERAGE								TOTAL
	< 50.0%		≥ 50.0% to < 75.0%		≥ 75.0% to < 95.0%		≥ 95.0%		
	Nº	%	Nº	%	Nº	%	Nº	%	Nº
2010	336	52.1	251	38.9	44	6.8	14	2.2	645
2011	6	0.9	69	10.7	294	45.6	276	42.8	645
2012	2	0.3	44	6.8	291	45.1	308	47.8	645
2013	3	0.5	19	2.9	260	40.3	363	56.3	645
2014	2	0.3	17	2.6	145	22.5	481	74.6	645
2015	6	0.9	29	4.5	150	23.3	460	71.3	645
2016	38	5.9	60	9.3	165	25.6	382	59.2	645
2017	7	1.1	45	7.0	201	31.2	392	60.8	645
2018	5	0.8	44	6.8	206	31.9	390	60.5	645
2019	9	1.4	78	12.1	258	40.0	300	46.5	645
2020	33	5.1	123	19.1	236	36.6	253	39.2	645
2021*	42	6.5	154	23.9	280	43.4	169	26.2	645

Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

Figure 5 shows the CV of 10-valent pneumococcal (conjugated) by spatial distribution of the cities of São Paulo in 2011, 2016 and 2021. In 2011 and 2021, there is a concentration of cities with coverage between ≥ 75% to < 95%, while in 2016 they were adequate in 59.2% cities. Despite being a pandemic year, in 2021 there was an increase in cities with coverage < 50% (42). This scenario evidenced the lack of vaccine protection at an opportune time.

Figure 5. Spatial distribution of coverage of 10-valent pneumococcal vaccine (conjugate) in children under 1 year of age, SSP, 2011, 2016 and 2021.*

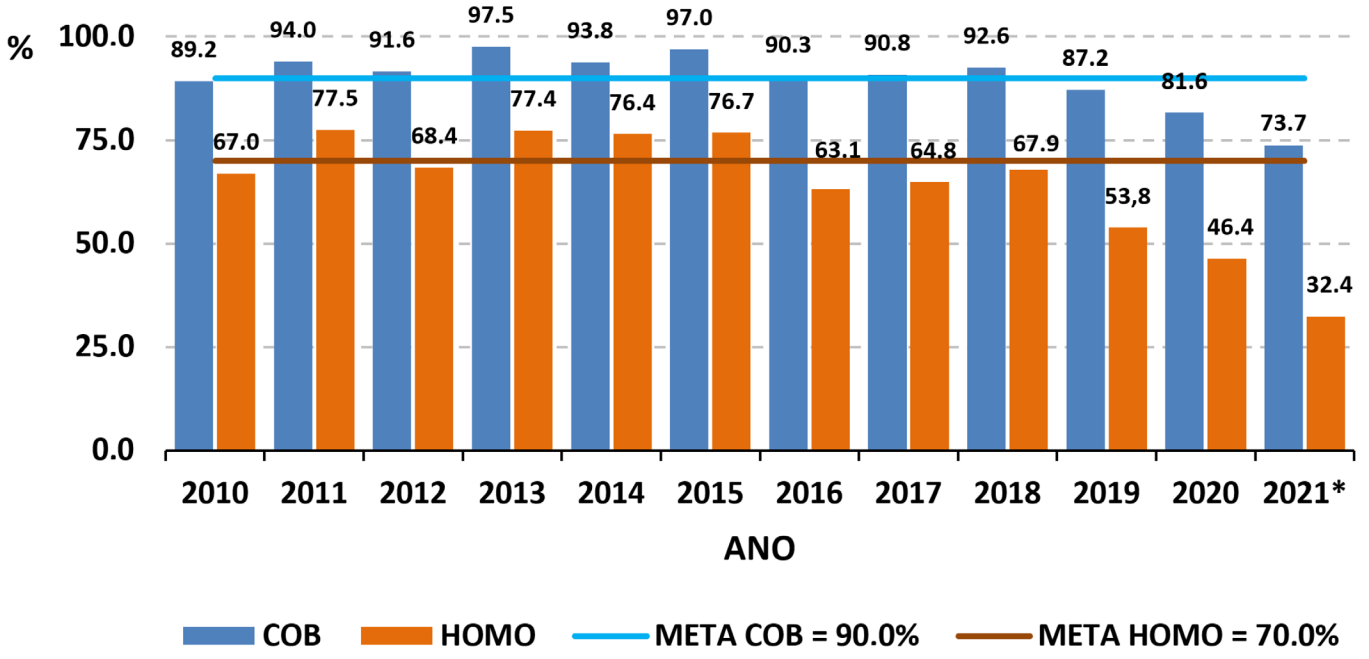


Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

The human rotavirus G1P[8] oral vaccine (attenuated) was incorporated into the infant calendar in 2006 to be administered at 2 and 4 months of age. The calculation of the CV of this immunizer falls on the second dose in children under 1 year of age.

VC and homogeneity targets are 90% and 70%, respectively. Graph 6 presents the result of VCs in an 11-year historical series starting in 2010. It is noteworthy that the coverage target was achieved in the period from 2011 to 2018, below expectations in 2010 (89.2%) and 2019 (87.2%). There was greater distance in the pandemic phase, especially in 2021, with 73.7%. The objective of homogeneity was achieved in 2011, 2013, 2014 and 2015, staying far from the goal in the emergency years of the covid-19 pandemic (2020 and 2021).

Graph 6. Coverage and homogeneity of G1P[8] human rotavirus vaccine (attenuated) in children under 1 year of age, second year, SSP, 2010 to 2021.*



Source: National Immunization Program Information System. *Data updated on March 27, 2023, subject to revision.

Table 7 shows that in the historical series the municipalities were allocated mainly in CV groups from ≥ 75.0% to < 90.0% and ≥ 90.0%, however from 2011 to 2015 most had adequate coverage. It is observed in 2016, 2020 and 2021 an increase in the number of cities with coverages < 50%. In the pandemic years (2020 and 2021) there is an expansion of municipalities with coverage ≥ 50% to < 75%.

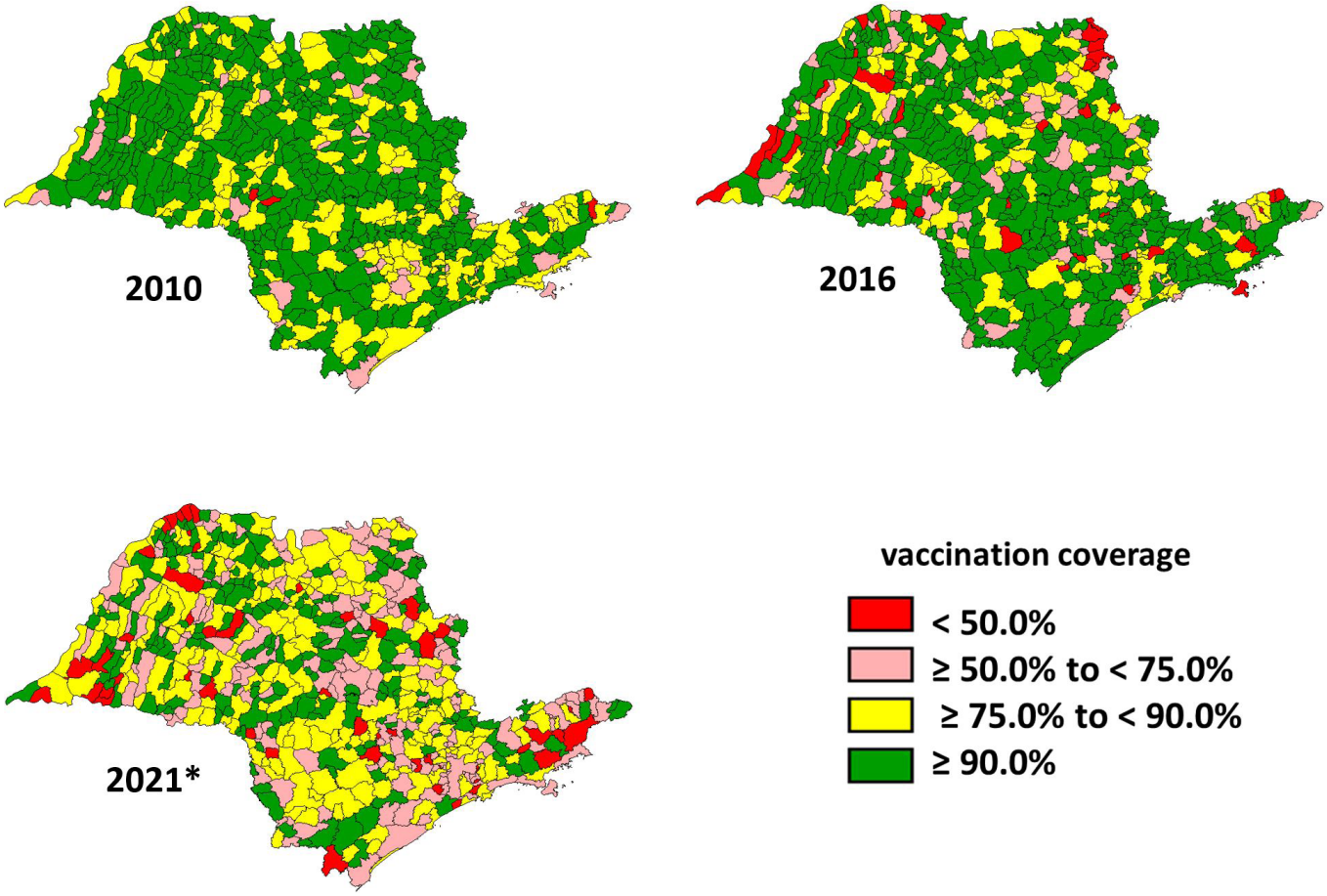
Table 7. Number and proportion of municipalities by year and coverage of human rotavirus G1P[8] vaccine (attenuated) in children under 1 year of age, SSP, 2010 to 2021.*

YEAR	VACCINATION COVERAGE								TOTAL
	< 50.0%		≥ 50.0% to < 75.0%		≥ 75.0% to < 90.0%		≥ 90.0%		
	Nº	%	Nº	%	Nº	%	Nº	%	Nº
2010	3	0.5	36	5.6	174	27.0	432	67.0	645
2011	1	0.2	33	5.1	111	17.2	500	77.5	645
2012	1	0.2	46	7.1	157	24.3	441	68.4	645
2013	0	0.0	32	5.0	114	17.7	499	77.4	645
2014	0	0.0	31	4.8	121	18.8	493	76.4	645
2015	2	0.3	37	5.7	111	17.2	495	76.7	645
2016	39	6.0	70	10.9	129	20.0	407	63.1	645
2017	12	1.9	60	9.3	155	24.0	418	64.8	645
2018	6	0.9	57	8.8	144	22.3	438	67.9	645
2019	10	1.6	82	12.7	206	31.9	347	53.8	645
2020	38	5.9	137	21.2	171	26.5	299	46.4	645
2021*	50	7.8	168	26.0	218	33.8	209	32.4	645

Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

Figure 6 shows that most municipalities (61.7%) had adequate CVs for the human rotavirus G1P[8] vaccine (attenuated) in 2010. In 2016, there was a slight drop in the number of cities with adequate coverage and an increase in those with coverage < 50%. In the pandemic year 2021, there was a concentration of municipalities with coverage between ≥ 75.0% and < 90% and ≥ 50% to < 75%.

Figure 6. Spatial distribution of G1P[8] human rotavirus VC (attenuated) in children under 1 year of age, SSP, 2011, 2016 and 2021.*

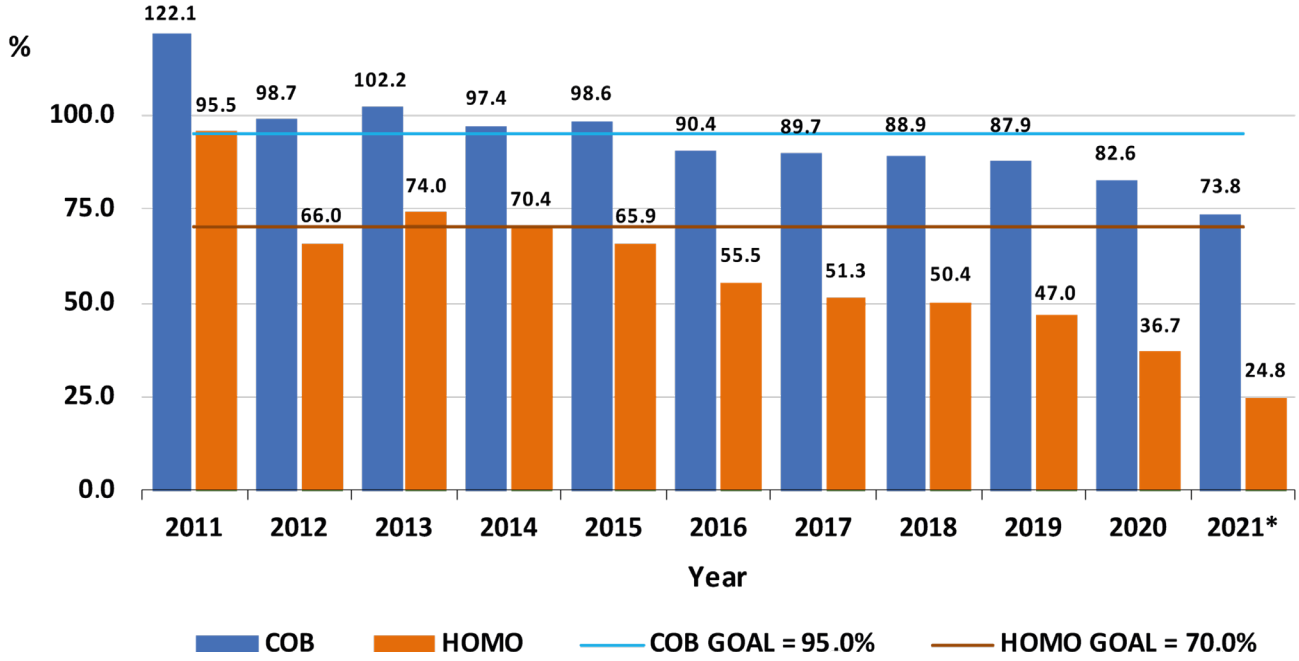


Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

Meningococcal C (conjugated) vaccine has been used in the RCSI for special groups since 2003. It was introduced in the São Paulo vaccination schedule for children from September 2010, with the schedule at 3 and 5 months of age, while the booster dose was recommended at 12 months. The calculation of the VC of this immunizer falls on the second dose in children under 1 year of age. The vaccine targets 95% coverage and 70% homogeneity.

Graph 7 shows the result of vaccination in the SSP in the period from 2011 to 2021. The goal was reached by 2015 and since 2016 the coverage has fallen, moving away from it completely in the pandemic years (82.6% in 2020 and 73.8 %, 2021). Homogeneity was reached only in 2011, 2013 and 2014, starting to drop significantly from 2016 onwards.

Graph 7. Coverage and homogeneity of meningococcal C (conjugate) vaccine in children under 1 year of age, second year, SSP, 2011 to 2021.*



Source: National Immunization Program Information System. *Data updated on March 27, 2023, subject to revision.

Table 8 shows the number and percentage of municipalities allocated by VC clusters, mainly from ≥ 75.0% to < 95.0% and ≥ 95.0%, confirming a greater number of cities with higher coverage. However, it appears that in 2016, 2020 and 2021 there was an increase in municipalities with coverage < 50.0%. In 2020 and 2021, there was also an increase in cities with VC between ≥ 50.0% and < 75.0% and a reduction in those with high coverage (≥ 95.0%).

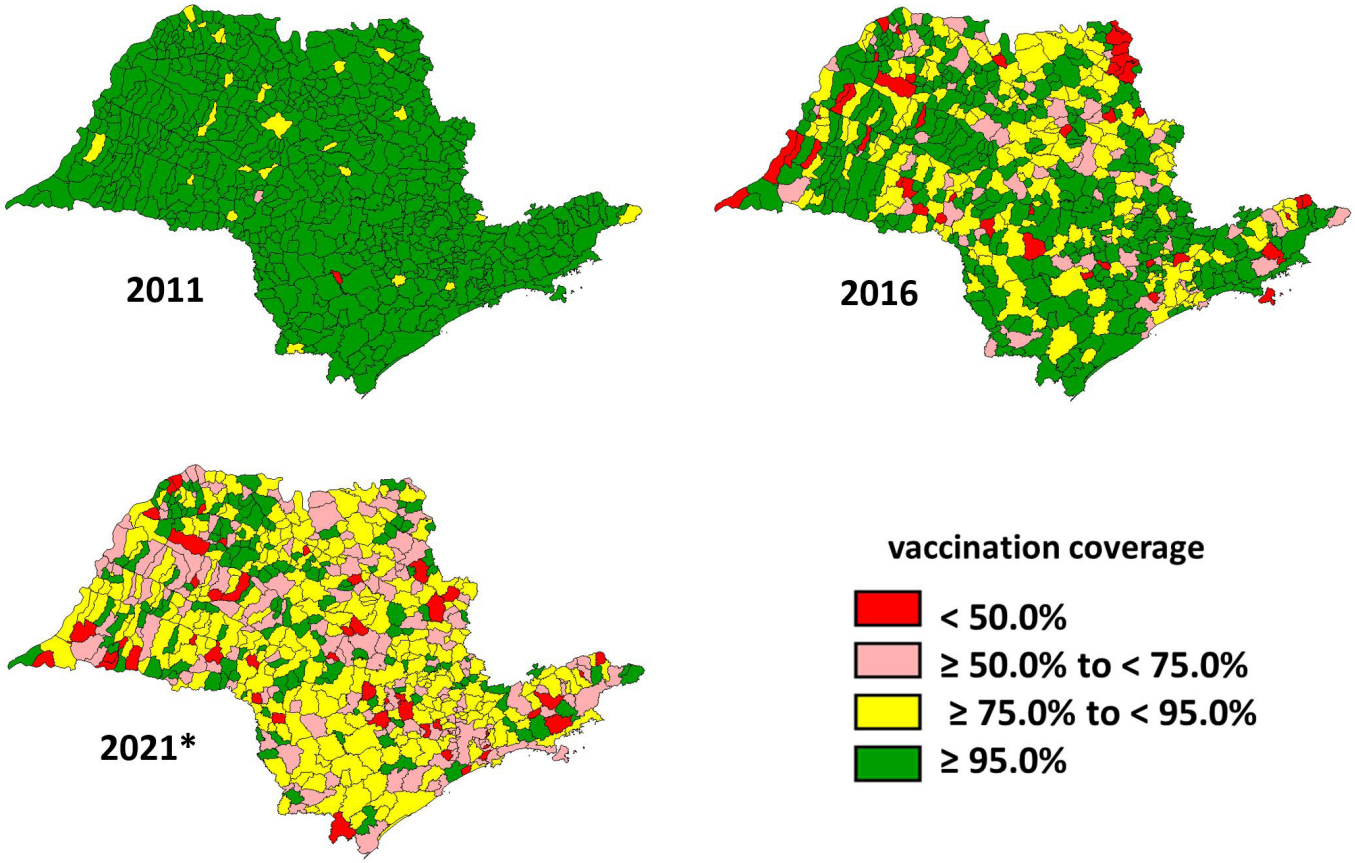
Table 8. Number and proportion of municipalities by year and coverage of meningococcal C (conjugated) vaccine in children under 1 year of age, SSP, 2011 to 2021.*

YEAR	VACCINATION COVERAGE								TOTAL
	< 50.0%		≥ 50.0% to < 75.0%		≥ 75.0% to < 95.0%		≥ 95.0%		
	Nº	%	Nº	%	Nº	%	Nº	%	Nº
2011	1	0.2	2	0.3	26	4.0	616	95.5	645
2012	2	0.3	25	3.9	192	29.8	426	66.0	645
2013	0	0.0	17	2.6	151	23.4	477	74.0	645
2014	4	0.6	25	3.9	162	25.1	454	70.4	645
2015	3	0.5	38	5.9	179	27.8	425	65.9	645
2016	42	6.5	65	10.1	180	27.9	358	55.5	645
2017	10	1.6	59	9.1	245	38.0	331	51.3	645
2018	9	1.4	68	10.5	243	37.7	325	50.4	645
2019	10	1.6	78	12.1	254	39.4	303	47.0	645
2020	32	5.0	127	19.7	249	38.6	237	36.7	645
2021*	46	7.1	160	24.8	279	43.3	160	24.8	645

Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

Figure 7 shows that most municipalities (95.5%) had adequate VC of meningococcal C (conjugated) in 2011, with only one city with VC < 50.0%. In 2016, it is possible to observe a slight drop in locations with adequate coverage (55.5%) and an increase in municipalities with VC < 50%. In the pandemic year 2021, there was a concentration of cities with coverage between ≥ 75.0% and < 90% and ≥ 50.0% to < 75%, and an increase in the number of cities with VC < 50%.

Figure 7. Spatial distribution of meningococcal C (conjugate) VC in children under 1 year of age, SSP, 2011, 2016 and 2021.*



Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

The vaccine against yellow fever (attenuated) was introduced in the state children's calendar since 2018, with the definition that the entire territory of São Paulo was an area of recommendation for vaccination due to the risk of transmission. This expansion was due to the circulation of the yellow fever virus, as of 2016, in areas with low VC, which triggered a mass immunization against the disease from January 2018 onwards.

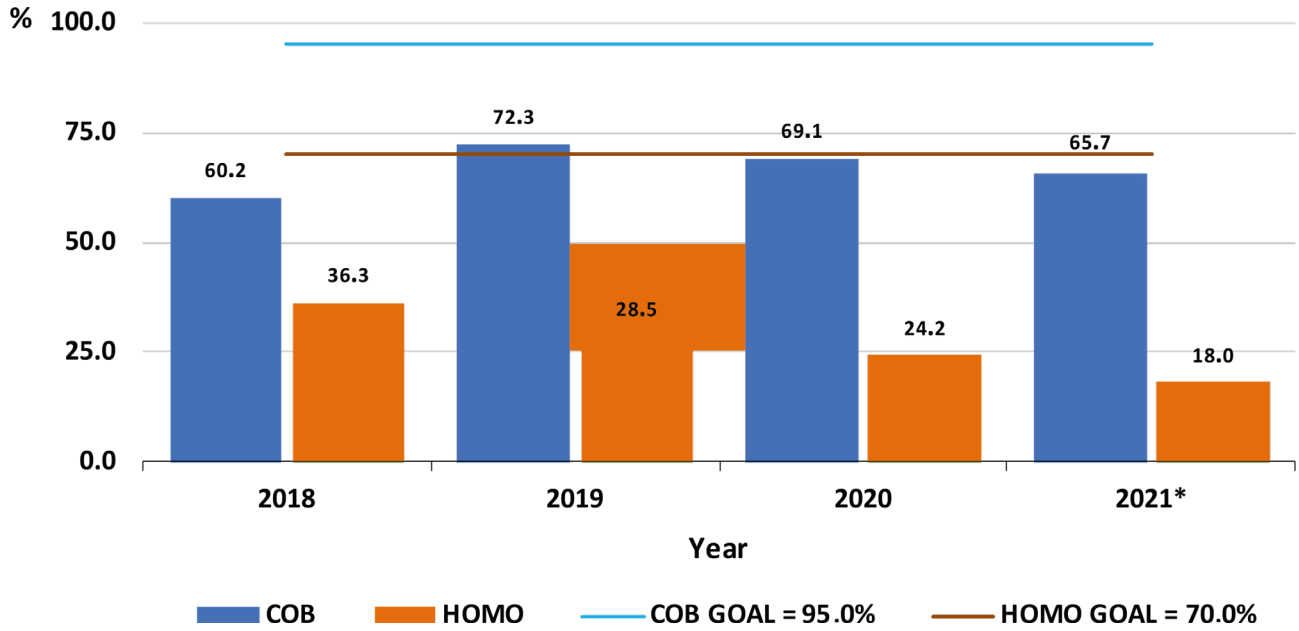
Until June of that year, due to the unavailability of many doses, the NIP chose to fractionate (0.1 ml) the full dose (0.5 ml) of the yellow fever vaccine (attenuated), targeting people aged 2 years or older. Individuals who had documentation of previous vaccination did not need a new dose.

Initially, it was recommended at 9 months of age in regions of the state with risk of transmission of the yellow fever virus, starting in 2020 with reinforcement every ten years. Currently, the vaccination schedule recommends the first dose at 9 months and the second at 4 years (for registration in the information systems, use a booster dose). The calendar also recommends that people who have

received only one dose of the vaccine before reaching 5 years of age should receive an additional dose regardless of the age of the person when they look for the vaccination service. International travelers who have received a fractional dose of yellow fever vaccine (attenuated) should be vaccinated with the full dose (0.5 ml) at least ten days before travel.

The calculation of coverage of this immunizer falls on the dose of 9 to 11 months of age. The VC goal of 95% and 70% homogeneity. Graph 8 shows that from 2018 neither of the two goals was achieved. In the first year of implementation, it is permissible not to reach it, however, in the others, coverage was close to 70%, far from the 95% recommended. Homogeneity, also not achieved, had an even greater reduction in pandemic years (2020 and 2021, respectively, 24.2% and 18%).

Graph 8. Coverage and homogeneity of the yellow fever vaccine (attenuated) in children under 1 year of age, by year, SSP, 2018 to 2021.*



Source: National Immunization Program Information System. *Data updated on March 27, 2023, subject to revision.

Table 9 depicts the number and percentage of municipalities allocated by VC clusters. There is a predominance of cities in the VC clusters of ≥ 50.0% to < 75.0% and ≥ 75.0% to < 95.0% for the entire period. in the pandemic years (2020 and 2021) the grouping of municipalities with ≥ 95.0% had a reduction.

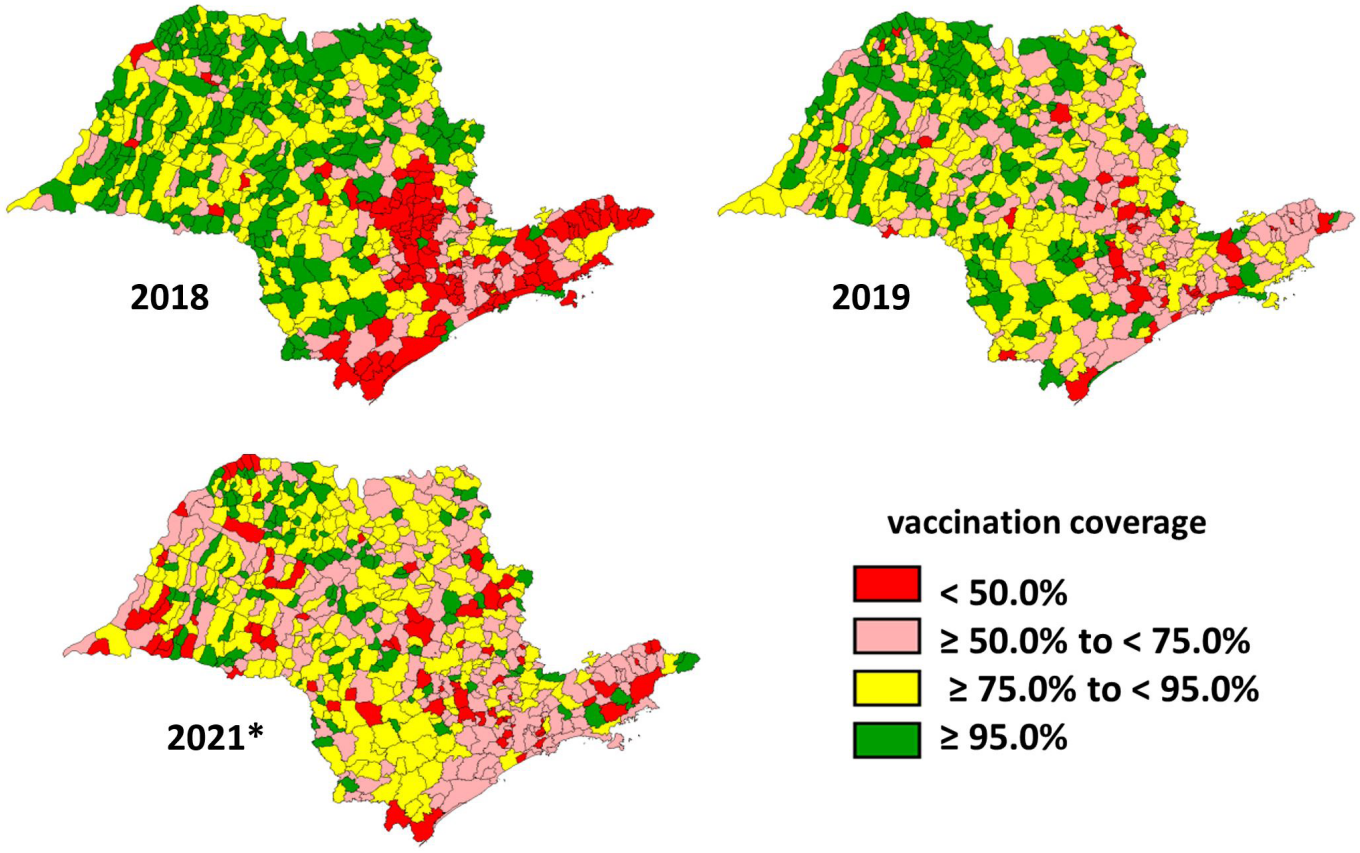
Table 9. Number and proportion of municipalities by year and coverage of the yellow fever vaccine (attenuated) in children under 1 year of age, SSP, 2018 to 2021*.

YEAR	VACCINATION COVERAGE								TOTAL
	< 50.0%		≥ 50.0% to < 75.0%		≥ 75.0% to < 95.0%		≥ 95.0%		
	Nº	%	Nº	%	Nº	%	Nº	%	Nº
2018	121	18.8	98	15.2	192	29.8	234	36.3	645
2019	43	6.7	186	28.8	232	36.0	184	28.5	645
2020	77	11.9	214	33.2	198	30.7	156	24.2	645
2021*	78	12.1	217	33.6	234	36.3	116	18.0	645

Source: National Immunization Program Information System. *Data updated as of June 15, 2022, subject to revision.

Figure 8 shows that the year 2018, when yellow fever vaccination increased, concentrated municipalities with very low coverage (< 50%) in which vaccination did not occur routinely. This performance confirms a better scenario in the regions of the state that already vaccinated children at 9 months of age in years prior to 2018.

Figure 8. Spatial distribution of coverage of the Yellow fever vaccine (attenuated) in children under 1 year of age, SSP, 2018, 2019 and 2021*.



Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

Figure 8 shows improvement of coverage in regions where vaccination had recently been scaled up, in 2019, evidencing the reduction of municipalities that had before reached, in 2018, the target of 95%. In the pandemic year 2021, there was a generalized scenario of low CV, with a predominance of clusters of ≥ 50.0% to < 75.0% and ≥ 75.0% to < 95.0%. There was an evident decrease of cities in the group of ≥ 95.0%.

The measles vaccine, introduced in Brazil in the 1960s, is aimed at children under 5 years old, indicated at 7 months of age. Since then, several vaccination schedules have changed the age group and the number of doses, always considering the epidemiological scenario. It is worth mentioning that in 1992 the MMR, (against measles, mumps, and rubella (SRC) was implemented in the SSP for a booster at 15 months. Based on epidemiological data and administrative VC in 2003 in the country, the application of the MMR vaccine against measles in a single dose at 12 months was recommended. In 2004, together with the National Follow-up Campaign Against Measles, the second dose of MMR was instituted at 4 years of age, since 2013 this dose is administered at 15 months.

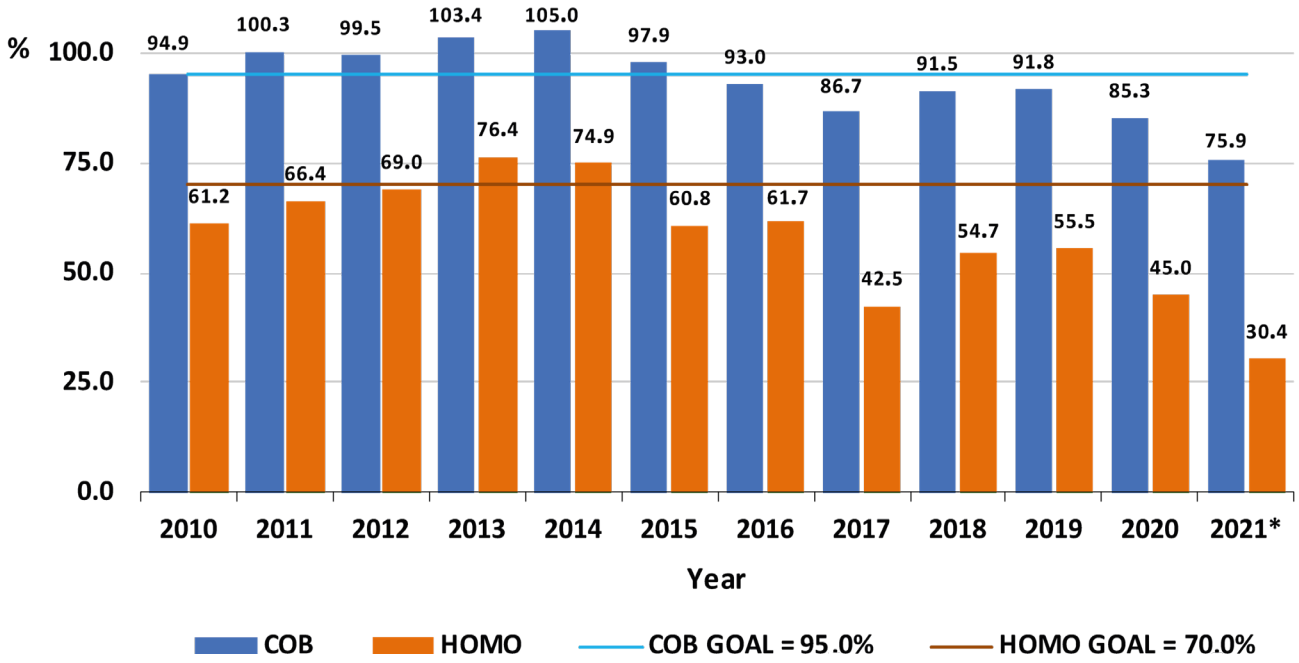
In addition to routine actions, there were several vaccination campaigns throughout the period analyzed, with emphasis on the pandemic scenario of 1987, when the SSP, based on Cuban experience, was a pioneer in Brazil in the adoption of indiscriminate measles vaccination (*"catch up"*), recommending the immunization of the population between 9 and 14 years of age. Since then, campaigns have been carried out in 1992, 1997, 2000, 2004, 2011, 2014, 2018 and 2022 (first semester), with recommendation of an indiscriminate strategy.

The endemic circulation of the virus was interrupted in 2000 in the country and in 2002 in the Americas. Thereafter, only sporadic cases and limited outbreaks were recorded in different countries of the region, always related to importation. The American continent was considered measles free in 2016, but in 2017, Venezuela recorded an outbreak of the disease that crossed borders and reached, in 2018, the territory of Brazil and other Latin American countries. Thus, after two decades without endemic circulation of the virus, in 2019 measles was reintroduced in the SSP, which triggered several vaccination actions. In 2020 and 2021, however, its sustained transmission was still maintained, and it is necessary to continue with the intensification strategies (selective vaccination) and campaigns (indiscriminate vaccination).

Currently, routine vaccination corresponds to a first dose of the measles, mumps and rubella vaccine (attenuated) at 12 months of age and the second at 15 months. As an intensification strategy, an additional dose was introduced from 6 and 11 months, although it is not considered routinely valid. A vaccination campaign aimed at children between 6 months and less than 5 years of age (indiscriminate) was carried out from April 4 to June 24, 2022. And, at the time this report was produced, the intensification of selective vaccination was maintained, ideally with the search for absentees.

The calculation of the coverage of this vaccine is based on the first dose of children aged 1 year, with a target of 95%, with 70% homogeneity. Graph 9 presents both goals of the first dose of the SCR vaccine (attenuated), with 1 year of age, in a historical series of 12 years. The VC showed a decrease from 2016 (93%) and 2017 (86.7%), followed by coverage still close to the recommended in 2018 and 2019 (respectively, 91.5% and 91.8%). However, in the pandemic years 2020 and 2021, they had a sharper drop (85.3% and 75.9%). Homogeneity was also far from the target of 70% in 2017 (42.5%), 2020 (45%) and 2021 (30.4%).

Graph 9. Coverage and homogeneity of the first dose of measles, mumps and rubeola vaccine (attenuated) at 1 year of age, by year, SSP, 2010 to 2021.*



Source: National Immunization Program Information System. *Data updated on March 27, 2023, subject to revision.

In the first six years of this historical series, VCs were concentrated in the target of 95% or more. The decline confirmed from 2016 onwards, however, diluted most municipalities in VC clusters from ≥ 75.0% to < 95.0% and ≥ 95.0%. Also noteworthy is the increase in the number of municipalities in the clusters < 50.0% and ≥ 50.0% to < 75.0%, especially in 2020 and 2021, pandemic years (Table 10).

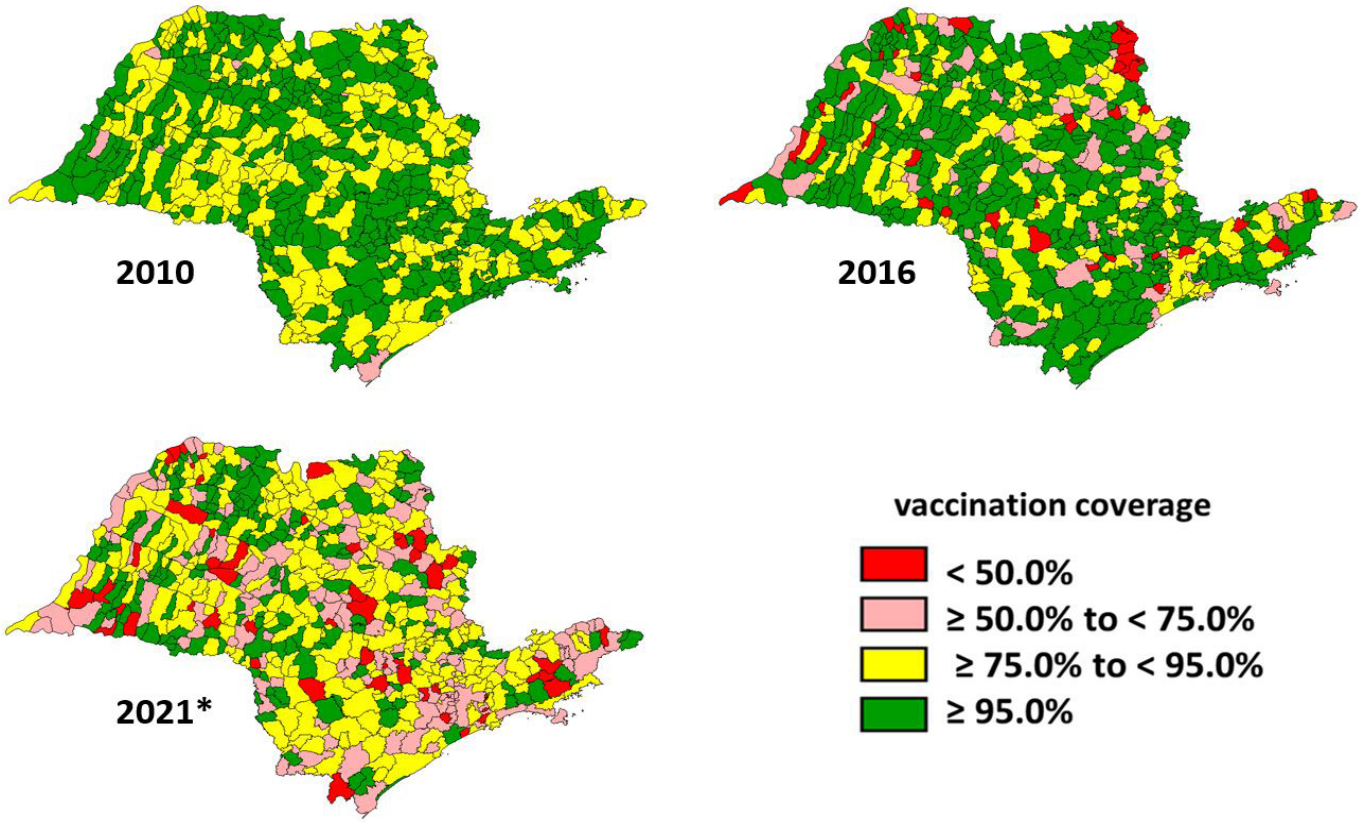
Table 10. Number and proportion of municipalities by year and coverage of the first dose of measles, mumps and rubeola vaccine (attenuated) at 1 year of age, SSP, 2010 to 2021.*

YEAR	VACCINATION COVERAGE								TOTAL
	< 50.0%		≥ 50.0% to < 75.0%		≥ 75.0% to < 95.0%		≥ 95.0%		
	Nº	%	Nº	%	Nº	%	Nº	%	Nº
2010	0	0.0	6	0.9	244	37.8	395	61.2	645
2011	2	0.3	35	5.4	180	27.9	428	66.4	645
2012	0	0.0	29	4.5	171	26.5	445	69.0	645
2013	2	0.3	26	4.0	124	19.2	493	76.4	645
2014	1	0.2	30	4.7	131	20.3	483	74.9	645
2015	14	2.2	63	9.8	176	27.3	392	60.8	645
2016	39	6.0	61	9.5	147	22.8	398	61.7	645
2017	18	2.8	101	15.7	252	39.1	274	42.5	645
2018	12	1.9	51	7.9	229	35.5	353	54.7	645
2019	7	1.1	62	9.6	218	33.8	358	55.5	645
2020	34	5.3	107	16.6	214	33.2	290	45.0	645
2021*	52	8.1	144	22.3	253	39.2	196	30.4	645

Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

Figure 9 shows the scenario achieved in 2010, with high coverage and the beginning of its decline from 2016, ending with a scenario that is inconsistent with the goal, which ensures, together with homogeneity, control, and the intention of the global elimination of the measles and maintenance of rubella clearance and congenital rubella syndrome.

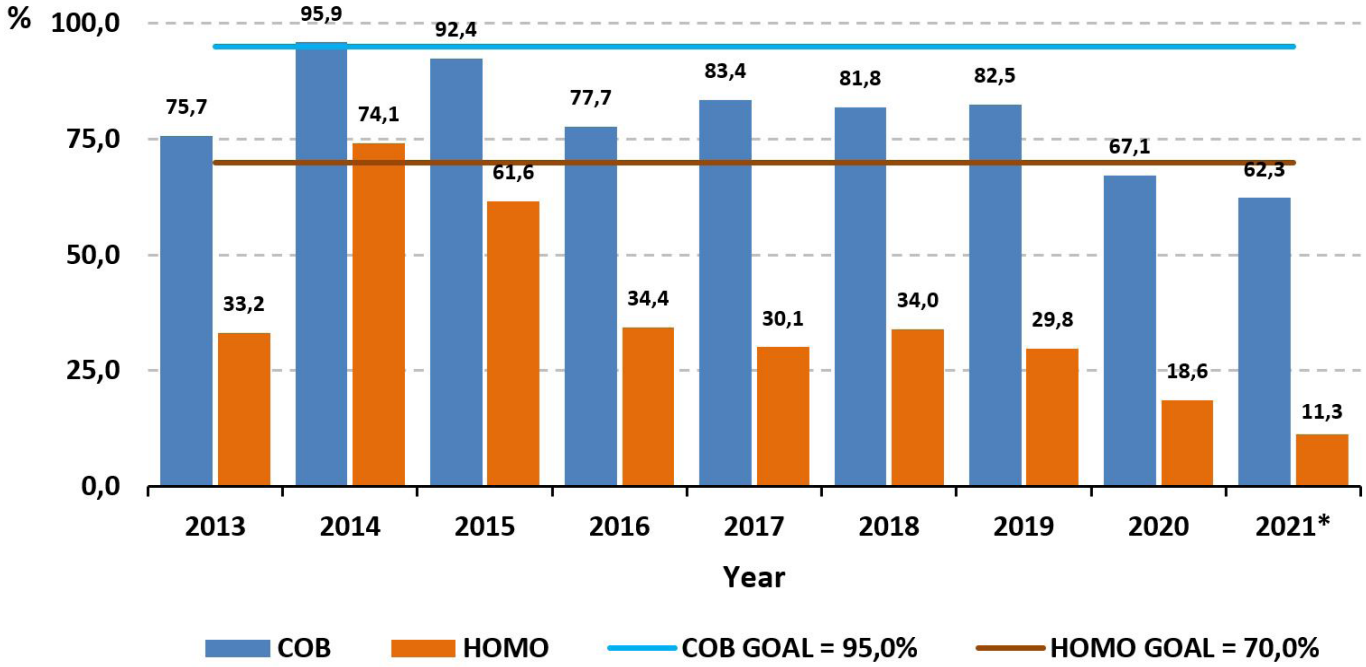
Figure 9. Spatial distribution of first-dose measles, mumps, and rubella (attenuated) VC at 1 year of age, SSP, 2010, 2016 and 2021.*



Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

As shown in Graph 10, 2013 started away from the goal because there was a change in the vaccination schedule. Until then the second dose should be applied before 4 years old; however, from the year in question, it started to be administered at 15 months. In 2014 there was a 95.9% measles VC, but since 2015, the goal has not been reached anymore, with great detachment from it in the epidemic (in 2020 e 2021, respectively, 67.1% and 62.3%). Homogeneity was only achieved in 2014 (74.1%) and approximated in 2015 (61.6%). In the other years, it remained very low among the municipalities in the SSP.

Graph 10. Coverage and homogeneity of the second dose of measles, mumps and rubella vaccine (attenuated) at 1 year of age, second year, SSP, 2013 to 2021*.



Source: National Immunization Program Information System. *Data updated as of March 27, 2023, subject to revision.

The increase in the number of municipalities with VC in the grouping of < 50.0% in 2016 and in pandemic years is significant (2020 and 2021), according to Table 11. The decrease of those that, being in the group ≥ 95.0%, reached the goal as of 2016 is also evident. This scenario signals the risk that is now posed for the elimination of the disease in the territory of São Paulo.

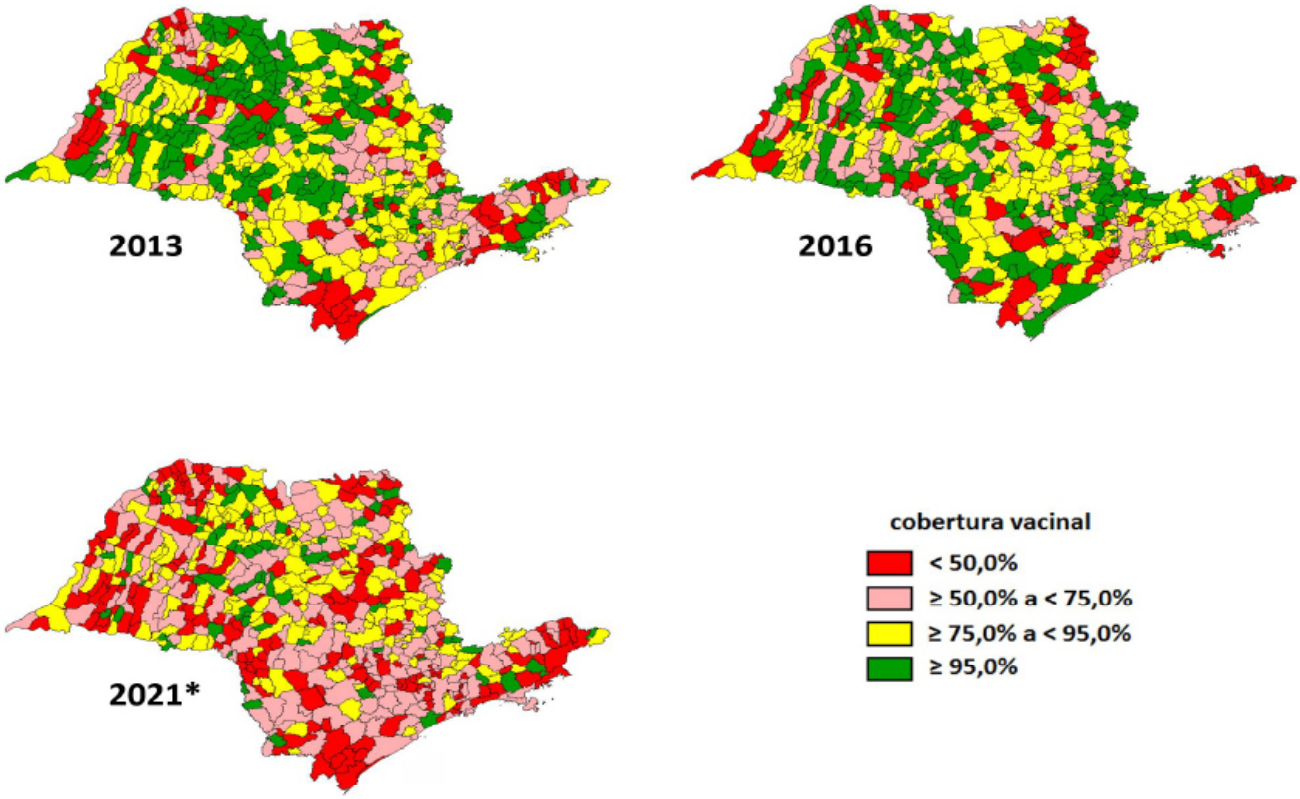
Table 11. Number and proportion of municipalities by year and coverage of the second dose of measles, mumps and rubella vaccine (attenuated) at 1 year of age, SSP, 2013 to 2021.*

YEAR	VACCINATION COVERAGE								TOTAL
	< 50.0%		≥ 50.0% to < 75.0%		≥ 75.0% to < 95.0%		≥ 95.0%		
	Nº	%	Nº	%	Nº	%	Nº	%	Nº
2013	95	14.7	140	21.7	196	30.4	214	33.2	645
2014	3	0.5	23	3.6	141	21.9	478	74.1	645
2015	2	0.3	38	5.9	208	32.2	397	61.6	645
2016	83	12.9	133	20.6	207	32.1	222	34.4	645
2017	42	6.5	164	25.4	245	38.0	194	30.1	645
2018	30	4.7	152	23.6	244	37.8	219	34.0	645
2019	25	3.9	116	18.0	312	48.4	192	29.8	645
2020	177	27.4	184	28.5	164	25.4	120	18.6	645
2021*	194	30.1	200	31.0	178	27.6	73	11.3	645

Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

Figure 10 shows that, since 2013, second-dose CVs were below the recommended target, as well as the heterogeneous distribution across the entire population of the SSP. This scenario was maintained in 2016, being deeply worsened in 2021. Despite the low VC of the first dose, it should be added that part of the 1-year-old vaccinated children may not be receiving the essential protection of the second dose.

Figure 10. Spatial distribution of coverage of the second dose of measles, mumps and rubella vaccine (attenuated) at 1 year of age, SSP, 2013, 2016 and 2021*.

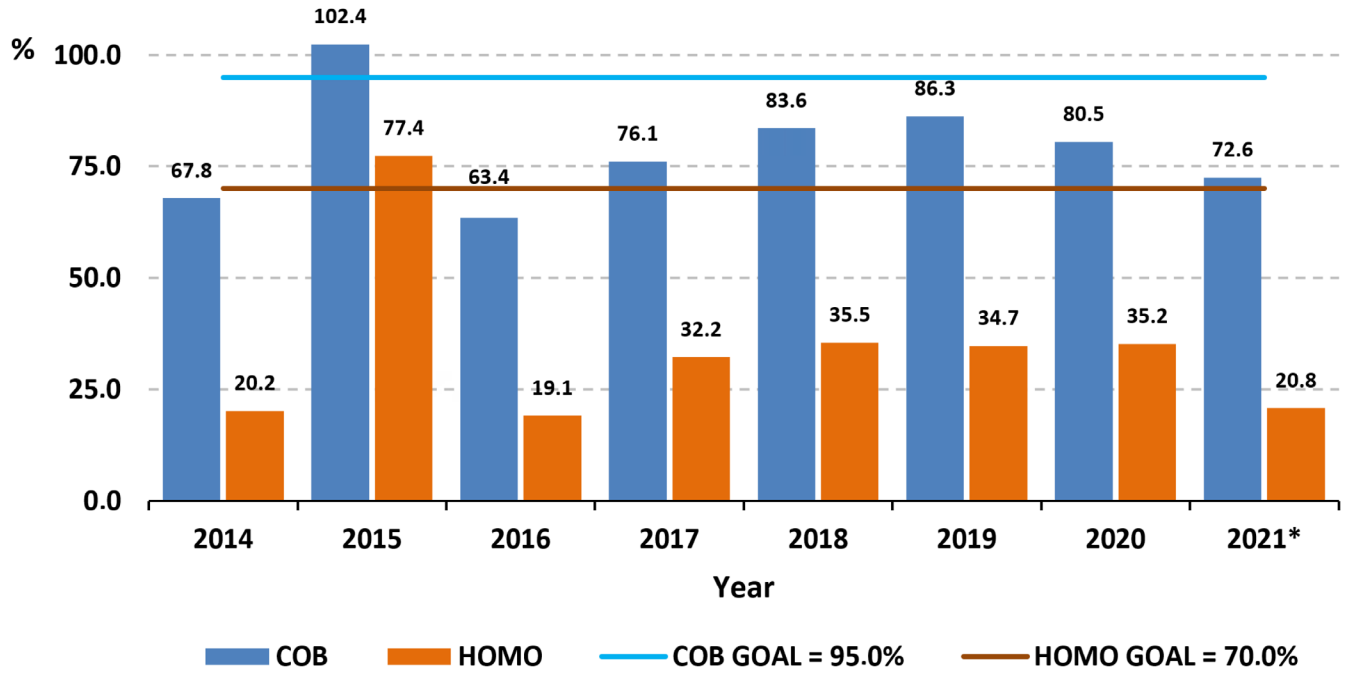


Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

The adsorbed hepatitis A (inactivated) vaccine was made available on ESP as of August 2014, with a one-dose schedule for children aged 12 months to under 2 years (1 year, 11 months and 29 days) born on or after July 2012. Initially, its administration was recommended at 12 months of age, starting in 2016, with the modification of the vaccination schedule, to be recommended at 15 months.

Graph 11 shows the historical series of VC from 2014 to 2021, in which it is observed that in the first year of implementation, the goal was not reached. But in 2015 it was surpassed, to again, in 2016, be below (63.4%), with a small increase in 2017, 2018 and 2019 (76.1%, 83.6% and 86.3%, respectively). Followed by a decrease in pandemic years (2020 and 2021 respectively, 80.5% and 72.6%). The goal of homogeneity was only reached in 2015 (77.4%), remaining in the other years with averages close to 35%.

Graph 11. Coverage and homogeneity of adsorbed hepatitis A (inactivated) vaccine at 1 year of age, by year, SSP, 2014 to 2021.*



Source: National Immunization Program Information System. *Data updated on March 27, 2023, subject to revision.

Table 12 shows that in the period in question, the municipalities were concentrated in coverage groups between ≥ 75.0% to < 95.0% and ≥ 95.0%. The year 2015 had the best result, with 449 cities (77.4%) having reached the target, while 2016 had the worst outcome, when only 123 (19.1%) cities were concentrated in the grouping of ≥ 95, 0%.

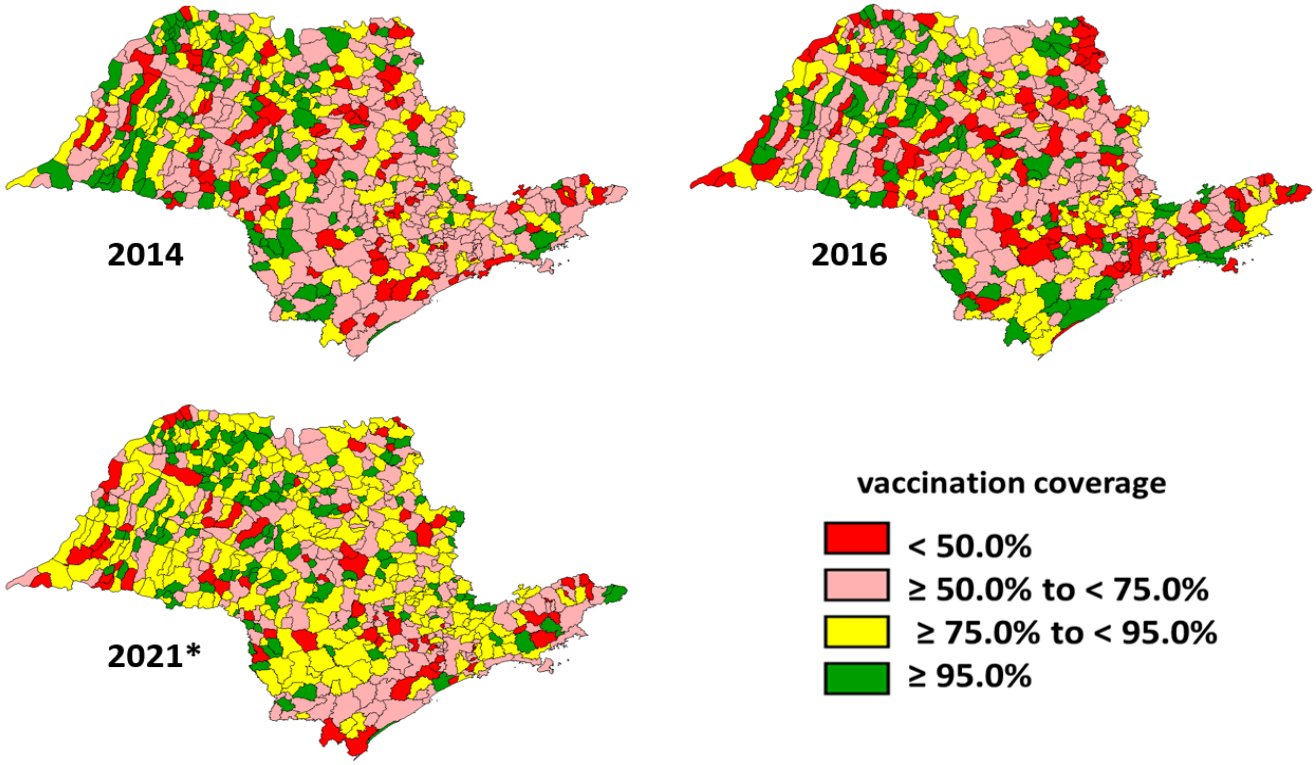
Table 12. Number and proportion of municipalities by year and coverage of adsorbed hepatitis A (inactivated) vaccine at 1 year of age, SSP, 2014 to 2021.*

YEAR	VACCINATION COVERAGE								TOTAL
	< 50.0%		≥ 50.0% to < 75.0%		≥ 75.0% to < 95.0%		≥ 95.0%		
	Nº	%	Nº	%	Nº	%	Nº	%	Nº
2014	97	15.0	265	41.1	153	23.7	130	20.2	645
2015	5	0.8	25	3.9	116	18.0	499	77.4	645
2016	111	17.2	238	36.9	173	26.8	123	19.1	645
2017	49	7.6	140	21.7	248	38.4	208	32.2	645
2018	27	4.2	131	20.3	258	40.0	229	35.5	645
2019	20	3.1	93	14.4	308	47.8	224	34.7	645
2020	57	8.8	127	19.7	234	36.3	227	35.2	645
2021*	70	10.9	185	28.7	256	39.7	134	20.8	645

Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

It is noteworthy that, as shown in Figure 11, 2014 and 2016 were very close in their results. In 2021, however, there was an increase in cities in the group ≥ 75.0% to < 95.0%, representing an improvement compared to the other years of the series. This analysis deserves further study in order to identify its determinants.

Figure 11. Spatial distribution of coverage of adsorbed hepatitis A (inactivated) vaccine at 1 year of age, SSP, 2014, 2016 and 2021.*



Source: National Immunization Program Information System. *Data updated on June 15, 2022, subject to revision.

CHALLENGES

Low CVs demand from all levels of management and health professionals the continuity of care focused on an integrated approach between epidemiological surveillance and primary care in the municipalities. Efficient use of resources and valuing the expanded discussion of proposals that change this scenario in a bipartite manner are also essential.

Other actions in the same direction point to specific demands, such as:

- In-depth analysis of VC;
- Intensification of articulation with the Education Departments with a view to shared actions and strategies to improve coverage;
- Adoption of the updated vaccination declaration as a strategy for reviewing the immunization schedule;
- search for an agreement on a communication plan at the state and municipal levels, so that the topic of vaccination is incorporated into government plans;
- Approach on expanding access and minimum operating structure of vaccine rooms in management forums;

- Development of capacity building for the registration of doses applied in the adopted systems (already in progress);
- Adoption of the matrix to identify the municipalities at greatest risk, with a view to monitoring and identifying the difficulties of vaccination services and the need for support;
- Monitoring the registration of doses applied for vaccines in primary health care units and other vaccination services; and
- Development of adjustments in the methodology used, to quickly monitor the VC of the population under 5 years of age, and identification of bottlenecks of susceptible in the municipalities.

As one of the points of influence on the current VC scenario, the covid-19 pandemic was and continues to be a remarkable experience, representing a great learning opportunity in all instances in which vaccination is involved. It certainly leaves a great legacy for immunization programs around the world, stimulating a necessary reflection on the real meaning of the promotion, prevention, and equitable protection of human well-being. Some basic premises should guide global and local decisions regarding the allocation of vaccines: transparency and scientific evidence, equal access to groups with the greatest problems in fighting vaccine-preventable diseases and equity in the availability of vaccines to low-income countries.

APPENDIX I - VACCINE CALENDAR

The Technical Standard of the Immunization Program, updated and approved by Resolution SS No. 118, published on August 4, 2021, establishes the vaccination schedule for the SSP

VACCINATION CALENDAR FOR CHILDREN UNDER 7 YEARS OF AGE.

AGE	VACCINES
FROM BIRTH	BCG HEPATITIS B
2 MONTHS	VIP, PENTAVALENT (DTP + Hib + Hepatitis B) ROTAVIRUS, PNEUMOCOCCIQUE 10 VALENT
3 MONTHS	MENINGOCOCCAL C
4 MONTHS	VIP, PENTAVALENT (DTP + Hib + Hepatitis B) ROTAVIRUS, PNEUMOCOCCIQUE 10 VALENT
5 MONTHS	MENINGOCOCCAL C
6 MONTHS	VIP PENTAVALENT (DTP + Hib + Hepatitis B)
9 MONTHS	YELLOW FEVER
12 MONTHS	MEASLES - MUMPS - RUBELLA (SCR) MENINGOCOCCALI C, PNEUMOCOCCAL 10 VALENT
15 MONTHS	OPVb DTP TETRAVIRAL HEPATITIS (SCR + Chickenpox)
4 YEARS	OPVb[9] DTP[10] VARICELLA YELLOW FEVER
ANNUALLY	INFLUENZA

PRIMO-VACCINATION SCHEDULE FOR CHILDREN (AGE 7 AND OVER) AND ADOLESCENTS.

INTERVAL BETWEEN DOSES	VACCINE	SCHEME
FIRST VISIT	BCG	SINGLE DOSE
	HEPATITIS B	FIRST DOSE
	dT – DOUBLE ADULT	FIRST DOSE
	VIP	FIRST DOSE
	HPV	FIRST DOSE
	MEASLES, MUMPS AND RUBELLA (SCR)	FIRST DOSE
TWO MONTHS AFTER THE FIRST VISIT	HEPATITIS B	SECOND DOSE
	dT – DOUBLE ADULT	SECOND DOSE
	VIP	SECOND DOSE
	MEASLES, MUMPS AND RUBELLA	SECOND DOSE
	MENINGOCÓCICA ACWY	SINGLE DOSE
FOUR TO SIX MONTHS AFTER THE FIRST VISIT	HEPATITIS B	THIRD DOSE
	dT – DOUBLE ADULT	THIRD DOSE
	VIP	THIRD DOSE
	YELLOW FEVER	SINGLE DOSE
	HPV	SECOND DOSE
EVERY TEN YEARS FOR LIFE	dT – DOUBLE ADULT	BOOSTER

VACCINATION SCHEME FOR ADULTS BETWEEN 20-59 YEARS.

INTERVAL BETWEEN DOSES	VACCINE	SCHEME
FIRST VISIT	dT – DOUBLE ADULT HEPATITIS B MEASLES, MUMPS AND RUBELLA YELLOW FEVER	FIRST DOSE FIRST DOSE SINGLE DOSE SINGLE DOSE
TWO MONTHS AFTER THE FIRST VISIT	dT – DOUBLE ADULT HEPATITIS B	SECOND DOSE SECOND DOSE
FOUR TO SIX MONTHS AF- TER THE FIRST VISIT	dT – DOUBLE ADULT HEPATITIS B	THIRD DOSE THIRD DOSE
EVERY TEN YEARS FOR LIFE	dT – DOUBLE ADULT	BOOSTER

VACCINATION SCHEDULE FOR ADULTS 60 YEARS OR OLDER .

INTERVAL BETWEEN DOSES	VACCINE	SCHEME
FIRST VISIT	dT – DOUBLE ADULT YELLOW FEVER HEPATITIS B MEASLES, MUMPS AND RUBELLA (SCR)	FIRST DOSE SINGLE DOSE FIRST DOSE SINGLE ÚNICA
TWO MONTHS AFTER THE FIRST VISIT	dT – DOUBLE ADULT HEPATITIS B	SECOND DOSE SECOND DOSE
FOUR TO SIX MONTHS AFTER THE FIRST VISIT	dT – DOUBLE ADULT HEPATITIS B	THIRD DOSE THIRD DOSE
EVERY TEN YEARS FOR LIFE	dT – DOUBLE ADULT	BOOSTER
ANNUALLY	INFLUENZA	ONE DOSE

VACCINATION SCHEDULE FOR PREGNANT AND PUERPERA.

INTERVAL BETWEEN DOSES	VACCINE	SCHEME
FIRST VISIT	dT – DOUBLE ADULT HEPATITIS B	FIRST DOSE FIRST DOSE
TWO MONTHS AFTER THE FIRST VISIT	dT – DOUBLE ADULT HEPATITIS B	SECOND DOSE SECOND DOSE
FOUR TO SIX MONTHS AFTER THE FIRST VISIT	dTpa HEPATITIS B	THIRD DOSE THIRD DOSE
AT ANY STAGE OF PREGNANCY	INFLUENZA	ONE DOSE
PUERPERIA	INFLUENZA MEASLES, MUMPS AND RUBELLA	ONE DOSE SINGLE ÚNICA

Publication
May 2023

Open access

How to cite

Araujo NVDL, Sato HK, Nerger MLBR, Babá SMN, Manrique AEI, Souza AC, Arantes BAF, Abdalla CSS, Santos DAS, Fernandes EG, Nunes EM, Moia G, Nemeth K, Imaizumi M, Oda M, Bordim MCH, Valente MG, Souza NR, Borges PA, Carvalho SF, Nery Junior WD. Epidemiological report of the immunization division. Bepa [Internet]. 2023 Feb 1 ;19:1-46.
Available in: https://periodicos.saude.sp.gov.br/BEPA182/article/view/37900