Chapter 133

A visual analysis of immunobiological coverage, its infrastructure, and effects in the state of Bahia

https://doi.org/10.56238/colleinternhealthscienv1-133

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ABSTRACT

The article illustrates the performance of the National Immunization Program (PNI) in Bahia, the vaccination coverage of the number of inhabitants, as well as the correlation with investment in health, through the extraction and analysis of data from DATASUS, IBGE, and FNS. It appears that although the investment in health in the analyzed period has been relevant, the logistics and storage of vaccines are still very precarious, given the lack of infrastructure, such as storage chambers for vaccines needed in the municipalities of Bahia. Some pathologies such as whooping cough, poliomyelitis, and hepatitis, in the face of vaccination coverage, are treated individually and graphically illustrated, to demonstrate weaknesses in the performance of the PNI and how the population's adherence to movements contrary to Brazilian vaccination campaigns, influence and bring serious systemic concerns to the medical and scientific community. The visual analysis of this article graphically demonstrates some of the known outbreaks of diseases, as well as the history of vaccine coverage of immunobiological, and intends to elucidate a method that can help in future decision-making.

Keywords: Vaccine; Conservation chambers; COVID-19; Epidemiological diseases; Immunization.

1 INTRODUCTION

The recognized Brazilian Immunization Program (PNI) has been playing an important and strategic role in the dispensation of immunobiological thermolabilities throughout the national territory (Temporão, 2003). Its success depends on a set of factors, ranging from the manufacture of the vaccine, through the conservation process to the dispensation, that is, the administration of the immunobiological to the citizen, whether in a vaccination room or another place prepared for this purpose.

The PNI figures are really impressive: 95% of children under one year of age are vaccinated against diphtheria, tetanus, pertussis, and hepatitis B, 70 million people are vaccinated in the "Campaign against Infantile Paralysis" and 80% vaccination coverage among the elderly. The national network is composed of more than 25 thousand vaccination units and 39 Special Reference Centers (Cries), distributed in all states, the PNI offers approximately 40 immunological in the modality of routine vaccination (Fiocruz, 2009).

An important factor in this scenario of immune preventives is the vaccine conservation chambers, which constantly require maintenance, calibration, and thermal qualification throughout their useful life. Thermal qualification is a process that checks the temperature at various points, through sensors installed inside the refrigeration chamber or freezer. The temperature should not exceed the appropriate limits for the vaccine, during the entire testing period. In the pharmaceutical and medical market, thermal qualification gains extreme importance, given the criticality of the activities involved, especially the storage and storage of medicines, blood, vaccine, and other products of interest to health that require controlled temperature (thermolability).

The World Health Organization (WHO) defines pharmaceutical stability as the ability of the pharmaceutical product to maintain its chemical, physical, microbiological, and biopharmaceutical properties within the specified limits throughout its shelf life (Organization; Meeting, 2015). Worldwide, the World Health Organization (WHO) approves and defines criteria and requirements for qualification equipment, according to the WHO document (WHO - Qualification of temperature controlled storage - Supplement 07) (Organization, 2019).

In Brazil, RDC 304 published on 09/17/2019 made even more rigorous the qualification and validation of thermolabile storage and transport equipment (Nacional, 2019). The qualification of the equipment related to the storage or transport of thermolabile is an essential requirement for the entire "Cold Network", from the shipment of the product to the manufacturer to the end user, and here are the numerous possibilities and needs to be met to those who participate in each stage of the logistics chain of medicines. According to Inmetro, qualification is "a set of operations that establishes, under specified conditions, that the results of the tests of certain equipment demonstrate that it presents the predicted performance" (Hübner, 2019).

The government sources of open data, DATASUS, IBGE, and FNS, among others, constitute an

important repository for the implementation of analyses, which help not only the population in their informational needs but mainly the strategic and managerial visions in each of the national spheres.

This article adds a new scientific contribution to Bahian society, since the researched materials, previously published, do not make the correlation between financial data, health data, and the situation of cold rooms in the State of Bahia, as well as a look at the behavior of the numbers related to vaccination coverage.

The main objective is to perform the visual analysis of the open data collected in the databases, on the number of vaccine doses applied, the incidence of associated diseases, the number of refrigerated chambers for the conservation of immunobiological, population density each year, and the investment of public financial resources, to understand and analyze a possible relational trend between this information within the State of Bahia.

2 METHODOLOGY

This is an integrative review that is a methodological approach that allows the inclusion of experimental and non-experimental studies in addition to data from the theoretical and empirical literature. Its purposes are the definition of concepts, the revision of theories and evidence, and the analysis of methodological problems of a particular topic. This research method allows the synthesis of multiple published studies and allows general conclusions about a particular area of study The review followed the following steps: formulation of the guiding question and the objectives of the review; establishment of criteria for the selection of articles; categorization of studies; evaluation of studies included in the integrative review; analysis of data and presentation of results. It is noteworthy that these steps are typical of integrative review studies. (Whittemore & Knafl, 2005).

The following guideline question was the present review: what is the importance of the National Immunization Program (PNI) in Bahia, the coverage of vaccination with the number of inhabitants, as well as the correlation with the investment in health?

We searched articles contained in the scientific databases LILACS, SCIELO, MEDLINE, BDENFSCIELO, and ESEnfC, with the keywords "vaccine and cold network", "vaccine and refrigeration", "evaluation and vaccine", "vaccines and health center", "vaccine and storage of medicines", "immunization", "vaccines" and "cold chain", related to this approach. No articles were found with the approach mentioned in the present study.

This study covers the state of Bahia, its 417 cities, 07 mesoregions, and 32 microregions, and brings a cross-sectional approach and collects data from various research sources, covering the period from 2006 to 2020. The vast majority of these are obtained through the national obligation that instructs public departments to publish and create an open data scenario.

Among those evaluated, the most relevant, due to the treatment of the chosen region, types of

vaccines applied, vaccination coverage, Anti-Vaccine movement, and conservation of immunobiological were six articles with the following approaches:

- Analysis of the Information System of the Surveillance of Post-Vaccination Adverse Events in Brazil, 2014 to 2016 (Pacheco et al., 2018).

- Aspects related to the administration and conservation of vaccines in health centers in Northeast Brazil (Luna et al., 2011).

- Vaccine conservation in public health units: an integrative review (Oliveira et al., 2013).

- Social inequalities and vaccination coverage in the city of Salvador, Bahia (Barata & Pereira, 2013).

- Public Spending on Health in Bahia: exploring evidence of inequalities (Teles, Coelho & Ferreira, 2017).

- Danger of the anti-vaccine movement: Epidemiol-literary analysis of the anti-vaccination movement in Brazil (Beltrão et al., 2020).

DATASUS is the most important department for this study, which concentrates a large volume of information from the "Unified Health System" (SUS). The Department of Informatics of the Unified Health System (DATASUS) was created in the early 90s to provide SUS agencies with the structure of information and computer support necessary for the planning, operation, and control process (SUS, 2020). In this public structure, data is provided in open data format and after filtering and selection, is extracted in standard CSV island plan format.

From DATASUS were extracted the data referring to the municipalities of the state of Bahia related to the number of doses and the vaccination coverage applied by the National Immunization Program (PNI), the health establishments that make the application of these vaccines, the number of conservation chambers for storage of vaccines and also the incidence of cases of diseases related to the immunization performed.

Table 1 shows the numerical data for the diseases and their corresponding vaccines. In this study, only the diseases that had vaccination data in the chosen period were used.

Table 1 – Diseases and immunobiological collected in DATASUS after ETL

Diseases and Injuries	**Immunobiological**	**Temperature**
Accidents by venomous animals	WHEY	2 to 8 ºC
Pertussis	Double Adult Acellular Triple Pregnant DTP DTP ref (4 to 6 years) dTpa pregnant Triple Bacterial (DTP) (1st Ref) Pentavalent	2 to 8 ºC
Viral hepatitis	Hepatitis A	2 to 8 ºC

	Hepatitis B Hepatitis B in children up to 30 Days Pentavalent	
Meningitis	Meningococcus C Meningococcus C (1ºRef) Pneumococcal Pneumococcal (1ºRef)	2 to 8 ºC
Acute flaccid paralysis	Polio Poliomyelitis (1ºRef)	-20 ºC
Accidental tetanus	Double Adult (dt) Double Adult Acellular Triple Pregnant DTP DTP ref (4 and 6 years) dTpa pregnant Triple Bacterial (DTP) (1st Ref) Pentavalent	2 to 8 ºC
Tuberculosis	BCG	2 to 8 ºC
Sars-Cov-2 COVID-19	Coronavac Oxford Pfizer Janssen Modern Sputnik	2 to 8 ºC 2 to 8 ºC -75 ºC 2 to 8 ºC -20 ºC -18 ºC

Source: Authors (2021)

The data regarding the population density of each municipality in the state of Bahia were taken from the database of the Brazilian Institute of Geography and Statistics (IBGE). The IBGE is the body responsible for providing annually, since 1996, the data for counting and population estimation (IBGE, 1993).

To survey the number of resources spent for each municipality, the National Health Fund (FNS) was consulted. The FNS is the financial manager of the resources destined for the SUS at the federal level to finance the current and capital expenditures of the Ministry of Health, its agencies, and entities of the direct and indirect administration that are members of the SUS (Government, 2020). On this basis, it was possible to collect a spreadsheet in CSV format with the numerical data of investments made in Bahia.

The collected CSV spreadsheets were submitted to the Extract, Transform, and Load (ETL) process. The ETL deals with the systematization of the treatment and cleaning of data from the various organizational systems (OLTP) for insertion, generally, in a Data Warehouse (DW) or Data Mart (Elias, 2014). Usually, each type of data required is arranged in a file/spreadsheet individually, with the name of the municipality concatenated in the same cell as the identification number and with a header that will not

be necessary for the load processes in the analysis tools. Thus, the spreadsheets were treated for removal of the header, and the municipalities and their identification numbers were separated into independent columns. For the data that did not have a numerical value, blank cell, the number 0 was assigned due to the limitation of the tool used, in addition to the removal of columns with information irrelevant to the study.

One of the tools used for the evaluation of the data was the visualization framework of the Visualize Your Region – VYR data (Deiro, 2020), which requires a specific configuration for the Excel spreadsheet used as a database. Several steps were carried out that included the extraction of open data, in their respective portals already listed, consolidation and grouping of these in a single file, to the formatting and conversion of information to the characteristic format of VYR through the construction of auxiliary views using Excel tools, such as pivot tables in various configurations.

At the end of this process, it was possible to obtain the formatted database, with open data by all the municipalities of Bahia, to then be carried out the load of the information in the VYR, which reads and groups these in microregions, macro-regions, in addition to the totalization of the information in the State. Microsoft Excel was also used to format other graphical views, as well as an approach to the data through a Linear correlation. In statistics or econometrics, Linear Correlation measures the intensity and direction of the linear relationship between two quantitative variables, allowing one to verify whether two independent variables are associated with each other and in what way (Oliveira, 2019).

3 RESULTS AND DISCUSSION

The data collected were separated into 03 analysis groups that demonstrate the performance, performance, and movement of the National Immunization Program in the territory of Bahia. The first group generates information about the financial investment in health resources and graphically shows the performance of the Brazilian government within the State and the differences between the Bahian cities that receive this resource. The second group analyzes and demonstrates some visualizations referring to the park of vaccine conservation chambers and freezers that make up the "Cold Network", as well as the presence of equipment and its distribution in Bahian territory. And finally, the third group relates the diseases with their vaccines and performs visual analyses, which demonstrate the performance of the PNI and its dynamics of action in cases and places where certain diseases are seen with greater incidence.

3.1 INVESTMENTS IN HEALTH IN THE STATE OF BAHIA

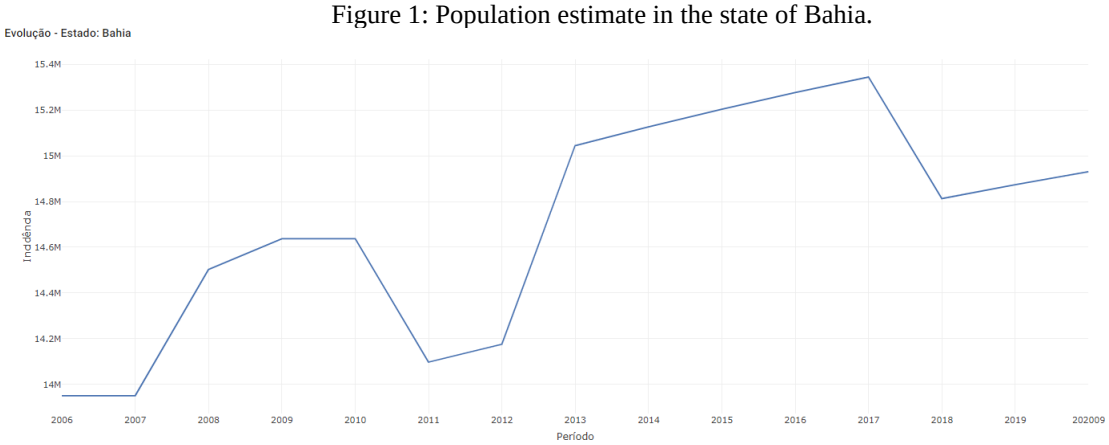
The National Immunization Program of Brazil (PNI) began in the 70s with the movement to eradicate spider hair. Derived from the Organic Law of Sanitary Campaigns, LAW No. 5,026, OF JUNE 14, 1966, its main objective was to coordinate throughout the Brazilian territory the public and private activities for the prevention and combat of diseases of clinical scope(Temporão, 2003).

Since then immunization campaigns have been increasingly intense and the program, with its more

than 40 years is recognized worldwide and cited by the World Health Organization (WHO) in several related events, as being a successful action of the Brazilian government to perform and ensure remarkable results. And it is not for less, because Brazil, a country of continental dimensions and great socioeconomic diversities, in addition to ensuring considerable vaccinal coverage, also has much of this immunological power developed and manufactured in the national territory thanks to the Brazilian scientific force (Scliar, 2003).

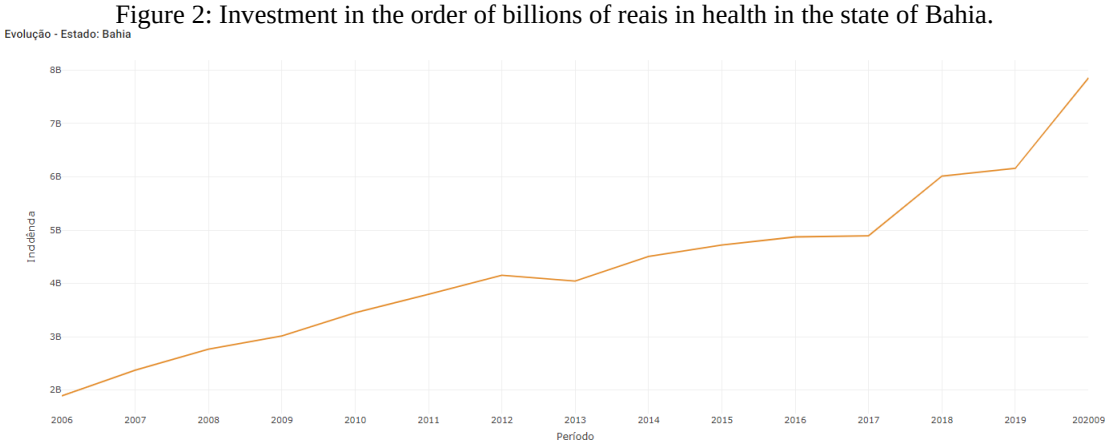
In the territory analyzed, corresponding to the State of Bahia, through Figures 1 and 2 it is possible to increase the investment in the field of health in its various cities, as well as the population estimate in the period analyzed.

Figure 1: Population estimate in the state of Bahia.



Source: Prepared by the authors using the Deiro tool (2020).

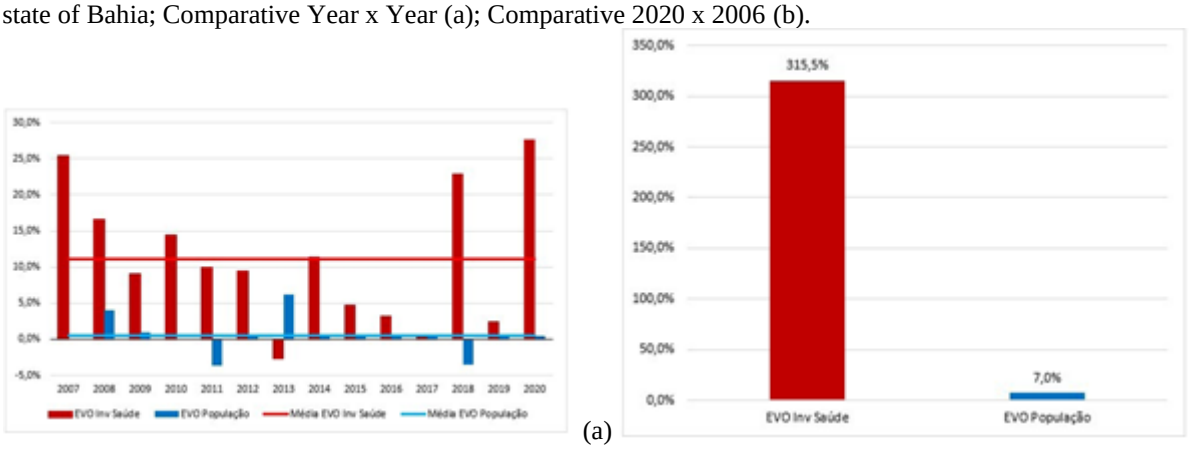
Figure 2: Investment in the order of billions of reais in health in the state of Bahia.



Source: Prepared by the authors using the Deiro tool (2020).

Correlating the annual evolution (EVO) of the amounts invested in health in the State of Bahia, with the evolution of the population estimate it is possible to observe that there was an investment in health higher than the population growth in the period. It is identified that the amount invested in health increased by 315% in the period, while the estimated population varied by 7%, as identified in Figure 3. However, only with this comparative data, it is not possible to affirm that it was a growth in investment in health itself, or a reduction of the accumulated difference with the low percentages of recent years, as shown in the graph.

Figure 3: Comparison of the evolution of population estimation and investment in health in the order of billions of reais in health in the state of Bahia; Comparative Year x Year (a); Comparative 2020 x 2006 (b).

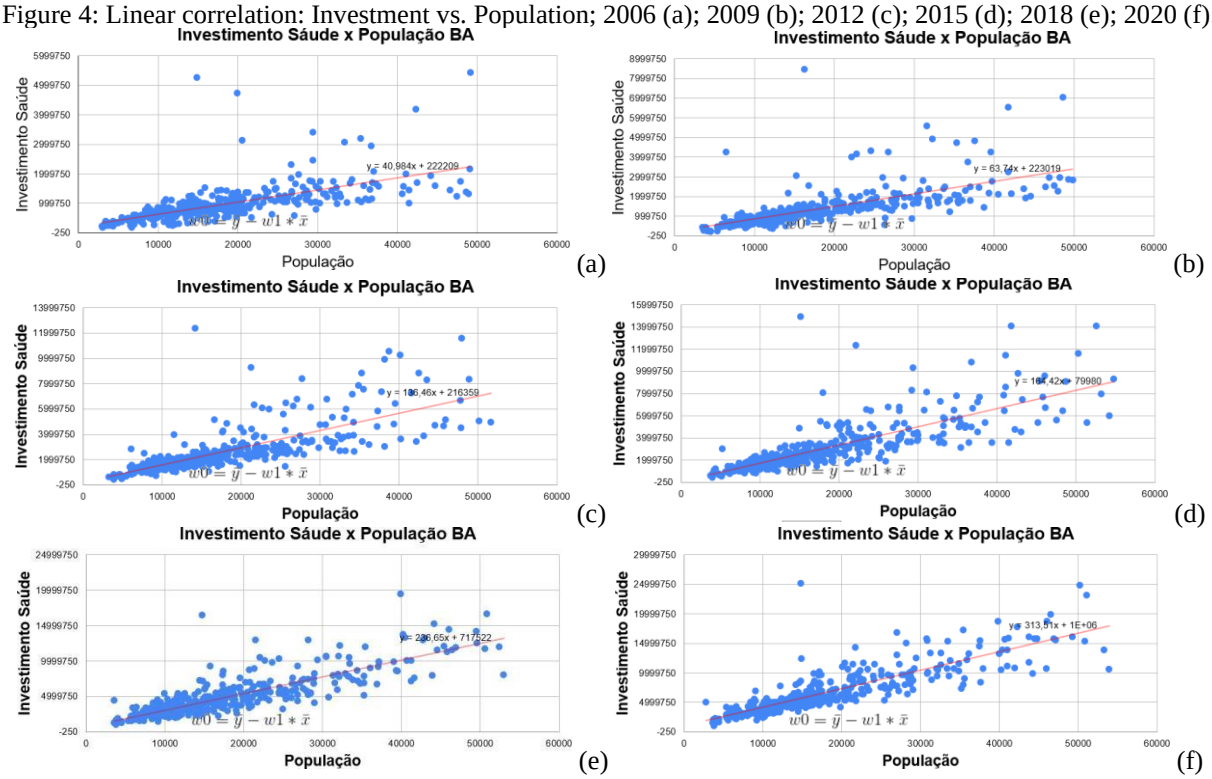


(a) (b)

Source: Authors (2021)

In the same vein, when analyzing the Investment in Health and Population, in Figure 4 the Linear Correlation technique was applied in the data for the years 2006, 2009, 2012, 2015, 2018, and 2020, separately for a more detailed analysis of each municipality. To improve the graphic visualization of the outliers among the other municipalities with lower population density, the 42 municipalities in Bahia with the largest number of populations, around 10% of the total, were removed.

Figure 4: Linear correlation: Investment vs. Population; 2006 (a); 2009 (b); 2012 (c); 2015 (d); 2018 (e); 2020 (f).



(a) (b) (c) (d) (e) (f)

Source: Authors (2021)

It is worth mentioning some of the outliers identified after the analysis of linear correlations performed, such as São Félix already recognized as a national reference in health since 2010 (Contreiras, 2010). The aforementioned municipality with approximately 15,085 inhabitants in the referenced period,

presented average values of investment in health per inhabitant three times higher than that of the State, in the order of R$ 868.23, while the average identified for the State of Bahia is R$ 290.76.

Another outlier to be highlighted is the municipality of Maetinga, which despite the average of R $ 586.75, presented considerable growth in the value of an investment in health per inhabitant from 2015, and surpassed the municipality of São Félix in 2017, with a peak of R $ 1826.70 reais invested per inhabitant in 2020. Salvador, the capital of the state, appears in second place in this ranking, with an average of R $ 695.64.

3.2 COLD NETWORK IN THE STATE OF BAHIA

From the perspective of vaccination, the vast majority of immunobiological require adequate and refrigerated storage to have a reliable and efficient application of the vaccine. The group of refrigeration equipment that will keep the vaccines at an adequate temperature, usually from +2 ºC to +8 ºC or -25 ºC to -15 ºC, is known as the "Cold Network", and constantly the private companies of the vaccine application branch and the government make investments in the purchase of new equipment to meet the growing demand for the population (MS, 2015). The focus of this study will be only on the quantities of conservation chambers declared in the DATASUS of the public "Cold Network".

To maintain the correct treatment of immunobiological, mostly sensitive terms, the Brazilian government created through the directives of the PNI, a manual that guides each health unit, on exactly how and what should be done for the handling of vaccines. This manual is called: the "PNI Cold Network Manual". It is a document that constantly evolves and guides with precision and in a practical way how each individual participating in the Cold Network should proceed in each stage of care with the vaccine (MS, 2015).

In the current scenario, January 2021, a little more than a year after the first case of COVID-19 in China, governments of all countries are preparing to invest in conservation chambers that meet the specifications of the most diverse vaccines created to combat the spread of this disease. Some laboratories manufacturers and developers of these vaccines specify Ultra Low-temperature freezers, which operate on the order of -70 ºC (Control; (CDC), 2020). The equipment that meets this ultra-low temperature has a higher cost of acquisition and maintenance, in addition to the vaccines maintained there require differentiated processes of handling and dispensing, so the entire dynamics of use will be changed and the protocols that determine the good practices for the "Cold Network" will be updated to this new method of conservation (Bahia, 2020).

In Brazil, at the beginning of the vaccination campaign against Sars-Cov-2, the vaccines used are Oxford from the AstraZeneca / FioCruz laboratory and Coronavac from the Sinovac / Butantan laboratory. The state of Bahia should receive these two vaccines, which have easier storage and conservation because they use temperatures from +2 to +8 ºC, and the Brazilian Cold Network is prepared and equipped for this

type of conservation.

Chapter 6.6 of the 2017 Refrigeration Network Manual guides what type of refrigeration equipment should be used, and also what technological items should be taken into account in purchasing this product. Calibrations and thermal qualifications should be provided annually to ensure proper functioning and control in the correct temperature range (MS, 2015).

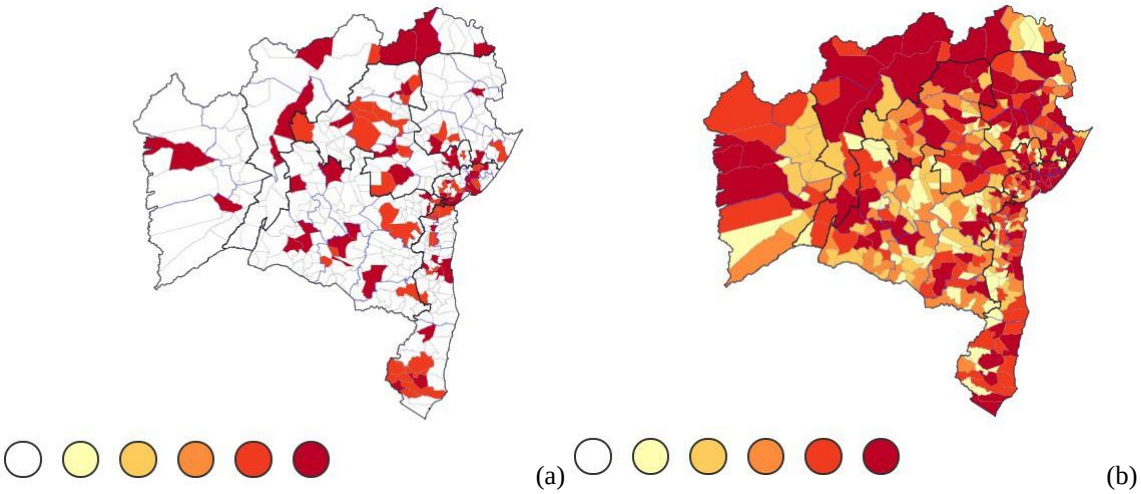
Figure 5 illustrates an example of a room used to accommodate a large number of vaccine conservation chambers. These rooms usually have access control and an included air-c system to maintain the ideal ambient temperature for the stored products. Each chamber needs a monitoring system external to the temperature controller, as the temperature is checked and stored for an eventual audit by regulatory agencies.

Figure 5: Example room of chambers for vaccine conservation.

Source: Authors (2021).

Figure 6 visually shows the distribution of existing chambers in the State of Bahia. When analyzing the data, it is identified that 78.9% (329) of the ages do not have any refrigeration equipment and that the geographical distribution of the existing equipment is uniform and not necessarily based on the population density of the municipalities.

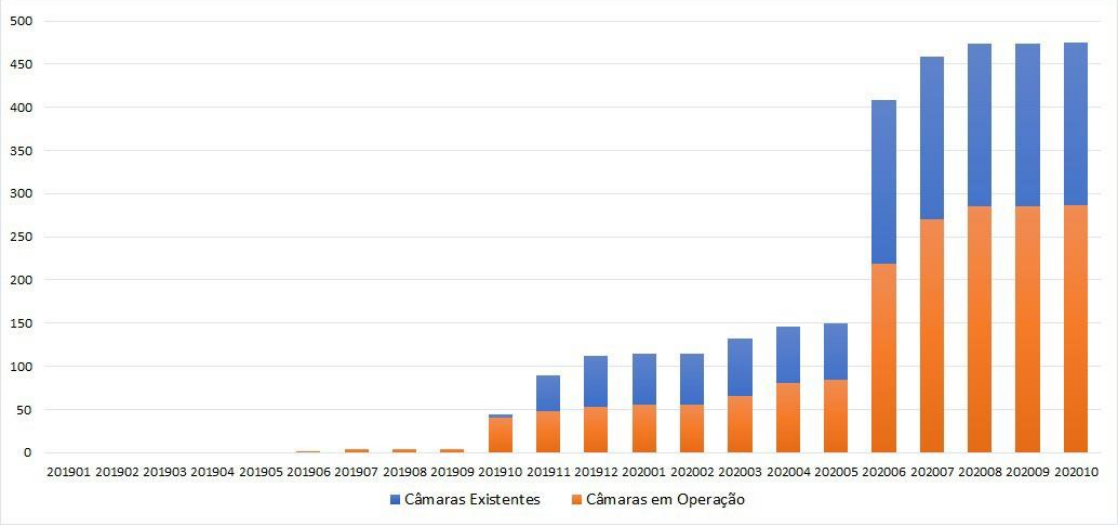
Figure 6: Comparative percentile of existing chambers and population size in 2020; Existing chambers (a); Population density (b).



Source: Prepared by the authors using the Deiro tool (2020).

It is also worth mentioning that only data were identified regarding the number of vaccine chambers for the years 2019 and 2020, according to Figure 7, where the respective values begin to be identified from June/19 (201906). The DATASUS database also tells you which cameras are in use, within the universe of existing cameras. It was not possible to identify the reasons why the cameras are not in full operation. An interpretation for such a fact may be the lack of vaccines, awaiting maintenance/calibration, or even units re-testing to meet a future emergency demand.

Figure 7: Existing conservation chambers and conservation chambers in operation.



Source: Authors (2021).

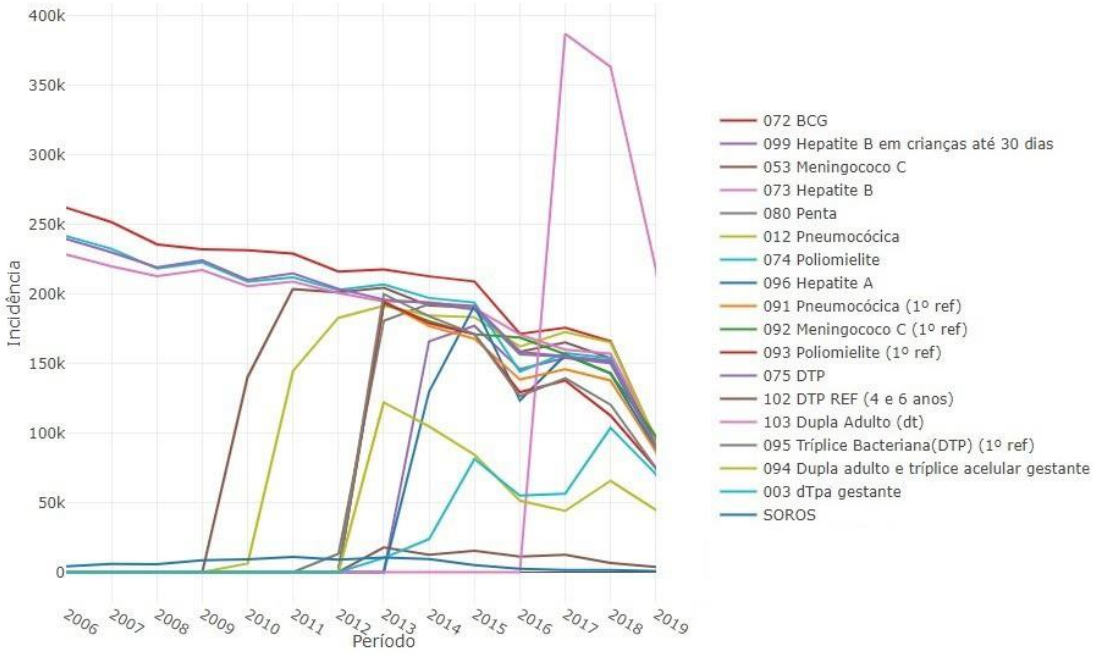
3.3 VACCINATION AND THE DISEASES ANALYZED

The efficiency of the PNI is constantly evaluated through the information collected in the field on doses applied, vaccination coverage, and especially the incidence of diseases in certain regions of the country. With this data, the intelligence of the immunization program determines where, which, and how many vaccines will be sent to each site (SI-PNI, 2020).

The DATASUS platform allowed the extraction of applied dose data and also the incidence of diseases, so it was possible to promote some visualizations to evaluate the effectiveness of the program and mobilization to better meet and mitigate the cases in the territory evaluated.

In an analysis referring to the number of vaccines applied in the State of Bahia, considering the immunobiological's consolidated for the study, it is visualized in Figure 8 that the number of v in falling in the period analyzed, however, there is also a peak in the amount of Double Adult (dT) vaccines applied in the years 2017, 2018 and 2019, in values much higher than those identified for the other types of vaccine, however, no cause for this behavior has been identified. It is also possible to identify no data for the entire period analyzed in the present study.

Figure 8: Evolution of the number of doses of Vaccine Applied in the state of Bahia.

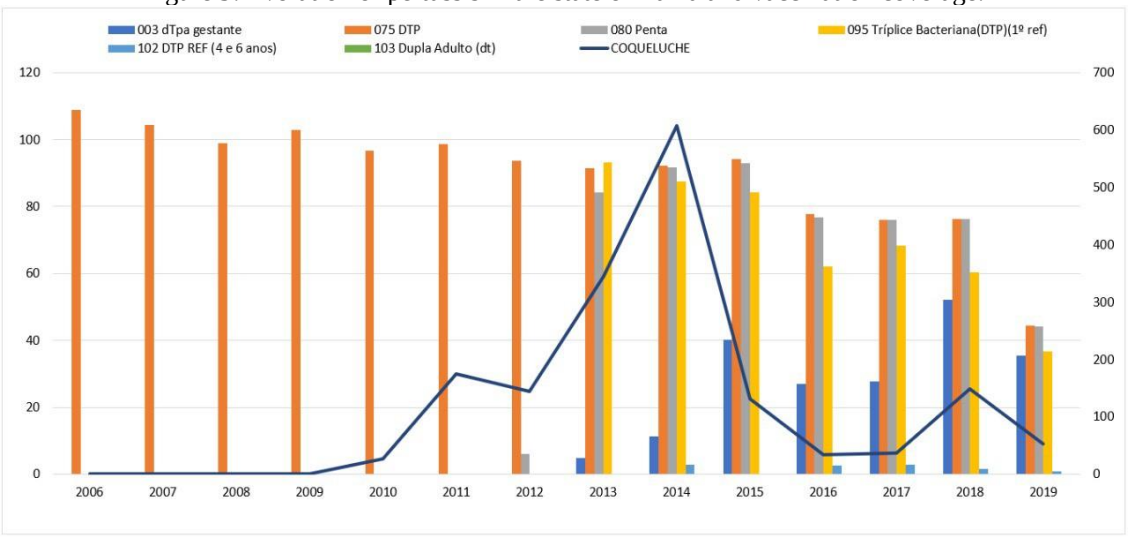


Source: Prepared by the authors using the tool Deiro (2020).

Next, we discuss the results obtained after analyzing the data regarding the number of cases reported for the selected diseases, and the vaccination coverage for immunobiological of interest to the prevention.

Figure 9 correlates the number of pertussis cases reported in the State, with vaccination coverage in the period, for immunobiological related to preventive treatment for this disease. Pertussis or pertussis is an acute and transmissible infectious disease that compromises the respiratory system (trachea and bronchi). It is caused by the bacterium Bordetella pertussis. (Fiocruz, 2010)

Figure 9: Evolution of pertussis in the state of Bahia and vaccination coverage.

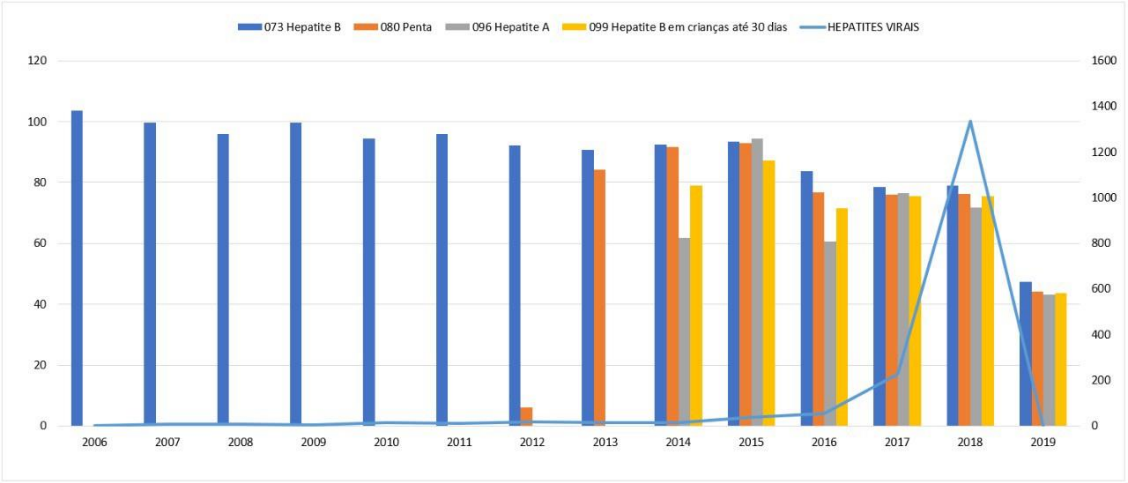


Source: Authors (2021).

During the period analyzed, a peak of pertussis cases was identified in 2014 (G1-BA, 2014), with Feira de Santana being the city with the highest concentration, with 120 cases (19.7%), followed by Salvador with 104 cases (17.1%). It is also worth mentioning that the population of Salvador was 4.74 times larger than that of Feira de Santana in that year. In the second growth curve identified, in 2018, Salvador and Feira de Santana are again noted as the largest cities with 32 and 28 reported cases, respectively, out of the 148 total for the year. Another important fact is that 291 (69.8%) municipalities did not present notifications of pertussis in the year with the highest number of notifications, 2014, and 201 (48.2%) had no cases reported in the period evaluated, between 2006 and 2019.

Following the same method of approach, Figure 10 shows the data regarding the number of notified cases of Hepatitis, compared with the vaccination coverage of the immunobiological of interest related in the period.

Figure 10: Evolution of Hepatitis in the state of Bahia and the strength of immunization.



Source: Authors (2021).

Viral hepatitis is a systemic infectious disease that affects the liver. Five different viruses are

recognized as etiologic agents of human viral hepatitis: hepatitis A virus (HAV), hepatitis B virus (HBV), hepatitis C virus (HCV), hepatitis D or Delta virus (HDV), and hepatitis E virus (HEV). Except for HBV, which has a DNA genome, all the others are RNA viruses (Fiocruz, 2020).

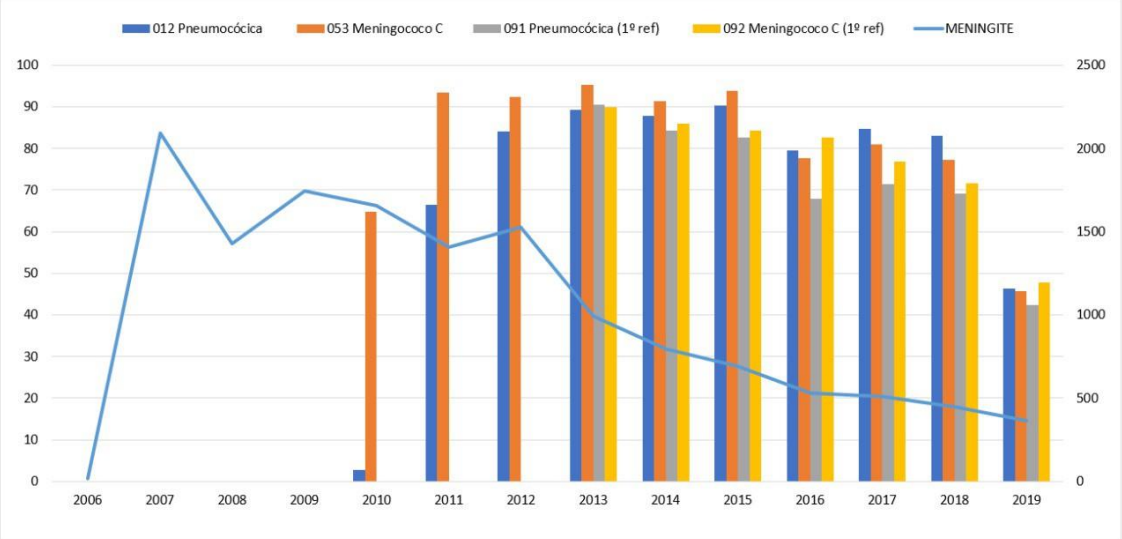
According to data released through the Epidemiological Bulletin of the Secretariat of Health Surveillance, which belongs to the Ministry of Health, Bahia was the state of the Northeast with the highest record of confirmed cases of viral hepatitis type B, C and D between 1999 and 2018 (Correio, 2019).

The data point to a peak of case notifications in 2018, yet the percentage of vaccination coverage fell from 75.56% among immunoprotective drugs in 2018 to 44.64% in 2019. In this case, it is worth remembering that most of the time, Hepatitis is a silent disease and the person does not realize that he has the virus. The World Health Organization (WHO) estimates that one in 20 people with hepatitis knows they have the virus (G1-BA, 2019).

Analyzing Figure 11 with data regarding Meningitis, and its immunopreventives, it is identified that the number of reported cases has been reducing in recent years. Although vaccination coverage also decreased in the period analyzed, the factor of reduction of reported cases of the disease may be related to the inclusion of new vaccines against meningitis in the vaccination schedule of the Unified Health System (Vigné, 2019). Vaccination began in 2010, with practically only one type of immune for prevention, and with a low percentage of coverage, increasing to 04 types in 2013, with a high percentage of coverage.

Meningitis is an inflammation of the membranes that cover and protect the central nervous system, located in the brain and which are called 'meninges'. Meningitis is a disease that can be caused by both viruses and bacteria, which is the most common (Nunes, 2020).

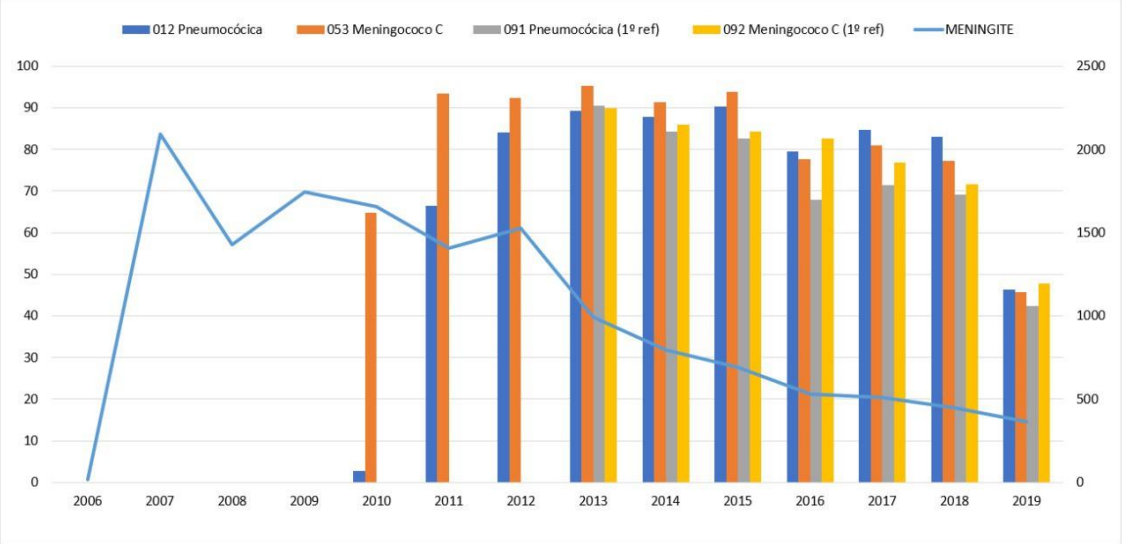
Figure 11: Evolution of Meningitis in the state of Bahia and the strength of immunization.



Source: Authors (2021).

Addressing Acute Flaccid Paralysis, Figure 12 shows the graphic visualization for the data of vaccination coverage and several cases reported in the period.

Figure 12: Evolution of Acute Flaccid Paralysis in the state of Bahia and the strength of immunization.



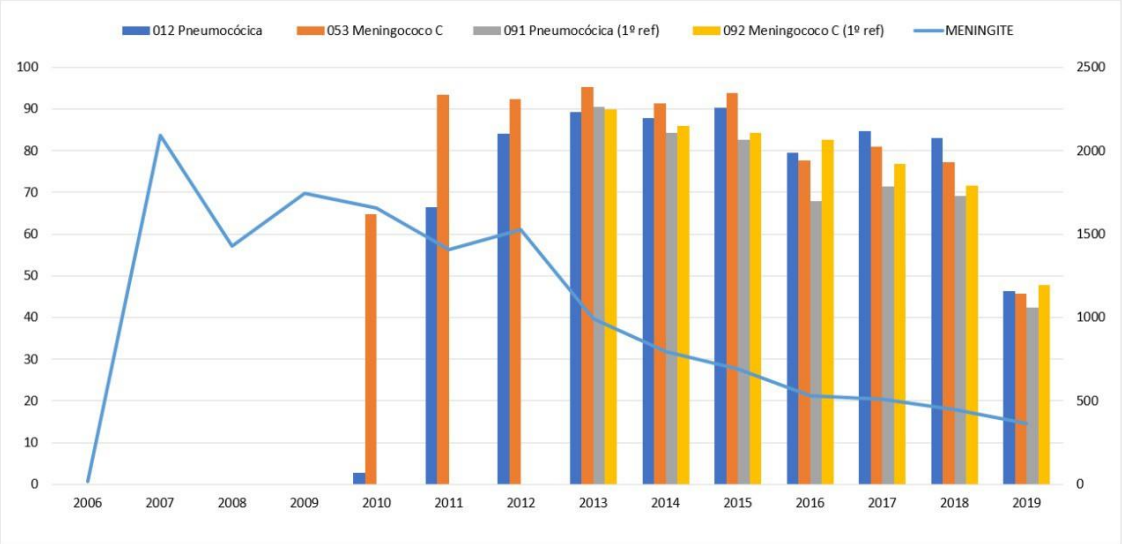
Source: Authors (2021).

Polio is a serious contagious infectious disease. In most cases, the child will not die when infected but acquires serious lesions that affect the nervous system, causing irreversible paralysis, especially in the lower limbs. Bahia is the Brazilian state with the highest rate of return of polio (infantile paralysis), according to information from the Ministry of Health, due to low vaccination coverage in recent years (G1-BA, 2018).

The surveillance of Acute Flaccid Paralysis (PFA) is a fundamental activity for the maintenance of the elimination of Poliomyelitis in the country. It is based on syndromic surveillance, with high sensitivity, in the population at the highest risk of involvement in the disease (Divepi, 2018). According to the World Health Organization (WHO), the target of vaccination coverage indicated for the control of the disease is 95%, which has not occurred in Bahia since 2015 (Cursino, 2020).

As seen, evaluating vaccination coverage, a movement of decrease in the percentage of the immunized population is identified. This behavior occurs for the various types of immune evaluated in the study. Figure 13 visually demonstrates a consolidated involution of vaccination coverage for the immunoviruses evaluated. There is a general drop in vaccination coverage over the years, especially in 2019 where the drop was approximately 40% when compared to the rates achieved in 2018.

Figure 13: Evolution of Vaccination Coverage in the state of Bahia.



Source: Authors (2021).

It is noticed, in general, that the amount of doses of vaccines applied in the state has been falling in recent years. It is worth remembering that the data used in the study are from the SUS, not taking into account the proportion of people who use private services for immunization. There are even ongoing studies to estimate the share of users who choose to use private immunization services (Fiocruz, 2018).

Not only in Brazilian territory but all over the world, the Anti-Vaccine movement is growing, which can explain with direct relation the behavior of the identified fall. Note that one of the biggest catalysts is the so-called Fake News, which happens mainly in groups of social media platforms such as Facebook, Instagram, Whatsapp, and similar, point out several alternative treatments not validated by the scientific community or present cases of false adverse reactions, isolated from vaccine applications, spreading the discredit of the PNI (Beltrão et al., 2020).

As a consequence of the Anti-Vaccine movement, comes the breaking of the link of epidemiological support, culminating with the risk of return of diseases previously eradicated or controlled, such as Acute Flaccid Paralysis, for example. According to infectologist Jaci Andrade, with pertussis, the immunity acquired with the vaccine decreases over time and when it reaches adulthood, especially women when they become pregnant, they can not pass immunity to the child. Children only begin to vaccinate at two months of age, so they are unprotected during this period (G1-BA, 2014).

The challenges and the NIP's war on disease are far from overcome. It is noted that investment in health, in general, has grown in recent years, however, the allocation of funds and resources for the dispensing structure is not enough, given the low number of chambers for the conservation of vaccines available in the "Cold Network" of the State of Bahia.

"Respecting vaccination is a matter of social responsibility. It is collective, it is a matter of empathy, of respect for life," says researcher and professor Luiz Carlos Dias, from the Institute of Chemistry of the University of Campinas (Unicamp) (Sampaio, 2018). It is also worth remembering that in the financial

sphere, prevention is the best remedy since the amounts involved in the purchase and application of vaccines are lower than those associated with the treatment of diseases.

In times of the coronavirus pandemic, the government has been paying close attention to the issue. National multi-vaccination campaigns began to be resumed with greater intensity, so as not to allow the stacking of different pathologies, and consequently potentiation of mortality by them (Araújo, 2020). Vaccination booster is essential to avoid the appearance of new cases and the outbreak of diseases already controlled in the region. It is necessary, in addition to the performance of Epidemiological Surveillance and Primary Care in ensuring the adoption of measures, also a working awareness of citizens, parents and guardians.

At the time of this article's construction, humanity is experiencing a dramatic pandemic period. More than 12 months after the first reported case of COVID-19, the world's population is eagerly awaiting approval of the vaccine by global health surveillance bodies. When then there will be a mass vaccination campaign to finally prevent and control the spread of this new disease, which has simply altered the lifestyle of humanity permanently.

This new scenario has brought new data to be analyzed with visualizations similar to those produced by this article since the acquisition of new and different vaccine conservation chambers by governments, the development of new techniques for the application of immunobiological and more accurate monitoring and communication of data on the DATASUS platform are supported.

4 CONCLUSION

It is then perceived that the National Immunization Program (PNI) is a Brazilian governmental action recognized worldwide by the World Health Organization (WHO) and the Pan American Health Organization (PAHO), this recognition is mainly due to the fact of the eradication of smallpox and polio cases in the 70s. Currently, Brazilian expertise is consulted to assist several countries such as East Timor, Haiti, and Angola, as well as neighbors in South America (Fiocruz, 2009).

From the point of view of management and optimization, it is necessary an integrated vision and planning, applying actions and campaigns for vaccination. Investments in advertising and marketing, such as the famous character Zé Gotinha, which contributes to greater awareness and greater adherence of the population to the PNI, to block the Anti-Vaccine movement and consequently the systemic drop in vaccination coverage, reversing the scenario currently presented. In addition, it is also necessary to make investments in infrastructure that are in line with the provision of the service, with more modern conservation chambers and in volume compatible with the number of doses and the territorial size of the State.

Given the data collected, it is possible to conclude the lack of investment in storage logistics in the various municipalities of Bahia. Even in municipalities with high demographic density, there is a lack of

equipment to reinforce the "Cold Network", compromising the immunization program in this region. The dispensing process in most municipalities not covered by vaccine conservation equipment occurs through boxes with passive refrigeration and without ideal temperature control, thus compromising the quality of the product applied (MS, 2015).

The intelligence and efficiency of the PNIderives mainly from the data that is inserted in the DATASUS information control platform. Some places still without basic infrastructure such as microcomputers, internet and even training compromise the integrity of what is being sent to processing.

The visualizations regarding the number of vaccines x the evolution of diseases, demonstrated in this article, is an example of what can be analyzed and processed for important managerial decision-making regarding the logistics and the correct direction of the public resource, to ensure the quality and success of the immunization of the population.

It is important to take advantage of this moment, in times of pandemic, where vaccination returns to prominence, to promote the importance and benefits, not only for the fight against the coronavirus but also for the other types of disease, which as evidenced in this article, had a significant reduction in vaccination coverage, with the chance of resurgence of some diseases that until then were controlled. In addition to the government, investing in science, infrastructure, health and educational campaigns to raise awareness about the importance of the vaccine, the population, parents and guardians must do their part in this pact.

It is suggested a future study of the application of the methodology used to other states of the country, to bring analyses about the variables raised in other locations and make a comparison between Brazilian states. Another possible approach would be the use of the linear regression technique with multiple predictors in the mass of data collected, correlating the municipalities through population density, vaccination coverage, investment in health, and amount of equipment present in the cold network, to list, for example, the best cities in the state of Bahia from the perspective of health care and conditions.

ACKNOWLEDGMENT

We thank the Federal Institute of Education Science and Technology of Bahia, through the Pro-Rectory of Research, Graduate Studies and Innovation (PRPGI), for the promotion approved in Notice No. 19/2020/PRPGI/IFBA, which enabled the publication of this article.

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