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CHILDHOOD VACCINATION IN CRISIS: THE RELATIONSHIP BETWEEN LOW VACCINATION COVERAGE AND THE RESURGENCE OF DISEASES IN BRAZIL

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Abstract: INTRODUCTION: Childhood vaccination is one of the most effective interventions in promoting public health and has contributed significantly to reducing morbidity and mortality from infectious diseases. However, Brazil is facing a crisis of low vaccination coverage, which has resulted in the resurgence of previously controlled diseases such as measles and polio. This integrative review seeks to analyze the factors that influence low adherence to the vaccination schedule and its consequences for public health. OBJECTIVE: The aim of this study is to identify and discuss the main factors that contribute to low childhood vaccination coverage in Brazil, assess the impact of vaccine hesitancy and inequalities in access to health services, and propose strategies to improve adherence to the vaccination schedule. METHODOLOGY: An integrative literature review was carried out using databases such as PubMed, LILACS and SciELO. The search was conducted using descriptors related to childhood vaccination, vaccine hesitancy and vaccine-preventable diseases, resulting in 150 articles. After applying inclusion and exclusion criteria, 27 articles were selected for detailed analysis. The data was organized into thematic categories, allowing a synthesis of the main findings. RESULTS: The results indicate that low vaccination coverage is influenced by multiple factors, including vaccine hesitancy, driven by misinformation and anti-vaccine movements, and unequal access to health services, especially in rural areas and vulnerable communities. The analysis revealed that vaccine hesitancy is associated with the resurgence of diseases such as measles and polio, with outbreaks occurring in unvaccinated populations. In addition, interventions such as awareness campaigns and training for health professionals have proved effective in increasing adherence to the vaccination schedule. CONCLUSION:

The crisis of low childhood vaccination coverage in Brazil is a complex phenomenon that requires a multifaceted approach. The combination of social, cultural and logistical factors that contribute to vaccine hesitancy and unequal access to health services must be addressed through integrated strategies. Promoting health education, improving access to vaccination and restoring confidence in vaccines are essential to ensure that all children receive the necessary vaccinations, thus protecting public health and preventing the re-emergence of preventable diseases.
Keywords: Childhood Vaccination; Vaccine Hesitation; Immunopreventable Diseases.

INTRODUCTION

Childhood vaccination is one of the fundamental pillars of public health and is widely recognized as one of the most effective interventions for preventing infectious diseases and reducing child morbidity and mortality. In Brazil, the National Immunization Program (PNI), established in 1973, has stood out as a model of success in promoting child health, offering a wide range of vaccines at no cost to the population. However, in recent decades, the country has faced a crisis of low vaccination coverage, intensified by the COVID-19 pandemic. This alarming situation has resulted in the resurgence of previously controlled diseases such as measles and polio, putting the health of millions of children at risk. In addition, the crisis of low vaccination coverage has generated additional concerns about the health system's capacity to deal with possible outbreaks of other infectious diseases, increasing the pressure on already limited resources[1,2,3] .

Low vaccination coverage is a complex and multifactorial phenomenon, involving social, cultural and logistical aspects. Vaccine hesitancy, driven by misinformation and anti-vaccine movements, has contributed significantly to the refusal to vaccinate. In addition, unequal access to health services and the lack of adequate infrastructure in more vulnerable regions have exacerbated the situation, resulting in significant disparities in vaccination rates between different population groups. The COVID-19 pandemic, with its restrictions and changes in population behavior, has further aggravated this scenario, leading to a sharp drop in childhood vaccination. Lack of trust in health institutions and the spread of false information about the safety and efficacy of vaccines have also played a crucial role in vaccine hesitancy, further hampering efforts to increase vaccination coverage[3,4] .

The importance of vaccination cannot be underestimated, as it not only protects children against serious diseases, but also contributes to collective health by creating a barrier against the spread of pathogens. Lack of adherence to the vaccination schedule can result in devastating consequences, not only for the individuals affected, but also for society as a whole, which can face outbreaks of preventable diseases. It is therefore imperative that effective strategies are implemented to increase vaccination coverage, including awareness campaigns, health education and improvements in vaccination logistics. In addition, it is essential that public policies are strengthened to ensure that all children, regardless of their geographical location or socioeconomic status, have access to the necessary vaccines. Collaboration between governments, non-governmental organizations and the community is key to overcoming the challenges and ensuring the protection of children's health[1,5] .

In this context, this article seeks to discuss the relationship between low vaccination coverage and the resurgence of diseases in Brazil, analyzing the factors that contribute to this crisis and proposing solutions to

reverse this trend. The analysis will be based on a comprehensive review of the available literature, focusing on recent studies that address childhood vaccination and its implications for public health. Through this discussion, it is hoped to highlight the urgency of coordinated actions to ensure that all children have access to the necessary vaccines, thus protecting public health and the future of the next generations. In addition, the review aims to identify gaps in current research and suggest areas for future study, with the aim of developing more effective and sustainable interventions to increase vaccination coverage and prevent the re-emergence of preventable diseases

METHODOLOGY

This is a systematic review article that has been structured according to the PRISMA guidelines, ensuring a rigorous and transparent process. The main objective was to identify, evaluate and synthesize the evidence available in the literature on the childhood vaccination crisis and its relationship with the resurgence of eradicated and controlled diseases. The review was conducted in several stages, including defining the research question, selecting studies, extracting data and critically analyzing the results. Initially, a clear and specific research question was formulated, aimed at understanding how childhood vaccination ceased to be a factor of population relevance and became a secondary project. The question was developed based on the need to address existing gaps in the literature and in clinical practice, particularly with regard to analyzing the factors that influence low childhood vaccination coverage and its consequences for public health in Brazil. The search for relevant studies was carried out in electronic databases such as PubMed, SciELO and BVS, using a combination of keywords related to "childhood vaccination", "vaccination coverage", "vaccine hesitancy", "measles", "poliomyelitis" and "COVID-19", as well as the association of these terms and expressions. Inclusion criteria were defined to ensure that only relevant studies were considered. Original articles, systematic reviews and case studies published between 2017 and 2023 that addressed topics related to childhood vaccination, vaccine hesitancy and the impacts of vaccine-preventable diseases were included. The search resulted in a total of 140 articles, of which 27 met the inclusion criteria. Studies that did not present empirical data or were not available in English or Portuguese were excluded. Studies were selected in two stages: first, titles and abstracts were screened, followed by a full reading of the selected texts to confirm eligibility. Data extraction was carried out by two independent reviewers who used a standardized form to collect information on the authors, year of publication, type of study, population studied and interventions carried out. Data analysis was conducted qualitatively, focusing on identifying patterns and recurring themes in the limitations found in the studies reviewed. In addition, the methodological quality of the included studies was assessed using appropriate tools, such as AMSTAR (A MeaSurement Tool to Assess systematic Reviews) and the Newcastle-Ottawa Scale (NOS) for observational studies. This assessment allowed the classification of studies in terms of robustness and reliability, contributing to the interpretation of the review's results. The synthesis of the data was organized into thematic categories, facilitating discussion of the limitations identified and their implications for clinical practice and future research. Finally, the results of the review were discussed in a broader context, considering the implications for public health and the need for more effective intervention strategies in the childhood vaccination

process.

RESULTS

A review of the literature on childhood vaccination in Brazil, focusing on low vaccination coverage and the resurgence of diseases, revealed a number of emerging themes and patterns that can be grouped into main categories, such as trends in vaccination coverage, factors contributing to low coverage, the impact of the anti-vaccine movement and the effectiveness of vaccination.

The data analyzed indicates an alarming downward trend in childhood vaccination coverage in several regions of Brazil. Studies have shown that between 2016 and 2020, vaccination coverage for essential vaccines, such as the MMR and polio vaccine, fell significantly, with some regions showing rates below 70%. This decrease is worrying, as the ideal vaccination coverage to guarantee collective immunity is at least 95%. In addition, the COVID-19 pandemic, exacerbated by the interruption of vaccination campaigns and the fear of contagion in health units, has contributed to this drop.

Analysis of the articles revealed multiple factors contributing to low vaccination coverage. Vaccine hesitancy, driven by misinformation and anti-vaccine movements, was identified as one of the main barriers to immunization. Studies have shown that the spread of fake news about vaccines, especially on social media, has generated distrust and resistance on the part of parents and guardians. In addition, unequal access to health services, particularly in rural areas and vulnerable communities, has also been highlighted as a critical factor limiting adherence to the vaccination schedule.

The resurgence of diseases such as measles and polio in Brazil is directly related to the increase in vaccine hesitancy and the influence of the anti-vaccine movement. Studies indicate that refusal to vaccinate children has been associated with measles outbreaks in various regions of the country, with the literature pointing out that the majority of measles cases in 2019 occurred in unvaccinated individuals. Analysis of epidemiological data suggests that misinformation about the safety of vaccines and belief in conspiracy theories have contributed to refusal to vaccinate, resulting in serious public health consequences.

Various interventions have been proposed to increase vaccination coverage and combat vaccine hesitancy. The literature reviewed suggests that awareness campaigns, which use evidence-based approaches and involve the community, can be effective in promoting vaccination. In addition, training health professionals to address parents' concerns and doubts about vaccines is key to restoring confidence in immunization. Home visiting programs and the use of digital technologies to facilitate vaccine scheduling and reminders have also been identified as promising strategies for improving adherence to the vaccination schedule.

Table 1 groups together the papers used during the presentation of the results, describing the author and year of publication of the papers, their titles, objectives and considerations about the main points of their content. However, it should be emphasized that some of these papers are not scientific research as such, with one of them being an informative article produced by the Ministry of Health and used as a reference thanks to its official nature. Photo 1 represents the process of screening and selecting the articles included in the current review.

DISCUSSION

Childhood vaccination is one of the most effective interventions for preventing infectious diseases, but it is currently facing a crisis of low vaccination coverage in Brazil, resulting in the resurgence of previously controlled diseases. Analysis of vaccination coverage reveals an alarming downward trend, especially among children, which is a multifactorial phenomenon. Between 2017 and 2019, a survey indicated a significant reduction in vaccination coverage in all regions of Brazil, with a 20% drop during the COVID-19 pandemic, which further compromised childhood immunization. This scenario is corroborated by data showing that vaccination coverage for diseases such as polio and measles is below the levels needed to guarantee collective immunity.[3, 6, 7, 8]

One of the factors contributing to this low vaccination coverage is hesitancy to vaccinate, which is influenced by cultural aspects, misinformation and anti-vaccine movements. The anti-vaccine movement, which has intensified in recent years, has generated a growing distrust of vaccines, leading to a decrease in the acceptance of immunizations. In addition, the COVID-19 pandemic has drastically altered access to health services, resulting in a sharp drop in childhood vaccination, especially in vulnerable populations. Lack of adequate information and the spread of fake news also play a crucial role in vaccine hesitancy, contributing to the perception of reduced risk in relation to preventable diseases.[3, 9, 10, 11, 12, 13]

Inequality in access to healthcare is another determining factor in vaccination coverage. Regions with lower population density and lower educational levels, such as some areas in the North and Northeast of Brazil, have significantly lower vaccination rates. Analysis of vaccination coverage data reveals that states such as Roraima and Maranhão are among the worst affected, with immunization rates that do not reach the levels recommended by the World Health Organization (WHO). The lack of adequate infrastructure and the shortage of qualified human resources for vaccination are also significant barriers that hinder the effective implementation of immunization campaigns.[8, 14, 15, 16, 17, 18]

The resurgence of diseases such as measles and polio in Brazil is a direct reflection of this vaccination crisis. Measles, which had been considered eradicated in 2016, has once again become a public health concern, with an increase in cases in 2018 and 2019. Vaccination coverage for the triple virus, which includes the measles vaccine, has fallen to alarming levels, especially among children under two. Polio, a disease that can cause irreversible paralysis, also has insufficient vaccination coverage, putting the eradication of the disease in the country at risk.[3, 7, 11, 19, 20, 21, 22]

In addition to issues of acceptance and access, the management and logistics of vaccination campaigns are also crucial to the success of childhood immunization. The implementation of the National Immunization Program (NIP) in Brazil, which aims to organize and guarantee vaccination throughout the national territory, faces significant challenges, including the need for constant updating and adaptation to new social and epidemiological realities. The lack of accurate data on vaccination coverage, often the result of underreporting and recording errors, makes it difficult to assess the effectiveness of vaccination policies and identify areas in need of intervention.[23, 24, 25]

The COVID-19 pandemic has brought to light the need to rethink vaccination strategies, emphasizing the importance of awareness campaigns and health education to combat misinformation and increase vaccine acceptance. The integration of health services and

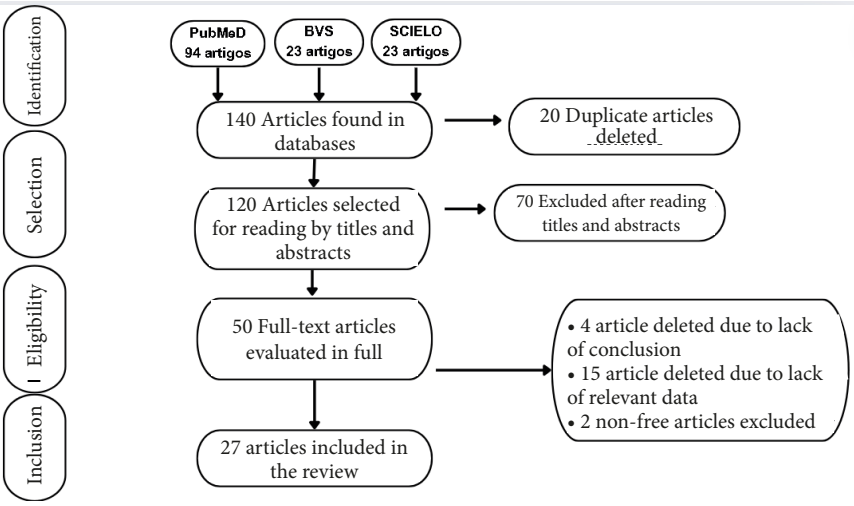

Figure 1: Screening process for the selection of articles included in the review.

	Author	Year of publication	Type of Study	Objective	Conclusion
1	Silva I, Et al	2023	Secondary data analysis	To observe the distribution of deaths from causes preventable by immunization actions in the Brazilian regions, in order to demonstrate the effects of encouraging vaccination in Brazil.	It was concluded that vaccination is a matter of public health, social responsibility, individual and collective awareness and respect for life.
2	Barcelos R, Et al	2021	Longitudinal study	To evaluate vaccination coverage, according to the National Immunization Program schedule, among children benefiting from the Bolsa Família Program, Brazil, according to the family's socioeconomic level and maternal characteristics.	It should be noted that the COVID-19 pandemic arrived in the country as soon as the research was concluded and, in all likelihood, more recent reports, showing that preventive actions in the basic network have been severely affected by the pandemic, indicate that vaccination coverage - by the end of 2020 - will be lower than that shown in this analysis.
3	Sato A, Et al	2020	Descriptive study	Assess the impact of the COVID-19 pandemic on childhood vaccination coverage in Brazil and discuss the challenges for a safe return to face-to-face classes.	Once a safe and effective vaccine for Sars-CoV-2 is available, immunization programs will have an even greater challenge to strengthen and reach the most vulnerable.
4	Silva G, Et al	2023	Integrative Review	Synthesize articles that address fake news and vaccine hesitancy against COVID-19 in the context of public health.	Hesitation and misinformation are the main obstacles to achieving vaccination coverage in many countries.
5	Araújo G, Et al	2022	Integrative Review	Presenting the importance of vaccination as a means of promoting and preventing diseases, and that non-adherence to vaccination can become a public health problem.	Although vaccination is the most efficient method of combating infectious diseases, there is still hesitancy when it comes to getting vaccinated.
6	Neves R, Et al	2023	Descriptive Study	To describe the coverage of pneumococcal, polio and rotavirus vaccines, from 2017 to 2020, in the regions and federation units (FUs) of Brazil.	There was a reduction in vaccination coverage during the period between 2019 and 2020, with the most affected coverage being that of the polio vaccine, followed by the rotavirus vaccine and, finally, the pneumococcal vaccine.

7	Silva J, Et al	2023	Bibliographic review	Investigate coverage rates the vaccination against poliomyelitis in recent years, as well as discussing the main reasons for this. behind these rates.	It is suggested that latest research and data analysis about these children who did not have access to vaccination, due to adverse situations related to nated to COVID - 19 and the impacts they have had in the face of losing this immunization.
8	Iglesias B, Et al	2023	Integrative Literature Review	To understand how the decrease in polio and measles vaccination coverage has affected the incidence of these diseases in the pediatric population over the last 10 years in Brazil.	There has been a drop in vaccination coverage for both measles and polio in all of Brazil's macro-regions, with local specificities for the rate of decline. The drop in vaccination coverage increases the risk of a resurgence of diseases that could be prevented by vaccination.
9	Luiz A, Et al	2021	Quantitative study	Highlight vaccination coverage data and discuss the reasons why the anti-vaccine movement is taking place in a context of globalization and social media, as well as the impacts it is having on Brazilian health.	There are economic and social reasons for the reduction in vaccination coverage.
10	Milani L, Et al	2021	Descriptive Study	Analyze the causes and consequences of the reduction in vaccination coverage in Brazil.	The reduction in vaccination coverage in Brazil is associated with several factors, including vaccine hesitancy, misinformation and logistical difficulties.
11	Almeida B, Et al	2022	Descriptive Study	To analyze the vaccination coverage rates and the dropout rate of the Poliomyelitis vaccination scheme in Brazil and Minas Gerais between 2018 and 2021, in order to assess the influences of the pandemic on these Poliomyelitis immunization parameters.	It is suggested that research be carried out with a multidisciplinary and homogeneous approach, through national and international cooperation networks, incorporating institutions and researchers, with the aim of achieving a better outcome for the scenario in question, improving vaccination rates and, concomitantly, the prognosis and decline in morbidity and mortality.
12	Santos J, Et al	2023	Descriptive Study	To analyze, according to the literature, the factors related to vaccine hesitancy and refusal in Brazil.	Uncertainty about the reactogenicity and safety of the vaccines, fear of adverse events and lack of information/guidance were the main causes of vaccine refusal.
13	Carvalho C, Et al	2021	Descriptive cross-sectional study	To carry out an epidemiological analysis of Poliomyelitis vaccination coverage in Brazil in 2018.	Vaccination coverage was not satisfactory in the South, Southeast and Center-West regions of the country, where better sociodemographic and cultural data were observed - better MHDI, greater access to information and better educational levels.
14	Silva A, Et al	2023	Retrospective Descriptive Epidemiological Study	Emphasize the importance of intensifying measles vaccination campaigns in Brazil, especially in the North, due to the reduction in vaccination coverage observed between 2010 and 2018.	There was an increase in the number of cases of measles in Brazil added to the decline gives immuno-prevention in the last six years.
15	Arroyo L, Et al	2020	Ecological Study	To highlight areas with falling BCG, polio and triple viral vaccination coverage in Brazil between 2006 and 2016.	There has been a downward trend in the number of immunizations in Brazil, with annual drops of 0.9% for BCG, 1.3% for polio and 2.7% for MMR.
16	Sales H, Et al	2023	Integrative Review	Understand the reasons for and impacts of non-adherence to immunization in Brazil.	The importance of promoting actions to increase vaccination coverage is reinforced.
17	Almeida L, Et al	2023	Descriptive epidemiological study with an ecological design	To evaluate the vaccination coverage of children under five years of age in the state of Alagoas over the last 9 years, comparing it with the vaccination coverage of children in Brazil.	It is hoped that, based on this information, further research will be carried out, such as population-based studies, to assess the delay in administering vaccine doses and identify the populations most at risk.

18	Morais J. and Quintilio M	2021	Literature Review	To gather and condense research results on a theme or problem in an organized and systematic way, generating contributions and 1056Literature Review improvement on the subject under investigation.	It is hoped that health professionals will understand the need to work in an articulated and systematic way, so that the objectives can be achieved in a concrete way.
19	Santos B, Et al	2021	Retrospective study	To analyze the epidemiological profile and vaccination coverage of measles in Brazil from 2011 to 2020, in order to promote a better understanding of the evolution of the epidemiological profile and vaccination coverage of measles in Brazil.	The return of measles reinforces the need for an action plan to guarantee its elimination and prevent new epidemics.
20	Pires C, Et al	2022	Cross-sectional study	Analyzing vaccination coverage and measles incidence in the Northern Region of Brazil in 2018	The need for vaccines stands out, as they reduce measles rates by preventing the disease and reducing the costs of complications from this infection.
21	Souza M, Et al	2022	Cross-sectional descriptive epidemiological study	To assess measles vaccination coverage in the municipalities of the state of Pará from 2010 to 2022, identifying the municipalities with low vaccination coverage and relating this to its re-emergence from 2018 to 2022.	It is important to guarantee the supply of the vaccine and to set up strategies to increase vaccination coverage and the benefits of the vaccine.
22	Sobral M, Et al	2023	Ecological study	Investigating the relationship between vaccination coverage and yellow fever morbidity and mortality rates in Brazil	It is clear that state negligence can be characterized as a limiting factor in expanding vaccination coverage. In this respect, the limited supply of this service also represents the (re)appearance of diseases and public health problems.
23	Lima A. and Pinto	2017	Literature Review	Discuss the importance of the PNI for public health and disease prevention.	It can be seen that the PNI has contributed positively to strengthening the Unified Health System through actions that have guided and organized the vaccine calendar, taking into account the population, age group and geographical area, thus increasing the effectiveness of the program.
24	West A, Et al	2023	Ecological study	Carry out a survey to analyze vaccination coverage and doses administered to children aged 0 to 1 in all Brazilian regions between 2012 and 2021.	It can be concluded that since 2014 there has been a downward trend in the number of vaccine doses administered in Brazil, except in the South, which has remained stationary.
25	Durans K, Et al	2021	Descriptive Study	To describe the number of cases of notifications and hospitalizations related to ACSC and compare them to the VC of the state of Maranhão and Brazil.	Vaccination coverage has been steadily declining since 2015, especially those on the children's calendar, such as Polio, Tetraviral, BCG, Triple Viral and Hepatitis A.
26	Borges V, Et al	2023	Descriptive study	To analyze vaccination coverage in children under five in the state of Mato Grosso from 2012 to 2021.	The study shows a significant reduction since 2016, which was further exacerbated during the years in which COVID-19 broke out, and demonstrates that the proportion of vaccinated children is low, when considering the targets recommended by the PNI.
27	Nunes P. and Ribeiro G	2022	Reflective study	Discuss the importance of equity in access to health services, with a focus on the acquisition and distribution of vaccines in the context of COVID-19.	There is an urgent need to promote actions to engage the population, stimulate vaccination, encourage credibility in science and reinforce the need to exercise citizenship in solidarity.

Table 1: Systematization of the articles included in the review.

the promotion of home visit programs have proven effective in improving vaccination rates, especially in vulnerable communities. In addition, training and capacity building for health professionals is essential to ensure that information about vaccines is transmitted clearly and accurately to the population.[2, 11, 13, 18, 26]

The childhood vaccination crisis in Brazil is a complex phenomenon that requires a multifaceted approach, involving coordinated actions between different sectors of society, including health, education and communication. Promoting equity in access to vaccines, especially for marginalized populations, is key to reversing the downward trend in vaccination coverage and preventing the resurgence of vaccine-preventable diseases. Collaboration between governments, non-governmental organizations and the community is essential to restore confidence in vaccines and ensure that all children have access to the immunization needed to protect their health and well-being.[12, 16, 22, 27]

CONCLUSION

In short, the recent crisis of low vaccination coverage in Brazil, exacerbated by the COVID-19 pandemic and the spread of misinformation, has resulted in the resurgence of previously controlled diseases such as measles and polio. This phenomenon represents a significant challenge for public health, since refusal or delay in vaccination can lead to the formation of pockets of infection and localized outbreaks. Analysis of the factors that contribute to low adherence to the vaccination schedule reveals a complex interaction between social, cultural and logistical aspects. Vaccine hesitancy, often fuelled by anti-vaccine movements and distrust of health institutions, has proved to be a significant obstacle to immunization. In addition, unequal access to health services, especially in more vulnerable regions, accentuates disparities in vaccination rates, compromising the protection of entire populations. Conducting educational campaigns, actively seeking out children who are behind on their vaccination schedule and training health professionals are all measures that can help to increase vaccination coverage. Promoting an environment of trust, where parents and caregivers feel safe and informed about the benefits of vaccination, is key to ensuring that all children receive the vaccines they need for a healthy life. Collaboration between different sectors of society, including governments, non-governmental organizations and the community, is essential to restore confidence in vaccines and ensure that immunization policies are effective and equitable. Finally, the current crisis of low vaccination coverage in Brazil requires a coordinated and multifaceted response that addresses the underlying causes of vaccine hesitancy and promotes equity in access to vaccines. Only through joint and sustained efforts will it be possible to ensure that all children have access to the necessary immunization, thus protecting the health of the population and preventing the resurgence of preventable diseases.

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