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RESEARCH

Epidemiological situation of pertussis in the Federal District between 2007 and 2016

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Abstract

Pertussis monitoring intensified in Brazil with the increase of cases since 2012. In 2015, the number of notifications in the Federal District decreased, possibly due to the introduction of diphtheria, tetanus and acellular pertussis vaccine for pregnant women in November 2014 in the country. This is a descriptive study based on the review of compulsory pertussis reporting in the National Notification System between 2007 and 2016. It was found that the disease mainly affects children under one year of age with incomplete vaccination regimens. The administration of this vaccine to pregnant women has proved to be an important tool to protect babies under six months.

Keywords: Bordetella pertussis. Pertussis vaccine. Mandatory reporting. Epidemiology.

Resumo

Situação epidemiológica da coqueluche no Distrito Federal entre 2007 e 2016

A vigilância da coqueluche intensificou-se no Brasil com o aumento de casos a partir de 2012. Em 2015, a quantidade de notificações no Distrito Federal diminuiu, possivelmente devido à introdução da vacina adsorvida difteria, tétano e *pertussis* acelular para gestantes em novembro de 2014 no país. Trata-se de estudo descritivo, baseado na revisão das notificações compulsórias de coqueluche no Sistema de Notificação Nacional entre 2007 e 2016. Constatou-se que a doença atinge principalmente crianças menores de 1 ano com esquemas vacinais incompletos. A administração dessa vacina para gestantes mostrou-se importante ferramenta para proteger bebês menores de 6 meses.

Palavras-chave: Bordetella pertussis. Vacina contra coqueluche. Notificação compulsória. Epidemiologia.

Resumen

Situación epidemiológica de tos ferina en el Distrito Federal entre 2007 y 2016

La vigilancia de la tos ferina se intensificó en Brasil con el aumento de casos a partir de 2012. En 2015, la cantidad de notificaciones en el Distrito Federal disminuyó, posiblemente debido a la introducción de la vacuna contra la difteria, el tétanos y la *pertussis* acelular para gestantes, en noviembre de 2014, en el país. Se trata de un estudio descriptivo, basado en la revisión de las notificaciones obligatorias de tos ferina en el Sistema de Notificación Nacional, entre 2007 y 2016. Se constató que la enfermedad afecta principalmente a niños menores de 1 año con regímenes de vacunación incompletos. La administración de esta vacuna a mujeres embarazadas se mostró como una importante herramienta para proteger a los bebés menores de 6 meses.

Palabras clave: Bordetella pertussis. Vacuna contra la tos ferina. Notificación obligatoria. Epidemiología.

Declararam não haver conflito de interesse.

Vaccination has been considered the most effective prophylactic measure, capable of eliminating outbreaks of communicable diseases that, before their discovery, affected and killed thousands of people. It is especially important for cost-effectiveness in health systems, both for reducing the number of patients in care and for ensuring a better quality of life for the population.

These attributes make it possible to relate vaccination and bioethics concerning both the principlist theory – despite the caveats to the principle of autonomy – and Brazilian theoretical proposals such as protection bioethics^{1,2}. In principlism, vaccination unequivocally promotes beneficence, prevents maleficence and, when universal in the health system, ensures justice by ensuring immunization to all, focusing on lower costs. In the bioethics of protection, this practice is fundamental as a sanitary policy, *also highlighting the joint responsibility of all as a basis for protection that is both individual and collective*³.

Considering this relationship between epidemiology and bioethics, this paper presents research on pertussis vaccination in the Federal District of Brazil in the first decade of the 21st century. The regional data were punctually compared with the national picture, seeking to identify the panorama of immunization against the disease, as well as to raise advances and barriers. Thus, the work intends to stimulate the continuous improvement of vaccination strategies, focusing on the most susceptible cases – newborns and children up to 1 year of age – who deserve the State's attention to assure their right to health, as defined by the constitutional framework⁴.

Methods

This is a descriptive study, with analysis of pertussis notifications in two databases, Tabnet and Tabwin, both from the Sistema de Informação de Agravos de Notificação do Departamento de Informática – Sinan (Information System of Notification Diseases of the Department of Informatics) of the Sistema Único de Saúde – Datasus (Unified Health System). The objective was to analyze the epidemiological profile of pertussis in the Federal District between 2007 and 2016 and to contextualize the results with the national findings^{5,6}.

We chose to analyze two different periods due to the diversity of data available, according to the system used. Tabnet provided the longest range of

information (2001-2016); however, its variables were more restricted. In turn, with Tabwin it was possible to work with all variables of the notification form, but were only accessible the records made from 2007 and in the territory of Brasília.

Thus, the first analysis was performed on Tabnet to better understand the disease profile in the Federal District and compare it with the incidence in the country. For the remaining analyses, the period from 2007 to 2016 was considered. The last year, 2017, was excluded as it was included the time of the study, therefore presenting incomplete data. Word and Excel software from the Microsoft Office 2013 package were used to create tables and charts.

Regarding the age profile of pertussis cases, most people affected were younger than 1 year, but the database did not detail this variable in months or days. To reach the exact age, the date of the first symptoms was subtracted from the date of birth; the result shown in days in the Excel spreadsheet was converted to months when greater than 30 days, and to years when greater than 12 months. Five cases were disregarded because their records had no date of birth.

Theoretical basis

Pertussis is an old infection that affects the respiratory tract causing long-lasting paroxysmal cough. *Bordetella pertussis* is its main etiological agent, and humans are its only natural hosts. The disease has universal distribution and can affect people of any age; however, in infants and younger children, the clinical picture becomes more severe. The worldwide epidemic pattern is observed every three and five years⁷.

The incubation period lasts from five to 10 days, rarely reaching 42 days. Transmission occurs five days after contact with the patient (usually at the end of incubation) and up to three weeks after characteristic coughing attacks are initiated⁸. Transmission occurs by droplets scattered by coughing, speaking or sneezing or by direct contact with secretions respiratory. Most transmission takes place within the catarrhal stage and two weeks after paroxysmal coughing if antibiotics are not used, or up to five days after beginning the treatment⁹.

Asymptomatic people or those with mild symptoms may also transmit the bacteria. A study in Paris documented that adults were the primary sources of two thirds of infants hospitalized for the disease. The seasonality of the disease is only

observed in population clusters in spring and summer and is not evident in other circumstances¹⁰.

There are three stages in pertussis, usually lasting from six to eight weeks. The first stage is catarrhal, lasts about 14 days and is characterized by malaise without a specific condition accompanied by anorexia, sneezing, runny nose, irritability, low fever, and mild dry cough. In the next, paroxysmal stage, which lasts from one to six weeks, the cough gets worse mainly at night, with a strong choking sensation.

Paroxysms are characterized by five or more short and rapid expirations, followed by respiratory arrest and sudden, prolonged forced inspiration, accompanied by characteristic noise (squeal). During attacks, the patient may become cyanotic and vomit. The cough continues to get worse and usually peaks in the third week, when it begins to regress. In the last convalescent stage, the clinical condition gradually improves until it ceases, around three or four weeks¹¹.

The diagnosis of pertussis is primarily clinical, evidenced by coughing for at least 10 days in children under 6 months, and 14 days in children 6 months and older, associated with paroxysm, squeal and/or vomiting. The presence of leukocytosis above 20,000 cells/mm³ with lymphocytosis is an important finding. *Bordetella pertussis* isolation in nasopharyngeal culture is the gold standard for pertussis diagnosis, and the current goal of the Ministry of Health ("Ministério da Saúde", MS) is that culture be collected for at least 80% of suspected cases^{8,9}.

Treatment includes hydration and electrolyte balance. Ventilatory support and aspiration may be required in very intense paroxysmal seizures. The patient should remain isolated until the fifth day after antibiotic initiation. Azithromycin at a daily dose of 10 mg/kg is recommended for five days for children under 6 months and the same dosage for children over 6 months, but only on the first day; in the remaining four days, 5 mg/kg should be administered, respecting the maximum dose of 500 mg on the first day and 250 mg on the others. For adults weight is not considered: the maximum dose is applied on the first day, and half of that on the remaining days⁹.

Legal bases

The report of pertussis cases has been mandatory since 1975, on the recommendation of the 5th National Health Conference, which established the Sistema Nacional de Vigilância Epidemiológica – SNVE (National Epidemiological Surveillance System). This system, formalized by Law 6,259 of the same year, and

regulated by Decree 78,231/1976, incorporated the set of communicable diseases considered of major health relevance in the country, including pertussis, classified in the group of immunopreventable diseases¹²⁻¹⁴.

This obligation is also included in the latest legislation in force, Ordinance MS 204/2016¹⁵. In the Federal District, notifications prevailed in sentinel units; In 2012, the same was demanded from all health units, which did not change the reporting profile but highlighted the need to intensify the identification of cases in other units.

In May 2014, the MS published Information Note 3, which defined new recommendations for pertussis epidemiological surveillance in Brazil. These changes aimed to improve the identification, treatment, and control of cases, at a time marked by the sudden and significant increase in the number of patients with the disease in the country¹⁶.

Following the same guidelines and priorities, the Federal District, through the Diretoria de Vigilância Epidemiológica da Secretaria de Vigilância em Saúde – Divep/SVS (Department of Epidemiological Surveillance of the Health Surveillance Secretariat), published Technical Note 9 on July 30, 2014, emphasizing the need for care teams and vigilance to be alert to suspected disease. This document, together with Information Note MS 3/2014, remains in force and in accordance with the latest publication of the Health Surveillance Guide¹⁶⁻¹⁸.

Case definition

Information Note MS 8/2014 divides suspected cases into two age groups. The clinical manifestation to be observed is the same; however, for children under 6 months, a condition is already considered suspicious when the cough remains for 10 days or more, along with other symptoms, unlike the other age groups, in which the individual is classified as possibly infected with pertussis from the 14th day of cough¹⁶.

Information Note MS 3/2014 considers suspicious *any individual who, regardless of vaccination status, has had a cough of any kind for at least 10 days for children under 6 months, and 14 days for children over 6 months associated with one or more of the following symptoms: paroxysmal cough (...); inspiratory winch; post-cough vomiting; cyanosis; apnea; choking*¹⁹. During outbreaks, when the number of possible cases is higher than expected, the only clinical evidence considered for classification is prolonged cough, regardless of any other symptoms¹⁶.

Surveillance components

The epidemiological surveillance of pertussis occurs in several stages. Its targeted and critical execution allows for better evaluation and control of cases, as well as providing important data for analysis of the epidemiological scenario of the disease. The surveillance flow comprises the following actions, not necessarily in this order: identification of the suspect, the area of transmission and intimate communicators, diagnostic confirmation, active case search, investigation, laboratory examinations, classification and closure of the case, evaluation and adoption of control measures (isolation, analysis of vaccination status, chemoprophylaxis).

According to the Health Surveillance Guide, intimate contacts (or intimate communicators) *are family members or people who live in the same house or habitually attend the place of residence of the case. Also communicating are those who spend the night in the same room, as institutionalized people and workers who sleep in the same physical space. Other types of exhibitions may define new communicators, as in situations where people are close (± 1 meter) most of the time and routinely (school, work or other circumstances that meet this criterion)*²⁰. Chemoprophylaxis should be performed for all intimate contacts occurring during the period of disease transmission, regardless of symptoms¹⁸.

Results

The Federal District reported 2,044 pertussis suspicions between 2007 and 2016. Of this amount, 880 cases were confirmed, of which 303 (34.43%) in 2014, representing more than a third of the occurrences of this period. Of the confirmed patients, 659 needed to be admitted to hospital units and 21 died due to the disease. The unit that received the most pertussis cases was the Brasília Maternal Children's Hospital, with 143 admissions (21.7%), followed by the Taguatinga Regional Hospital, which attended 124 patients with pertussis (18.82%) in the years surveyed.

The clinical criterion was the most commonly used to confirm occurrences of the infection. Despite the remarkable increase in the number of cases closed by laboratory examination, it cannot be ignored that this number is still much lower than expected. In 2014, 84 cases (27.72%) were diagnosed by the second criterion, a result still far below the 80% target set by the MS. When it comes

to intimate communicators, only 80 of the confirmed cases (9.09%) collected nasopharyngeal material.

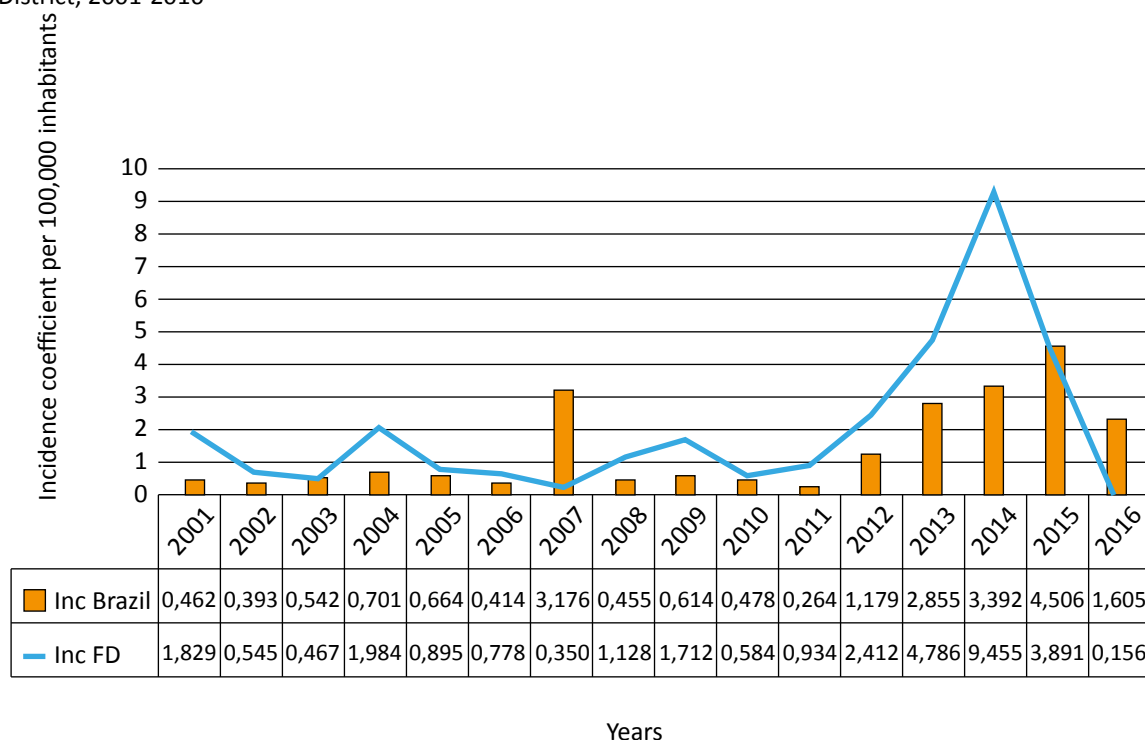
Most patients with pertussis (82.5%) in the Federal District were younger than 1 year old. In infants, the disease can result in several complications. All 21 deaths recorded by this injury in Brasília were children under 4 months. There was no significant difference in gender in the affected population: 54.43% (479) were female and 45.57% (401) male.

As for color, white was more present (250 cases, representing 55.19% of those who filled this variable). It is important to note that the answers to this item were incomplete; of the total of 880, 427 records remained blank or reported "ignored" in this item. As expected due to the age group most frequently affected, in 91.47% of patients with pertussis (805) the education variable did not apply; only 42 of them (4.72%) had some type of training.

Figure 1 shows the historical series of pertussis incidence rate in the Federal District compared to confirmed cases in Brazil reported in Sinan between 2001 and 2016. In 2001 this coefficient in Brasília was almost four times that of the country, and an important difference was maintained until 2014, except for 2003 and 2007. In the latter, the rate in the Federal District fell to less than half (0.35) compared to the previous year (0.78), while in Brazil the incidence was seven times higher. This leads to reflection on what may have occurred in the disease pattern or notification flow.

As in the following year, the number grew again in the Federal District and fell in Brazil, there seems to be no change in the pattern of the disease. These data indicate the need for a specific and in-depth investigation to generate more appropriate conclusions, including sensitivity verification, record, and flow of the surveillance system of this problem in the period. In 2006 the national notification form was updated, which may also have interfered with case registration.

From 2015 on, the incidence in the Federal District drops to less than half (3.89) compared to the previous year (9.45), which has the highest index in this historical series. This decrease remained in 2016 (0.16), and the Federal District recorded a coefficient 10 times lower than the national one, despite the fall recorded throughout the Brazilian territory: between 2015 and 2016 were reported almost three times fewer cases in the country.

Figure 1. Pertussis incidence rate (per 100,000 inhabitants) per year of occurrence – Brazil and the Federal District, 2001-2016

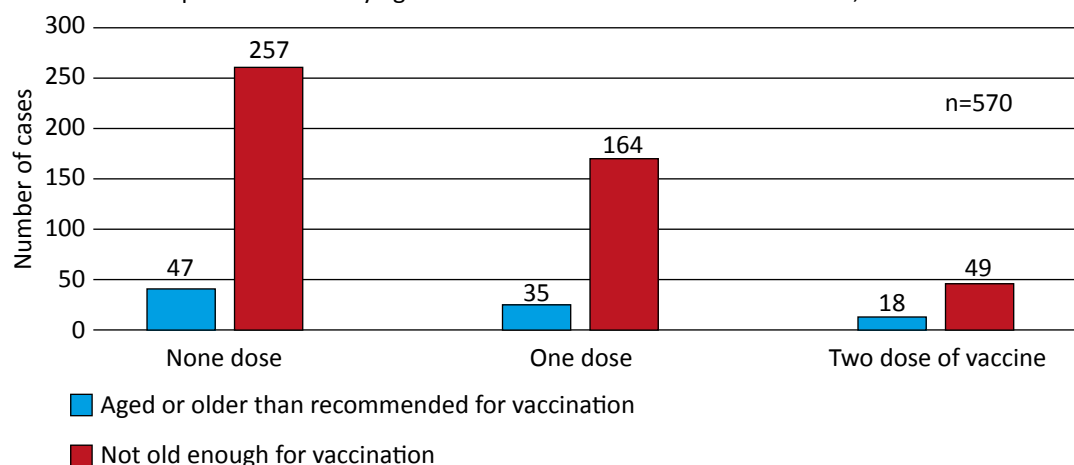
Source: Sinan

An important event that was probably reflected in the recent decrease in pertussis cases in Brazil and the Federal District was diphtheria, tetanus, and *pertussis* (DTP) vaccination for pregnant women from the 26th week. The purpose of this action was to protect the newborn before receiving the first dose of the vaccine, according to the National Immunization Program schedule. Currently, the measurement is indicated from the 20th week of pregnancy to the puerperal period. Health professionals working in neonatal intensive care units or maternity units must also be vaccinated.

Protection against pertussis appears on the routine calendar from the second month of age. The full schedule includes two other doses, at 4 and 6 months respectively; There are also two boosters to be given at 15 months and 4 years of age. In the first three doses, the pentavalent vaccine is used, which, besides pertussis, also protects against tetanus, diphtheria, type B *Haemophilus influenzae* and hepatitis B. In the other two doses, DTP is applied. Immunization is not permanent; 6 to 12 years after the last dose the protection is greatly reduced or disappears^{8,21}.

Of the patients diagnosed with pertussis in the Federal District, 65.23% (570) did not complete the basic scheme of the national calendar. Approximately 6% (54) of them received only the first three doses, while another 6.36% (56), besides these, took the two recommended reinforcements. Just over 12% of those receiving the basic regimen contracted pertussis, so vaccine efficacy is as expected, between 75% and 80%. However, 22% (196) of the total reported no information on vaccination status, which impairs a more qualified analysis of this variable.

Regarding the age group of those who had pertussis without a complete basic vaccine scheme, 64.91% (370 of 570 cases) were not old enough for the missing dose. Of the 304 who never received a vaccine, only 47 (15.46%) were older than 2 months, which reinforces the importance of immunizing the pregnant woman or postpartum woman to protect newborn infants until at least the first dose of the basic regimen. Of the 199 single-dose registrations, 82.41% (164) were not aged for the second; and of the 67 who received two doses of the vaccine, 18 (26.87%) were already old enough to complete the scheme, eight of them less than 7 months old (Figure 2).

Figure 2. Confirmed pertussis cases by age and vaccination status – Federal District, 2007-2016

Source: Sinan

In cases of newborns, there is still no variable notification form to assess the mother's vaccination status during pregnancy and puerperal period. With the implementation of the DTPa for pregnant women, it is important to include this variable to measure the new control and prevention actions. According to the Federal District's Department of Epidemiological Surveillance Management's Immunization Technical Area⁸, DTPa coverage for pregnant women in the Federal District was 76.4% in 2015 and 67.9% in 2016, while in Brazil this coverage was 44.97% and 33.81% in the same years. The coverage goal is 100%.

As expected from the clinical picture, 95.91% (844) of the pertussis patients had a cough, 72.73% (640) paroxysmal – that is, the disease was reported in the second phase, when the clinical manifestation was more evident. Cyanosis (73.97%), vomiting (57.27%) and squealing (55.23%) were also observed. Of the 524 records of fever (59.54%), only in 194 (37.02%) it exceeded 38° C. The least mentioned symptom was apnea, present in almost 30% of cases. Approximately 21% reported complications. Pneumonia was very common, affecting 124 patients (78.98%).

In addition to supportive therapies, the antibiotic is the only recommended treatment for pertussis. Still, 33 patients did not receive the medication, two of which died. Rapid diagnosis can contribute to proper treatment. In this process, as it is a disease with a clinical condition that is often dragged, the interval between first symptoms and notification is crucial. Of the cases analyzed, in 45.8% (403) this interval was less than 10 days; in 31.59% (278), it was 10 to 20 days, and in 45.79% it was longer than 30 days.

Identifying contacts close to the patient allows them to be vaccinated and directed to

chemoprophylaxis, an extremely important control measures. When the investigator cannot obtain this information, it is recorded as "ignored"; if this question is not asked during the investigation, the field remains "blank". This shows fragility in the survey and the need to clarify the meaning and importance of this variable.

Although the communicants were identified in 570 (64.77%) of the cases, in only 358 (40.58%) of them the chemoprophylaxis was offered to the patient contacts, of which only 20 (2.27%) received vaccine protection. Considering the notified population, most of them under 1 year old, it is noticeable fragility of investigation and filling in this variable as well. Both more identified communicators and chemoprophylaxis offered to them are expected.

Final considerations

This study showed that pertussis mainly affects children under 1 year of age with incomplete vaccination regimens, thus a vulnerable group that deserves special state attention, not only for pertussis, but for all immunopreventable diseases with low vaccination coverage. Unlike other health interventions, vaccination is a benefit that goes beyond the individual and reaches the community. More than a right, it is presented as a duty of the State and of every citizen²².

The increase in this condition among young people and adults corroborates what is known about the effectiveness of immunization – it is not permanent, it reaches its peak after one year of vaccination and it tends to disappear 10 years later. Considering both the most affected population and the one whose immunization has lost its validity,

the importance of further qualifying primary care professionals to identify cases early, avoiding the spread of the disease becomes evident. The same measure can help the appropriate referral to vaccination of pregnant women and postpartum women, to ensure the immunization of babies.

For a long time, the Federal District had a higher incidence coefficient than Brazil. However, from 2015 on, rates were below the national scenario. This drop was probably related to the introduction of the DTPa vaccine for pregnant women in the country in November 2014, and to the above-national vaccination coverage of Brasília in the two subsequent years.

As for applied ethics, the DTPa vaccine for pregnant women can also be related to the bioethics of protection, which applies to any moral patient who is unable to defend himself or to act autonomously for any reason independent of his will. The decreased incidence demonstrates the importance of vaccination to ensure access to health for the population, especially the most vulnerable²³.

The clinical picture in older people is sometimes milder; many have probably not been identified or reported, but this does not prevent transmission of the bacteria to susceptible groups. Thus, it is essential to intensify attention to identify these cases, as well as informing the population about the main and most evident characteristics of the disease, allowing people to be more responsible for their self-care.

Laboratory research is far from collecting samples in 80% of notified cases, the goal recommended by the MS. In addition to confirming suspicions, tests are also essential to identify intimate communicators, some with clinical features not always evident. This result confirms the importance of early detection and allows us to understand points that should be improved in health services to achieve greater effectiveness in the control of communicable diseases.

Pertussis vaccination remains the main measure of prevention and control of the disease. It is recommended to constantly monitor the

vaccination coverage of the population, in order to ensure the completion of the recommended scheme for children under 1 year, the application of booster doses, and immunization of pregnant women and postpartum women. In case of a suspicious case, the individual's isolation is prioritized until the hypothesis is discarded or five days after the antibiotic treatment is started. It is essential to identify intimate communicators and perform vaccination and chemoprophylaxis when necessary.

The difficulty to analyze some variables found in this study stems from the lack of information or incorrect completion of certain fields of the notification form. This demonstrates that it is indispensable for the professional to be attentive when completing the form, as the quality of the recorded data directly influences the monitoring, evaluation, planning and implementation of prevention and control measures.

From the results presented, it is clear that adhering to the most advanced vaccination parameters and constantly improving them are the most effective prophylactic measures in public health, also meeting the principles of equity and citizenship prescribed for SUS and reinforced by the values of bioethics. The immunization policy must be supported and continuously reinforced to protect all Brazilians from preventable diseases, enabling them the health necessary to fight for quality of life. To emphatically support this policy is to combat the anti-vaccine perspective that has plagued many countries, including Brazil, by turning them back in their efforts to eliminate communicable diseases.

By briefly relating these results to the principles and values of bioethics, we seek to reiterate the importance of the current immunization policy in the country. By adding to the epidemiological considerations technical propositions of applied ethics that reinforce the legitimacy of vaccination as a fundamental public health framework, bioethics broadens the analytical dimension, contributing to the improvement of the discussion.

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