Original Article

Hospitalizations of children for preventable conditions in the state of Parana: causes and trends

Hospitalizações de crianças por condições evitáveis no Estado do Paraná: causas e tendência

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Abstract

Objective: To analyze the trends of hospitalizations for ambulatory care-sensitive conditions, according to the main causes among children under five years old.

Method: Ecological time-series study carried out with data from the Hospital Information System of the State of Parana. The analysis was based on hospitalization rates and polynomial regression models according to age and cause.

Results: The most frequent causes were pneumonia, gastroenteritis, asthma, kidney and urinary tract infection and nutritional disorders. Hospitalizations for pneumonia, asthma and nutritional deficiencies decreased among children under five and hospitalizations rates for gastroenteritis remained stable. There was an increase in hospitalization rates for kidney and urinary tract infection in all ages.

Conclusion: Hospitalization for care-sensitive conditions among children under five years presented an increasing trend only for children under one year old. Hospitalizations for pneumonia, gastroenteritis, asthma and nutritional deficiencies showed a decreasing trend.

Resumo

Objetivo: Analisar a tendência das hospitalizações por condições sensíveis à atenção primária, segundo principais causas em menores de cinco anos.

Métodos: Estudo de séries temporais do tipo ecológico realizado com dados do Sistema de Informação Hospitalar do Estado do Paraná. A análise ocorreu a partir das taxas de hospitalização e de modelos de regressão polinomial segundo idade e causa.

Resultados: As causas mais frequentes foram pneumonias, gastrenterites, asma, infeção no rim e trato urinário e deficiências nutricionais. As hospitalizações por pneumonia, asma e deficiências nutricionais em menores de cinco anos reduziram e por gastroenterites mantiveram-se estáveis. Houve aumento nas taxas de hospitalização por infecção no rim e trato urinário em todas as idades.

Conclusão: A tendência de hospitalização por condições sensíveis em menores de cinco anos foi crescente apenas para as crianças menores de um ano. As hospitalizações por pneumonias, gastroenterites, asma e deficiências nutricionais apresentaram tendência decrescente.

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Introduction

Ambulatory Care-Sensitive Conditions - ACSC are conditions that can be managed through an adequate assistance in the Primary Health Care – PHC.[1] Hospitalizations for these conditions are understood as preventable, since the causes should be handled at a primary level of care. Therefore, these hospitalizations have been widely used as indicators of the impact of public policies and the accessibility and quality of basic health services.[1-3]

In the field of child health, hospitalizations for ACSC indicate poor attention in primary care, especially since children are considered a priority due to their susceptibility to illness.[4] The importance of primary care for the prevention of hospitalizations is emphasized in several studies, such as one conducted in the United States, which concluded that children who were attended by ambulatory care teams with preventive actions and early detection of health problems had a significant reduction in hospitalization.[5] In Brazil, hospitalizations of children for ACSC still have a high incidence.[6]

Data on the main causes and the trends of hospitalizations for ACSC contribute to support managers and health professionals, especially nurses, in planning and implementing actions to combat the most frequent diseases that affect this population and that can be treated in PHC, thus preventing unnecessary hospitalizations.[3]

An important Brazilian tool that professionals can use to find data on these hospitalizations is the Hospital Information System (SIH-SUS). The SIH-SUS provides reliable data for epidemiological analysis, mainly due to the advantage of covering the entire national territory and all hospitalizations funded by the public health sector.[7] This source is useful for health professionals and managers and includes data on the impact of hospitalizations for ACSC in the country. A survey conducted in the western region of the State of Paraná using data from the SIH-SUS identified that 55.6% of hospitalizations were for respiratory problems, 14.8% for infectious and parasitic diseases and 12.9% for diseases in the perinatal period, all ambulatory care-sensitive conditions.[7]

This study was proposed considering the priority of child health and the need to indirectly assess the quality of primary care and the availability of a safe data source, so that actions can be better targeted. Up to the present no other research was conducted on the causes, behavior and trends of hospitalizations of children for ACSC over the last years in the State of Paraná.

Thus, this study aimed to analyze the main causes and the trends of hospitalizations for ACSC among children under five years of age living in the State of Paraná - Brazil from 2000 to 2015.

Methods

This is an ecological time-series study based on all hospitalizations of children under five years of age residing in the State of Paraná - Brazil, occurred between 2000 and 2015 and funded by the Unified Health System - SUS. The data used are available in the SIH-SUS, a tool that systematizes information from the Authorization for Hospital Admission (AHA), a document based on the medical report and filled at the time of hospitalization. The data were arranged using the official software of the Ministry of Health - Tabwin and are available according to the month and the year. Therefore, twelve files were obtained for each year of the study.

After the selection of all hospitalizations in the State of Paraná, hospitalizations of children under 5 years of age were identified, extension AHAs were excluded (type 5 AHA), residence addresses were confirmed and the hospitalization diagnoses were classified (Figure 1).

The Brazilian National List of Ambulatory Care-Sensitive Conditions - LCSAP, composed of 19 diagnosis-related groups based on the 10th revision of the International Classification of Diseases - ICD 10, was used to select the diagnoses of interest: vaccine-preventable diseases and avoidable condi-

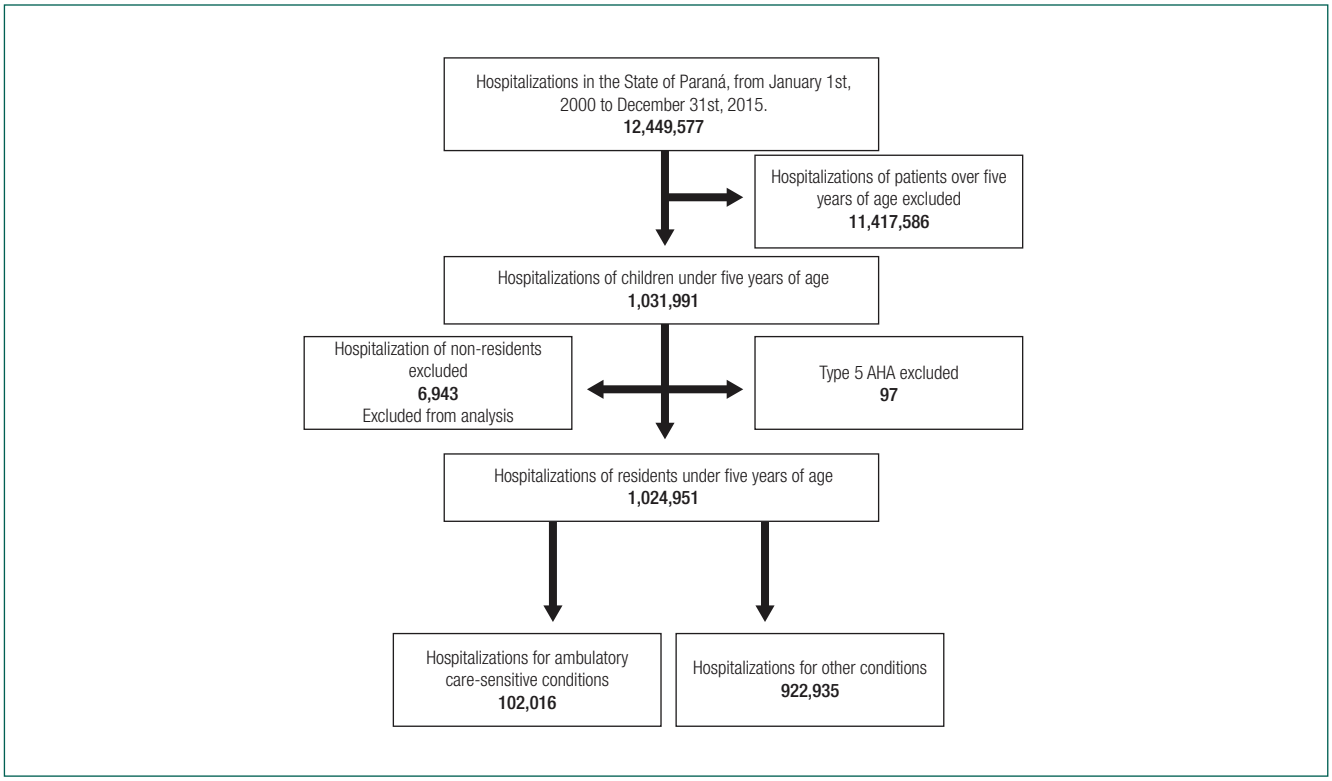

Figure 1. Process of identification of hospitalizations of children under five years of age

tions (A33-A37, A95, B16, B05-B06, B26, G00.0, A17.0, A19, A15-A16, A18, A17.1-A17.9, I00-I02, A51-A53, B50-B54, B77), infectious gastroenteritis and its complications (E86, A00-A09), anemia (D50), nutritional deficiencies (E40-E46, E50-E64), infections of the ear, nose and throat (H66, J00-J03, J06, J31), bacterial pneumonia (J13-J14, J15.3-J15.4, J15.8-J15.9, J18.1), asthma (J45-J46), lower respiratory diseases (J20, J21, J40-J44, J47), hypertension (I10-I11), angina pectoris (I20), cardiac insufficiency (I50, J81), cerebrovascular conditions (I63-I67, I69, G45-G46), diabetes *mellitus* (E10-E14), epilepsies (G40-G41), kidney and urinary tract infections (N10-N12, N30, N34, N39.0), skin and subcutaneous tissue infections (A46, L01-L04, L08), pelvic inflammatory disease in females (N70-N73, N75-N76), gastrointestinal ulcer (K25-K28, K92.0, K92.1, K92.2) and conditions related to prenatal care and childbirth (O23, A50, P35.0).

Hospital morbidity was analyzed by absolute and relative frequencies, for three years. Trends were calculated based on hospitalization rates (per 10,000 inhabitants of each age group). The censuses and estimates of the Brazilian Institute of Geography and Statistics (IBGE) were used as data source of the resident population between the years of 2000 and 2012. For the years of 2013 to 2015 statistical projections were calculated. Polynomial regression models were constructed according to age and cause of hospitalization.

The hospitalization rate was considered as dependent variable (Y) and the calendar years as independent variable (X). The variable year was transformed into the variable year-centered, that is, X= Year - 2007, the midpoint of the time-series, and the simple linear regression models ($Y=\beta 0+\beta_1 X$), the second-degree models ($Y=\beta_0+\beta_1 X+\beta_2 X^2$) and the third degree models ($Y=\beta_0+\beta_1 X+\beta_2 X^2+\beta_3 X^3$) were tested. Scatter diagrams were constructed considering rates and calendar years to identify the most appropriate function. A trend in which the estimated model presented $p<0.05$ was considered significant and the parsimony principle was taken into account when two models were statistically similar. The Excel® software was used for organization of the data and calculation of hospitalization rates and the

Statistical Package for the Social Sciences® - SPSS 18.0 software was used for statistical analysis.

The study did not name the hospitalized children; therefore, exemption from the consent form was requested. The research project was submitted to the Research Ethics Committee of the Universidade Estadual de Maringá-UEM and exempted from analysis under the number 038/2012, due to the nature of the research and the design using exclusively secondary and public access data.

Results

From 2000 to 2015, 1,024,951 hospitalizations of children under five years of age occurred in Paraná. 9.9% (102,016) of them were for ACSC, of which 1.1% (1,160) were of patients under one year of age, 66.1% (67,444) of patients one and two years old and 32.8% (33,412) of patients three and four years old. The five main diagnoses of hospitalization for ACSC among children under five in the four trienniums assessed were bacterial pneumonia (38.4%), gastroenteritis (35.8%), asthma (8.8%), kidney and urinary tract infection (7.4%) and nutritional deficiencies (3.8%). Considering the first and last trienniums, the number of hospitalizations for kidney infection increased (8.3%), whereas for pneumonia, the number decreased (-6.9%). The hospitalization rates for pneumonia presented oscillations, with an increase in the second triennium (8.6%) and a subsequent decrease (9.0%), and after 2007 it became the second leading cause of hospitalization in children from Paraná, only behind gastroenteritis. Asthma remained as the third leading cause until 2007, and then it became the fourth after kidney and urinary tract infection. There was a 4.1% reduction in the percentage of hospitalizations due to nutritional deficiencies and a 7.8% increase in the proportion of pulmonary diseases (Table 1).

Rates of hospitalizations for all care-sensitive conditions decreased ($r^2 = 0.39$; p=0.016). The analysis by age group showed differentiated patterns, with increase for children under one year old ($r^2 = 0.38$; p=0.017), decrease for children aged one to two years old ($r^2 = 0.58$; p=0.001) and stability for children aged three to four years ($r^2 = 0.01$; p=0.713). The trends of hospitalization for pneumonia, gastroenteritis and nutritional deficiencies were different according to the age groups investigated. The rates of hospitalization for pneumonia decreased for children aged one to four years and remained stable for children younger than one year old ($r^2 = 0.20$, p= 0.633). Rates of hospitalization for gastroenteritis decreased for children aged one to two years and remained stable in the other age groups. In all age groups asthma presented a decrease and kidney and

Table 1. Hospitalizations of children under five years of age (no. and %) for care-sensitive conditions, according to main diagnosis, per triennium

Care-sensitive conditions groups	n(%)	n(%)	n(%)	n(%)
Bacterial pneumonia	10721(37.2)	13726(45.8)	8788(36.8)	5890(30.4)
Gastroenteritis and complications	10595(36.8)	10100(33.7)	8848(37.1)	6989(36.1)
Asthma	3299(11.5)	2803(9.4)	1565(6.6)	1280(6.6)
Kidney and urinary tract infections	1348(4.7)	1642(5.5)	2013(8.4)	2518(13.0)
Nutritional deficiencies	1875(6.5)	980(3.3)	587(2.5)	462(2.4)
Respiratory diseases	198(0.7)	48(0.2)	1132(4.7)	1642(8.5)
Diabetes *mellitus*	202(0.7)	206(0.7)	313(1.3)	254(1.3)
Skin and subcutaneous tissue infections	268(0.9)	172(0.6)	210(0.9)	117(0.6)
Vaccine-preventable diseases and preventable conditions	52(0.2)	105(0.4)	180(0.8)	19(0.1)
Gastrointestinal ulcer	106(0.4)	58(0.2)	51(0.2)	74(0.4)
Hypertension	16(0.1)	28(0.1)	83(0.4)	52(0.3)
Conditions related to prenatal care and childbirth	74(0.3)	47(0.2)	46(0.2)	9(0.1)
Cerebrovascular conditions	21(0.1)	54(0.2)	36(0.2)	56(0.3)
Cardiad insufficiency	9(0.0)	5(0.0)	15(0.1)	10(0.1)
infections of the ear, nose and throat	2(0.0)	1(0.0)	8(0.0)	8(0.0)
Total	28786(100.0)	29975(100.0)	23875(100.0)	19380(100.0)

urinary tract infection an increase. The percentage variation of kidney and urinary tract infection was higher for children aged three to four years, going from 2.97 in 2000 to 9.18 in 2015, an increase of 208.47%. On the other hand, the rate with the greatest decrease was nutritional deficiencies, which went from 4.18 to 0.75, a reduction of 81.89%. (Table 2).

Table 2. Trends in hospitalizations for ambulatory care-sensitive conditions, according to main diagnosis and age

Age	Model*	r^{2}**	p-value	Trend
	All ambulatory care-sensitive conditions			
< 1 year	y= 4.85 + 0.24 x	0.38	0.017	Increasing
1-2 years	y= 141.17 – 2.65 x	0.58	0.001	Decreasing
3-4 years	y= 63.48 – 0.11 x	0.01	0.713	Stable
< 5 years	y= 79.10 – 1.09x	0.39	0.016	Decreasing
	Bacterial pneumonia			
<1 year	y= 1.488 + 0.012x	0.20	0.633	Stable
1-2 years	y= 54.20 – 2.06x	0.41	0.013	Decreasing
3-4 years	y= 22.99 – 0.71x	0.38	0.019	Decreasing
< 5 years	y= 31.01 – 1.11x	0.40	0.014	Decresasing
	Gastroenteritis			
< 1 year	y= 0.57+ 0.01 x	0.07	0.334	Stable
1-2 years	y= 47.38- 0.84 x	0.45	0.009	Decreasing
3-4 years	y= 22.61+ 0.27 x	0.25	0.066	Stable
< 5 years	y= 27.97 – 0.02x	0.15	0.160	Stable
	Asthma			
< 1 year	y= 0.193- 0.01 x	0.45	0.007	Decreasing
1-2 years	y=10.56 – 0.71x	0.85	<0.001	Decreasing
3-4 years	y= 6.34 – 0.39 x	0.75	<0.001	Decreasing
< 5 years	y= 6.79 – 0.44 x	0.82	<0.001	Decreasing
	Kidney and urinary tract infections			
<1 year	y=0.63 + 0.08x	0.84	<0.001	Crescente
1-2 years	y=8.12 + 0.64x	0.94	<0.001	Crescente
3-4 years	y=5.74 + 0.44x	0.92	<0.001	Crescente
< 5 years	y=5.66+0.44x	0.95	<0.001	Crescente
	Nutritional deficiencies			
<1 year	y=0.25 + 0.03x	0.84	<0.001	Crescente
1-2 years	y=5.46 – 0.56x	0.86	<0.001	Decrescente
3-4 years	y=1.63 – 0.13x	0.72	<0.001	Decrescente
< 5 years	y=2.86 – 0.27x	0.83	<0.001	Decrescente

*Model y= hospitalization rate (per 10.000); x= estimate year - 2007; **r^{2}= coefficient of determination

Discussion

The main causes of hospitalization for ACSC among children under five were pneumonia, gastroenteritis, asthma, kidney and urinary tract infection, and nutritional deficiencies.

Considering the age group, the results showed that hospitalizations for care-sensitive conditions had an increasing trend among children under one year old. This was the only age group that presented an increase in hospitalizations for nutritional deficiencies and stability in hospitalizations for pneumonia. Considering the substantial number of health programs and policies for infants, especially those under one year of age, the results showed that the actions did not have an impact on the reduction of ambulatory care-sensitive conditions.

Discontinuation of breastfeeding, introduction of the child in group settings, such as schools and day care centers, and their immunological system which is still in development, may be reasons that increase the exposure of infants to risk factors for illnesses such as respiratory diseases, infectious diseases and nutritional deficiencies, which are included in the ACSC group. However, all these aspects can be worked out in primary health care.

The childcare consultation is one of the possible vigilance actions; it is instituted in several health policies and it is critical to the child's healthy growth and development, especially for children under one year of age. It is a systematic follow-up in which the physician or nurse conducts detailed clinical examination, guides the family about the proper care for each age and teaches how to identify signs and symptoms of the most common childhood illnesses. Childcare facilitates the contact of the child's family with the primary care team and, if done properly, should result in the reduction of hospitalizations for care-sensitive conditions.

The trend analysis revealed a decrease in hospitalizations for all care-sensitive conditions among children under five and children aged one to two years, and stability in hospitalizations among children aged three to four years. This stable trends is considered a negative result of public health policies, since primary health care is regarded as essential to prevent and treat these health problems, especially in the most vulnerable populations, such as children under five years of age.[8]

It is important to note that several factors may have influenced this result. Health practices are not

totally dependent on primary care services. Other factors such as family experiences and habits are determining factors in the process. However, it is essential to stress the importance of the healthcare team's efforts to maintain relationships with the families they attend and, based on that, provide guidance on the early signs and correct treatment of childhood illnesses.

There was a decrease in hospitalizations for pneumonia among children aged one to four years. Respiratory diseases are some of the main causes of hospitalization of children, which was also identified in this study. A recent study comparing rates of hospitalization for pneumonia among children under 4 years of age before and after the adoption of pneumococcal vaccination in Brazil identified a 12.65% decrease and a decreasing trend, demonstrating the efficacy of the vaccine on Brazilian public health.[9]

The main respiratory diseases that affect children's health have known risk factors, such as exposure to smoking and household overcrowding.[10,11] In the presence of factors that contribute to the onset of respiratory diseases, the healthcare team can plan measures for prevention and control of these diseases. These measures must be continuously implemented and evaluated, since table 1 showed an increase in the number of hospitalizations for pulmonary diseases, which includes bronchitis, bronchiectasis and other chronic obstructive pulmonary diseases. However, this increase may also be related to the already mentioned negative aspects of the information system.

Hospitalizations for gastroenteritis remained stable among children under one year of age and for children aged three to four years, and presented a decrease among children aged one to two years. Gastroenteritis is another important ACSC and a cause of morbidity in the world. However, most cases are of mild intensity and would mostly not lead to hospitalization if there was a proper resolution in primary care.[12]

In addition, several actions were implemented to help reduce the incidence of this condition, such as the rotavirus vaccination, implemented in Brazil in the mid-2000s, and the expansion of basic sanitation, which contributed to the reduction of cases, as demonstrated by a study carried out in a large urban center in Brazil.[13] A study conducted in the state of Bahia found a reduction in hospitalization for gastroenteritis among children, and the expansion of health and basic sanitation services was associated with the decrease.[14]

Asthma appears as the third leading cause of hospitalizations for care-sensitive conditions among children under five years of age. Several studies show the impact of asthma on children's health and the importance of nurses providing health education to control the disease.[15,16] A study conducted in China showed an increase in the prevalence of childhood asthma, which indicates the need to control the disease and reduce hospitalizations.[17]

A decrease in hospitalizations for asthma was found among all age groups of the study. Asthma is relevant because it is one of the main childhood diseases, demanding special attention from the healthcare team for its control. A study conducted in the United States demonstrated the importance of the nurses' work in asthma programs, in which these professionals follow the evolution of the acute condition and assist in deciding the most appropriate treatment for each child.[18]

Rates of hospitalizations for nutritional deficiencies, as well as asthma, presented a reduction among children aged one to four years. This is a positive aspect identified in the study. Nutritional deficiencies were a cause of infant morbidity and mortality for many years. However, the reorganization of the health system in Brazil, the increased level of education of mothers and socioeconomic improvements are aspects that may have influenced this result.[19] However, despite the good results, children under one year old still remain vulnerable to this condition.

Another factor worth mentioning is the increase in hospitalizations for kidney and urinary tract infections, observed in all age groups. A study carried out with the population of Brazil identified an increase in admissions for kidney and urinary tract infection between 1998 and 2009.[20] In the State of São Paulo, kidney and

urinary tract infections were more frequent in children under one year old. These conditions were the third leading cause of hospitalizations in 2006 and 2007 (6.86% and 9.33%, respectively) and the second leading cause in 2008 (14.63%) among that age group.[21]

Kidney and urinary tract problems are common in childhood, and the main factors that contribute to their occurrence are hygiene habits and the anatomy of the genitalia.[22] However, signs that show early manifestation of urinary diseases may be easily identified and managed by the family and health care team through proper inspection and hygiene of the genitals, adequate nutrition and hydration, and in case of illness, hospitalizations can be prevented through proper early treatment in primary care.

Nurses play a key role in the context of hospitalizations for care-sensitive conditions. The performance of these professionals as health care providers is demonstrated in studies that point to the importance of nurses in the management of care. Nurses are responsible for monitoring the child's health, which allows the detection of the diseases and a proper and early assistance, thus avoiding hospitalization. In addition, as a primary care professional, the nurse must train team members to identify risk factors and cases of respiratory and infectious diseases.

Regarding the team, the work of the primary care professionals and the bond that they develop with the population have an impact on the reduction of hospitalizations for care-sensitive conditions, since they provide health surveillance, early detection of major diseases and treatment and control of their causes.[23]

The assessment of ambulatory care-sensitive hospitalization rates may provide an understanding of the effectiveness and the quality of the care provided in this area. The use of information systems in Brazil, especially the SIH-SUS, has an important impact in the area of epidemiology, since they enable this monitoring, which represents the work of the health services and morbidity trends. Therefore, the results of the present study demonstrated the real evolution of hospitalizations of children under five years. In addition, the results can guide actions of the healthcare professionals and public policies for the treatment of children in primary care, mainly targeting the main illnesses.

The limitations of the surveys that use the SIH-SUS are related to the reliability of the information obtained. The system is filled in a decentralized way, and each hospital unit enters the records of hospitalizations. In addition, the SIH-SUS data determines the funding given to hospitals and, for this reason, mistaken system insertions may occur.

However, the results of epidemiological studies that use the SIH-SUS represents publicly funded hospitalizations, and the large number of registered hospitalizations contributes to minimize the possible errors. In several localities, secondary data sources have been used to study hospitalizations in large populations,[24,25] including children.[2,4]

Conclusion

Trend analysis showed that hospitalizations for pneumonia, asthma, and nutritional deficiencies presented a decrease and hospitalizations for gastroenteritis remained stable among children under five years of age. There was an increase in hospitalization rates for kidney and urinary tract infection among all age groups assessed.

Collaborations

Prezotto KH, Lentsck MH, Aidar T, Fertonani HP and Mathias TAF declare that they contributed to the conception of the project, the analysis and interpretation of data, the writing of the article, the critical review of intellectual content and the final approval of the version to be published.

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