

## Number of health care teams and hospitalizations due to primary care sensitive conditions

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**Abstract** *This study aimed to analyze the correlation between the number of health care teams of the Family Health Strategy (FHS) and the number of hospitalizations due to primary care sensitive conditions (HPCSC) taking into account rates, costs and hospital days in a large municipality of the state of Minas Gerais, Brazil, between 2010 and 2019. We performed an ecological time series correlation study on HPCSC of patients hospitalized by the public health system. Data were obtained from the Hospital Information System of the IT Department of the Public Health System (DATASUS) and from the Primary Care Information and Management System. The correlation analysis was performed based on the number, gross and standardized rates, percentages, costs and hospital days of HPCSC and health care coverage (average number of teams) using Spearman's correlation coefficient at a significance level of 5% ( $p < 0.05$ ). No satisfactory correlation was found in the entire period between the increase in the number of health care teams and HPCSC (except for the standardized hospitalization rate). However, during the period in which the FHS coverage of the population was greater than 70%, all correlations were inversely proportional and statistically significant.*

**Key words** *Hospitalization, Health care quality, Access and evaluation, Primary health care, Family Health Strategy*

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## Introduction

Hospitalizations due to Primary Care Sensitive Conditions (HPCSC) are an important managerial indicator used in Brazil and in some other countries to evaluate, in a complementary way, the accessibility and resolution capacity of Primary Health Care (PHC) teams<sup>1,2</sup>. Originally called *Ambulatory Care Sensitive Conditions*, this indicator was developed in the 1990s in the United States. It started to be officially used in Brazil when a specific list was created that records clinical conditions which may cause serious issues of access to the health system or its performance when high rates of hospitalizations in a given population or one of its subgroups are observed<sup>3</sup>.

Excess of HPCSC is a warning signal which may trigger mechanisms of analysis and a search for explanations for its occurrence to identify opportunities for intervention by managers and health professionals. Studies show that high rates of hospitalizations due to primary care sensitive conditions are associated with deficiencies in service coverage and/or a low trouble-shooting capacity in primary care of certain health issues<sup>1,4</sup>. In principle, an increase in the coverage rates of PHC teams, represented in Brazil by the Family Health Strategy (FHS) teams, should result in a decrease in HPCSC rates and their costs<sup>5,6</sup>.

Using the HPCSC indicator prompts us to think about timely access to health services, but also on the service quality of health teams at the first level of care. According to our literature review, Nedel *et al.* highlight primary care features associated with HPCSC, pointing out that some attributes of PHC are strictly related to lower hospitalization rates<sup>1</sup>. Indeed, in addition to access, care coordination, care comprehensiveness, and care continuity have the potential to be associated with lower HPCSC rates.

Some studies evaluated the development of HPCSC rates and proportions in certain regions over time and obtained divergent results regarding the correlation between population coverage by PHC teams and a decrease in HPCSC<sup>7,8</sup>. These results show that the relationship between assessed parameters needs to be better studied and that some aspects that may interfere in the analysis and interpretation of the results need to be standardized. The global analysis by health regions, for example, may produce invalid results if very different coverage rates among municipalities are included in the analysis. No study was found that evaluates both the coverage rate and possible correlations with the number of teams,

a fact that represents greater robustness and an important feature for that kind of studies.

Due to the complex relationships that involve the work of the FHS teams and HPCSC, especially one question guided the development of this study: *What would be the effect caused by an increase in the number of FHS teams and the coverage percentage of the population assisted by these teams on the number, percentage and costs of HPCSC?* By evaluating the relationship between these parameters more accurately, this study aimed to analyze the correlation between the number of FHS health teams and the number of HPCSC, including rates, costs and hospital days of patients admitted to the public health system in a large municipality of the state of Minas Gerais, Brazil over ten years.

## Methods

This is an ecological study of a time series trend analysis of HPCSC of patients living in the city of Montes Claros, north of Minas Gerais from 2010 to 2019. The city's health infrastructure consists of eight accredited hospitals of low, medium and high complexity which provide a total of 963 inpatient beds, 72.9% of which are destined to the Public Health System (SUS). The basic health network has broad population coverage that includes, in addition to Family Health teams, 106 Oral Health teams, 20 vaccine rooms, a Street Doctor's Practice team, five Health Gyms, 31 pharmacies and four nocturnal emergency care units. This study is based on records from the Hospital Information System of the IT Department of the Public Health System (DATASUS) and from the Primary Care Information and Management System.

The assessed municipality presented a growing number of FHS teams during the examined period. It has a wide hospital network that provides assistance to all its residents and only a negligible number of hospitalizations take place in other cities, which is a unique opportunity to evaluate the effects of the expansion of the FHS on HPCSC. Data on population was obtained from the Brazilian Institute of Geography and Statistics (IBGE). The average number of teams per year and the annual population coverage rate by the FHS were obtained from the Department of Primary Care (DPC) of Brazil's Ministry of Health.

Our database contained the following variables: municipal hospitals (identification and

municipality of location), patients (place of residence or postal address) and hospitalizations per se (date of hospitalization, date of discharge, main diagnosis, outcome, total amount paid by SUS and amount paid for using the intensive care unit – ICU). Each hospitalization was classified as either HPCSC or non-HPCSC, according to the National List of Primary Care Sensitive Conditions<sup>3</sup>.

Information obtained from the Hospital Admission Authorization (HAA) records were extracted and processed using the Tabwin (version 4.15) software program and later exported to Microsoft Excel and IBM-SPSS software programs for data analysis. The following indicators were calculated: financial costs of the total number of hospitalizations for general causes, financial costs of the total number of HPCSC, hospital stay due to general causes in days and hospital stay due to HPCSC in days. In this study, financial data were updated according to the current inflation rate of the Broad Consumer Price Index (IPCA) issued by the Brazilian Institute of Geography and Statistics (IBGE).

Hospitalization rates were calculated considering the quotient of the ratio between the number of hospitalizations in all hospitals for one year and the population of the municipality of that respective year, multiplied by one thousand. Rates were then adjusted (direct adjustment) by using the age structure of the standardized population of the state of Minas Gerais as a reference. Adjusted rates are summary-measures that take into account and remove the potential confounding effect of variables that may be particularities of the evaluated group. By defining the standardized population of the entire state of Minas Gerais, we aimed to remove the effect of possible variables or particularities of the local population.

The correlation between hospitalization parameters (rates, percentages, costs and hospital days) and care coverage (average number of teams) was analyzed based on Spearman's rank correlation coefficient, assuming a significance level of 5% ( $p < 0.05$ ).

This study was not submitted to any Research Ethics Committee because it relied on secondary data that belong to the public domain and was made available by the Brazilian Ministry of Health.

## Results

The total number of hospitalizations showed a slight increase over the analyzed time period. Small fluctuations were recorded both in the rates of hospitalizations due to general conditions (non-HPCSC) and of hospitalizations due to primary care sensitive conditions (HPCSC). The highest standardized rate of hospitalizations due to general conditions was 48.49/1,000 inhabitants in 2014, whereas the highest standardized rate of HPCSC was 10.56/1,000 inhabitants in 2012 (Table 1).

Regarding amounts paid by SUS for all hospitalizations that took place in the municipality and exclusively for its residents, there was a progressive increase until 2015. After that, amounts showed a decreasing trend, except for the last year of the series. Regarding HPCSC, amounts behaved in an irregular way and oscillated throughout the series. The number of hospital days generated by all hospitalizations followed the cost pattern and the highest number of hospital days was recorded in 2015. The analysis of the number of HPCSC hospital days showed an increase until 2014, but then a downward trend, except for an increase in 2017. Regarding the percentage of amounts paid for HPCSC in relation to the total number of hospitalizations, there was an increase in the first three years of the series, followed by a downward trend that was interrupted by an increase in amounts 2017. Percentages of hospital days increased until 2013, followed by a slump that was interrupted by an increase from 2017 (Table 2).

The average number of FHS teams operating in the municipality per month increased in the studied period, reaching a coverage rate above 70% from 2013 and above 100% from 2015. The number of HPCSC, the number of hospital days that result from them and the amounts paid by SUS for them varied only slightly over ten years (Table 3).

Correlation between the number of teams each year and the hospital indicators was performed considering both the entire period (2010 to 2019) and the period in which the FHS population coverage exceeded 70% (2013 to 2019). The first period showed a negative and significant correlation between the number of teams and the HPCSC rate. The period in which FHS coverage exceeded 70% showed large, negative and significant correlations between the number of teams and the HPCSC rate ( $p = 0.003$ ), the amounts paid ( $p = 0.003$ ) and the number of

hospital days per HPCSC ( $p = 0.007$ ). Although no significant correlation with the number of HPCSC was found during that period, the correlation coefficient shows a fairly close trend ( $p = 0.052$ ) (Table 4).

## Discussion

Correlation analysis of the number of FHS teams and hospital care indicators related to HPCSC produced two different results. The first one, when comparing the entire period, shows no substantial correlation with the increase in

**Table 1.** Distribution of the number and rates of general hospitalizations and hospitalizations due to primary care sensitive conditions (HPCSC) in Montes Claros (MG); 2010-2019.

Year	Population	Total number of hospitalizations	Number of non-HPCSC hospitalizations	Number of HPCSC hospitalizations	Non-HPCSC gross rate*	HPCSC gross rate*	Non-HPCSC standardized rate*	HPCSC standardized rate*
2010	363,227	21,886	18,299	3,587	50.38	9.88	44.33	8.69
2011	361,915	23,417	19,286	4,131	53.29	11.41	46.89	10.04
2012	366,134	23,335	18,943	4,392	51.74	12.00	45.53	10.56
2013	370,216	24,237	19,982	4,255	53.97	11.49	47.50	10.11
2014	385,898	25,350	21,264	4,086	55.10	10.59	48.49	9.32
2015	390,212	25,101	21,095	4,006	54.06	10.27	47.57	9.03
2016	394,350	25,621	21,578	4,043	54.72	10.25	48.15	9.02
2017	394,350	22,917	19,021	3,896	48.23	9.88	42.45	8.69
2018	402,027	24,306	20,411	3,895	50.77	9.69	44.68	8.53
2019	404,084	24,781	20,827	3,954	51.54	9.79	45.36	8.61

\* Rate per thousand inhabitants.

Source: Authors.

**Table 2.** Distribution of hospital admissions amounts paid by the Public Health System and corresponding number of hospital admissions and hospital days per year in Montes Claros, Minas Gerais, from 2010 to 2019.

Year	Global amounts of hospitalizations (BRL)	HPCSC amounts* (BRL)	Number of hospital days generated by general hospitalizations	Number of hospital days generated by HPCSC*	Percentage of HPCSC amounts* in relation to general hospitalizations	Percentages of hospital days due to HPCSC* in relation to general hospitalizations
2010	48,193,162.53	9,902,490.95	126,264	24,471	20.55%	19.38%
2011	52,325,959.21	12,074,201.97	136,800	29,207	23.07%	21.35%
2012	50,591,102.69	11,948,805.80	131,015	30,666	23.62%	23.41%
2013	49,376,080.49	10,332,389.77	129,673	31,798	20.93%	24.52%
2014	51,659,279.59	10,174,634.10	137,756	32,729	19.70%	23.76%
2015	48,739,196.46	9,070,340.93	138,621	31,704	18.61%	22.87%
2016	43,857,258.91	7,844,955.17	138,052	30,943	17.89%	22.41%
2017	39,675,727.48	7,710,120.70	129,230	31,405	19.43%	24.30%
2018	36,592,875.40	6,770,109.19	125,004	28,406	18.50%	22.72%
2019	35,289,587.90	6,536,530.47	123,393	27,802	18.52%	22.53%

\* HPCSC: Hospitalizations due to primary care sensitive conditions.

Source: Authors.

the number of teams on HPCSC (except for the standardized rate of hospitalizations). However, if we evaluate only the period in which the population coverage by the FHS is greater than 70%, there are important correlations that point to the interdependence between an increasing number of teams and the reduction of the hospitalization rate, the amounts paid and even the number of hospital days generated by HPCSC.

Expansion of FHS coverage in the municipality proved to be important during the study

period, as an increase in the number of teams was observed even after reaching 100% coverage. That coverage expansion behavior was observed in Brazil by the Family Health Expansion and Consolidation Program (PROESF) which supported, through specific funding, the expansion, qualification and consolidation of the FHS in municipalities with more than 100 thousand inhabitants but which did not always produce uniform results<sup>9</sup>. Regarding Brazil in general, the number of FHS teams increased from 2,054 in

**Table 3.** Evolution of the average number and coverage rate of Family Health Strategy teams and behavior of the number, rates and amounts paid for hospitalizations due to primary care sensitive conditions (HPCSC) in Montes Claros (MG); 2010-2019.

Year	Population	Average number of FHS teams*	Percentage of FHS coverage	Number of HPCSC hospitalizations**	Standardized rate of HPCSC***	Number of hospital days generated by HPCSC	HPCSC amounts (BRL)
2010	363.227	58,8	55,9	3.587	8,69	24.471	9.902.490,95
2011	361.915	60,5	57,7	4.131	10,04	29.207	12.074.201,97
2012	366.134	67,9	64,0	4.392	10,56	30.666	11.948.805,80
2013	370.216	75,4	70,3	4.255	10,11	31.798	10.332.389,77
2014	385.898	86,41	77,3	4.086	9,32	32.729	10.174.634,10
2015	390.212	112,4	100	4.006	9,03	31.704	9.070.340,93
2016	394.350	128,8	100	4.043	9,02	30.943	7.844.955,17
2017	394.350	126,5	100	3.896	8,69	31.405	7.710.120,70
2018	402.027	131,2	100	3.895	8,53	28.406	6.770.109,19
2019	404.084	134,5	100	3.954	8,61	27.802	6.536.530,47

\* Family Health Strategy; \*\* hospitalizations due to primary care sensitive conditions; \*\*\* FHS coverage rate took into account that a single team would serve 3,000 people; \*\*\*\* rate per thousand inhabitants.

Source: Authors.

**Table 4.** Correlation between the number of FHS teams and hospital care indicators for Hospitalizations due to Primary Care Sensitive Conditions in Montes Claros (MG); 2010-2019.

	Year	Number of HPCSC** hospitalizations	HPCSC admission rate***	Amounts paid per HPCSC	Number of HPCSC hospital days
<b>Period: 2010-2019 (entire period)</b>					
Number of FHS teams*					
Spearman's rho	0.988	-0.333	-0.638	-0.382	-0.006
p-value	<0.001	0.347	0.047	0.276	0.987
<b>Period: 2013-2019 (Coverage &gt; 70%)</b>					
Number of FHS teams					
Spearman's rho	0.964	-0.750	-0.929	-0.929	-0.964
p-value	<0.001	0.052	0.003	0.003	0.007

\* Family Health Strategy; \*\* hospitalizations due to primary care sensitive conditions; \*\*\* rate per thousand inhabitants.

Source: Authors.

July 1998 to 41,619 in October 2017. Coverage rate increased from 4.4% to approximately 70% and showed important results in improving the monitoring of chronic conditions, improving diagnosis and in ease of access to drugs<sup>5</sup>.

Although it seems natural to assume that an increase in coverage by PHC teams would proportionally impact the decrease in HPCSC rates, literature shows conflicting results when we strictly evaluate the relationship between the coverage rate and the number of hospitalizations, which sometimes reveals positive results<sup>10,11</sup> and other times reveals no association<sup>12,13</sup>. Even systematic review studies on the topic conclude that association measures should be interpreted with caution if no other factors are taken into account<sup>14,15</sup>. These results reveal the need for additional considerations to calculate coverage percentage, since some HPCSC are conditioned by aspects that are not controlled by PHC, such as the distance between the patient's residence and the hospital<sup>1</sup>, socioeconomic conditions of the population and adherence to PHC attributes by health teams.

The results of the present study suggest that significant impacts on HPCSC are only achieved by well consolidated primary care with a wide coverage. Some studies record a well-established association between an FHS with a coverage above 70% for more than four years and the decrease in infant mortality rates<sup>16-18</sup>, but no studies were found that evaluate the development of HPCSC based on certain values for population coverage rates.

It is essential to consider that the coverage rate defined by the Brazilian Ministry of Health defines the proportion of the population potentially covered by primary care using an average number of 3,000 people covered by each FHS team or by every 60 hours of medical professionals who are allocated to other primary care models<sup>19</sup>. In other words, even a coverage rate of 100% does not mean that the entire population is being served within the scope of primary health care under the attributes of primary care (especially first contact, longitudinality, integrality and coordination of care)<sup>20</sup>. The present study made clear that it is the expansion of the number of FHS teams rather than the coverage rate of primary care that has the potential to have a positive impact on HPCSC.

A recent systematic review that evaluated the impact of FHS on HPCSC concluded that no clear pattern of association was found<sup>21-24</sup>. The authors highlight that the selected studies pre-

sented inconsistent results, showing records of decreased hospitalization rates associated with increased FHS coverage<sup>24</sup>. A positive effect was only observed in women or for diabetes and cardiovascular diseases<sup>10,22</sup>. Absence of significant effects was also found<sup>25</sup>. One study describes an increase in hospitalizations associated with the expansion of FHS<sup>23</sup>. It might be that these conflicting results denote the effects of a lack of standardization in the definitions of population coverage, coverage percentages and number of health teams.

In addition to quantitative association, the possibility that the relationship may involve care quality should also be discussed. Although this study did not aim to evaluate care quality and its relationship with HPCSC, it is essential to highlight that the increase of the number of FHS teams in the municipality largely influenced the increase of Medical Residency in Family and Community Medicine, an aspect that certainly implies improvement of patient care<sup>26</sup>. A study that analyzed the association between the quality of PHC in Brazilian municipalities and the number of HPCSC found an inverse association, i.e., municipalities with a lower quality level (quartile 1) presented 21.2% more HPCSC than municipalities with a better evaluation<sup>27</sup>. Its results showed that the quality of PHC in Brazil had an impact on the decrease of HPCSC, even in contexts of greater social vulnerability<sup>27</sup>.

In this study, the increase in the number of FHS teams did not only influence the number of HPCSC positively, but also significantly decreased hospital days and HPCSC costs. These results represent aspects that have not yet been explored by the literature. Regarding hospitalization costs, figures and other variables showed an inverse behavior as soon as the coverage exceeded 70%. A study performed with children up to five years old in the state of Bahia from 2000 to 2012 showed a 50.4% reduction in hospitalization costs by comparing the first year with the last one of the series<sup>28</sup>. Figures were corrected by the General Price Index (PGI-M) of the Getúlio Vargas Foundation, adopting the year 2000 as the base year for calculation<sup>28</sup>. In addition, an ecological study found a decrease in HPCSC costs in Brazil regarding children, the elderly and women from 2000 to 2013<sup>29</sup>. In this study, the HPCSC cost proportion indicator was used in relation to total hospitalizations costs financed by SUS, since this proportion is not influenced by resource availability or by the differences in amounts paid for each procedure over the period analyzed. There-

fore, neither inflation adjustments nor changes in amounts reimbursed by SUS were taken into account for each procedure<sup>29</sup>.

Regarding the evaluation of ESF results on some hospital indicators in the state of Minas Gerais, another study did not find any significant correlations between hospital stay and the increase in FHS coverage in the different health regions of the state<sup>8</sup>. However, the correlation did not take into account either the minimum percentage of coverage, or the size of the municipality.

One study stressed the influence of the “size of the city” variable has on the behavior of HPCSC and described the rate of HPCSC in groups of municipalities (by grouping 452 municipalities according to the size of their populations and comparing data from 2004 to 2007 and from 2010 to 2013). It compared that association with FHS coverage, both before and after the implementation of the Master Plan of Primary Health Care in the state of Minas Gerais (PDAPS) and found that the correlation between FHS coverage and the rate of HPCSC was statistically significant and had a positive impact on the group of medium to large municipalities<sup>30</sup>. Similar results were also found for the state of Goiás<sup>6</sup>. These findings are consistent with the data of the present study, which was performed in a large municipality.

To summarize, and as reported by the literature, the increase in the number of FHS teams may have an important impact on hospital indicators if we take into account HPCSC, but only from a coverage rate of 70%, which establishes a minimum structure for consolidated PHC. However, results may not be applied to small

municipalities, as other aspects may interfere with patient hospitalization. It is important to highlight that, more important than the numerical increase of teams, there is a need for professional qualification, closer approximation to the assisted population and improvement of work processes, aspects that together may help achieve more precise goals: reduce unnecessary hospitalizations, reduce costs and, above all, improve care quality.

In an area in which resources are limited and needs are virtually unlimited, creating or improving assessment and monitoring tools is critical. New studies are required to support follow-up and adoption of managerial and epidemiological control measures in the context of PHC and HPCSC.

We would like to point out that the limitations of the present study are intrinsic to ecological studies. We may not claim, for example, that hospitalized patients had or did not have access to FHS services. The occurrence of issues in the diagnostic records of hospital admission authorizations may also not be ruled out. Finally, studies of this kind do not take into account social and economic aspects that may influence the hospitalization process. Nevertheless, results reinforce and improve the role of HPCSC as a measure of indirect evaluation of access and resolution capacity of primary health care.

To conclude, it is suggested that future studies performed with the same observation unit should consider the stratification of these trends by sex, age or diagnostic group of hospitalized patients so as to explore how this correlation would behave in specific population groups by taking into account the profile features of PHC users.

## Collaborations

All authors participated equally in the planning, collection and analysis of data and writing of the final text.

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