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Public Health

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Original Research

Access to emergency care services: a transversal ecological study about Brazilian emergency health care network



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ARTICLE INFO

Article history:

Received 20 February 2017

Received in revised form

3 July 2017

Accepted 10 July 2017

ABSTRACT

Objectives: Studies of health geography are important in the planning and allocation of emergency health services. The geographical distribution of health facilities is an important factor in timely and quality access to emergency services; therefore, the present study analyzed the emergency health care network in Brazil, focusing the analysis at the roles of small hospitals (SHs).

Study design: Cross-sectional ecological study.

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<http://dx.doi.org/10.1016/j.puhe.2017.07.013>

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Keywords:

Spatial analysis

Hospitals

Evaluation

Emergency health services

Access to health services

Methods: Data were collected from 9429 hospitals of which 3524 were SHs and 5905 were high-complexity centers (HCCs). For analytical purposes, we considered four specialties when examining the proxies of emergency care capability: adult, pediatrics, neonatal, and obstetric. We analyzed the spatial distribution of hospitals, identifying municipalities that rely exclusively on SHs and the distance of these cities from HCCs.

Results: More than 14 and 30 million people were at least 120 km away from HCCs with an adult intensive care unit (ICU) and pediatric ICU, respectively. For neonatal care distribution, 12% of the population was more than 120 km away from a health facility with a neonatal ICU. The maternities situation is different from other specialties, where 81% of the total Brazilian population was within 1 h or less from such health facilities.

Conclusion: Our results highlighted a polarization in distribution of Brazilian health care facilities. There is a concentration of hospitals in urban areas more developed and access gaps in rural areas and the Amazon region. Our results demonstrate that the distribution of emergency services in Brazil is not facilitating access to the population due to geographical barriers associated with great distances.

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Introduction

Adequate spatial distribution of emergency care services (ECSs) is fundamental for health system access. The demand for ECS is projected to increase amid an aging global population.¹ Adequate access to ECS is vital to reduce avoidable deaths and losses related to disability-adjusted life years.² Access barriers are the main challenge to overcome to guarantee an effective reduction in morbidity and mortality associated with lack of care. Access barriers are especially strong in the context of low- and middle-income countries.^{2,3}

The literature on access to ECS focuses heavily on social determinants of health related to demand-side barriers, such as unaffordable costs or lack of patient education.⁴ However, in the case of ECS, the role of supply-side factors, particularly the geospatial distribution of health facilities, is not well understood.⁵ The majority of geographically-oriented studies concentrate on travel time or distance to primary care facilities and the subsequent effect on healthcare access and patient outcomes.^{6,7} Likewise, there exists a volume of studies on the distribution of emergency services in relation to patient mortality and morbidity.^{8,9} However, there is a lack of studies dedicated to examining spatial distribution of high-complexity facilities and the resultant impact on access to health care.

The interest in spatial distribution of health services infrastructure has increased in recent years. Geospatial analysis studies regarding this infrastructure are a component of the field of health geography, which can be divided into two groups: geographic epidemiology and health systems planning.^{10,11} Geospatial analysis has also proved to be of great utility to study the allocation and planning of health services.¹² Several studies containing literature reviews contemplate the evolution of research in the field of health geography and its different applications in diverse countries.^{12–15} These studies show that spatial analysis has been widely used to investigate the relationship between access, utilization, quality, and health indicators to assess disparities in health systems.^{12,13} For this reason, studies of this

nature are essential for health managers to analyze and define priorities for the provision of health services.^{12,13}

The adequate distribution of health service facilities is a challenge that runs through the Brazilian reality. Brazilian's health system combines a mix between interconnected public and private providers. The users choice between each provider depends on aspects such as access and ability to pay.¹⁶ The Brazilian challenges associated with hospital care are the same as those faced by other countries: lack of efficiency, need of quality assurance, lack of access, and coordination among the different levels of providers.¹⁷ The discussion between access and the spatial distribution of services is crucial for the Brazilian reality. One in five hospital admissions in the public system occurs in hospitals in different municipalities to those where the patient lives. Thus, inhabitants of low-income municipalities are less likely to obtain hospitalization than inhabitants of high-income municipalities.¹⁸

In Brazil, the spatial distribution of health services has been gaining attention in recent years.^{19,20} One study mapped the network of the provision of health services, based on the origin and destination of patients.²⁰ The results revealed an extensive network of primary health care provision, in which only a few municipalities are disconnected. Despite that, almost half of the Brazilian municipalities are disconnected from a network providing ECS. For the present work, health care networks (HCNs) can be understood as a network composed by multiple nodes offering emergency care, connected to each other, and allowing the transit of patients among each node of the web constituted. Great distances to ECS are a critical geographic barrier to access. In 2014, the Brazilian hospital system was composed of 9429 hospitals divided into two categories: 3524 small hospitals (SHs) and 5905 high-complexity centers (HCCs). In Brazil, a SH is defined as a hospital with 50 or fewer beds, while the HCC are units certified as of emergency and capable to perform surgeries and deliveries.

Units classified as SH are recognized to face operational and quality problems, despite their large number in Brazil.²¹ In most cases, SHs offer services similar to primary health care

and lack the capacity for surgeries or admissions.²¹ Few SHs are capable of performing more complex surgeries or accepting admissions on a regular basis.²¹ Thus, populations only assisted by SH frequently need to be transferred to cities with HCC when needing access to more complex care. Since there is a wider distribution of SH throughout Brazil, it is important to better understand the roles of SH in the emergency system. Analysis of new roles for the SHs can be part of a solution to address an inadequate distribution of emergency services in Brazil. Considering this, our research is intended to highlight the understudied topic of the spatial distribution of ECS. In doing so, we devote attention to discussing the role of SH in Brazilian HCN.

Methods

Our study has a cross-sectional ecological design. Brazilian municipalities were divided according to hospital coverage, resulting in two groups: cities exclusively covered by SHs and those covered by HCCs. When a city had both, SH and HCC, we opted to classify it in the second group because it had the capacity to offer high-complexity care. The combined analysis according to these two groups allowed for the observation of distances needed to overcome to access ECS.

All hospitals included in our study were identified based on records in the 2014 National Registry of Health Facilities.²² A total of 2578 municipalities were included under the SH category, corresponding to 3524 hospitals. In addition, we included all Brazilian HCC that meet at least one of the four

proxy criteria related to ECS capability. The first three proxies were the presence of at least one the following beds: adult ICU, pediatric ICU, and neonatal ICU. The fourth criterion was the availability of a maternity ward that performed at least 300 births during 2014. Based on these criteria, we included 5905 HCC distributed throughout 3598 municipalities. In total, 9429 hospitals were included in the analysis, as outlined in Fig. 1. In addition, data on the Brazilian population socio-economic characteristics were collected from the Brazilian Institute of Geography and Statistics data repository.²³

Data analysis

To analyze the spatial distribution patterns among municipalities with SH and HCC, we considered the Euclidean distance. This kind of analytical methodology is based on the concept of spatial friction, which states that every distance requires some effort to be overcome. Therefore, with an increase of distance, more effort will be required to gain health services access.²⁰ Individuals will only opt to travel great distances if the benefits of doing so are greater than the total amount of resources consumed to surpass the distance. In the context of hospital services, it would be expected that municipalities only covered by SH will face access barriers due to increased geographical distance from HCC. Based on this concept, it was possible to identify the existence of gaps in Brazilian HCN. The distances between the epicenters of municipalities with SH and those municipalities with HCC were evaluated using the distance formula for great circles to define the nearest HCC.

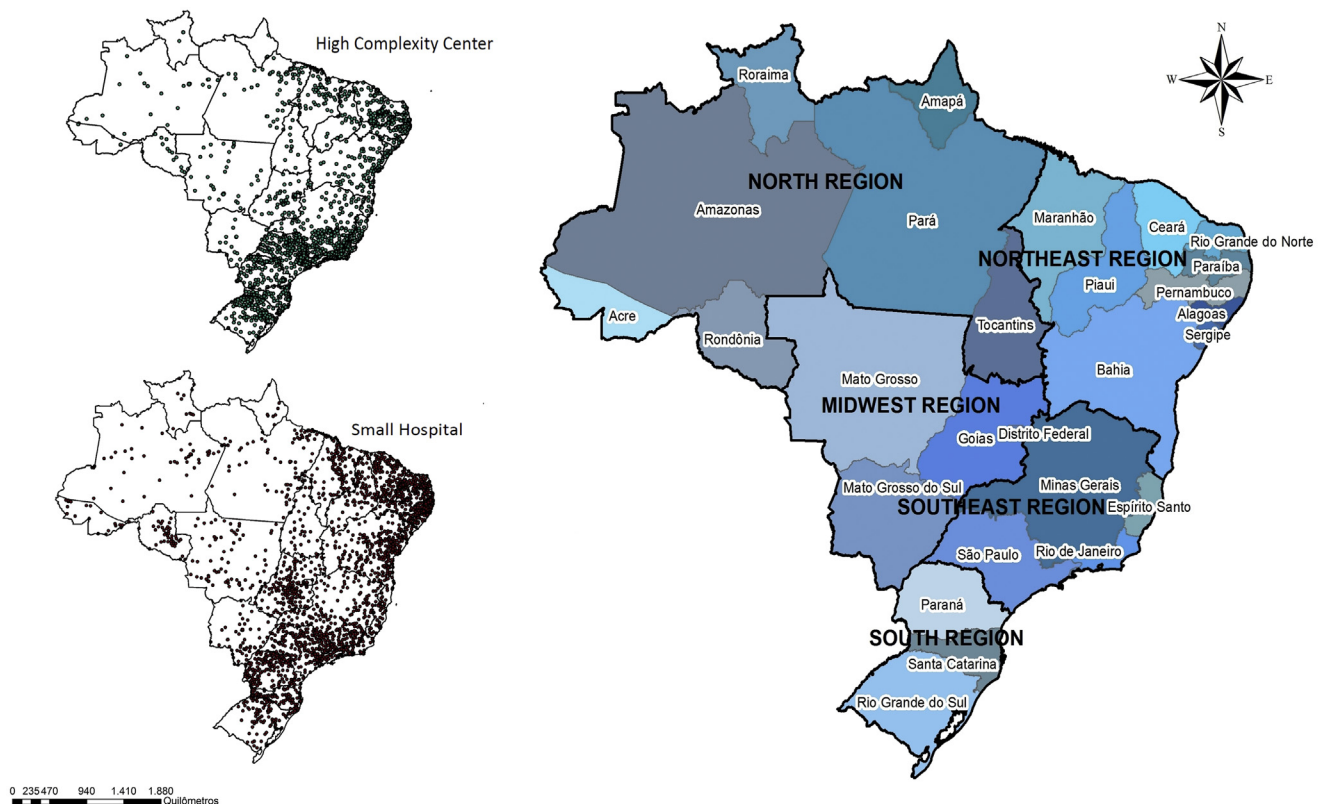


Fig. 1 – Spatial distribution of SHs and HCCs, Brazil 2014. Abbreviations: SH, small hospital; HCC, high-complexity center.

State borders defined the maximum distance limit of analysis in each case. Thus, the search for the nearest municipality with at least one HCC unit was confined to each state. Cities with HCCs were classified as reference points once they have ECS capability. Spider diagrams were drawn to illustrate the flows from cities only covered by SHs to reference centers capable of offering ECS. Municipalities containing SHs but lacking high-complexity care capability were classified according to the distance of the closest municipality with a HCC in the same state. Distance was divided into four groups:

1. Municipalities less than 60 km from the HCC (1 h of travel time),
2. Municipalities located between 60 and 90 km from the HCC (1.5 h of travel time),
3. Municipalities located between 90 and 120 km from the HCC (2 h of travel time),
4. Municipalities located more than 120 km from the HCC (more than 2 h of travel time).

Data regarding the population were used to identify the contingent allocated in each distance. Population data as obtained from the most recent estimates of Brazilian Institute of Geography and Statistics (2013).²³

Results

Fig. 2 depicts the distance between municipalities that possess HCC with adult ICU beds and those covered only by SHs. Approximately, 26% of SHs were in municipalities that

had also HCCs (black squares). The majority of municipalities with both SHs and HCCs are located in the South, Southeast, and Northeast coastal regions. Approximately, 63% of municipalities were located within less than 60 km from the closest city with a HCC with an adult ICU. Yet, there is an observed shortage of HCCs with adult ICUs in the Midwest, rural Northeast, and especially the North regions. In these regions, there is a polarization of HCCs with adult ICUs at state capitals. In our analysis, we noted that more than 14 million people were at least 120 km away from a HCC with an adult ICU.

The polarization observed at HCCs with adult ICUs is more pronounced when dealing with HCCs with pediatric ICUs, shown in Fig. 3. The concentration of HCCs with pediatric ICUs is mostly confined to the states of São Paulo, Rio de Janeiro, southern Minas Gerais, and northeastern Paraná. In the North, Northeast, and Midwest regions, there were large regions not covered by a health facility with pediatric ICU within 120 km, along with a concentration of hospitals in state capitals.

The distribution of HCCs with neonatal ICUs was rather similar to that observed with respect to pediatric ICUs (Fig. 4). Approximately, 12% of the population, located in 24% of Brazilian municipalities, were more than 120 km away from a health facility with a neonatal ICU. In states like Rondônia, no municipality was located less than 120 km from a neonatal ICU, with the exception of the capital Porto Velho.

Of the four ECS proxies selected, the distribution of maternity wards that performed more than 300 births in 2014, had the lowest percentage of the population living more than 120 km from a referral city (Fig. 5). The distribution of maternity units was more homogeneous throughout the different regions in comparison with the others proxies selected.

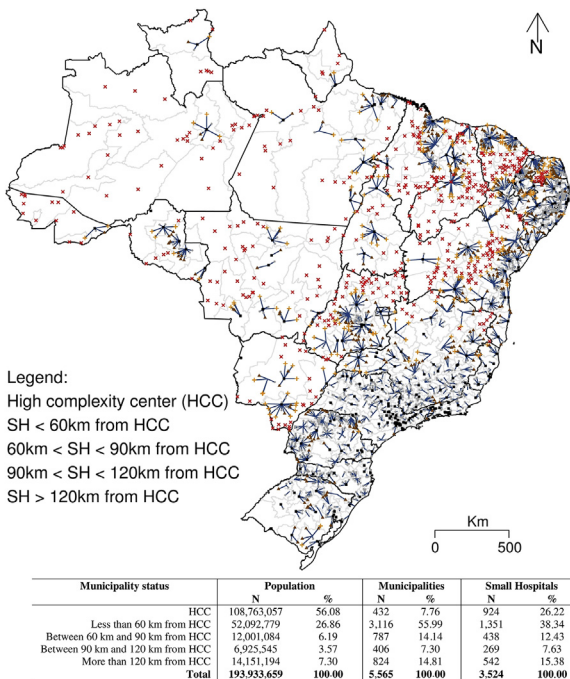


Fig. 2 – Distance between municipalities that have a HCC with adult ICU and municipalities only served by SHs, Brazil 2014. Abbreviations: SH, small hospital.

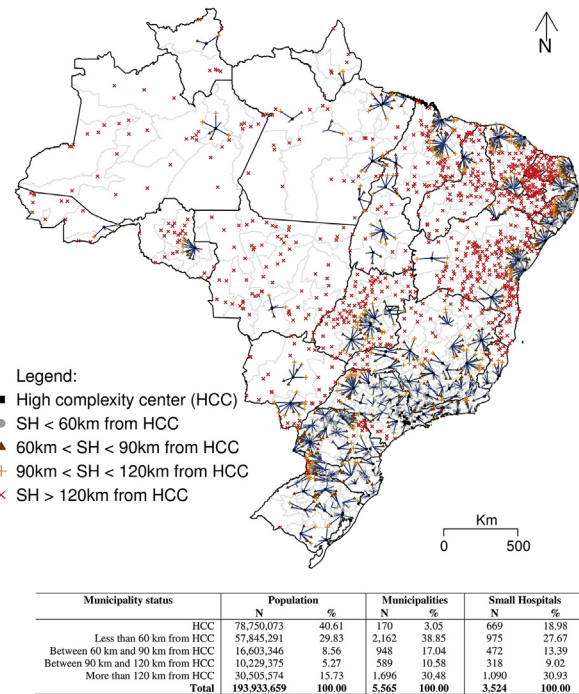


Fig. 3 – Distance between municipalities that have a HCC with a pediatric ICU and other municipalities only served by SHs, Brazil 2014. Abbreviations: SH, small hospital.

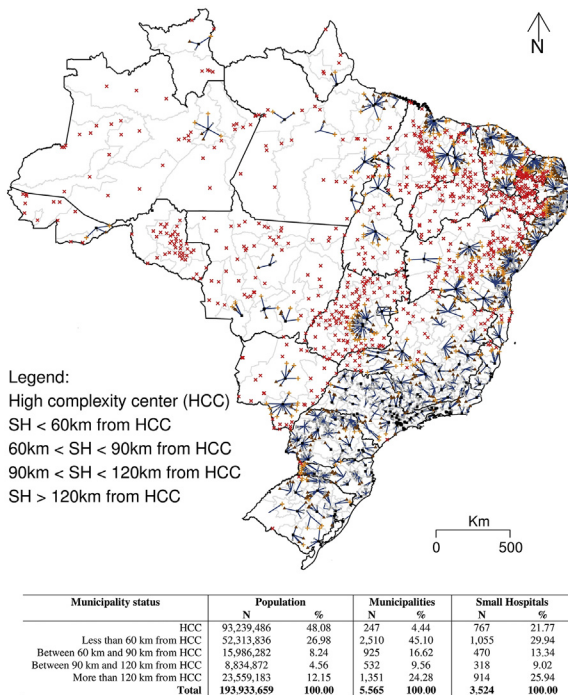


Fig. 4 – Distance between municipalities that have a HCC with neonatal ICUs and other municipalities only served by SHs, Brazil 2014. Abbreviations: SH, small hospital.

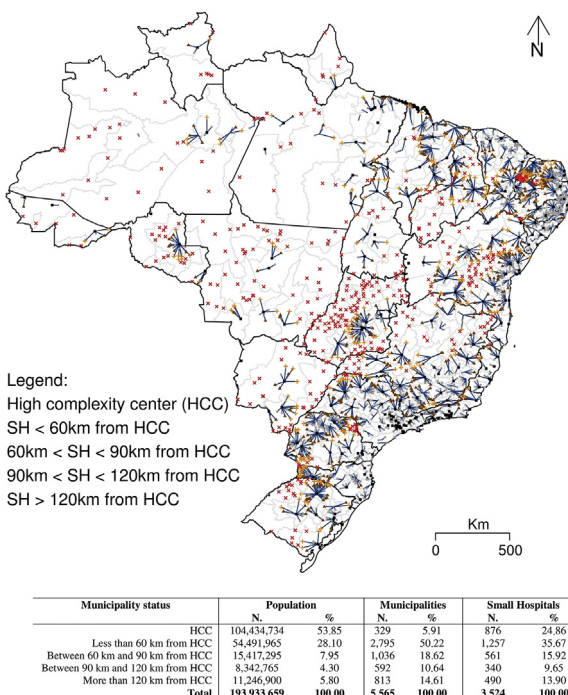


Fig. 5 – Distance between municipalities that have a maternity ward that performed more than 300 births in 2014 and the other municipalities only served by SHs, Brazil 2014. Abbreviations: SH, small hospital.

Discussion

The analysis of distances among municipalities only covered by SHs and those that contain HCCs highlights the presence of geographic barriers to ECS in Brazil. Moreover, it draws attention to the important roles that SHs can play in the Brazilian Health System. Our results pointed out imbalances in distribution of Brazilian emergency facilities by emphasizing the concentration of hospitals in more developed areas and access gaps in rural areas and the Amazon region.

For HCCs, the data show that more than half of the population live in municipalities with access to an adult ICU. However, in the North and Midwest regions, the distribution of these units is markedly dispersed. The states of Acre, Amapá, and Roraima are good illustrations of this situation, as only their capital cities have health facilities with adult ICUs. These same regions, along with the Northeast coastal region, have an even more pronounced need in the areas of pediatrics and neonatal ICU services. In a large part of these regions, the corresponding health units are concentrated in greater population centers, creating gaps in the HCN for these services. These regional disparities imply that more than one-third of municipalities have a travel time of more than 90 km to obtain health care from both pediatric and neonatal ICUs. These same groupings of municipalities are home to more than 40 million and 33 million inhabitants, respectively. In these circumstances, the possibility of reconfiguring the role of SHs in the Brazilian HCN provides a way to improve access to ECS.

The presence of SHs throughout the Brazilian regions is fairly homogeneous, particularly in the regions with low concentration of HCCs. The results that were found in this study showed high percentages of SHs in municipalities with the presence of HCC facilities. In these situations, the presence of SHs is inadequate once there is an overlap among ECS capacities available. Posnett highlighted that the main reason to maintain a hospital operating without a scale economy regimen should be the guarantee of access to a disadvantaged population.²⁴ The debate about the role of a SH in Brazilian HCN is reinforced by the fact that the SHs fell short in attaining optimal points of economies of scale.²¹ Therefore, their primary purpose should be to ensure access to emergency services.^{24–26} Thus, the large volume of SHs allocated in municipalities with HCCs characterizes a situation of resources wasting. This concentration of SHs in municipalities with HCC capability was observed in all four proxies for ECS considered in this study. The percentage of SHs in municipalities with a max distance of 60 km from a city with a HCC varied from 46.7% in relation to pediatric ICUs and 64.3% for adult ICUs. These findings highlight the presence of overlapping roles and regional disparities in ECS coverage in Brazil. On the other hand, there are municipalities in North, Northeast, and Midwest regions with unmet ECS needs and SHs with idle capacity due to lack of a better definition, in terms of the type of care that should be prioritized.

The results show municipalities with both SHs and HCCs are concentrated in the South, Southeast, and Northeast coastal regions. These regions also show many SHs close to reference HCC, which could indicate a potential overlap

between care roles. If some of these SHs offer adult ICUs, their role in the HCN is not optimal and their integration into the health system needs to be rethought.

The SHs often experience challenges due to a lack of structure, human resources, and work processes; generally, their lack of a specific role in regional HCN results in an idle capacity.³ It is argued that SHs are justified in remote regions with limited access to HCN, particularly, for general health needs beyond primary care, urgent care services and low-risk maternal-infant care.³ The low level coverage of hospitals in the Midwest, rural Northeast, and especially the North region results in states such as Amazonas, Amapá, Pará, and Roraima having large segments of territory without any emergency specialized services. In these circumstances, changing the roles of SHs is not sufficient to improve access. It is essential to invest in the implementation and operation of an integrated HCN, which takes into account offering necessary services to the population. Analyses about the desirable features of each SH should be defined by current health care infrastructure, workforce composition, financial profile, the broader HCN to which the hospitals belong, and the needs of the surrounding population. A combined analysis of these factors could catalyze reforms that are conducive to better emergency services.

Regarding maternity units performing more than 300 births in 2014, the North, Midwest, and rural Northeast demonstrated a lack of such units; the majority of units were concentrated in highly populated areas. The need for maternity units is also seen in areas of Minas Gerais, Paraná, and Rio Grande do Sul, demonstrating that spatial disparities in service provision is not exclusive to North, Midwest, and Northeast regions. For this reason, the creation of public policies should be tailored to target different regions based on their specific characteristics.

The results found demonstrate overlaps among the roles performed by SHs and HCCs and several states with precarious cover of ECS. Both the concentration and the roles of health facilities in HCN need to be rethought to overcome the current inequalities in accessing emergency health services. HCNs need to be reorganized in a way that optimizes flows and fosters efficient processes according to a scale economy logic without curtailing the population access to services.²⁶ Based on our findings, a first target could be the pediatric emergency care. Nearly 30% of Brazilian municipalities situated 120 km far from a HCC with pediatric ICU had 30% of the SHs and in which lives more than 30 million inhabitants. Redefining the roles attributed to SHs to offer more actions dedicated to emergency pediatric care can improve the access to this kind of service to an impressive amount of the population. In this case, rethinking the roles assumed by the SHs can promote access, thus minimizing geographical access barriers.

While overcoming some of the limitations of previous studies, it is worth emphasizing that we did not analyze distances to health facilities located in other states. All analyzed distances were confined to the same state. This option is justifiable by the fact that Brazilian decentralization in health care has led to the development of health policy plans that have a state logic and not an interstate comprehensiveness. Notwithstanding, there is evidence of the existence of agreements between states, which may influence transportation time to access health services, primarily in the case of border municipalities.

Conclusion

This study sought to analyze how the spatial distribution of emergency health facilities in Brazil could influence access to health services, with a focus on the examination of pertinent roles of SHs. The results demonstrate an unequal hospital spatial distribution, with significant gaps in HCN and overlapping activities between SHs and HCCs. Due to the importance of spatial distribution of health services for population access and the growing relevance of health geography, the current discussion points for the need to reorganize the distribution of hospitals in Brazil. Although such organization is not easily executed from a pragmatic point of view, our results highlight how a combined analysis between different services is necessary to consolidate an equitable health system. The methodological design adopted by our study could be applied in other contexts to examine the distribution of health facilities within a specific HCN and provide evidence for public policy formulation. For future studies, it would be best to examine the quality of services offered in these facilities, particularly considering the patient population of each hospital and resultant capacities. Moving forward, it will also be necessary to evaluate other indicators from other levels of health care, given that functional reforming of SHs may be influenced by the quality of care delivered at other levels.

Author statements

Ethical approval

Our study was carried out with ethical approval from the Committee on Ethics in Research of the Federal University of Pelotas under review appreciation number 546.012, (CAAE): 27098914.9.0000.5317.

Funding

The funding from the Brazilian Ministry of Health (92242.0800001/13-008 from National Health Fund.) exclusively covered the costs of data collection from small hospitals. Dr. Staton acknowledges salary support funding from the Fogarty International Center (Staton, K01 TW010000-01A1). Dr Thomaz acknowledges support for participation in the writing workshops of this article received from the Foundation of Research Support of Maranhão (FAPEMA; Grant conceived ED 24/12).

Competing interests

None declared.

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