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Number of Hospital Beds: Population Estimate, Installed Capacity and Performed in two Mesoregions of Rio De Janeiro, Brazil, 2015

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Abstract *—Introduction: Planning health resources in a continental country like Brazil demands adapting the structures to different regions and their needs. Objective: To compare the installed hospital structure (number of existing beds) with the health care parameters proposed by the Brazilian national health system (estimated beds) and the beds per activity performed in two mesoregions of the state of Rio de Janeiro in 2015. Methods: Cross-sectional analysis with data obtained from the information systems of the Brazilian national health system. Results: An excess of hospital beds was identified (208.9% of the ideal average, per activity performed), low occupancy rates (24.2% below the ideal average) and irregular distribution between the mesoregions. Conclusions: The unequal division of resources unrelated to population demands results in higher health care costs and undermines the universality of access and integrality of the care.*

Keywords *—**Health Management, Hospital Bed Capacity, Public Administration, Public Health**.*

I. INTRODUCTION

The Brazilian public national health system (Unified Health System - SUS) is structured according to its doctrinal (universalization, integrality of actions and equity) and operational principles (regionalization, hierarchy, political-administrative decentralization, social control, among others), present in the Brazilian Federal Constitution of 1988 and in the Organic Health Law (Law No. 8080/90).

A little more than 25 years after the promulgation of the SUS political-legal framework, universal access to health services still has limited coverage. In the sphere of primary care, it went from 64.3% in December 2008 to 74.8% in December 2019[1]. With regard to secondary care, the situation is more dramatic, especially due to an increase positively generated by the expansion of the coverage of primary care. The referral system of primary care to secondary care services or medium complexity is directly linked to the process of regionalization and hierarchy of health services and their formation in care networks. In tertiary care or high complexity, there is involvement of high technological density and cost, being organized in networks (eg: dialysis procedures, chemotherapy, radiotherapy and hemotherapy).

In a health system, it is essential to plan the investment of resources, aiming at a greater reach of the population and the rationalization of medical assistance so that there is no waste with underutilization. However, many factors are involved in understanding the real care needs. The use of hospital beds, for example, has several variables involved: availability of beds, type of population with their age and sex distribution, payment system for hospital services, geographical distribution of beds, capacity of auxiliary services of the hospital (ambulatories, tests), number of doctors, health habits, social norms, number of private hospitals in the region, types of housing and morbidity[2], which makes their prediction difficult to perform.

To have an idea of the volume of hospitalization, it is necessary to analyze the number of hospitalizations and their duration, in addition to the geographic and functional relationships between population and resources[3]. Thus, it is essential to carry out various regional studies on other

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health sectors, such as primary care, whose absence can determine the progression from simple diseases to greater complexity, with an indication for hospitalization[4].

The universalization of health proposed by the Unified Health System is tenuous in regarding the rationalization of resources and equity of services offered in different Brazilian regions[5]. In the case of hospital admissions, there is a concentration in affiliated units, in which public spending is carried out indirectly and linked to the limitation of the local structure and costs of each type of procedure[6]. And, thus, causing unequal distribution of resources and sometimes unrelated to population needs.

In Brazil, there is a growing demand for health resources, requiring sustainable management, which seeks to optimize resources with real needs. The difficulty in analyzing the use of resources in which price determination is complex, as in health, makes the assessment of the real primordiality of beds even more complicated[7]. Furthermore, idleness must be taken into account, a situation that allows adjustments for when unforeseen events occur that cause excess demand[8].

It should be noted that access to health is an abstruse concept, which depends on the context, time, region and population, often ending up being used inappropriately[9]. The certainty of the sufficiency of beds can vary, as well as their benefit to the population, costs and quality, depending on multiple social sectors[10,11,12]. And furthermore, the population's perception may differ from the reality, in some situations, about the real lack of hospital beds.

The existence of criteria and parameters for the production of services dates back to 1982, prior to the institutionalization of SUS, In 2015 the "Criteria and Parameters for the Planning and Programming of Health Actions and Services within the scope of the Unified Health System - SUS Parameters" were approved [13]. Three assumptions supported these parameters: the reduction of inequalities in access to health services, the reorientation to the needs of the population and regionalization.

In this context, this article aims to compare the application of SUS assistance parameters (estimated and necessary beds for the production of services performed) to the health service assistance network existing in the mesoregions of "BaixadasLitorânea" and "Norte Fluminense", in the state of Rio de Janeiro (RJ), Brazil, 2015.

II. METHODS

A cross-sectional studywas conducted to compare the installed hospital structure (number of existing beds) with the health care parameters proposed by the Brazilian national health system (estimated beds) and the beds per activity performed in two mesoregions of the state of Rio de Janeiro in 2015.

Data regarding hospital beds were obtained from the National Registry of Health Facilities (CNES). Information about of the number of live births, resident population, hospital morbidity, hospital procedures and average length of stay in a hospital internment in SUS facilities were obtained from the SUS databases, especially the Hospital Information System (SIH/SUS) and the Live Birth Information System (SINASC).All data above wasgathered from the month of July 2015, except for population by age group (pediatric, adult and elderly) and number of live births,which were extrapolated from 2010 to 2015 by the population growth coefficient of the municipalities in the period,due to the unavailability of this information for the year 2015.

Hospital beds were divided for analysis in the following areas: pediatric clinic, adult and elderly clinic; pediatric surgery, adult and elderly surgery; obstetrics and neonatology.The number of existing beds was then compared to the number of beds needed. The latter was calculated based on two different criteria, giving rise to different estimates:

a) By demographic criteria: calculated according to the care parameters contained in Ordinance No. 1,631 / 2015, using the following formula: No. beds by specialty = [Reference population x Hospitalization rate x Average length of stay] / 365 x occupancy rate.

As to the reference population of each type of hospital bed, were used demographic data from 2015. Regarding the rate of hospitalization and average length of stay per hospitalization, were used the minimum and maximum values recommended for each type of bed. As to the ideal occupancy rate, the range of 72% to 82% was chosen, respecting that recommended by the assistance parameters[13].

b) Beds according to activity performed: this estimate is based on actual bed occupancy in 2015. It was calculated using the following formula: No. of beds by specialty = [Number of hospitalizations in 2015 x average of actual stay in 2015]/365.

This estimate represents the minimum number of hospital beds that would meet the need of all activities carried out in 2015, that is, with an occupancy rate of 100%.This second criterion has the advantage of adapting to the peculiarities of each municipality because ittakes into account the real activity of health services and the

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disadvantage of showing a lower demand than the real one, if it the latter is not being fully met.

Were also analyzed separately each establishment that had beds registered in the National Registry of Health Establishments (CNES) to outline the hospitals' size in the mesoregions.Health establishments were classified into six types: general hospital, specialized hospital, isolated day hospital, general emergency room, specialized emergency room and isolated normal birth center.These data were exclusively based on the date of the last local update of each establishment in the national registry at the time of the survey (April 2017).In accordance with the Ministry of Health's definitions, a small hospital was considered to be one with up to 50 beds, average between 50 and 150 beds, large between 150 and 500 beds and with extra capacity the hospital above 500 beds.

Municipal Human Development Index (MHDI) data were obtained from the most recent report (2013) by the Brazilian Institute of Geography and Statistics (IBGE), to estimate the average quality of life of the locale. All information was calculated separately by municipality and later grouped into micro and mesoregions.

For the tabulation and analysis of the data were used theTabNetWin 32 3.0 *software*, later exported to an electronic spreadsheet. Comparisons were also made between themicro and mesoregions in search of significant discrepancies that could affect the overall assessment of results.

Finally, this article is a version of the conclusion paper presented to the discipline of Health Administration and Planning, from the sixth semester of the undergraduate medical course at the Federal University of Rio Grande do Sul (UFRGS).

III. RESULTS

The two mesoregions assessed are located in the north of the state of Rio de Janeiro (RJ) and are divided into two microregions each (Table 1).Together, they comprise 19 municipalities with an estimated total population for 2015 of 1,694,852 inhabitants (10.2% of the state total).The MHDI varied between 0.639 and 0.773, with an average of 0.711, a value considered to be high by the United Nations (UN).

Table 1 – Number of municipalities, live births, population and Municipal Human Development Index (MHDI) in "BaixadasLitorâneas" and "Norte Fluminense" mesoregions, Rio de Janeiro, 2015

	Number of municipalities	Live births	Population	Average MHDI (±DP)
Microregion Lagos	7	7,637	596,660	0.728 (0.018)
Microregion Bacia de São João	3	3,663	193,588	0.718 (0.060)
Mesoregion Baixadas Litorâneas	9	11,300	790,248	0.725 (0.032)
Microregion Campos dos Goytacazes	5	9,941	610,105	0.673 (0.031)
Microregion Macaé	4	4,800	294,499	0.723 (0.027)
Microregion Norte Fluminense	9	13,441	904,604	0.695 (0.038)
Total	19	24,741	1,694,852	0.711 (0.037)

Table 2 contains the comparison between the number of hospital beds existing, the number according to the parameters employed by SUS and the bed occupancy rate.In the two mesoregions there are a total of 3,388 beds installed, exceeding the number of necessary beds estimated by reference population (n = 1,764 - 3,247) and by hospital production (n = 1,622). According to the demographic criteria, the excess occurred in adult and obstetric surgical beds; according to the activity performed, all types of beds installed were greater than the estimated need.This discrepancy was more accentuated in obstetric beds, which exceeded the average estimated by demography by 71.6% and by 455.9% the estimate based on the activity performed.The average occupancy rate of thebeds was 47.8% and there was a large variation in the indicator between the micro-regions, with a predominance of values below the 72% recommended as the ideal minimum[13].

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Table 2 – Number of installed and estimated beds by demographic and activity performed for the aggregate of the mesoregions, and bed occupancy rate.

Typeofbed	Adequacy interval by demographic criterion	Number of estimated beds by the activity performed	Number of installed beds	Percentage of beds installed in relation to the estimated activity	Bed occupancy rate
Obstetrics	241-281	81	453	555,85%	18,0%
Neonatology	55-125	42	72	172,73%	57,9%
PediatricClinic	191-365	165	363	219,5%	45,6%
AdultClinic	766-1494	101	1346	133,32%	75,0%
Pediatricsurgery	30-99	44	48	108,75%	92,0%
AdultSurgery	474-883	279	1106	396,07%	25,2%
Total	1764-3247	162	3388	208,94%	47,9%

Table 3 shows the comparison between the number of existing hospital beds, estimated according to population criteria and performed within each of the micro-regions. Regarding the demographic criteria, the microregions of "BaixadasLitorâneas" have a number of beds within the normal range while those of "Norte Fluminense" show an excess.On the other hand, there was an irregular distribution of beds intra and interregionally, with no micro-region remaining within the normal range for all types of bed analyzed.When considering the hospital activity actually performed, the number of all types of beds installed in the microregions of Macaé and Lagos exceeded the estimated need.

Table 3 – Number of existing hospital beds, estimated according to population criteria and performed, according to type of bed (clinical or surgical, pediatric or adult), microregion and mesoregion.

Mesoregion	**NORTE FLUMINENSE**						**BAIXADAS LITORÂNEAS**					
Microregion	Campos de Goytacazes			Macaé			Lagos			Bacia de São João		
Type	Perfor med	Populat ion	Install ed	Perfor med	Populatio n	Install ed	Perfor med	Populat ion	Install ed	Perfor med	Populat ion	Install ed
Obstetrics	2	7(± 5)	87	4	50 (±3)	4	5	5 (±5)	61	0	2 (±2)	1
Neonatology	7	3 (± 11)			17 (±6)	2		9 (±11)	6		1 (±4)	
PediatricClinic	08	9 (± 31)	78	9	48 (±15)	7	2	8 (±25)	4	6	3 (±10)	4
AdultClinic	19	24 (± 136)	88	30	177 (±58)	14	84	08 (±123)	31	7	20 (±39)	13
Pediatricsurgery	5	3 (± 12)	9		11 (±6)			3 (±10)	2		(±4)	
AdultSurgery	41	50 (± 76)	69	3	112 (±33)	92	5	42 (±70)	02	9	4 (±22)	3
Total	53	27 (± 272)	.549	19	416 (±121)	46	21	86 (±244)	.056	29	78 (±80)	37

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Table 4 systematizes the size of the different hospitalization units in the mesoregions. There were located 61 organizations with inpatient services, predominantly general hospitals, corresponding to 70.5% of services and 83.6% of available beds.No "specialized emergency room" or "normal delivery center - isolated" units were found.There was a predominance of small hospitals in a percentage close to those of medium size, together representing 90% of the found services.

Table 4 - Stratification of inpatient units in relation to their size.

	Number of beds	Number of inpatient units	Small Hospital	Medium-Sized Hospital	Large Hospital	Hospital with Extra Capacity
General Hospital	3,789	43	17	20	5	1
Specialized Hospital	641	13	7	6	0	0
Isolated Day Hospital	13	2	2	0	0	0
General FirstAid	92	3	2	1	0	0
Total	4,535	61	28 (45,9%)	27 (44, 3%)	5 (8,2%)	1 (1,6%)

IV. DISCUSSION AND CONCLUSION

All types of beds installed were in larger number than those estimated by the activity performed in health services in the aggregate of the mesoregions. The total number of beds in the mesoregions was also above those estimated based on the number of inhabitants, predominantly obstetric and surgical adult. This inconsistency should increase the cost of the health service[14]. In the assessment by type of bed, values of adequacy, scarcity and lack of beds were irregularly distributed among the micro-regions, implying irrationality not only in the availability but also in the distribution of these beds.

The stratification of the units by the number of beds revealed a predominance of small and medium-sized hospitals, almost half having less than 50 beds. Although important to guarantee the capillarity of the health system to interior regions and the integrality of care and access to the health system, this form of organization is unsuitable for densely populated regions, such as the mesoregions under study, which cover approximately 116 inhabitants / km². Such inpatient units end up operating with low technology and resolvability and with low hospital occupancy rates, as verified in the study. The historical overvaluation of tertiary care plays an important role in the genesis of the phenomenon found, and goes back to the Basic Operating Standards NOB SUS 01/1991 and 01/1993, which led to the beginning of the SUS regionalization and decentralization process; however, many of these structures acquired an indefinite role in the regional service network after the consolidation of the Family Health Program (PSF), sometimes overlapping with those of primary care[15].

The low activity of the beds also characterizes the disuse of installed capacity and causes adversities to financial management. La Forgia and Couttolenc attest that the ideal occupancy rate for hospital beds is 75 to 85% and that Brazilian hospitals typically work below that[16]. In this study, SUS parameters were used, which work with a slightly lower range, between 72 and 82%. Even so, only the adult clinic beds reached the appropriate occupancy range and the occupation reached percentages as low as 18% and 25.2% in adult obstetric and surgical beds. A study that analyzed 25 hospital organizations in the country, upon finding more than 60% of hospitals operating below the parameter[17], endorses the one found in this study. Other national studies indicate that small hospitals are the main responsible for this, as they work with only 32.8% of occupation in the country on average[18].

This work has some limitations inherent to ecological studies, given that the aggregated information may not be true for the individual level. In addition, the high average MHDI, population density and the proximity to the metropolitan region impact on the ability to generalize data to the national level, especially considering the high inequality in the country. The authors believe that the discrepancy between the number of beds proposed and used reflects a low rate of hospital occupancy that may be even more significant in less populated regions, suggesting the need for further studies.

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On the other hand, the study allowed an in-depth analysis of the infrastructure of these mesoregions, unveiling important weaknesses to be considered by managers, for the construction of a regionalized and hierarchical health care network encompassing hospital establishments in size and services adequate to the needs of the population.

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