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National Registry of Health Facilities: data reliability evidence

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Abstract *This study compared the reliability of a data group registered in the secondary databases of the National Registry of Health Facilities. A survey was conducted in 2,777 with hospitals to achieve this objective. Visited hospitals provided information on equipment, geographic location, operating status and number of beds. Regarding matching data between visited hospitals and the National Registry, it can be noted that the operating status was updated in 89% of cases, the number of beds in 44%, 82% had the correct amount of equipment and 63% had accurate geographic coordinates. These findings point to a good reliability of information from the National Registry of Health Facilities, regarding the compared categories, excepting for data on the number of registered beds and for some equipment. As a further development of this work, we stress the need to discuss strategies and incentives to improve the reliability of data that still have inconsistencies, in order to improve the instruments used to formulate public policies.*

Key words *Information systems, Data sources, Data analysis, Hospitals with less than 100-bed capacity*

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Introduction

Health information systems (SIS) are defined as a set of interrelated components that collect, process, store and distribute information to support the decision-making process and to assist the organization of the health system[1]. Thus, it is expected that they contribute to support actions geared to improving the supply of health care[2]. Several SIS are available in Brazil, most of which are publicly accessible and administered by the Ministry of Health, through the Department of Informatics of the Unified Health System (DATASUS), whose data has guided the conduction of studies that address the analysis of epidemiological, health and service provision structure and infrastructure parameters[2].

Araújo Lima et al.[1] point out that managers and society appropriation of data conveyed in these SIS must consider the strengths and limitations of these systems. They also emphasize that the knowledge about the quality of data organized in these databases can only arise from regular and systematic evaluations of the data made available. The lack of assurance that data from these systems portray the reality compromises the processes of policy formulation and production of knowledge at their core[3].

The systematic review of literature by Araújo Lima et al.[1] addressed the SIS on the understanding of the concept of quality applied to them, highlighting the following realms: reliability, completeness, coverage, validity, timeliness, non-duplicity, consistency, accessibility and methodological clarity. Results pointed out that the SIS were being used for academic and public management purposes, but not all of them had been evaluated regarding the quality of their data. In addition, there was a geographical imbalance in relation to the federation units whose data were evaluated, with only a few being considered.

Evidence such as these has raised the importance of expanding SIS quality analyses that play a relevant role in the Unified Health System (SUS), such as the National Registry of Health Establishments (CNES), a database that contains data on all the Brazilian health institutions. An establishment is included in the CNES by filling in specific forms with data on physical area, human resources, equipment and outpatient and hospital services in operation, regardless of whether or not they provide care to SUS users. Once registered, the Ministry of Health generates a numerical code for each establishment. The managers responsible for each institution may request changes or even their exclusion from the CNES database.

CNES data are important for health planning, control and evaluation and should reflect the real situation of the health system[4]. However, the scarce recent studies which addressed elements of the CNES revealed inconsistencies in the database with the potential of negatively affecting eventual analyses developed with it.

Matos and Pompeu[5], when analyzing the contractual situation of the private healthcare network linked to the SUS, based on CNES data, identified inconsistencies in the number of registered contracts, considering that contracts signed between 1950 and 1980 and not renewed were still there. Discrepancies in the CNES registry were also sources of limitations for the National Health Service Evaluation Program (PNASS) from 2004 to 2006, such as, for example, registrations of High Complexity Centers in Oncology that did not even have chemotherapy, radiotherapy or oncologic surgery activities[6]. Data available in the system were from the last update of the registry made by the establishment and were outdated[6].

Santos et al.[7] and Costa et al.[8] carried out studies using data on the distribution of professionals, registered in the CNES by establishment, and were able to verify the limitations regarding data fragility for a portion of the analyzed establishments. Medeiros and Calvo[9], when describing the distribution of public physiotherapy services registered in the outpatient medium complexity in Santa Catarina, observed that the CNES was outdated and not completed, mainly in relation to the service's telephone number, number of professionals and type of equipment.

The publication of Ordinance Nº 134 of April 4, 2011[10] was an attempt to minimize some of the deficiencies reported in the CNES, since it stipulated new registration rules in order to minimize irregularities, among them all public links of professionals. Ordinance N° 118, dated February 18, 2014[11] provides for the automatic CNES deactivation of establishments that do not update their registry every six months, seeking to ensure that data are closer to reality. However, despite these efforts, there is a need to broaden actions to assess the reliability of data provided by CNES.

The comparison of the data registered in the CNES, with those observed in loco can contribute to the identification of criteria with low reliability and direct improvements. We did not observe in the national literature studies that

used this comparative strategy in the evaluation of data quality, especially regarding the realm of reliability. Thus, this study aims to compare what was registered in the CNES with what can be observed in small Brazilian hospitals. The choice of this typology of health facilities drew from a census study[12], which ended up establishing comparison criteria in relation to CNES for the whole set of health facilities in the country. In a health system, the existence of small hospitals is justified mainly for the implementation of low complexity actions, but not primary health care actions and actions related to urgent/emergency and mother and child care[13] services, especially in remote and hard-to-access locations.

The data set obtained in this study allowed discussing the reliability of the CNES data when comparing: operating status / participation of the establishment, number of beds, availability of equipment and geographic location. The hypothesis is that there is a discrepancy between data recorded in the CNES and those observed *in loco*.

Methods

This is a cross-sectional descriptive study carried out with the approval of the Research Ethics Committee of the Federal University of Pelotas (CEP/UFPEL).

All small hospitals with up to 50 bed-capacity were selected for the study, considering the records of September 2013 at CNES. According to this criterion, 3,524 hospitals distributed in the national territory were eligible for the survey. Table 1 shows the quantitative distribution of the selected establishments.

Most small hospitals are municipalized and obtaining permits to carry out the study had to be addressed on a case-by-case basis. Each facility received an invitation letter signed simultaneously by the research coordinator and by the Directorate of Hospital Care and Urgency of the Ministry of Health, requesting cooperation regarding participation in the study. In addition, there was a negotiation with the National Council of Health Secretaries (CONASS) to obtain the cooperation of the municipalities and hospitals to be visited. Since participation in the research was voluntary, only those who consented were visited. It is important to note that even the establishments that refused to participate were visited for the collection of geographical coordinates and completion of the information regarding the reason for the refusal.

Collection of primary and secondary data

Primary data were collected between February and September 2014 and secondary data obtained at CNES were related to September 2014.

The primary research goal was broader than just the characterization of existing equipment in small hospitals. Thus, more equipment was evaluated by the study in each hospital than those existing in the CNES. Data on bed capacity, geographic coordinates, quantity of facilities, work process compliance, availability of diagnostic support, financial and human resources aspects, among others, were collected locally. Thus, the selection of variables to be compared in this paper considered all the equipment that were registered in the CNES, for the hospitals visited, in both primary and secondary databases. Data extracted from the CNES, listed in Chart 1, were only related to the number of each equipment under conditions of use in each hospital.

The study's collection instrument was designed in electronic format and based on extensible markup language (XML) technology. The XML questionnaire was applied with the help of tablets and the open data kit collect (ODK collect) application. They were completed with a self-reported response and were preferably provided by the clinical director, the head of nursing or the general director of the establishment.

The electronic application was based on the benefits of the possible automated checking of data immediately after collection. All data collected that violated specific validation rules were checked. There were two verification levels: the first one, embedded in the ODK collect, only allowed the submission of complete questionnaires and with data that showed the sum of values compatible between the different sections of the questionnaire: for example, there was a field for entering total expenditure of the establishment and then, right after that, several fields for the breakdown of these expenses. The collection tool only allowed the submission of the questionnaire if the total and the sum of the detailed expenses were the same. The second level used five validation indicators: i) verification of the establishment's geographical coordinates; ii) proportion of missing values; iii) number of beds; iv) proportion of financial data completion; and v) proportion of human resources data completion.

For each of the indicators, criteria were established that, when infringed, entailed carrying out additional checks. Geographic coordinates were verified if they belonged to the municipality of the registered establishment. Mean values were

Table 1. Acceptance of participation in the research for the characterization of small hospitals, by administrative states and regions, Brazil-2014.

		In relation to the research:						
		N	**% in relation to Brazil**	**% Consented to participate**	**% Refused to participate**	**% Property does not exist or has not been found**	**% Hospital was closed**	**% Refusal for other reasons**
Midwest	Federal District	25	0.7	32.0	36.0	8.0	12.0	12,0
	Goiás	269	7.6	78.4	10.8	1.5	0.0	9,3
	Mato Grosso	114	3.2	83.3	7.0	0.9	7.0	1,8
	Mato Grosso do Sul	80	2.3	76.3	15.0	1.3	6.3	1,3
Northeast	Alagoas	52	1.5	69.2	25.0	0.0	5.8	0,0
	Bahia	367	10.4	79.8	10.9	0.5	0.0	8,7
	Ceará	166	4.7	86.7	4.2	0.6	6.0	2,4
	Maranhão	161	4.6	87.6	5.0	0.6	0.0	6,8
	Paraíba	94	2.7	74.5	3.2	6.4	9.6	6,4
	Pernambuco	200	5.7	91.5	2.0	0.5	5.0	1,0
	Piauí	134	3.8	87.3	2.2	1.5	8.2	0,7
	Rio Grande do Norte	132	3.8	84.8	3.0	2.3	3.0	6,8
	Sergipe	26	0.7	96.2	0.0	0.0	3.8	0,0
North	Acre	21	0.6	95.2	4.8	0.0	0.0	0,0
	Amapá	11	0.3	81.8	0.0	0.0	9.1	9,1
	Amazonas	56	1.6	89.3	3.6	0.0	0.0	7,1
	Pará	119	3.4	83.2	5.0	0.0	6.7	5,0
	Rondônia	68	1.9	80.9	11.8	4.4	0.0	2,9
	Roraima	13	0.4	84.6	0.0	0.0	0.0	15,4
	Tocantins	43	1.2	81.4	11.6	0.0	0.0	7,0
Southeast	Espírito Santo	49	1.4	67.3	8.2	2.0	10.2	12,2
	Minas Gerais	334	9.5	83.8	9.3	0.0	5.1	1,8
	Rio de Janeiro	190	5.4	40.0	25.8	2.1	16.3	15,8
	São Paulo	324	9.2	67.0	22.5	1.2	3.1	6,2
South	Paraná	247	7.0	82.6	10.9	0.4	4.5	1,6
	Rio Grande do Sul	119	3.4	78.2	16.8	0.0	1.7	3,4
	Santa Catarina	110	3.1	90.0	6.4	0.0	1.8	1,8
Midwest		488	13,9	76.8	11.9	1.6	3.3	6.4
Northeast		1,332	37,8	84.2	6.2	1.2	3.6	4.9
North		331	9,4	84.3	6.6	0.9	2.7	5.4
Southeast		897	25,5	67.6	17.5	1.0	7.0	6.9
South		476	13,5	83.2	11.3	0.2	3.2	2.1
Brasil		3,524	100	78.8	10.6	1.0	4.3	5.3

defined for the share of missing, completion of financial data and human resources. These mean values were dynamic and recalculated each time a hospital's data entered the validation system, thus we aimed at defining cut-off levels reflecting the data provision profile of the hospitals that were visited. The only indicator with a fixed comparison criterion was the number of beds, and any questionnaire that reported a hospital with more than 50-bed capacity was submitted for verification. Regarding other indicators, whenever a questionnaire evidenced, for at least one of the indicators monitored, a discrepancy of three standard deviations from the mean criteria defined by data already collected, this questionnaire was automatically submitted for verification.

The entire procedure for calculating indicators, defining reference means, comparing for the selection of questionnaires to check and monitor the resolution of verifications was done automat-

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Chart 1. List of analyzed equipment.

Laparoscope / Video	Electroencephalograph
Respiratory Tract Endoscope	Heated Cradle
Digestive Endoscope	Defibrillator
Gamma Chamber	Phototherapy Equipment
Simple Command Mammography	Incubator
Stereotactic Mammography	Temporary Pacemaker
PET/CT	ECG Monitor
X-ray up to 100 mA	Invasive Pressure Monitor
Fluoroscopy X-ray	Non-invasive Pressure Monitor
X-ray 100-500 mA	Pulmonary Resuscitator / AMBU
X-ray above 500mA	Respirator / Ventilator
Dental X-ray	Ophthalmoscope
X-ray for Bone Densitometry	Ultrasound / Short Wave Diathermy Apparatus
Hemodynamics X-ray	Electro-Stimulation Device
Magnetic Resonance Imaging	Apheresis Equipment
Computed Tomography	Extracorporeal Circulation Equipment
Color Doppler Ultrasound	Audiometry Equipment
Ultrasound Scanner	Hemodialysis Equipment
Electrocardiograph	

ically, in a system specially designed for such task. This system was web-based and provided follow-up charts of these multiple aspects to control study data validation actions.

Once listed for verification, questionnaires were entered in the definitive database only after their data veracity was ascertained. Logistical facilitators were responsible for conducting telephone checking of non-standard data, addressing respondents from the hospitals visited, as well as the interviewers responsible for the collection. If necessary, the interviewer could be asked to return to a previously visited hospital to collect data that were missing or required further details. Once the verification was made, a report was issued, detailing the justification for the apparently inconsistent information, and possible corrections were made in the electronic file containing the data by exclusive programmers. Subsequently, the revised questionnaire was incorporated into the definitive database. These procedures were designed to ensure that large differences were, in fact, a reflection of the hospitals' situation and not stemming from collection errors.

Data analysis

The descriptive analyses performed observed aspects of data reliability, since they examined the agreement between the measurements obtained by the different sources considered. Therefore, we chose to show differences found by means of proportions.

First, the operating status of the establishment was analyzed to ascertain the existence of outdated registries in the CNES. Secondly, the situation regarding the number of beds was verified, since hospitals having less than 50 beds found in the CNES reported having more than 50 beds during the visit.

Regarding the equipment, quantities listed in the CNES were subtracted from the values found in the face-to-face survey. If no differences were found in the hospital's status regarding a specific equipment, the establishment was defined as "updated CNES". After comparing all the equipment considered, of all hospitals, a table was drawn up with those that evidenced updated data, by equipment and administrative region.

Finally, the geographic coordinates were analyzed. CNES coordinates were obtained through the registry mirror of each hospital in the DATASUS databases, and those of the survey were collected through the GPS of the tablets used. The formula for calculating distance in large circles was used to examine the distance between both.

$$\Delta\sigma = 2 \arcsen \left(\sqrt{\mathrm{Sen}^2 \left(\frac{\Delta\phi}{2}\right) + \cos\phi_s \cos\phi_f \, \mathrm{sen}^2 \left(\frac{\Delta\lambda}{2}\right)} \right)$$

$\Delta\sigma$ = Spherical inner angle

$\Delta\phi$ = Latitude *survey* – Latitude CNES
ϕ_s = Latitude *survey*
ϕ_f = Latitude *CNES*
$\Delta\lambda$ = Longitude *survey* – Longitude CNES

This formula is used to identify the shortest path between two points on the surface of a sphere. Thus, Earth was considered as a perfect sphere, with a radius corresponding to 6,371 km. Latitudes and longitudes collected by GPS were deemed correct and their respective distances, with those registered with the CNES, examined considering km as the reference measurement unit.

Results

According to Table 1, of the universe of 3,524 hospitals, 2,777 consented to participate in the study, of which 2,455 (88%) provided care to SUS and 322 (12%) were exclusively private.

In the country, only 1% (N = 35) of the hospitals were not found or the registered property did not exist, especially in the Federal District, Paraíba, Rio Grande do Norte, Espírito Santo and Rondônia. The number of hospitals not located or closed corresponded to a reduced percentage compared to the total number of hospitals considered.

Despite all articulation to make the study feasible, some establishments refused to participate. Private and military hospitals, for example, had a higher refusal pattern than the others. States such as São Paulo, Alagoas, Rio de Janeiro and the Federal District also fit in this situation, due to the smaller involvement of collegiate bodies that aided in the dissemination of the research.

Table 2 shows the percentage of beds identified through primary data in relation to those recorded in the CNES database. Thus, 44% of the hospitals visited showed between 91% and 110% of the registered beds of the CNES. This category includes those situations of small discrepancy between the two sources used. A small percentage of hospitals (4.5%) owned less than 50% of the CNES beds. In the Southeast region, more than 23% of the hospitals obtained values ranging from 111% to 150% of CNES beds, and in the Northeast region, more than 12% of the establishments were included in the category of more than 150% of CNES beds. Hospitals with values above 111% indicate a greater discrepancy, affecting the reliability of data on the hospitalization capacity of these establishments. Considering the country as a whole, approximately 31% of hospitals fell into categories above 111% and over 150%.

Table 3 shows equipment-related data. Considering the 39 pieces of equipment evaluated, the average number of hospitals with updated data for Brazil was 82%. The proportions of equipment analyzed revealed that the expensive one such as PET/CT, magnetic resonance imaging, hemodialysis, mammography, tomography and others showed a higher updating level than those of lower cost, such as defibrillators, AMBU, ECG monitors and electrocardiographs.

As for the geographic coordinates, Table 4, it is observed that 63% of them showed a difference less than or equal to one kilometer. Of the total, almost 10% of hospitals are more than five kilometers from what is registered in the CNES. In states with a lower population density, this percentage of imprecision increases as in the case of Acre, Amazonas, Mato Grosso, Maranhão, Pará and Roraima.

Discussion

The importance of information systems for the effective management of health services is undeniable. The possibility of obtaining accurate data about a large number of services, with the potential to characterize them in terms of infrastructure, accreditation, localization and characteristics of human resources, equips health managers with data supporting evidence-based decisions.

The initial hypothesis of this study was that data registered in the CNES evidenced lags in relation to those existing in health facilities, which can be partially observed. Different levels of divergence between CNES data and those observed at hospital visits were verified, depending on the type of information analyzed.

In fact, the most dynamic aspects in the health facilities evaluated showed a higher discrepancy pattern. It was possible to observe several closed hospitals that still appeared as assets in CNES databases. The approach to issues of this nature requires a change in the steps and procedures necessary for a given health apparatus to cease to be considered active.

The recent instructions provided by DATASUS, guiding the steps necessary to exclude an establishment from CNES, demonstrates an incipient stance to address this situation[14]. Nevertheless, other initiatives are necessary such as the possible establishment of partnerships with other public entities such as commercial boards

Table 2. Characterization of the difference in the number of beds in small hospitals and in the CNES, by size, administrative regions and states, Brazil-2014.

		N	% with 50% or less of CNES beds	% between 51% and 90% of CNES beds	% between 91% and 110% of CNES beds	% between 111% and 150% of CNES beds	% with more than 150% of CNES beds
Midwest	Federal District	8	12.5	37.5	25.0	12.5	12,5
	Goiás	211	9.0	29.4	30.8	22.7	8,1
	Mato Grosso	95	3.2	27.4	47.4	13.7	8,4
	Mato Grosso do Sul	61	0.0	8.2	42.6	21.3	27,9
Northeast	Alagoas	36	5.6	13.9	52.8	16.7	11,1
	Bahia	293	5.8	14.7	43.7	21.8	14,0
	Ceará	144	5.6	23.6	45.8	18.8	6,3
	Maranhão	141	9.2	17.0	47.5	17.7	8,5
	Paraíba	70	5.7	21.4	35.7	28.6	8,6
	Pernambuco	183	4.4	25.1	31.1	20.8	18,6
	Piauí	117	2.6	29.1	41.0	21.4	6,0
	Rio Grande do Norte	112	4.5	27.7	33.0	26.8	8,0
	Sergipe	25	4.0	8.0	8.0	20.0	60,0
North	Acre	20	0.0	5.0	55.0	25.0	15,0
	Amapá	9	22.2	33.3	22.2	11.1	11,1
	Amazonas	50	0.0	20.0	40.0	32.0	8,0
	Pará	99	4.0	26.3	47.5	19.2	3,0
	Rondônia	55	3.6	16.4	63.6	9.1	7,3
	Roraima	11	18.2	9.1	27.3	36.4	9,1
	Tocantins	35	2.9	11.4	54.3	8.6	22,9
Southeast	Espírito Santo	33	3.0	18.2	33.3	33.3	12,1
	Minas Gerais	280	1.1	12.9	47.9	29.3	8,9
	Rio de Janeiro	76	7.9	23.7	21.1	28.9	18,4
	São Paulo	217	4.1	15.2	58.5	12.4	9,7
South	Paraná	204	2.5	16.2	56.9	20.1	4,4
	Rio Grande do Sul	93	5.4	15.1	52.7	19.4	7,5
	Santa Catarina	99	0.0	17.2	54.5	22.2	6,1
Midwest		375	6,1%	25.6	36.8	20.0	11.5
Northeast		1,121	5,4%	20.9	40.1	21.4	12.2
North		279	3,9%	19.4	49.1	19.0	8.6
Southeast		606	3,1%	15.3	47.5	23.4	10.6
South		396	2,5%	16.2	55.3	20.5	5.6
Brazil		2,777	4,5%	19.5	44.3	21.3	10.4

and federal revenue, so that it is only possible to consider that activities inherent to the provision of health services by an institution are terminated through a certificate of cancellation of records from information systems.

Discrepancies regarding the number of beds interfere in several areas of the formulation of public health policies. Oftentimes, these data are used as a basis for the framework of public funding lines, making health facilities, up to a certain size, eligible to claim resources from public policies[12]. Errors or size inconsistencies contribute to the increasing difficulty in differentiating institutions that claim resources, promoting financing imbalances. In addition, the impossibility of estimating precisely the size of a given hospital

Table 3. Percentage of equipment found, among those registered in small hospitals, by region - Brazil, 2014.

Regions and N of hospitals		Midwest N = 375	Northeast N = 1121	North N = 279	Southeast N = 606	South N = 396	Brazil N = 2777
Equipment	**N**	**% of hospitals with updated CNES, by equipment**					
Ultrasound / Short Wave Diathermy Apparatus	215	90	88	81	84	91	87
Electro-Stimulation Device	294	87	88	82	85	89	86
Heated Cradle	3,072	54	62	62	51	56	57
Defibrillator	3,789	35	53	54	37	42	45
Electrocardiograph	2,749	55	56	61	46	51	53
Electroencephalograph	114	93	97	97	94	98	96
Respiratory Tract Endoscope	130	95	97	95	92	94	95
Digestive Endoscope	282	88	86	86	82	89	86
Extracorporeal Circulation Equipment	56	100	99	99	98	99	99
Phototherapy Equipment	1,771	68	78	67	58	62	69
Audiometry Equipment	134	95	99	96	95	98	97
Hemodialysis Equipment	135	99	100	99	98	99	99
Apheresis Equipment	104	99	99	98	97	97	98
Complete Dental Equipment	359	93	76	77	94	95	85
Bier oven	113	95	91	90	89	88	91
Gamma Chamber	7	99	99	100	99	99	99
Incubator	2,400	58	67	59	58	57	62
Laparoscope / Video	655	83	91	85	82	85	86
Simple Command Mammography	138	95	96	91	93	96	95
Stereotactic Mammography	24	99	99	99	99	99	99
Temporary Pacemaker	233	94	97	96	91	95	95
ECG Monitor	4,855	37	59	54	29	36	46
Invasive Pressure Monitor	1,170	86	91	90	76	84	86
Non-invasive Pressure Monitor	4,101	58	71	66	34	56	58
Ophthalmoscope	1,280	72	82	81	58	67	73
PET/CT	5	99	100	100	100	100	100
X-ray up to 100 mA	1,079	66	73	64	56	69	67
Fluoroscopy X-ray	77	97	98	98	93	97	97
X-ray 100-500 mA	1,062	62	71	62	57	64	65
Dental X-ray	227	94	88	81	95	97	91
X-ray above 500mA	175	87	93	90	84	89	90
X-ray for Bone Densitometry	35	97	99	98	98	98	98
Hemodynamics X-ray	24	100	99	100	99	99	99
Pulmonary Resuscitator / AMBU	9,182	28	40	19	7	13	26
Respirator / Ventilator	2,665	55	69	71	38	51	58
Magnetic Resonance Imaging	25	99	99	99	99	99	99
Computed Tomography	98	97	98	98	96	98	97
Color Doppler Ultrasound	544	78	85	78	80	86	82
Ultrasound Scanner	659	62	74	68	71	70	71

triggers a cascade effect that negatively affects regulatory activities, since it makes it difficult to know the availability of beds in different health care networks[12].

The requirement to update data according to a defined time periodicity alone is a strategy that does not ensure data quality. It makes room for timely changes, not ensuring that data reported

Table 4. Distribution of the distances between the geographical coordinates of the location of small hospitals, by administrative regions and states, Brazil -2014.

		N	% Less than or equal to 1 km	% More than 1km and less than or equal to 2km	% More than 2km and less than or equal to 3km	% More than 3km and less than or equal to 4km	% More than 4km and less than or equal to 5km	% More than 5km
Midwest	Federal District	20	35.0	20.0	20.0	10.0	10.0	5,0
	Goiás	260	48.5	24.2	7.3	3.8	3.1	13,1
	Mato Grosso	104	45.2	25.0	7.7	1.9	1.0	19,2
	Mato Grosso do Sul	67	55.2	23.9	9.0	4.5	0.0	7,5
Northeast	Alagoas	31	58.1	19.4	9.7	6.5	3.2	3,2
	Bahia	335	57.0	20.6	11.0	1.5	1.2	8,7
	Ceará	146	63.7	19.9	3.4	1.4	0.0	11,6
	Maranhão	145	53.1	17.2	5.5	3.4	2.1	18,6
	Paraíba	86	65.1	17.4	3.5	8.1	0.0	5,8
	Pernambuco	189	63.5	19.6	7.4	1.6	2.1	5,8
	Piauí	123	74.8	17.1	3.3	0.0	1.6	3,3
	Rio Grande do Norte	121	76.0	16.5	3.3	0.8	0.8	2,5
	Sergipe	24	58.3	25.0	8.3	0.0	0.0	8,3
North	Acre	20	30.0	25.0	5.0	0.0	5.0	35,0
	Amapá	10	70.0	30.0	0.0	0.0	0.0	0,0
	Amazonas	49	55.1	8.2	6.1	2.0	0.0	28,6
	Pará	115	47.8	26.1	2.6	1.7	3.5	18,3
	Rondônia	66	59.1	28.8	4.5	3.0	1.5	3,0
	Roraima	13	53.8	7.7	0.0	0.0	0.0	38,5
	Tocantins	40	57.5	30.0	7.5	0.0	0.0	5,0
Southeast	Espírito Santo	45	68.9	15.6	4.4	2.2	2.2	6,7
	Minas Gerais	302	64.9	16.9	7.0	2.3	0.7	8,3
	Rio de Janeiro	137	81.8	2.9	1.5	2.9	0.7	10,2
	São Paulo	267	77.5	8.6	3.4	1.1	0.7	8,6
South	Paraná	215	67.4	17.2	7.0	4.7	0.9	2,8
	Rio Grande do Sul	106	73.6	10.4	6.6	0.0	0.9	8,5
	Santa Catarina	106	79.2	13.2	3.8	0.0	3.8	0,0
Midwest		451	48,1%	24.2	8.2	3.8	2.4	13.3
Northeast		1,200	62,8%	19.0	6.7	2.1	1.3	8.3
North		313	52,4%	23.6	4.2	1.6	1.9	16.3
Southeast		751	72,7%	11.3	4.5	2.0	0.8	8.7
South		427	71,9%	14.5	6.1	2.3	1.6	3.5
Brazil		3,142	63,2%	17.8	6.0	2.3	1.4	9.2

are current, making the measure useless for handling the situation. Defining protocols or different forms of control to register criteria that evidence rapid changes, such as the existence of beds

or low cost equipment can contribute to the improved reliability of the data available in this SIS.

Some hypotheses were elaborated seeking an approximation to understand these findings. The control of items of lower value, which can be purchased without the mobilization of a large volume of funds, seems to be tied to the delay in adjusting the infrastructure criteria of the CNES to the hospitals visited.

Another topic that draws attention to the reliability of equipment data is the high level of outdated information of items dedicated to support urgent and emergency care, such as: X-ray of 500 mA or less, respirator/ventilator, electrocardiograph, incubators, AMBU and ECG monitors. Thus, findings of this study raise caution regarding the use of some CNES data to analyze the service provision infrastructure.

Finally, the accuracy of the location of health establishments is fundamental so that studies are made that can mark services spatialization criteria. The structuring of care networks, coverage analysis and access demand reliable data on the existence of high-cost equipment, for example. Thus, the geographical distribution of health facilities is an important information for the organization of service supply flows.

Considering that the range of influence of a hospital often exceeds the geographical limits of the municipality of installation, the inaccuracies shown in the geographical coordinates registered in the CNES have little influence on the organization of care networks. Notwithstanding, findings of this study raise issues on whether differences greater than 2 km could not generate deleterious impact when they refer to primary care.

The importance of CNES is to gather all the health facilities in the country. More than the broad scope of coverage, this is about the relevance of high-quality data delivery. Inaccuracies in this SIS can distort information needed for managerial decision-making and undermine policy-making. The imprecise provision of geographical coordinates by the CNES may hinder the induction of studies that seek to evaluate the appropriateness of spatial allocation of health services, for example. This debate is traversed by the conduct of actions that encourage the regular and accurate feeding of data, in order to curb inadequacies.

Previous studies that focused data quality in the Brazilian SIS addressed tangentially the CNES without the possibility of comparing primary and secondary data[1,6-9]. There were no reports of broader studies that considered the country as a whole[1]. Some studies[6,7] have highlighted, in some establishments and in some federal units, the outdated data, the lack of entries informing new or deactivated establishments, as well as the mismatch between the services registered and those actually in place. The findings of this study partially confirmed this evidence and raised some new questions such as the relation between the cost of the equipment and time elapsed to update the CNES or what leads some regions and states to show a higher level of imprecision regarding geographical coordinates. In spite of study limitation when not addressing issues inherent to this level of care, the findings discussed here point to the importance of carefully examining the geographical location data of health facilities, by level of care analyzed.

The examination of the PHC facilities' location accuracy appears as a potential future work, since high discrepancies in their real location may modify access criteria, sociodemographic characteristics of the assisted population, attendance by public transportation, among other criteria that would allow better characterization of the environment of health facilities. Recommendations include the possibility of using financial incentive measures, stipulating conditions for participation in public policies aimed at financing actions, as well as the development of information quality indicators using multiple sources of data and which can evidence data validity are examples of strategies that can foster the improved reliability of CNES-linked data.

It is worth highlighting the limitations of this study, which are the impossibility of stratifying apparatuses compared in terms of their availability or not for the SUS, as well as the lack of comparisons of workforce availability aspects. With regard to the latter, the high number of missing resulting from hospitals' lack of availability of human resources information ended up compromising the comparative possibilities of this aspect.

Due to findings, and taking into account the time required to perform primary data collection, it is possible that, for the hospitals evaluated at the beginning of the survey, there was some change in the quantity of equipment registered at the CNES, which could affect the results of these establishments. Despite challenges and limitations explained above, findings of this study seek to clarify some aspects of CNES' reliability and may contribute to the examination of certain aspects of health information systems in the country with greater security and validity.

Collaborations

TAH Rocha: design and preparation of the manuscript, data collection, analysis and tabulation, data analysis and discussion, critical review and approval of the final version. NC Silva, ACQ Barbos, V Álvares and J Victor: writing the manuscript, data consolidation and validation, elaboration and description of tables, critical review of the document and approval of the final version. E Thumé and LA Facchini: writing of the manuscript, data consolidation and validation, critical review of the document and approval of the final version. PV Amaral: design and preparation of the manuscript, data collection, analysis and tabulation, data analysis and discussion, critical review and approval of the final version.

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