

# Hospitalizations due to diseases associated with poor sanitation in the public health care network of the metropolitan region of Porto Alegre, Rio Grande do Sul State, Brazil, 2010-2014\*

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## Abstract

**Objective:** to describe the occurrence, characteristics and expenditures of hospitalizations due to diseases associated with poor sanitation funded by the Brazilian National Health System (SUS) among residents of the metropolitan region of Porto Alegre-RS, Brazil, from 2010 to 2014. **Methods:** descriptive study with data from SUS Hospital Information System (SIH/SUS). **Results:** out of 13,929 hospitalizations for diseases associated with poor sanitation, 93.7% were related to fecal-oral transmission diseases and 20.4% were children from 1 to 4 years of age (28.1 hospitalizations/10,000 inhabitants/year); hospital fatality rate was of 2.2%, fecal-oral transmission diseases were the main causes of death; intensive care unit (ICU) was used in 2.0% of hospitalizations; total expenditures on hospitalizations was around BRL6.1 million. **Conclusion:** diseases associated with poor sanitation are still an important issue in the metropolitan region of Porto Alegre-RS, although this region presents good development indicators.

**Keywords:** Communicable Diseases; Sanitation; Basic Sanitation; Health Policy, Planning and Management; Epidemiology, Descriptive.

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## Introduction

The lack of sanitation affects negatively the population's health in several ways. Besides harming individual health, it increases public and private health expenditures regarding the treatment of diseases. Cairncross and Feachem<sup>1</sup> proposed a classification to infectious-parasitic diseases that are potentially determined by the environment, which they called 'diseases associated with poor sanitation' (DAPS). The term should be understood in the context of lack or insufficient environmental sanitation, in addition to poor housing conditions. The DAPS are classified as follows: (i) fecal-oral transmission diseases; (ii) vector-borne diseases; (iii) water transmitted diseases; (iv) diseases associated with hygiene; and (v) geohelminths and taeniasis. This classification can contribute to the creation of health protection programs, as well as to the assessment and development of public sanitation policies.

*The World Health Organization (WHO) mentions poor sanitation as a serious life threat.*

The DAPS comprise diarrhoeas, leptospirosis, Chagas' disease (American trypanosomiasis), taeniasis and hepatitis A, among others.<sup>2</sup> These diseases should not result in hospitalization, as they are considered potentially preventable since there are appropriate sanitary actions.<sup>3</sup>

The World Health Organization (WHO) mentions poor sanitation as a serious life threat. Despite the sanitation coverage improvements in American countries, the deficit of this service, even in large urban centers, is still a challenge to ensure universal access and, consequently, to reduce iniquity. The low coverage of essential services is associated with poverty. The low-income population is more vulnerable to these diseases associated with hygiene and malnutrition, among other risks.<sup>4</sup>

The United Nations defined the Sustainable Development Goals (SDG) as part of a new agenda – set in 2015 – whose challenge is to structure the global efforts that aim to eradicate poverty, as well as to integrate effectively the economic, social and environmental dimensions of the sustainable development. It presents a set of 17 goals and 169 universal and transforming targets; it is broad, far-reaching and people-centred, and its goal No. 6 aims

to ensure availability and sustainable management of water and sanitation for everyone.<sup>5</sup>

In Brazil, the reduction of mortality rates due to DAPS, since the 1930s, has not been followed by a reduction – as significant – of morbidity caused by this group of diseases.<sup>6</sup> In 2013, over 340,000 hospitalizations due to gastrointestinal infections were recorded in the country. The fact that most of these hospitalizations occurred in the North and Northeast regions stands out; the records show that these areas present less access to sanitary sewer. According to data from the National Information System on Sanitation (SNIS), 93.2% of individuals who live in the North and 80.5% of those who live in the Northeast did not have access to a sewer collection system in 2011.<sup>7</sup>

Law No. 8,080, dated September 19<sup>th</sup>, 1990, which regulates health actions and services all over the country and points out the environment as one of the several conditioning health factors (article 3), proposes a series of integrated actions regarding health, environment and sanitation.<sup>8</sup>

In the municipality of Porto Alegre, an increase in the incidence of dengue in the period from 2001 to 2013 was observed. The incidence rate, of 2.5 to 3 per 100,000 inhabitants/year, increased to 15 per 100,000 inhabitants/year, which is about 5 times higher. The unplanned urbanization was pointed as an aggravating factor for health inequalities in cities. In the case of DAPS, the morbidity increase may eventually result in an elevated number of hospitalizations.<sup>9</sup>

This study aimed to describe the occurrence, characteristics and expenditures of hospitalizations due to diseases associated with poor sanitation (DAPS), funded by the Brazilian National Health System (SUS), among residents of the metropolitan region of Porto Alegre-RS, Brazil, from 2010 to 2014.

## Methods

A descriptive study was carried out with data from SUS Hospital Information System (SIH/SUS). The files from the Inpatient Hospital Authorization (IHA) for the period from January 2010 to December 2014 were used.

The metropolitan region of Porto Alegre (MRPA) has the largest population of Rio Grande do Sul State. In 2010, it concentrated over 4 million inhabitants, which is equivalent to 37.7% of the state population. The

population density of the region was of 391.8 inhabitants/km<sup>2</sup>. In 2010, the MRPA had 96.9% of its population living in the urban area, and a gross domestic product (GDP) per capita of BRL27,026, about 1/3 above the national average (BRL20,372). In that year, the MRPA was the fourth Brazilian urban agglomeration, with 34 municipalities, and the main economic polo of the state of Rio Grande do Sul.<sup>10</sup>

Initially, all the 1,620 IHA files corresponding to the studied period were downloaded (27 federation units x 12 months x 5 years); the hospitalizations of MRPA residents (in any Brazilian area) were extracted in order to compose the main database.

Thus, a main unified file with 1,382,108 records, being 1,376,828 normal hospitalizations and 5,280 extended hospitalizations, was obtained. From this database, hospitalizations due to DAPS were identified.

The hospitalization cause was the one informed as the main diagnosis, which motivated it. The DAPS selected were those corresponding to the main diagnosis with the following codes from the International Statistical Classification of Diseases and Related Health Problems – 10<sup>th</sup> Revision (ICD-10):

- i) fecal-oral transmission diseases (diarrhoeas [A09], typhoid fever [A25] and hepatitis A [B15]);
- ii) vector-borne diseases (dengue [A90], yellow fever [A95], leishmaniasis [B55], cutaneous leishmaniasis [B55.9], visceral leishmaniasis [B55.0], lymphatic filariasis [B74], malaria [B50] and Chagas' disease [B57]);
- iii) water-borne diseases (leptospirosis [A27] and schistosomiasis [B65]);
- iv) diseases associated with hygiene (eye disorders [Z13.5], trachoma [H54.3], conjunctivitis [H10], skin diseases [B08] and superficial mycosis [B36]; and
- v) geohelminths and taeniasis (helminthiasis [B82.0] and taeniasis [83.9])

For physical dimensioning, we considered "hospitalization" the paid normal type IHA (IHA-1). However, for financial dimensioning, the long-stay IHA (IHA-5) was included, as the hospitalization expense already computed in IHA-1, continues.

The analysis plan included all the hospitalizations that occurred from 2010 to 2014. In the travel analysis, the residence municipalities and the hospitalization municipalities were identified in each IHA, in order to categorize if the hospitalization place was in the same municipality of the patient's residence, other MRPA municipality or a municipality outside the MRPA. The

average quantity of hospitalizations and hospital annual deaths were calculated for the MRPA, according to sex and 18 age groups (in years: under 1; 1 to 4; 5 to 9; and five-year intervals, until the age group of 80 years and more).

Hospitalization rates and hospital mortality rates were calculated per 10,000 and per 100,000 inhabitants based on the average number of hospitalizations during the five years (2010-2014), divided by the population projection of the midpoint year (2012), considering the official estimates of the Brazilian Institute of Geography and Statistics. The rates were calculated to each municipality, standardized by direct method, considering the MRPA population projection to 2012 as the standard-population, divided into 18 age groups (in years: <1, 1-4; and five-year intervals, until the age group of 80 and more). The hospital fatality rate was calculated by dividing the number of hospital deaths by each age group's hospitalizations, per sex. The average stay (in days) was calculated by dividing the total number of hospitalization days by the number of hospitalizations.

The expenditures were calculated using the values directly recorded in each IHA. They correspond to hospitalizations with nursery (hospital services, professionals and exams) and include the expenditures of the intensive care unit (ICU). The values are recorded in Brazilian *Reais* (BRL), with no monetary updates.

We adopted the economic perspective of the universal public funder, the Brazilian National Health System – SUS. Thus, the values correspond to the government expenditures, not necessarily 'costs', regarding the technical meaning of the term. They refer to the values paid to public and private health care providers, according to the table set by SUS.<sup>11</sup>

The study was carried out exclusively with secondary data of public access, so it is not possible to identify the individuals; also, the ethical principles established by the National Health Council Resolutions No. 466, dated December 12<sup>th</sup>, 2012, and No. 510/2016, were regarded. The Research Committee of the Medical School of the Federal University of Rio Grande do Sul (UFRGS) approved the project: Research Protocol No. 30,009, dated October 31<sup>st</sup>, 2015.

## Results

We identified a total of 13,929 hospitalizations in SUS due to diseases associated with poor sanitation among

residents of the metropolitan region of Porto Alegre, from 2010 to 2014. The highest number (2,848, or 20.4%) of hospitalizations corresponded to the age group from 1 to 4 years old (28.1 hospitalizations/10,000 inhabitants/year) (Table 1). However, the biggest DAPS hospitalization rate per 10,000 inhabitants/year is for the age group under 1 year old (59.7/10,000 inhabitants/year). Out of the 13,929 hospitalizations, 7,256 (52.1%; 7.4/10,000 inhabitants/year) were male and 6,673 (47.9%; 6.3/10,000 inhabitants/year) were female. For individuals over 60 years old, there was a higher number of hospitalizations among female individuals, although the rate for this sex has only overcome the male in the age group of 80 years old or more (23.0 versus 19.4).

With regard to hospitalization frequency per municipality of residence, there were 6,114 (43.8%; 8.6/10,000 inhabitants/year) hospitalizations of residents from Porto Alegre, 797 (5.7%; 7.6/10,000 inhabitants/

year) from Alvorada, 698 (5.0%; 5.8/10,000 inhabitants/year) from Viamão, 658 (4.7%; 4.1/10,000 inhabitants/year) from Canoas and 547 (3.9%; 4.6/10,000 inhabitants/year) from Novo Hamburgo. The hospitalizations per 10,000 inhabitants/year ranged from 1.4, in Glorinha, to 26.1, in Triunfo (Table 2).

The hospital fatality rate was higher among the residents of the municipality of Santo Antônio da Patrulha (7.8%; fatality rate of 3.1/100,000 inhabitants/year), followed by Nova Santa Rita (5.9%; 1.1/100,000 inhabitants/year), Taquara (5.7%; 4.5/100,000 inhabitants/year), Canoas (5.6%; 2.5/100,000 inhabitants/year) and Campo Bom (5.4%; 4.8/100,000 inhabitants/year).

When we evaluate deaths according to sex, 49.1% were male and 50.8% were female. Among the causes of death, according to the ICD-10, the most frequent ones were related to groups of other intestinal bacterial infections (41.7%) and diarrhoea and gastroenteritis of presumed infectious origins (21.6%) (Table 3).

**Table 1 – Number hospitalizations due to diseases associated with poor sanitation in the public health care network and rates per 10,000 inhabitants/year, according to sex and age group of the residents of the metropolitan region of Porto Alegre, Rio Grande do Sul, 2010-2014**

Age group (in years)	Male		Female		Total	
	N	Rate	N	Rate	N	Rate
<1	899	67.5	673	51.8	1,572	59.7
1-4	1,519	29.5	1,329	26.6	2,848	28.1
5-9	669	9.3	616	8.9	1,285	9.1
10-14	320	3.8	262	3.2	582	3.5
15-19	181	2.2	161	2.0	342	2.1
20-24	254	3.0	175	2.0	429	2.5
25-29	291	3.2	181	2.0	472	2.6
30-34	292	3.6	184	2.2	476	2.9
35-39	289	4.1	232	3.1	521	3.6
40-44	337	5.0	210	2.8	547	3.9
45-49	394	5.8	279	3.6	673	4.7
50-54	344	5.7	295	4.3	639	4.9
55-59	351	7.2	309	5.3	660	6.2
60-64	293	8.0	308	6.7	601	7.3
65-69	229	9.1	295	8.8	524	8.9
70-74	208	11.9	304	11.7	512	11.7
75-79	185	16.1	314	15.9	499	16.0
≥80	201	19.4	546	23.0	747	21.9
<b>Total</b>	<b>7,256</b>	<b>7.4</b>	<b>6,673</b>	<b>6.3</b>	<b>13,929</b>	<b>6.8</b>

**Table 2 – Distribution of hospitalizations due to diseases associated with poor sanitation in the public health care network, by municipality of hospitalization and standardized rate (per 10,000 inhabitants/year), according to municipality of residence in the metropolitan region of Porto Alegre, Rio Grande do Sul, 2010-2014**

Municipality of residence	Municipality of Hospitalization						Total	Standardized <sup>b</sup> rate
	In the municipality of residence		In other MRPA <sup>a</sup>		In a municipality outside MRPA <sup>a</sup>			
	N	%	N	%	N	%		
Alvorada	330	41.4	460	57.7	7	0.9	797	7.6
Araricá	–	–	12	100.0	–	–	12	4.5
Arroio dos Ratos	60	64.5	33	35.5	–	–	93	13.3
Cachoeirinha	300	74.3	102	25.2	2	0.5	404	6.9
Campo Bom	186	91.2	16	7.8	2	1.0	204	7.3
Canoas	537	81.6	117	17.8	4	0.6	658	4.1
Capela de Santana	–	–	25	100.0	–	–	25	4.2
Charqueadas	–	–	98	100.0	–	–	98	5.5
Dois Irmãos	183	96.8	3	1.6	3	1.6	189	14.7
Eldorado do Sul	–	–	71	100.0	–	–	71	3.7
Estância Velha	159	87.4	21	11.5	2	1.1	182	8.9
Esteio	326	90.5	32	8.9	2	0.6	360	9.0
Glorinha	–	–	5	100.0	–	–	5	1.4
Gravataí	143	33.7	274	64.6	7	1.7	424	3.3
Guaíba	96	46.4	110	53.1	1	0.5	207	4.5
Igrejinha	114	80.3	23	16.2	5	3.5	142	9.2
Ivoti	78	78.0	22	22.0	–	–	100	10.4
Montenegro	100	87.7	11	9.7	3	2.6	114	3.7
Nova Hartz	–	–	28	100.0	–	–	28	3.6
Nova Santa Rita	–	–	16	94.1	1	5.9	17	1.5
Novo Hamburgo	502	91.8	41	7.5	4	0.7	547	4.6
Parobé	440	95.0	18	3.9	5	1.1	463	18.0
Portão	75	75.8	23	23.2	1	1.0	99	6.2
Porto Alegre	6,054	99.0	45	0.7	15	0.3	6,114	8.6
Rolante	108	93.9	7	6.1	–	–	115	11.4
Sto. Antônio da Patrulha	81	78.6	8	7.8	14	13.6	103	5.0
São Jerônimo	118	92.9	9	7.1	–	–	127	10.9
São Leopoldo	418	84.6	70	14.2	6	1.2	494	4.6
São Sebastião do Caí	19	26.8	51	71.8	1	1.4	71	6.5
Sapiranga	127	86.4	18	12.2	2	1.4	147	4.2
Sapuçaia do Sul	160	69.9	68	29.7	1	0.4	229	3.5
Taquara	188	82.1	39	17.0	2	0.9	229	8.1
Triunfo	359	98.9	4	1.1	–	–	363	26.1
Viamão	160	22.9	534	76.5	4	0.6	698	5.8
<b>Total</b>	<b>11.421</b>	<b>82.0</b>	<b>2,414</b>	<b>17.3</b>	<b>94</b>	<b>0.7</b>	<b>13,929</b>	<b>6.8</b>

a) MRPA: Metropolitan Region of Porto Alegre.

b) Age-standardized.

On Table 2, it is also possible to verify where the residents of the metropolitan region were hospitalized. We can notice that 82% of hospitalizations due to DAPS occurred in the municipality of residence, although 17.3% of them took place in other MRPA municipalities and 0.7% in municipalities outside the MRPA. Porto Alegre had 6,054, or 99% of its residents hospitalized due to DAPS in the municipality itself (Table 2). However, 22.7% of the hospitalizations in the capital due to DAPS were of residents from other MRPA municipalities (data not presented). Out of the 34 municipalities, in five (Viamão, São Sebastião do Caí, Gravataí, Alvorada and Guaíba), less than half of the hospitalizations due to DAPS took place in the town of origin. Seven municipalities (Araricá, Capela de Santana, Charqueadas, Eldorado do Sul, Glorinha, Nova Hartz and Nova Santa Rita) did not have any hospitalization in the residence municipality, because there were no hospitals there (Table 2).

The use of ICU reached 2.0%; the hospitalizations due to leptospirosis stood out, with 13.2% of the cases. The age group with the highest absolute (61 hospitalizations) and relative (3.9%) ICU utilization was for infants under 1 year old, followed by the 60 to 64 years old age group, with absolute (27) and relative (4.5%) utilization. Out of the hospitalizations, 309 (2.2%) resulted in death, of which 78 (25.2%) required use of ICU (Table 4). The highest rates of ICU utilization are concentrated in the elderly group over 75 years old; however, in all the 3 hospitalizations of the under 1-year-old infants, which required ICU utilization, the outcome was death.

The total expenditure with hospitalizations due to DAPS among MRPA residents, in the period from 2010 to 2014, was about BRL 6.1 million. According to age group, the highest expenditures were for hospitalizations of 1 to 4 year-old children, which represented 27.2% (Table 5). Hospitalizations with death outcome presented more elevated average values (BRL 1,049.61) than those with other outcomes (BRL 423.99).

## Discussion

This study revealed that hospitalizations due to DAPS were concentrated among children and the elderly, and the most frequent diagnosis was fecal-oral transmission diseases. There was a significant difference in the hospitalization rates for DAPS among the municipalities

that are part of the metropolitan region of Porto Alegre. Considering the five municipalities with the highest hospital fatality rates, the fact that only Nova Santa Rita did not have a hospital unit stands out. There were expressive travels – even of residents in the capital Porto Alegre, which concentrates the largest number of health services and hospitals – to other municipalities of the MRPA. There was a difference concerning sex when it comes to the main diagnosis that motivated hospitalization. The utilization of ICU occurred more often among younger and older age groups. The DAPS caused deaths and involved considerable expenditures for SUS.

DAPS are still present in the metropolitan areas of Brazil, despite the increasing prevalence of chronic non-communicable diseases. The numbers of hospitalizations and expenditures that result from them represent resources spent on potentially preventable diseases, that is, they should not have high costs for SUS and society with hospital treatments.

These diseases, which manifest mainly as diarrhoeas, are among the main causes of morbidity and mortality in developing countries. It is known that the prevalence of these diseases is an indicative of a weak and fragile public sanitation system. In the period from 2001 to 2009, diarrhoea and dengue were responsible for more than 93% of hospitalizations caused by DAPS in the country.<sup>12</sup> In the municipality of Guarulhos, in the metropolitan region of São Paulo, from 2005 to 2006, the risk of diarrhoea was 15 times bigger for children living in environments without appropriate housing and sanitation conditions.<sup>13</sup>

Thus, diarrheal morbidity is an important indicator for Public Health because it responds to various changes in sanitation conditions, food quality, habits and behaviours of an individual and of an entire community.<sup>14</sup> The model of utilization of the urban soil is directly related to the way it affects urban health. The reality is characterized by epidemiological and demographic transformations, and by unique social inequalities, depending on the geographic areas.

Despite the differences, higher hospitalization coefficients are observed in the extremes of the life cycle, that is, children and the elderly. This finding is corroborated by other studies, and demonstrates that these age groups, especially those under the age of 2 years old and the elderly, were the groups with the highest number of hospitalizations and hospital stays.<sup>15</sup>

**Table 3 – Deaths in hospitalizations due to diseases associated with poor sanitation in the public health care network, by sex, according to main diagnosis of residents of the metropolitan region of Porto Alegre, Rio Grande do Sul, 2010-2014**

Diagnosis – ICD-10 <sup>th</sup>	Male	Female	Total
A00 Cholera	11	15	26
A01 Typhoid and paratyphoid fevers	1	2	3
A02 Other Salmonella infections	5	4	9
A04 Other bacterial intestinal infections	64	65	129
A06 Amebiasis	–	2	2
A07 Other specified protozoal intestinal diseases	2	–	2
A08 Viral and other non-specified intestinal infections	18	25	43
A09 Diarrhoea and gastroenteritis of presumed infectious origins	27	40	67
A27 Leptospirosis	20	1	21
B35 Dermatophytosis	2	–	2
B36 Other superficial mycoses	1	–	1
B53 Other parasitologically confirmed malaria	1	–	1
B57 Chagas' disease	–	3	3
<b>Total</b>	<b>152</b>	<b>157</b>	<b>309</b>

a) ICD-10: International Classification of Diseases – 10th Revision.

**Table 4 – Number of deaths, hospital mortality rates (per 100,000 inhabitants/year) and number of hospitalizations due to diseases associated with poor sanitation with Intensive Care Unit utilization in public health care network, according to age group of residents of the metropolitan region of Porto Alegre, Rio Grande do Sul, 2010-2014**

Age group (in years)	Deaths	Rate	ICU <sup>a</sup> utilization	(%)
<1	3	1.1	3	100.0
1-4	1	0.1	–	–
5-9	–	–	–	–
10-14	1	0.1	–	–
15-19	2	0.1	–	–
20-24	3	0.2	2	66.7
25-29	5	0.3	2	40.0
30-34	7	0.4	1	14.3
35-39	9	0.6	4	44.4
40-44	6	0.4	1	16.7
45-49	16	1.1	5	31.3
50-54	14	1.1	5	35.7
55-59	23	2.2	6	26.1
60-64	20	2.4	8	40.0
65-69	23	3.9	7	30.4
70-74	33	7.6	7	21.2
75-79	50	16.0	10	20.0
≥80	93	27.3	17	18.3
<b>Total</b>	<b>309</b>	<b>1.5</b>	<b>78</b>	<b>25.2</b>

a) ICU: Intensive Care Unit.

**Table 5 – Total average expenditures (in Brazilian Reais - BRL) per hospitalization and per day of hospitalization due to diseases associated with poor sanitation in the public health care network, according to sex and age group of residents of the metropolitan region of Porto Alegre, Rio Grande do Sul, 2010-2014**

Age group (in years)	Male		Female		Total	Average expenditure hospitalization day
	Total value	Expenditure per Hospitalization	Total expenditure	Expenditure per Hospitalization		
<1	396,348.43	440.88	293,620.57	436.29	689,969.00	96.14
1-4	522,996.23	344.30	448,498.35	337.47	971,494.58	99.77
5-9	230,188.02	344.08	208,056.67	337.75	438,244.69	106.94
10-14	135,085.08	422.14	106,671.11	407.11	241,756.19	115.45
15-19	96,639.32	533.92	75,336.88	467.93	171,976.20	116.36
20-24	104,015.29	409.51	59,785.33	341.63	163,800.62	93.28
25-29	134,641.56	462.69	74,294.53	410.47	208,936.09	94.20
30-34	143,684.99	492.07	73,871.68	401.48	217,556.67	92.34
35-39	131,708.48	455.74	99,693.62	429.71	231,402.10	91.03
40-44	151,419.66	449.32	89,033.63	423.97	240,453.29	80.58
45-49	182,500.80	463.20	131,813.29	472.45	314,314.09	83.44
50-54	177,859.33	517.03	119,236.35	404.19	297,095.68	84.62
55-59	166,939.76	475.61	157,145.92	508.56	324,085.68	84.49
60-64	186,164.59	635.37	173,934.62	564.72	360,099.21	100.03
65-69	137,094.64	598.67	140,359.26	475.79	277,453.90	86.84
70-74	103,032.69	495.35	158,040.82	519.87	261,073.51	85.79
75-79	95,784.48	517.75	167,904.54	534.73	263,689.02	87.93
≥80	104,316.66	518.98	321,289.52	588.44	425,606.18	90.11
<b>Total</b>	<b>3,200,420.01</b>	<b>441.07</b>	<b>2,898,586.69</b>	<b>434.38</b>	<b>6,099,006.70</b>	<b>93.67</b>

Source: SUS Hospital Information System (SIH/SUS).

These findings reinforce the importance of public health policies with emphasis on those groups.

A study performed in two general secondary hospitals in the municipality of São Paulo in 2010 revealed that white male elderly adults, in poor health conditions and with lower income, had higher chances of hospitalization when compared to women. Probably, these results indicate more serious situations, since it is known that women take better care when it comes to health.<sup>16</sup> The larger number of hospitalizations among female may also be related to the fact that women look for health services more frequently.<sup>17</sup>

Canoas, the second most populous municipality of Rio Grande do Sul, after Porto Alegre, the fourth largest city in terms of hospitalizations and the second in absolute number of hospital deaths, had a high hospital fatality rate, despite having several health services installed and available infrastructure. These

data probably reflect the severity of health conditions of hospitalized individuals. Besides that, it can make room for proposing and developing new studies on the quality of services provided, as well as on the coverage and effectiveness of the Family Health Strategy. It is reasonable to suspect that limited access to primary health care and, consequently, late hospitalization, are possible causes of such high fatality rates.

Extending the analysis of this indicator, the hospital fatality rate concerning DAPS among the MRPA residents, taking the 34 municipalities into consideration, can be considered low: for every 100 hospitalizations there were 2.2 deaths. However, if this type of disease is preventable and it should not result in hospitalization, the value found is mainly expressive. Moreover, the results presented lead us to agree that, among the main causes of SUS hospitalizations related to DAPS, oral-faecal

transmission diseases were responsible for the higher hospital mortality rates.

Despite being the capital of the state and having the highest concentration of services, residents of Porto Alegre went to other municipalities in order to receive health assistance, including municipalities outside the metropolitan region. This result reveals a municipality with possible network management problems and/or insufficient primary care. There, 34.2% of hospitalizations corresponded to non-residents of the municipality and 22.3% of Porto Alegre residents were hospitalized in other municipalities (important reminder: due to avoidable diseases); some problems may have led to this reality, which deserves to be studied with the objective of correcting errors and qualifying the management of services/resources.

Data regarding place of residence and place of hospitalization may show limited access to health services, which is an important indicator of the quality and capacity of a health care system to meet the needs of a population. However, there are significant inequalities concerning the access to health services in different regions,<sup>18</sup> and ensuring universal and equitable access is still a challenge given the national scenario, characterized by epidemiological, demographic, and geographic transformations, besides prominent social inequalities.

There is a significant difference in hospitalization expenditures for SUS. This value varies greatly among the municipalities of the same metropolitan region. From 2001 to 2009, the average annual cost of hospitalizations due to DAPS in the country was responsible for 3.3% of the total SUS expenditures involving hospitalizations, and from 2010 to 2014, the absolute values paid had an increase of 141.4%.<sup>12</sup> The assessment of hospital services is a key factor when it comes to promoting greater awareness of the effectiveness of the health assistance offered, and when it comes to the achievement of greater efficiency in spending, in order to avoid unnecessary expenditures.

It is important to create mechanisms of evaluation of health services – their quality and costs – regarding the planning of how to invest the available resources in order to avoid waste and to meet the real needs of patients, without overloading the hospital health system.<sup>19</sup> The World Organization of Health – WHO – stated that, for each dollar invested in treated water and sanitary sewer, 4.3 dollars are saved in terms of health expenditures

in the world. In 2014, 2.5 billion people did not have access to sanitation services, and 1 billion people used to defecate outdoors, according to WHO.<sup>20</sup>

The Brazilian Basic Sanitation Law (Federal Law No. 11,445/2007)<sup>21</sup> establishes the national guidelines for sanitation and defines sanitation as 'the set of services, infrastructures and facilities for water supply, sanitation, urban cleaning, solid waste management and urban rainwater drainage'. This sector of great magnitude produces positive externalities in the area of Public Health, in the environment and in the development and economic growth of the country. However, a qualitative and quantitative study regarding Federal Government investments from 2004 to 2009 revealed that these investments did not meet the profile of the services deficits.<sup>22</sup> Similarly, the evaluation of 18 municipal sanitation plans showed that, in most cases, the implementation of the politics was fragile, and the incorporation of principles into these plans was incipient.<sup>23</sup>

Some limitations of this study should be mentioned. The first one results from the use of databases from SUS Hospital Information System – SIH/SUS – originally designed for administrative functions. Readmissions and/or manipulations are possible, also in face of the administrative and financial purpose of the system. Coding or diagnosis errors are also possible. The record of hospital death cases in SIH/SUS by cholera calls attention, and is probably due to coding error: there is no record of death by cholera in the Mortality Information System (SIM), regarding the period studied in the country. Rates were calculated using the total population as the denominator; however, about 25% of the population of the metropolitan region of Porto Alegre had health insurance with hospital coverage registered at the National Supplementary Health Agency in 2010.<sup>24</sup>

This study shows that the DAPS still represent an important public health issue for one of the main metropolitan regions of the country, Porto Alegre, which is traditionally considered to have good development indicators. It shows a recent overview of the health situation of the largest metropolitan area in the South of the country, points to priority population segments, such as children and the elderly, and reveals high expenditures to the public health system, whether in value or hospital bed use – including the ICU.

Other local investigations on diseases associated to poor sanitation – DAPS – could measure, in a more appropriate way, the reality and diversity of the municipalities in Rio Grande do Sul, which is more heterogeneous than a preliminary analysis would suggest, even when it comes to the metropolitan region of Porto Alegre. This kind of study allows a better design of the situation and, therefore, promotes actions and better allocation of resources, so these diseases can be properly tackled.

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## Authors' Contributions

Siqueira MS and Rosa RS contributed to the conception and design of the study, manuscript analysis, drafting and critical review. Bordin R and Nagem RC contributed to the analysis, interpretation of results and critical review of the manuscript. All the authors approved the final version of this article and declared to be responsible for all aspects of the study, ensuring its accuracy and integrity.

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