

## Original Article

# Burns in the Brazilian Unified Health System: a review of hospitalization from 2008 to 2017

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**Abstract:** Background: Burns are a public health problem, especially in vulnerable populations. The costs of treatment remain poorly studied in developing countries. This study aimed to evaluate the incidence of burn admissions in the Brazilian public health care system between 2008 and 2017. Methods: This study used publicly available data from hospital information and mortality systems. We investigated information as sex, age, length of stay, admission costs (reimbursement), and mortality. Results: There were 170,554 admissions and most patients were male. Annual admission rates were between 1.32 and 1.87 for children aged  $\leq$  nine years and between 0.58 and 0.71 for adults aged  $\geq$  60 years, per 10,000 population. Overall cost was US \$158,332,891.11 (R\$614,537,450.29). In-hospital mortality was 3.56%. Conclusion: Admissions showed a downward trend, while mortality remained stable and demanded substantial resources.

**Keywords:** Burns, hospital costs, hospital information system, national health programs, Brazil

## Introduction

Burns is a significant public health issue, especially in low-income countries, which account for more than 95% of all deaths caused by this type of injury worldwide. World Health Organization Global Health Estimates reported 152,300 deaths in 2016, based on official data from 183 countries. The estimate showed that 83,600 (54.9%) burn victims were female; regarding age group, 26,200 (17.2%) were children aged < 5 years and 43,500 (28.6%) were adults aged  $\geq$  60 years [1].

However, deaths represent only part of the problem, as disability or disfigurement due to burns impairs the lives of a significant number of people. For some, this means stigma and rejection, in addition to economic losses for victims and their families [2, 3]. Estimated fire-related injuries accounted for 10 million disability-adjusted life years (DALYs) lost each year worldwide [4]. Thus, rehabilitation is considered the primary objective in the treatment of burn survivors [3].

Epidemiological data (excluding low-income countries) have demonstrated a global trend

toward reduction in burn incidence, severity, length of hospital stay, and mortality rate [5]. Conversely, we treat some injuries at health care facilities, and this situation underestimates burn-related [6].

Burn treatment costs are high because of factors such as the complexity of procedures and the need for a multidisciplinary team. In a systematic review conducted by Hop et al. [7], treatment cost per patient was US \$88,128 (USD 704 to \$717,306; mean USD 44,024) in high-income countries. In Brazil, a retrospective, hospital-based study [8] analyzing secondary data of burn victims found that mean admission cost was USD 856.00. Another study involving a cohort of intensive care unit (ICU) patients evaluated burn severity and direct treatment costs. Mean daily cost was USD 1 330.48, and mean admission cost was US \$39,594.90 [9].

Advances in care and treatment of burn patients have contributed to reducing mortality rates in high-income countries [3]. Additionally, better care has led to improved functional and emotional outcomes in burn victims [4].

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However, scarce burn-related data, together with incomplete reports of burn events, may lead to minimizing the significance of burns as a public health issue in Brazil. Thus, this study aimed to evaluate the incidence of admissions to burn patient in the Brazilian Unified Health System.

### Materials and methods

This study was performed by retrospectively reviewing about burn admissions we obtained the aggregate data from Hospital Information System, the Mortality Information System and National Register of Health Facilities, which provided by the Brazilian Unified Health System Information Technology Department (DATASUS). The DATASUS is an open national database. In addition to describing characteristics and costs of burn admissions, this study includes their geographic distribution and time trend from 2008 to 2017. We used only anonymous and publicly available data, because of this; a research ethics committee did not evaluate the study project, as recommended by the Brazilian National Health Council Resolution no. 510/2016.

Variables collected from Hospital Information System were those related to clinical and economic data of burn patients (number of admissions, burn severity, in-hospital deaths, length of stay, mean stay, mean cost, and total admissions cost) per local of residence. These variables were obtained using procedure codes established in the Hospital Information System operating manual, including minor burn treatment (code: 04.13.01.009-0), moderate burn treatment (code: 04.13.01.008-2), major burn treatment (code: 04.13.01.006-6), and urgent care for moderate and major burns (code: 04.13.01.001-5; refers to care provided to patients at an emergency department before transference to a burn care unit). We included the ICU stay in procedure costs [10].

Mortality variables were obtained from Mortality Information System using International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) codes describing accidental or intentional burns, grouped in categories X00 to X19. Variables collected from epidemiology/morbidity section were those regarding sex and age of patients in the groups of causes related to those codes.

Data on specialized burn care beds were collected from DATASUS by National Register of Health Facilities. Also, we divide the data on adult and pediatric surgical and clinical beds per year (annual means per region and nationwide).

The Brazilian States and Federal District were the geographic units of measure, considering the place where burn victims lived. We described the cumulative data for each region, while we consolidated data at the national level.

The following equation was used to calculate incidence rates, where the denominator corresponded to a population from a specific stratum as defined by the 2010 Census [11]. We calculate the admission rates using as the numerator the number of admissions occurred in the period (obtained from Hospital Information System) and as the denominator the number of inhabitants from that stratum according to the 2010 Census. We used the equation  $\text{Burn admission rate} = \frac{\text{Number of admission in stratum (Datusus)}}{\text{Population from that stratum (2010 Census)}} \times 10,000$ . We included the absolute frequencies in the results. The use of number from the Census in the study might overestimate the burn admission rate.

We calculate the mortality in the hospital using the number of hospitalized patients who died of burn injuries. We collect the mortality rates from the Mortality Information System.

We obtained the costs of admission from the Hospital Information System for each year analyzed in the study period. The authorization of hospital admission by the Brazilian Ministry of Health for financial give information about reimbursement at those hospitalizations. All values were adjusted by the Brazilian General Market Price Index, between December 31 of the corresponding year and June 1, 2018. An economic calculator was used to adjust those values [12]. Values were converted from Brazilian reais (R\$) to American dollars (USD) using an exchange rate of US \$1.00 = R\$3.88 (as of June 14, 2019) [13].

All data were entered into Microsoft Excel spreadsheets and analyzed in SSPS software (IBM, version 23). We use the descriptive statistics to present the results, and we obtained the means from DATASUS, which prevented any

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estimate of measures of dispersion. We used Spearman's correlation coefficient for trend analysis, where  $r = 1$  meant a perfect positive correlation, and  $r = -1$  meant a perfect negative correlation. A  $p$ -value  $< 0.05$  was considered significant.

Maps of geographic distribution (States and Federal District - Capital of Brazil) and time trend (2008, 2013, and 2017) of burn injuries were created in Quantum GIS software, version 2.18.24, using burn admission rates in the general population and among men, women, and children aged  $\leq 9$  years, as well as absolute number of in-hospital deaths.

### Results

In Brazil, the hospital admitted approximately 170,000 people for burn treatment in the study period, which corresponds to an accumulate rate of 8.94 admissions per 10,000 population from 2008 to 2017. There was a downward trend in burn admission rates ( $r = -0.853$ ;  $P = 0.002$ ) over time.

Concerning patients' sex, 93,761 men and 57,291 women had burn injuries requiring admission to hospitals in the period, accounting for a male-to-female ratio of 1.64:1. The admission rate per year according to age group was 1.32 to 1.87 for burn victims aged  $\leq$  nine years; 0.36 to 0.70 for 10 to 19 years; 0.58 to 0.84 for 20 to 59 years; and 0.58 to 0.71 for  $\geq$  60 years, per 10,000 population.

According to the Hospital Information System, of all hospitalized patients, 90.8% had moderate and major burns (**Table 1**). This percentage remained almost unchanged in the study period; however, there was a decrease in the number of patients with minor burns requiring hospital care.

Trend analysis showed that female and male admission rates had similar decreases ( $r = -0.888$ ;  $P = 0.001$  vs.  $r = -0.903$ ;  $P < 0.001$ , respectively). There were no significant changes in the period for burn victims aged  $\geq 60$  years ( $r = -0.575$ ;  $P = 0.082$ ), contrasting with findings for other age groups.

Regarding admission rates in terms of burn severity, there was a decrease only for patients with minor burns ( $r = -0.997$ ;  $P < 0.001$ ) in the study period. The admission rates of patients

with moderate and significant burns had no changes; however, there was a substantial increase in urgent admissions ( $r = 0.787$ ;  $P = 0.007$ ) (**Table 1**).

**Table 2** shows burn admissions stratified by macro-regions and nationwide. An analysis of each region revealed that, individually, they do not necessarily follow a nationwide trend. Midwest ( $r = -0.733$ ;  $P = 0.016$ ), North ( $r = -0.699$ ;  $P = 0.024$ ), and Southeast regions ( $r = -0.685$ ;  $P = 0.029$ ) showed a decrease in burn admission rates, which was also observed nationwide. However, South ( $r = -0.280$ ;  $P = 0.434$ ) and Northeast regions ( $r = -1.176$ ;  $P = 0.627$ ) had no changes in admission rates over the study period.

The length of hospital stay in the Southeast region had the highest mean (10.3 days) across all regions. The mean length of stay remained stable nationwide ( $r = 0.141$ ;  $P = 0.698$ ), ranging from 7.5 to 8.5 days in the period, with a total hospital stay of 1,300,000 days.

According to the Mortality Information System, there were 9,415 deaths due to burn injuries in Brazil in the study period, and most of them occurred in a hospital setting. In-hospital mortality was 3.6%, corresponding to approximately 6,000 patients. Midwest region had the lowest rate of in-hospital mortality (1.8%;  $n = 363$ ), while the Southeast region had the highest (5.3%;  $n = 2,838$ ). Nationwide, there was no change in in-hospital mortality ( $r = -0.401$ ;  $P = 0.250$ ) and in burn-related mortality rate ( $r = -0.133$ ;  $P = 0.732$ ). An exception was the North Region, where in-hospital mortality ( $r = 0.661$ ;  $P = 0.038$ ) increased among burn victims.

In the study period, 170,554 admissions had a cost of USD 158,332,891.11 (R\$614,537,450.29), the mean of admission cost of USD 923.31 (R\$3,583.65). North region had the lowest mean cost (USD 540.10; R\$2,096.32), while the Southeast region had the highest (USD 1,086.21; R\$4,215.91).

The number of SUS-level hospital beds for specialized treatment of burn patients increased over time in most regions, except for the Midwest, which had a decrease (**Table 2**). It is worth noting that the Northeast region tripled the number of specialized care beds between 2013 and 2017.

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**Table 1.** Distribution of admission rates and characteristics of hospitalized burn victims in Brazil, 2008-2017

Year	Total admissions <sup>a</sup>	Overall admission rate <sup>b</sup>	Number and rate men <sup>c</sup>	Number and rate women <sup>c</sup>	Number and rate age ≤ 9 years <sup>c</sup>	Number and rate age 10 to 19 years <sup>c</sup>	Number and rate age 20 to 59 years <sup>c</sup>	Number and rate age ≥ 60 years <sup>c</sup>	Patients with minor burns <sup>a</sup> (n; %)	Patients with moderate burns <sup>a</sup> (n; %)	Patients with major burns <sup>a</sup> (n; %)	Urgent care for patients with moderate and major burns <sup>a</sup> (n; %)
2008	18,418	0.97	10,053 (1.08)	6,349 (0.65)	4,796 (1.67)	2,172 (0.64)	7,975 (0.74)	1,459 (0.71)	2,649 (14.4)	7,912 (43.0)	6,081 (33.0)	1,776 (9.6)
2009	16,887	0.89	10,396 (1.11)	6,542 (0.67)	5,222 (1.82)	2,192 (0.64)	8,179 (0.76)	1,345 (0.65)	2,124 (12.6)	7,326 (43.4)	5,652 (33.5)	1,785 (10.6)
2010	18,524	0.97	11,399 (1.22)	6,845 (0.70)	5,389 (1.87)	2,386 (0.70)	9,017 (0.84)	1,452 (0.71)	2,176 (11.7)	7,927 (42.8)	6,351 (34.3)	2,070 (11.2)
2011	18,455	0.97	9,860 (1.06)	6,244 (0.64)	4,904 (1.70)	2,100 (0.61)	7,695 (0.72)	1,405 (0.68)	1,834 (9.9)	7,566 (41.0)	6,569 (35.6)	2,486 (13.5)
2012	18,335	0.96	9,545 (1.02)	5,895 (0.61)	4,506 (1.57)	1,999 (0.59)	7,726 (0.72)	1,209 (0.59)	1,574 (8.6)	7,306 (39.8)	7,062 (38.5)	2,393 (13.1)
2013	17,086	0.90	8,999 (0.96)	5,275 (0.54)	4,179 (1.45)	1,676 (0.49)	7,217 (0.67)	1,202 (0.58)	1,346 (7.9)	6,284 (36.8)	7,650 (44.8)	1,806 (10.6)
2014	16,671	0.87	8,453 (0.90)	3,888 (0.52)	3,888 (1.35)	1,594 (0.47)	6,750 (0.63)	1,260 (0.61)	1,156 (6.9)	6,461 (38.8)	6,420 (38.5)	2,634 (15.8)
2015	16,008	0.84	8,469 (0.91)	5,185 (0.53)	3,973 (1.38)	1,518 (0.44)	6,833 (0.64)	1,330 (0.65)	1,106 (6.9)	6,763 (42.2)	5,321 (33.2)	2,818 (17.6)
2016	15,737	0.82	8,742 (0.94)	5,255 (0.54)	4,215 (1.47)	1,473 (0.43)	6,983 (0.65)	1,326 (0.64)	930 (5.9)	6,799 (43.2)	5,444 (34.6)	2,564 (16.3)
2017	14,433	0.76	7,845 (0.84)	4,662 (0.48)	3,826 (1.32)	1,240 (0.36)	6,192 (0.58)	1,249 (0.61)	841 (5.8)	6,089 (42.2)	4,928 (34.2)	2,547 (17.6)
Total	170,554	8.95	93,761	57,291	44,898	18,350	74,567	13,237	15,736 (9.1)	70,443 (41.3)	61,478 (36.0)	22,879 (13.6)
Spearman's correlation (p-value)	N/A	-0.846 (0.002)	-0.866 (0.001)	-0.911 (< 0.001)	-0.858 (0.001)	-0.944 (< 0.001)	-0.855 (0.002)	-0.589 (0.073)	-0.971 (< 0.001)	-0.177 (0.625)	0.140 (0.700)	0.804 (0.005)

<sup>a</sup>Data obtained per procedure and <sup>d</sup>data obtained per group of causes, both from DATASUS (2018). <sup>b</sup>Admission rate per 10,000 population. N/A: not applicable.

**Table 2.** Time trend, characteristics and costs\* of burn admissions in Brazilian macroregions and nationwide, 2008-2017

North	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
Total admissions (n)	1,138	869	929	1,018	950	971	905	871	834	784	9,269
Admission rate <sup>a</sup>	0.72	0.55	0.59	0.64	0.60	0.61	0.57	0.55	0.53	0.49	5.84
Days of stay (n)	7,942	7,134	8,484	8,986	9,257	8,876	7,961	8,354	8,013	7,848	82,855
Mean length of stay (days)	7.0	8.2	9.1	8.8	9.7	9.1	8.8	9.6	9.6	10.0	8.99
In-hospital deaths (n)	19	10	18	27	14	33	35	33	29	19	237
In-hospital mortality (%)	1.67	1.15	1.94	2.65	1.47	3.39	3.86	3.79	3.48	2.42	2.56
Total cost <sup>b</sup> (US \$)	454,194.10	487,947.10	519,288.07	595,711.67	525,048.73	505,713.45	522,882.59	530,247.57	462,739.91	419,734.52	5,023,507.75
Mean admission cost <sup>b</sup> (US \$)	399.11	561.49	558.97	585.17	552.68	520.81	577.77	608.77	554.84	535.37	932.53
Mean specialized care beds (n)	(...)	(...)	(...)	(...)	(...)	11	16	21	23	24	N/A
Northeast	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
Total admissions (n)	5,732	5,502	5,928	5,994	6,083	6,504	6,793	5,845	5,470	4,791	58,642
Admission rate <sup>a</sup>	1.08	1.04	1.12	1.13	1.15	1.23	1.28	1.10	1.03	0.90	11.05

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Days of stay (n)	47,101	42,305	41,769	42,292	41,324	37,029	33,215	36,414	36,218	31,508	389,175
Mean length of stay (days)	8.2	7.7	7.0	7.1	6.8	5.7	4.9	6.2	6.6	6.6	6.68
In-hospital deaths (n)	172	178	166	179	156	160	168	175	175	128	1,657
In-hospital mortality (%)	3.00	3.24	2.80	2.99	2.56	2.46	2.47	2.99	3.20	2.67	2.83
Total cost <sup>b</sup> (US \$)	5,465,597.15	5,847,699.85	5,665,581.74	5,940,039.10	6,168,735.85	7,596,176.46	5,909,288.32	3,827,998.21	3,291,829.25	2,901,762.27	52,614,708.23
Mean admission cost <sup>b</sup> (US \$)	953.52	1,062.83	955.73	990.99	1,014.09	1,167.92	869.90	654.91	601.79	605.67	887.74
Mean specialized care beds (n)	(...)	(...)	(...)	(...)	(...)	40	63	65	76	115	N/A
<b>Southeast</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>TOTAL</b>
Total admissions (n)	6,087	5,249	5,497	5,524	5,634	5,002	5,126	5,058	5,315	4,694	53,186
Admission rate <sup>a</sup>	0.76	0.65	0.68	0.69	0.70	0.62	0.64	0.63	0.66	0.58	6.62
Days of stay (n)	63,383	54,524	58,080	56,938	56,587	49,951	51,407	51,217	56,345	48,944	547,376
Mean length of stay (days)	10.4	10.4	10.6	10.3	10.0	10.0	10.0	10.1	10.6	10.4	10.28
In-hospital deaths (n)	334	256	362	342	318	295	288	241	220	182	2,838
In-hospital mortality (%)	5.49	4.88	6.59	6.19	5.64	5.89	5.62	4.76	4.13	3.88	5.34
Total cost <sup>b</sup> (US \$)	6,128,449.55	6,722,688.05	6,988,288.28	6,590,076.49	6,281,020.87	5,797,088.60	5,389,504.70	5,065,821.93	5,032,957.43	4,436,383.26	58,432,279.04
Mean admission cost <sup>b</sup> (US \$)	1,006.80	1,280.75	1,271.29	1,192.98	1,114.84	1,158.95	1,051.40	1,001.54	946.93	645.11	1,096.84
Mean specialized care beds (n)	(...)	(...)	(...)	(...)	(...)	40	62	68	70	73	N/A
<b>South</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>TOTAL</b>
Total admissions (n)	3,005	2,889	3,272	2,908	2,907	2,742	2,666	3,086	2,973	2,822	29,270
Admission rate <sup>a</sup>	1.10	1.05	1.19	1.06	1.06	1.00	0.97	1.13	1.09	1.03	10.69
Days of stay (n)	23,744	22,274	25,628	24,147	24,151	23,420	22,898	24,707	23,818	21,626	236,413
Mean length of stay (days)	7.9	7.7	7.8	8.3	8.3	8.5	8.6	8.0	8.0	7.7	8.08
In-hospital deaths (n)	98	82	111	119	113	106	63	92	105	80	969
In-hospital mortality (%)	3.26	2.84	3.39	4.09	3.89	3.86	2.36	2.98	3.53	2.83	3.31
Total cost <sup>b</sup> (US \$)	2,790,593.63	3,555,710.85	3,835,828.91	3,400,404.91	3,354,136.23	3,149,931.69	3,039,571.12	2,990,679.58	2,836,598.79	2,576,955.39	31,530,411.13
Mean admission cost <sup>b</sup> (US \$)	928.65	1,230.77	1,172.31	1,169.32	1,153.81	1,148.76	1,140.12	969.11	954.12	913.16	1,078.01
Mean specialized care beds (n)	(...)	(...)	(...)	(...)	(...)	31	39	40	41	37	N/A
<b>Midwest</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>TOTAL</b>
Total admissions (n)	2,456	2,378	2,898	3,011	2,761	1,867	1,181	1,148	1,145	1,342	20,187
Admission rate <sup>a</sup>	1.75	1.69	2.06	2.14	1.96	1.33	0.84	0.82	0.81	0.95	14.36

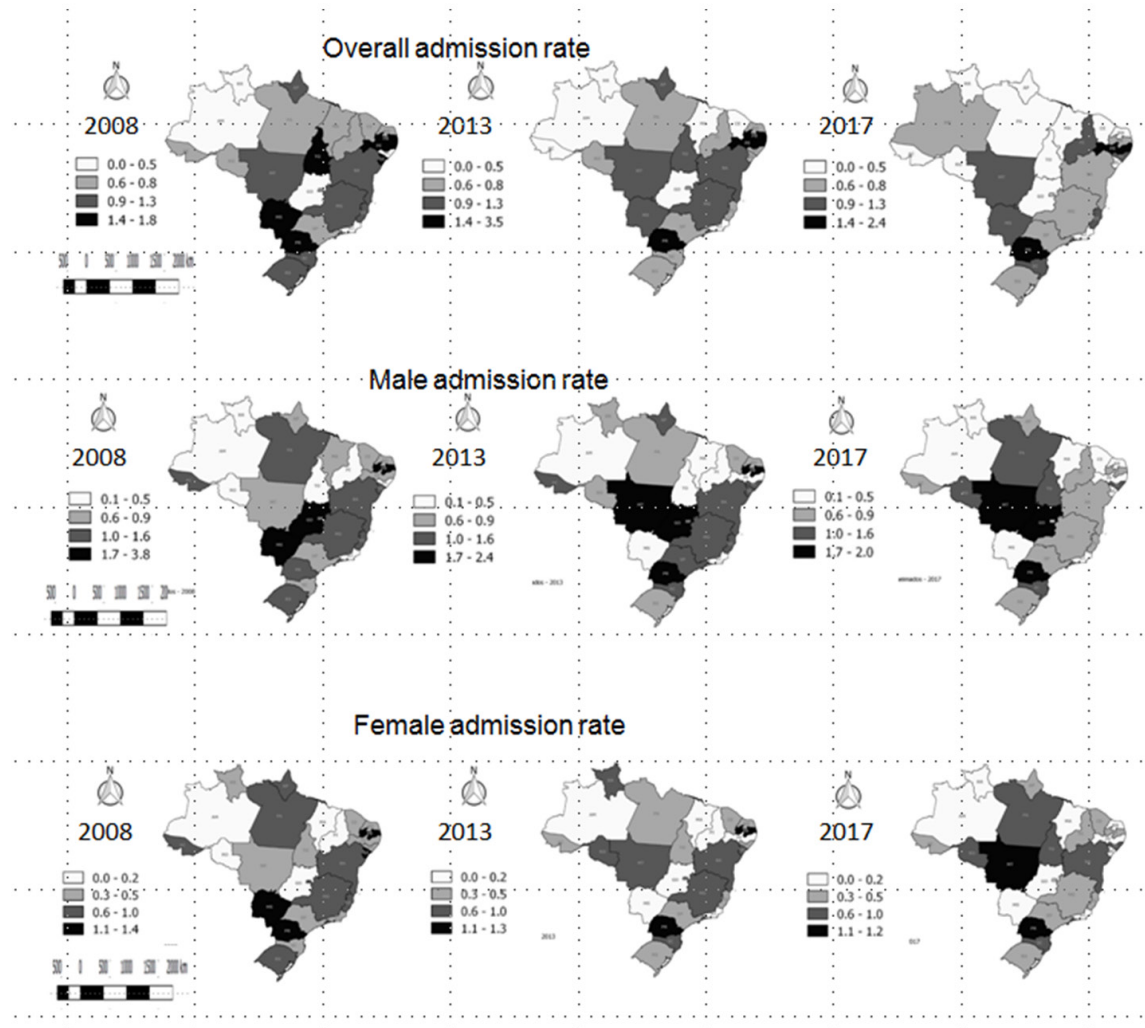
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Days of stay (n)	10,899	10,321	12,398	12,008	11,897	10,934	9,521	8,673	9,462	9,894	106,007
Mean length of stay (days)	4.4	4.3	4.3	4.0	4.3	5.9	8.1	7.6	8.3	7.4	5.86
In-hospital deaths (n)	49	44	46	37	40	52	26	20	30	19	363
In-hospital mortality (%)	2.00	1.85	1.59	1.23	1.45	2.79	2.20	1.74	2.62	1.42	1.80
Total cost <sup>b</sup> (US \$)	1,315,021.05	1,527,841.98	1,704,443.88	1,632,131.56	1,435,332.73	1,139,337.48	895,694.49	711,924.63	692,165.08	826,446.18	31,530,411.13
Mean admission cost <sup>b</sup> (US \$)	535.42	642.48	588.14	542.05	519.85	610.25	758.41	620.14	604.51	615.82	603.71
Mean specialized care beds (n)	(...)	(...)	(...)	(...)	(...)	56	63	46	26	20	N/A
<b>Brazil</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>TOTAL</b>
Total admissions (n)	18,418	16,887	18,524	18,455	18,335	17,086	16,671	16,008	15,737	14,433	170,554
Admission rate <sup>a</sup>	0.97	0.89	0.97	0.97	0.96	0.90	0.87	0.84	0.82	0.76	8.94
Days of stay (n)	153,069	136,558	146,359	144,371	143,216	130,201	125,002	129,365	133,856	119,820	1,361,826
Mean length of stay (days)	8.3	8.1	7.9	7.8	7.8	7.6	7.5	8.1	8.5	8.3	7.99
In-hospital deaths (n)	672	570	703	704	641	646	580	561	559	428	6,064
In-hospital mortality (%)	3.65	3.38	3.80	3.81	3.50	3.78	3.48	3.50	3.55	2.97	3.56
Deaths due to burns (n)	956	835	1,025	1,096	1,088	1,313	1,086	990	1,026	(...)	9,415
Mortality rate for deaths due to external causes	70.33	60.20	71.55	75.15	71.57	86.56	69.20	65.07	65.83	(...)	70.66
Total cost <sup>b</sup> (US \$)	16,034,655.11	18,012,694.00	18,583,100.87	18,028,502.16	17,635,906.98	18,050,736.87	15,639,982.41	13,033,434.05	12,229,350.28	11,084,528.34	158,332,891.11
Mean admission cost <sup>b</sup> (US \$)	870.59	1,066.66	1,003.18	976.89	961.87	1,056.46	938.15	814.18	777.10	768.00	923.31

<sup>a</sup>Or Brazilian Ministry of Health for financial reimbursement. <sup>a</sup>Admission rate per 10,000 population. <sup>b</sup>Values were converted from Brazilian reais (R\$) to American dollars (US \$) using an exchange rate of US \$1.00 = R\$3.88 (as of June 14, 2019). (...) Information not available. N/A: not applicable.



## Burn in the Unified Health System



**Figure 1.** Time trend and geographic distribution of burn admission rates (per 10,000 population) in the general population and stratified by sex, in Brazil, 2008, 2013, and 2017. Source: authors of the study using DATASUS data.

Time trend and geographic distribution show the burn admission rates in the general population and among men and women in **Figure 1**.

Time trend and geographic distribution show the in-hospital deaths (absolute numbers) in **Figure 2**.

**Figure 3** shows the time trend and geographic distribution of admission rates of children with burns in Brazil. In this case, we included only children aged nine years (the most frequent age group).

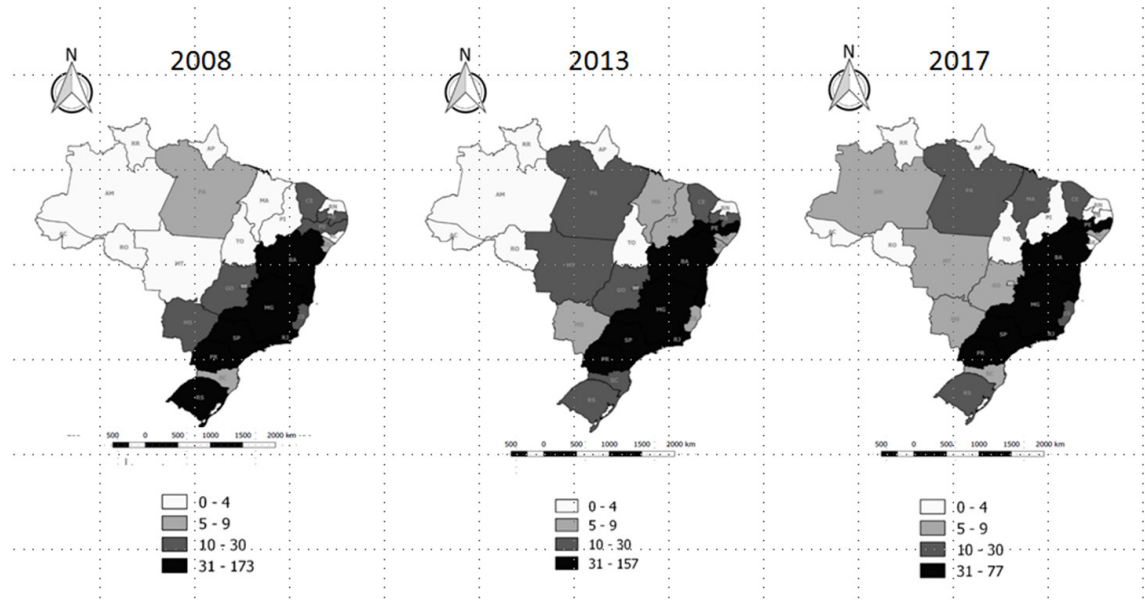
### Discussion

This study analyzed cases of burn patients who required admission to Unified Health System hospitals in the past ten years, revealing the

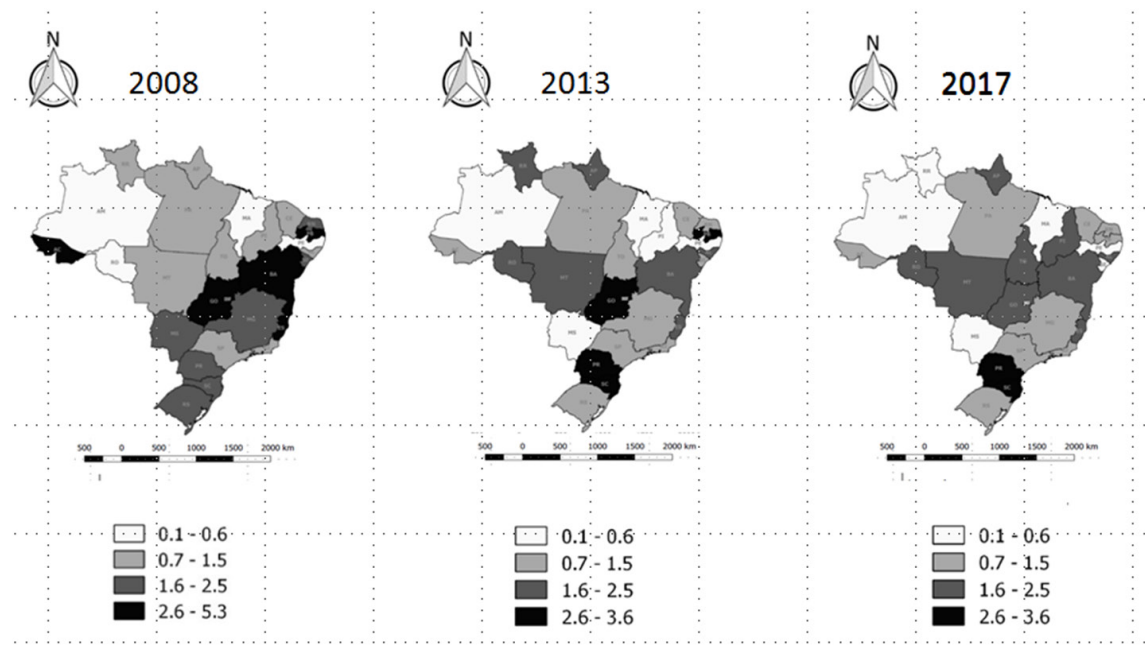
magnitude of the problem. We observed approximately 170,000 hospitalized because of burn injuries, and men were the most frequent victims. Children, especially those aged nine years, were the most common age group. At least 6,000 people died in hospitals, and it is worth noting that this number does not include those who died at the burn injury site or on the way to the hospital. Inpatient treatment cost was approximately US \$160 million and involved more than 1.3 million days of Unified Health System hospital stay.

In the present study, burn admission rate was 8.95 per 10,000 population in 10 years. A systematic review analyzing worldwide trends of burn epidemiology reported that most countries had a decrease in admission rates in re-

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**Figure 2.** Time trend and geographic distribution of in-hospital deaths (absolute numbers) of burn patients in Brazil, 2008, 2013, and 2017. Source: authors of the study using DATASUS data.



**Figure 3.** Time trend and geographic distribution of burn admission rates (per 10,000 population) in children aged  $\leq 9$  years, in Brazil, 2008, 2013, and 2017. Source: authors of the study using DATASUS data.

cent years [5]. Consistent with such trend, burn admission rate decreased in Brazil. By reporting admission rates, we estimated the incidence of burn injuries requiring hospitalization, as well as the size of the problem. Moreover, higher admission rates for a given cause sug-

gest correlations with the socioeconomic context in Brazil [14].

In this study, men were most frequently affected by burn injuries. Similarly, a Dutch study [15] analyzing burn admissions between 1995 and



2011 found a male-to-female ratio of 1.86:1. The results are consistent with those of other studies [6, 16] and with the findings of the present study.

Rode et al. [17] conducted a literature review on children with burns in sub-Saharan African countries, demonstrating that this type of injury is highly prevalent in this age group. In the present study, children aged nine years were the most frequently reported age group, despite a trend of strong negative correlation of admission rate in the study period. This study did not investigate burn injury settings; thus, maybe other researchers could calculate the proportion of preventable situations. However, other findings suggest that most injuries could have been prevented [18].

The Brazilian Ministry of Health [14] classifies the burn severity as minor, moderate, and major burns, which prevents a direct comparison with classification systems from other countries. The criteria for this classification system include extent and depth of burn, patient's age (< 3 years or > 60 years), presence of inhalation injury, chemical burn, electrical burn, the involvement of specific parts of the body, and use of violence.

We observed higher admission rate among those with moderate and major burns because as severely burned patients require more complex care [18], who may stay in specialized care beds or urgent care beds, as shown in that study. It is worth noting that despite a downward trend in burn admissions, patients requiring urgent care had a significant increase, which is probably related to burn severity.

In Brazil, one explanation about a downward trend in burn incidence is the reduction in minor burn admissions, and it is possible to treat in an outpatient setting. Of note, we admit patients with minor burns when it occurs in specific parts of the body, such as face or hands, or when the injury results from violence or suspicion of violence [10]. Conversely, this finding causes concern because it does not necessarily mean a reduction in burn incidence, but a reduction in admissions.

In the study period, the length of hospital stays of burn patients had no variation (8 days). Contrastingly, Dokter et al. [15] showed that

the mean length of stay reduced from 23 to 11 days from 1995 to 2011. Thus, investigating how functional these patients are at discharge is essential, as most of them require outpatient treatment [3].

In this study, mean in-hospital mortality was 3.56% and remained stable in the period. Other studies reported similar in-hospital mortality rates [6, 15]. Decreased in-hospital mortality suggests that the quality of burn care (multi-disciplinary, patient safety-oriented) has been improved [19]. Although the present study found no reduction in mortality, burn treatment has probably improved considerably in Brazil, as data show an increase in severity in the study period (reduced number of patients with minor burns and increased number of those requiring urgent care) with no change in in-hospital mortality. As an exception, the North region had an increase in mortality, which may be related to socioeconomic characteristics and lack of specialized care services. However, when we observe this data for Regions as North and Midwest, these present an inferior number of Burn Centers. We can suppose the burn patients, especially more complex ones, receive treatment in another Region, and this transference of patients could change the real number of deaths per Region.

Increased survival usually requires additional financial resources [19]. In Brazil, the mean cost, in other words, the value of reimbursement of burn treatment decreased from USD 870.59 (R\$3,379.05) in 2008 to USD 768.00 (R\$2,980.84) in 2017, which is lower than those of high-income countries such as Finland (USD 20,289.60; €18,000) [20] and England (USD 6,765.21; £5,337.45) [21], and lower than that of India (US \$1,060.50) [22].

A Brazilian study of ICU direct costs of burn patients estimated that mean treatment cost was US \$39,668.05 (R\$153,939.80) per patient [9], which is higher than the value found in the present study (mean direct cost: USD 932.53; R\$3,618.86). Cost differences were expected as Anami et al. [9] analyzed treatment costs in the ICU (severe patients need life support care), known to be costly. However, the values reported in the paper should be interpreted with caution, as they may not represent the overall costs of these patients.

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In contrast, in this study, DATASUS system allowed obtaining inpatient treatment costs from a specialized burn unit (ward and surgical procedures required), which include the cost of ICU stay. Nevertheless, the costs of burn patients were expected to increase over time, either because of severity or indexation, which was not confirmed. This finding can be explained either by lack of data update in the values Unified Procedure Table or by the absence of complete records of all procedures performed during admissions.

Burns occurred across all Brazilian states when distribution was analyzed by sex and among children. Perhaps this can be explained by the accidental nature of most injuries. In this respect, health promotion, and risk prevention actions [14] could be useful to prevent burn injuries.

The results of this study help identify the Brazilian regions requiring incentives for implementation of specialized burn care services [23], especially those with higher incidence or mortality rates. Concerning specialized burn care beds, DATASUS records (starting in 2013) showed a variation in the number of beds per region. In 2017, the Midwest region had the lowest while the Northeast region had the highest number of registered beds, which seems to be related to the number of patients admitted to hospitals because of burn injuries.

Brazilian Burn Society (Sociedade Brasileira de Queimaduras) records of public and private facilities reveal that the Northeast region has less specialized burn care services than the other regions [24]. However, according to the present findings, that region had the highest increase in the number of beds in recent years and, simultaneously, had the highest number of burn admissions in the study period.

This study has some limitations. The information system used to collect data does not include admissions to hospital units not affiliated with the Unified Health System, which may have a significant demand for burn care. Also, the results may reflect payment criteria for inpatient treatment adopted at Unified Health System level. Another limitation is that the information system may fail to detect inconsistencies in the classification of cause of admission. Coding errors related to cause of admis-

sion may interfere with results and require caution in interpretation. Finally, DATASUS system provides access to consolidated data, thus preventing the report of dispersions for mean length of stay and costs. In other words, the quality of health data (mortality and causes of death data) and other Datasus data in Brazil have some limitations.

However, the information reported in this study reflects conditions of access to hospital services, which are related to the provision of care at Unified Health System-level and might partially describe the nosologic state of the Brazilian population for burn injuries.

### Conclusion

The results of this study are favorably comparable to previous international reports. Most hospitalized burn victims were male, children aged nine years, classified as patients with moderate and major burns. The admission costs of burn victims by Unified Health System-fund were substantial and possibly underestimated.

This study identified geographic and time variations in burn admissions and deaths that occurred in Brazil, which are possibly related to the accidental or violent nature of the injury. The use of these data may be as inputs for planning, managing, and evaluating hospital care policies for burn victims at SUS level.

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### Disclosure of conflict of interest

None.

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