Hospitalization and bed occupancy rate in a COVID-19 intensive care unit

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Abstract

Most people develop mild or moderate symptoms of COVID-19, but some people develop severe symptoms, leading to hospitalizations. The objective of the research was to analyze the prevalence of confirmed cases of COVID-19, hospitalization for this disease in Intensive Care Units, and the occupancy rate of beds resulting from the same in these units in the municipality of Rondonopolis, Mato Grosso. This was a cross-sectional, descriptive study with a quantitative approach, with data from secondary sources of epidemiological bulletins in Rondonopolis, Mato Grosso, from June 2020 to May 2021. The average number of hospitalized cases per month and the occupancy rate of intensive care beds were calculated. All cases reported with COVID-19 and hospitalized in the Intensive Care Unit of public hospitals in the municipality were included. Analyses were performed with R Software and the chi-square goodness-of-fit test and Kendall's correlation were performed. A total of 28,443 new cases of COVID-19 were reported during the study period, with the highest average of hospitalizations in the intensive care unit in the public health network was in May 2021 (n=51.1) and the bed occupancy rate was in September 2020 (129.17%). In all regions analyzed in comparison with this study, the ICUs operated in a state of calamity with high occupancy rates. A relationship between the increase in the number of cases and hospitalizations and occupancy rates of Intensive Care Units was identified, which are findings that indicate the need to control COVID-19.

Keywords: COVID-19. Hospitalization. Occupation of Beds. Intensive Care Units. Access to Health Services.

INTRODUCTION

The new coronavirus disease called CO-VID-19 is a respiratory illness caused by the SARS-CoV-2 virus with the first confirmed cases in Wuhan, China, in 2019[1]. The transmission of this virus occurs from one sick person to another or through a contaminated environment, through respiratory droplets, which, in turn, can remain on surfaces or objects[2].

The most frequent symptoms related to the disease are: fever, cough, myalgia, headache, sore throat. However, in some cases, severe symptoms may develop, often associated with pre-existing cardiovascular comorbidities and advanced age, which also affect the nervous and digestive systems. This virus, in turn, is more associated with the respiratory system, which explains its relationship with the development of a specific type of pneumonia that is directly related to severe acute respiratory syndrome (SARS) and respiratory failure[3].

This disease has a high lethality rate approaching 100%, especially in cases of hospitalizations due to SARS that require intensive care and invasive procedures. Complications are more frequent in elderly, male patients with more than two associated comorbidities[4].

The COVID-19 pandemic generated a high demand on health services and, in relation to general beds, if the disease infection rate reached 1% of the population in a month, 30% of the country's health micro-regions would be compromised and, in this same scenario, in relation to ICU beds, 100% would be operating beyond capacity. This data means that there was a need to reduce the spread of the disease and expand available beds, reorganizing the supply of healthcare services[5].

The World Health Organization (WHO) reported, until May 1, 2021, approximately 151 million confirmed cases of COVID-19 in the world, of these, more than 3 million cases of deaths from this disease. The Americas are responsible for more than 62 million of the total cases[6]. Regarding cases in Brazil until April 29, 2021, of the 14 million reported, almost 454,000 were reports of severe acute respiratory syndrome (SARS) hospitalized for COVID-19. In the same period, the Midwest region registered approximately 42 thousand SARS cases, of which approximately 5.6 thousand were in the state of Mato Grosso (MT)[7].

On March 17, 2020, the Municipal Health Secretariat of Rondonopolis (MT) confirmed the first case of infection by the Coronavirus, whose patient had been hospitalized since March 13 of the same year in a hospital of a private healthcare network and presented a stable condition. There were also two suspected cases in the city and one case that was discarded[8]. After two months, on May 14, 2020, the municipality released the first Epidemiological Bulletin, presenting 79 confirmed cases: 24 in home isolation, four hospitalized, 49 recovered, and two deaths. In addition, 196 cases were suspected and 192 were in home isolation[9]. Almost a year later, on May 1, 2021, 111 cases of SARS hospitalizations due to COVID-19 were reported, with 85 confirmed hospitalizations and 26 suspected hospitalizations awaiting test results[10].

In the state of Mato Grosso, until July 27, 2021, there were 587 adult ICU beds, 128 available and a state occupancy rate of 76.12%, with no waiting list per bed[11]. On that same date, Rondonopolis reported 34,380 confirmed cases and 87 hospitalized, of which 46 were in ICUs at public and private hospitals. Furthermore, the municipality had 61 dedicated ICU beds for hospitalizations due to COVID-19, distributed in the public and private healthcare network, registered in the National Register of Health Establishments. Of these, there were 15 beds available, with a municipal occupancy rate of 73.3% for public beds and 200% for private beds[12].

In this context, considering the fact that COVID-19 causes a rapid increase in demand for healthcare services, including hospital beds in ICUs, the rise in the number of cases, and the high occupancy rate of COVID-19 ICU beds in the municipality in Rondonopolis, MT, this study is reasonable. Data analysis may provide important information for decision-making, making it possible to avoid shortages of beds and, therefore, establish solid and adequate management of healthcare facilities.

Therefore, the following question is asked: what is the prevalence of confirmed cases of COVID-19, the prevalence of hospitalizations for the disease in Intensive Care Units, and the rate of occupancy of beds in these units, in the city of Rondonopolis (MT)? Thus, the objective of this study is to analyze the prevalence of confirmed cases of COVID-19, hospitalization for the disease in Intensive Care Units, and the occupancy rate of beds resulting from the same in these units in the city of Rondonopolis (MT).

METHODOLOGY

This is a cross-sectional study, with a quantitative approach, with data from secondary sources in the city of Rondonopolis (MT), referring to the period from June 1, 2020, to May 31, 2021, on reported and confirmed cases with COVID-19, hospitalizations for the disease in ICUs at public and private hospitals, as well as the occupancy rate of beds in these units for the same cause. There was no distinction between adult ICU beds or pediatric ICU beds.

The municipality in question is located in the south of the state of Mato Grosso, with an estimated population of over 230,000 inhabitants, and constitutes, together with 19 other municipalities, one health region[13]. Rondonopolis (MT) is among the three municipalities in the state with the highest number of confirmed cases of the disease and has allocated five "sentinel" health centers and a Backup Municipal Hospital to exclusively care for these cases.

In the time frame of the study, on June 1, 2020, there were 31 ICU beds available in the city, of which 20 were public and 11 were private[14]. With the increase in cases of illness and the need for hospitalization in the ICU, on May 31, 2021, there were 61 beds prepared and intended exclusively for patients with COVID-19, of which 60 were public beds and one was private[12].

Still concerning ICU beds, on July 24, 2020, according to Ordinance No. 249/2020/GBSES, the beds were covered by the State Department of Health. In the city of Rondonopolis, in the public network, 27 beds were initially reported, distributed in 12 beds at the Irmã Elza Giovanella Regional Hospital and 15 at the Santa Casa de Rondonopolis Hospital. In 2021 these hospitals had 50 beds prepared, 30 in the first and 20 in the second[15-17].

The research population consisted of all notified and confirmed cases of COVID-19 and cases of hospitalization for this disease in the ICU. All reported cases and ICU hospitalizations due to COVID-19, from June 2020 to May 2021, of residents of the city of Rondonopolis (MT) were included. Blank/ignored cases and those transferred from other municipalities were excluded.

Data were collected from August to September 2021 on the official website of the Municipality of Rondonopolis, available in the Coronavirus Epidemiological Bulletins (COVID-19), taken from the website: http://www.rondonopolis.mt.gov.br/covid-19/boletins/, of data within the public domain. Regarding the period of the data collected, the starting date considered the fact that June 2020 was the first month to present data for 30 complete days on hospitalization and the occupancy rate of ICU beds in the hospitals that treated the patients with COVID-19 and the month of May 2021 comprised the 365-day bulletins. Regarding the hospital occupancy rate, the degree of use of available beds and the calculation performed to obtain the rate was the division between days spent in bed and days of available beds[18].

A total of 365 epidemiological bulletins were analyzed and recorded in Microsoft Excel. It should be noted that these bulletins were daily (n=365). Statistical analyses were performed with the aid of R Software[19]. The quantification of COVID-19 cases was evaluated using the absolute frequencies (N) of cases with their respective percentage. The dependent variable was the number of COVID-19 cases according to the historical series. The independent variables were: the average of confirmed cases of hospitalization for COVID-19 in the ICU and the occupancy rate in the ICU due to the disease.

The chi-square goodness-of-fit test with

p-value was performed. As these data are quantified over time, and Kendall's correlation test (Kendall's rank correlation coefficient) was used at a significance level of 5% (p-value<0.05).

Despite being secondary data and within the public domain, this research was approved by the Research Ethics Committee of the Federal University of Mato Grosso, University Campus of Rondonopolis (CAAE 39427420.1.0000.5541 and opinion 4.418.798). The ethical aspects of research with human beings were respected, according to Resolution no. 466/2012[20].

RESULTS

During the period studied, 28,443 new cases of COVID-19 were reported in Rondonopolis (MT). The highest and lowest number of notified and confirmed cases of the disease occurred in March 2021 (n=3,530; 12.41%) and June 2020 (n=1,276; 4.5%), respectively. In the chi-square goodness-of-fit test, we tested whether a given sample comes from a supposed distribution of probability. In this sense, the null hypothesis (H0) of the chi-square goodness-of-fit test verified whether there was a difference between the frequencies obtained in the sample and whether it had a known probability distribution. Thus, there were statistically significant differences between the total cases over the 12 months (p<0.001) (Table 1).

In that year of study, the average of cases hospitalized in ICUs in the public network of Rondonopolis (MT) was higher in May 2021 (n=51.1) and lower in November 2020 (n=10.93). Regarding the ICU occupancy rate, in the public network, there was a higher average in September 2020 (129.17%) and a lower average in June of the same year (74.38%). The null hypothesis (H0) of the chi-square test of association is based on the independence between qualitative variables. Therefore, when the variables are independent, it is equivalent to saying that there is no association, and in this case, the chi-square value is statistically equal to zero (p-value>0.05). In practical terms, the following rule is used: H0 is rejected if the calculated value of the chi-square is greater than the critical value for a significance level defined a priori. In this study, a significance level of 5% was adopted (p-value<0.05). There was a statistically significant difference between the monthly average of cases hospitalized in the ICU and between the monthly average of the occupancy rate in the ICU (p<0.001) over the 12 months studied (Table 2).

Relating the number of cases and the occupancy rate of ICU beds, in the public network, relationship between confirmed cases and the ICU occupancy rate is observed, and there were peaks in the months of July and August 2020 and March 2021 concerning the ICU occupancy rate and the number of cases. In September 2020, there was a peak in the occupancy rate of ICU beds and a drop in the number of confirmed cases (Figure 1).

Table 1 - Distribution of total notified and confirmed cases of COVID-19, in the municipality of Rondonopolis (MT), from June 2020 to May 2021.

NOTIFIED AND CONFIRMED COVID-19 CASES			
MONTH/YEAR	N	%	P value*
June/2020	1.276	4.5	<0,001
July/2020	2.575	9.0	
August/2020	2.945	10.3	
September/2020	2.005	7.0	
October/2020	1.821	6.4	
November/2020	1.846	6.5	
December/2020	2.247	8.0	
January/2021	2.365	8.3	
February/2021	2.076	7.3	
March/2021	3.530	12.5	
April/2021	2.991	10.5	
May/2021	2.766	9.7	
TOTAL	28.443	100	

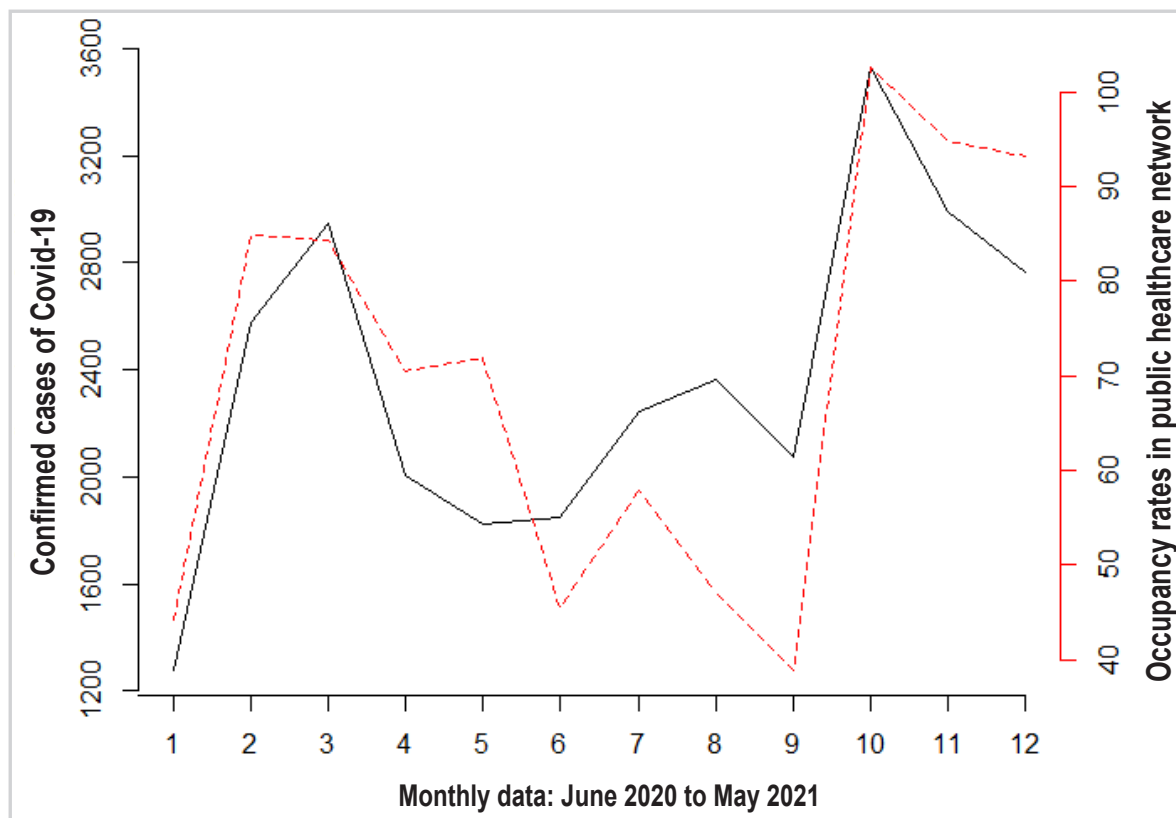Fonte: Boletim epidemiológico de Rondonópolis, MT. * teste de qui-quadrado de aderência.

Figure 1 - Distribution of confirmed cases of COVID-19 and occupancy rate of public ICUs, in the city of Rondonopolis (MT), from June 2020 to May 2021. Source: Epidemiological Bulletin of Rondonopolis - MT.

Table 2 - Distribution of the average number of cases hospitalized in the ICU and the ICU occupancy rate, in the municipality of Rondonopolis (MT), from June 2020 to May 2021.

MONTH/YEAR	HOSPITALIZED IN ICU		ICU OCCUPANCY RATE	
	AVERAGE		% AVERAGE	
	Public	P value*	Public	P value*
June/2020	16.0	<0.001	74.4	<0.001
July/2020	22.8		103.7	
August/2020	16.1		111.0	
September/2020	15.5		129.2	
October/2020	12.8		106.7	
November/2020	10.9		89.4	
December/2020	11.2		78.9	
January/2021	24.6		82.0	
February/2021	23.4		78.0	
March/2021	35.3		117.6	
April/2021	45.2		87.1	
May/2021	51.1		85.2	
Annual monthly average	23.7		103.0	

Source: Epidemiological Bulletin of Rondonopolis, MT. *chi-square goodness-of-fit test.

DISCUSSION

Regarding the distribution of COVID-19 cases over a year of study, there was a considerable number of notifications of new cases, with the month of March 2021 being responsible for the highest number of cases reported and June 2020 for the lowest, with statistically significant differences (p<0.001). This differs from research carried out in the city of São Paulo (SP), with 23,397 participants and samples from June to September 2020, in which the period between February 16 and 18, 2021, was responsible for the highest number of confirmed cases of COVID-19 and from September 22 to 24, 2021, fewer cases[21]. Still, in another study carried out in Uberlândia (MG), from March 21 to August 7, 2020, 14,389 confirmed cases were reported, showing a continuous increase in cases[22], which is also different from the city studied, which presents oscillations in the pattern of confirmed cases.

The occupancy rate of ICU beds due to COVID-19 in the public network was considerably high, with the highest average in September 2020 and the lowest in June of the same year. A relationship between confirmed cases of the disease and the ICU occupancy rate is highlighted, and there were peaks in the months of July and August 2020 and March 2021. There were statistically significant differences between the monthly average of hospitalizations in the ICU (p<0.001) and between the monthly mean ICU occupancy rate (p<0.001).

In the state of Mato Grosso, according to the daily epidemiological bulletin, on June 1, 2020, 2,636 confirmed cases of COVID-19 were reported. Of this total, there were 164 hospitalizations, with 81 ICU beds occupied. Public ICU beds had an occupancy rate of 22.8%[23]. In the epidemiological bulletin of March 31, 2021, 310,337 confirmed cases of this disease had been reported. On that day,

2,380 hospitalizations were reported, of which 866 were in the ICUs, with an occupancy rate of 98.02%[24].

Comparatively, in the state of Goias, a survey was carried out in order to understand the burden on the healthcare system within its healthcare regions. In the period from February 11 to 27, 2021, 13 healthcare regions operated with an occupancy rate greater than 80%, with three of these operating at 100% of their capacity. In the period from February 27 to March 5, 2021, there were 14 healthcare regions operating with an occupancy rate of more than 80%, and also three regions operating with a rate of 100%[25].

In the study on the capacity of ICU beds in Brazil, in the pandemic period, between January and October 2020, in several states of the country, citing Rio de Janeiro, Amazonas, and Ceará, the occupancy rates of ICU beds were critical, exceeding 95% of occupied beds[26], as well as the occupancy rates of ICU beds in the study.

Still, regarding hospitalization in the ICU due to COVID-19, in the Federal District, it was estimated that there would be a peak in the need for intensive care for 6,214 people hospitalized in the ICU by the probable date of July 14, 2020, if there were no measures to control the situation. However, on May 17, 2020, these units were already overcrowded, and such demand would continue for at least 125 days[27].

With the increase in the distribution of doses of vaccines against COVID-19 and the pace of the vaccination campaign in Brazil, more than 96 million people had already received at least the first dose of the vaccine, reflecting in the total number of cases of the disease, which decreased the daily average to 42.77 thousand[28]. Despite the advances in vaccination, the present study revealed the highest peak of confirmed cases of the disease in March 2021.

In this context, it is advisable to adopt measures that contribute to flattening the epidemic curve of COVID-19, preventing an abrupt growth in the number of cases, and reducing the peak demand for healthcare services, above all, within ICUs, and with that, the burden on the healthcare system may be avoided. Therefore, it is imperative that the population follow the recommendations of health organizations[29].

The relationship between the number of confirmed cases of COVID-19 and the number of hospitalizations and ICU occupancy rates was evident, so that there was a correspondence between these variables, that is, when the number of cases increased the average number of hospitalizations in the ICU and the occupancy rates of beds in these units also increased statistically. This research has limitations since it is a regionalized study and secondary sources used may have underreported or incomplete information.

CONCLUSION

The increase in severe cases of the disease that evolved to hospitalization signals the need to offer specialized beds to care for the population with COVID-19. It is therefore necessary to slow down the spread of the disease in order to reorganize the local healthcare system, increase the number of available beds by building field hospitals and organizing referrals through a dynamic regulatory system. It is fundamental that new studies in other populations be developed, in order to contribute to the knowledge about this relevant theme.

CRediT author's statement

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