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**Brief Communication**

**Hospital-Acquired SARS-CoV-2 infection among patients admitted to a university hospital**

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1 Transmission of severe acute respiratory coronavirus virus 2  
2 (SARS-CoV-2) occurs primarily through contact with respira-  
3 tory secretions such as droplets.<sup>1</sup> Aerosol transmission has  
4 been reported in situations that favor the dispersion of aero-  
5 solized particles.<sup>2</sup> In-hospital transmission of SARS-CoV-2  
6 has been reported at various institutions.<sup>3-7</sup> In a prospective  
7 study of 1,353 health care workers in Singapore, Ran et al.<sup>6</sup>  
8 found that 86 (6.4%) were infected with SARS-CoV-2, suggest-  
9 ing that the infections were hospital-acquired.

10 The objective of this study was to evaluate the impact of  
11 nosocomial transmission of SARS-CoV-2 among inpatients in  
12 Brazil. We evaluated patients hospitalized at a tertiary care  
13 teaching hospital—the Hospital São Paulo, operated by the  
14 Federal University of São Paulo, in the city of São Paulo, Brazil  
15 —between March 1 and May 31 of 2020.

To define cases of nosocomial transmission of SARS-CoV- 16  
2, we applied the criteria established by the Brazilian National 17  
Health Oversight Agency<sup>8</sup>: having been hospitalized with a 18  
diagnosis unrelated to infection with the target pathogen - 19  
SARS-CoV-2 - and having presented signs and symptoms or 20  
radiological findings consistent with the target disease—coro- 21  
navirus disease 2019 (COVID-19) - or having tested positive 22  
for infection with the target pathogen - SARS-CoV-2 (by 23  
reverse-transcriptase polymerase chain reaction)—after day 24  
14 of hospitalization or between days seven and 14 of hospi- 25  
talization in case of close contact with an infected individual 26  
(health care worker, companion, or visitor) for more than 27  
24 hours. Patients who were readmitted with signs and symp- 28  
toms of COVID-19 within the first seven days after discharge 29  
were also evaluated. 30

This study was approved by the Research Ethics Commit- 31  
tee of the Hospital São Paulo (Reference nos. 4,264,650 and 32  
37048020.3.0000.5505). Because of the retrospective nature of 33  
the study, the requirement for written informed consent was 34  
waived. 35

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During the study period, positivity for SARS-CoV-2 was identified, by reverse-transcriptase polymerase chain reaction, in respiratory secretions collected from 455 inpatients. Of those, 42 (9.3%) were considered cases of nosocomial transmission.

Among the 42 patients identified as cases of nosocomial SARS-CoV-2 infection, the mean age was 59 years (range, 23–86 years), 24 (57.1%) male and 22 (52.3%) self-reported their skin color as White.<sup>11</sup> The main diagnoses that prompted admission were diseases of the circulatory system in 12 (28.5%), infectious and parasitic diseases in 10 (23.8%), and injury, poisoning, and certain other consequences of external causes in 7 (16.6%). The most affected hospital wards were the emergency/internal medicine ward, with 18 cases (42.8%), the semi-intensive care unit, with 8 (19.0%), and the cardiac intensive care unit, with 5 (11.9%).

Out of the 42 patients evaluated, the main comorbidities were diabetes, in 17 (40.4%), chronic kidney disease, in 10 (23.8%), and heart failure, in 8 (19%). We also calculated the Charlson comorbidity index, which was found to be 0 in 3 (7.0%) cases, 1–2 in 9 (21.4%), 3–4 in 13 (31.0%), and > 4 in 17 (40.4%).

In 69.0% (29/42) of the cases, SARS-CoV-2 infection was identified after day 14 of hospitalization, whereas in 13 (31.0%) it was identified between days 7 and 14. Of those, 69.2% (9/13) were tested because they had been in close contact with SARS-CoV-2-infected patients and 4 (30.7%) were tested after isolated outbreaks among the staff of the wards.

During the study period, 85.7% (36/42) of the patients with nosocomial infection were diagnosed with COVID-19 during their hospital stay. The mean time from admission to the onset of COVID-19 symptoms was 19.5 (8–129) days. Six patients (14.3%) were discharged and readmitted with symptoms of COVID-19 within seven days after discharge (mean, 3.8 days). Among those patients, the mean hospital stay during the first hospitalization was 21.6 (8–39) days and the mean time from discharge to symptom onset was 1.8 (1–3) days. In the 42 patients with confirmed nosocomial infection, the symptoms reported were dyspnea, in 20 cases (47.6%); cough, in 16 (38.0%); fever, in 15 (35.7%); diarrhea, in 10 (23.8%); nausea, in 6 (14.2%); vomiting, in 3 (7.1%); coryza, in 2 (4.7%); myalgia, in 1 (2.3%); and sore throat, in 1 (2.3%). Seven patients (16.6%) were asymptomatic. Supplemental oxygen was required in 25 (59.5%) cases. Twenty-six (62.0%) patients were treated in the intensive care unit, and mechanical ventilation was required in 15 (57.6%) of those patients. The mean stay at the intensive care unit was 14 (1–69) days and the mean time on mechanical ventilation was 9.5 (3–28) days. In 5 (15.1%) cases, the first symptom was acute respiratory failure, and the affected patients were promptly intubated. Twenty-three (54.7%) patients died. The mean time from the diagnosis of COVID-19 to death was 22 (1–88) days. Of the 23 patients who died, 9 (39%) had a Charlson comorbidity index > 4.

Despite preventive measures, nosocomial infections affect health care workers disproportionately. We identified nosocomial transmission of SARS-CoV-2 in 42 (9.3%) of the 455 inpatients diagnosed with COVID-19 during the study period. Other studies have reported similar rates.<sup>4,5,7</sup> In Brazil, until May 31, 2020, 514,992 cases had been confirmed (2,437 cases per 1,000,000 inhabitants), 29,341 (5.7%) deaths, 206,555 (40%) cases recovered, according to official data released by the

Ministry of Health. In the same period in São Paulo, 109,698 cases and 7,615 deaths were reported.<sup>9</sup>

**Table 1 – Characteristics of Inpatients Infected Nosocomially with Severe Acute Respiratory Coronavirus Virus 2 (n = 42).**

Variable	n (%)
Sex	
Male	24 (57.1)
Female	18 (42.8)
Age (years)	
20–59	17 (40.4)
60–79	23 (54.7)
> 80	2 (6.1)
Skin color	
White	22 (52.3)
Brown	14 (33.3)
Black	6 (14.2)
Initial reason for hospitalization	
Diseases of the circulatory system	12 (28.5)
Infectious or parasitic diseases	10 (23.8)
Injury, poisoning, or other external causes	7 (16.6)
Neoplasms	4 (9.5)
Respiratory system diseases	3 (7.2)
Diseases of the digestive system	2 (4.8)
Diseases of the genitourinary system	2 (4.8)
Diseases of the skin or subcutaneous tissue	1 (2.4)
Endocrine, nutritional, or metabolic diseases	1 (2.4)
Hospital sectors	
Emergency/internal medicine	18 (42.8)
Semi-intensive care unit	8 (19.0)
Cardiology ward	5 (11.9)
Orthopedics ward	4 (9.5)
Neurology ward	2 (6.0)
Internal medicine ward	2 (6.0)
Internal medicine intensive care unit	2 (6.0)
Cardiology intensive care unit	1 (3.0)
Comorbidities	
Diabetes	17 (40.4)
Chronic kidney disease	10 (23.8)
Heart failure	8 (19.0)
Neoplasms	7 (21.2)
Liver disease	7 (16.6)
Chronic lung disease	5 (11.9)
Acquired immunodeficiency syndrome	2 (6.0)
Acute myocardial infarction	1 (2.3)
Cerebrovascular disease	1 (2.3)
Charlson comorbidity index	
0	3 (7.1)
1–2	9 (21.4)
3–4	13 (31.0)
> 4	17 (40.4)
Signs and symptoms	
Dyspnea	20 (47.6)
Cough	16 (38.0)
Fever	15 (35.7)
Diarrhea	10 (23.8)
Nausea	6 (14.2)
Vomiting	3 (7.1)
Coryza	2 (4.7)
Myalgia	1 (2.3)
Sore throat	1 (2.3)
Outcome	
Death	23 (54.7)
Discharge	19 (45.2)

97 We chose to define nosocomial transmission on the basis  
98 of the criteria established by the Brazilian National Health  
99 Oversight Agency,<sup>8</sup> which defines cases as those occurring  
100 after day 14 of hospitalization or after day 7 if the individual  
101 has been in close contact with a confirmed case. Nishiura et  
102 al.<sup>12</sup> found the mean incubation time in cases of nosocomial  
103 transmission to be 6.4 days. In other studies, cases of nosoco-  
104 mial SARS-CoV-2 transmission have been defined as those  
105 that occur after day 5 of hospitalization in patients hospital-  
106 ized with a diagnosis unrelated to COVID-19,<sup>4,5</sup> which could  
107 result in the inclusion of cases of community transmission,  
108 given the  $\leq 14$  day incubation period of COVID-19. In our sam-  
109 ple, the reasons for hospitalization and the comorbidities  
110 reported at admission were similar to those reported in other  
111 studies,<sup>4</sup> indicating that chronic diseases are potential aggra-  
112 vating factors for SARS-CoV-2 infection.

113 Few studies have investigated the possibility that the hospi-  
114 tal ward where a patient is could be a risk factor. In all of the  
115 wards identified in the present study, there was considerable  
116 foot traffic, which made it difficult for us to identify sources of  
117 transmission.

118 In our sample, the most common symptom of COVID-19  
119 was dyspnea, followed by cough and fever. Other studies  
120 have found the predominant symptoms to be fever, sore  
121 throat, nausea, and diarrhea.<sup>4,5,7</sup> Our finding of asymptomatic  
122 cases supports evidence that  $< 50\%$  of individuals infected  
123 with COVID-19 in the hospital environment are asymptom-  
124 atic.<sup>12</sup> However, it should be borne in mind that asymptom-  
125 atic individuals are a major source of silent transmission.  
126 Therefore, the COVID-19 contact tracing process should  
127 include the contacts of asymptomatic individuals.

128 It is well known that comorbidities are risk factors for the  
129 severe form of COVID-19.<sup>4</sup> In the present study, comorbidity  
130 rates (i.e., Charlson comorbidity indices) were highest among  
131 those who died.

132 Nosocomial SARS-CoV-2 transmission can be prevented  
133 through early identification of cases, diagnostic confirmation  
134 (by reverse-transcriptase polymerase chain reaction and  
135 imaging analysis), and better communication among hospital  
136 sectors, as well as precautions and isolation measures. It  
137 should be underscored the need for the hospital infection  
138 control team to establish daily communication sessions and  
139 provide continuing education on the use of personal protec-  
140 tive equipment to prevent SARS-CoV-2 outbreaks. (Table 1)

## 141 Uncited reference

142 <sup>10</sup>

## 143 Conflicts of interest

144 The authors declare no conflicts of interest.

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