

COVID-19 and demand for nursing work in intensive care units: retrospective cohort

COVID-19 e demanda de trabalho de enfermagem em unidades de terapia intensiva: coorte retrospectiva

Tayná Oliveira Mendes¹
ORCID: 0000-0001-8499-4273

Rute Merlo Somensi²
ORCID: 0000-0002-0231-4236

Rúbia Knobeloch dos Santos¹
ORCID: 0000-0003-2729-5091

Andreza Mello da Silva²
ORCID: 0000-0002-8517-0396

Renata Neto Pires²
ORCID: 0000-0002-0846-143X

Rita Catalina Aquino Caregnato¹
ORCID: 0000-0001-7929-7676

Luccas Melo de Souza¹
ORCID: 0000-0003-1629-9935

¹Universidade Federal de Ciências da Saúde de Porto Alegre, Porto Alegre, RS, Brasil

²Irmã Santa Casa de Misericórdia de Porto Alegre, Porto Alegre, RS, Brasil

Editors:

Ana Carla Dantas Cavalcanti
ORCID: 0000-0003-3531-4694

Paula Vanessa Peclat Flores
ORCID: 0000-0002-9726-5229

Adriano Menis Ferreira
ORCID: 0000-0002-4054-768X

Corresponding author:

Tayná Oliveira Mendes
E-mail: tayna.om@gmail.com

Submission: 08/03/2023

Approved: 07/28/2024

ABSTRACT

Objective: To identify the nursing work demand and the staff in two intensive care units that provide care for patients with New Coronavirus Disease. **Method:** Retrospective cohort study with 107 adults/elderly from two intensive care units exclusive to patients with New Coronavirus Disease. Data were collected in electronic records, considering a period of 63 days. The nursing workload was measured using the Nursing Activities Score. **Results:** Men (67.3%) predominated with a mean of 59.3 ± 16.8 years old. The average score of the *Nursing Activities Score* was 91.4 (ranging from 32.9 to 155.7 points), indicating that 21.8 hours of assistance is required on the day. It was identified that 40.2% presented of the patients had a final mean of the Nursing Activities Score greater than 100 points, requiring more than 24 hours of direct care in one day. The daily mean of the *Nursing Activities Score* in the units ranged from 82.79 to 128.64 points, without statistical difference between them. The ideal ration of patient: nursing professional was 1:1. **Conclusion:** the study identified a high demand for nursing work, both per patient and per unit.

Keywords: Nursing; COVID-19; Critical cares; Workload; Staff sizing; Intensive care units.

RESUMO

Objetivo: identificar a demanda de trabalho de enfermagem e o quadro de equipe em duas unidades de terapia intensiva exclusivas para pacientes com a Doença do Novo Coronavírus. **Método:** estudo de coorte retrospectivo com 107 adultos/idosos de duas unidades de tratamento intensivo exclusivas para pacientes com Doença do Novo Coronavírus. Os dados foram coletados em prontuário eletrônico, considerando um período de 63 dias. A demanda de trabalho de enfermagem foi analisada a partir do *Nursing Activities Score*. **Resultados:** Predominaram homens (67,3%) com média de $59,3 \pm 16,8$ anos de idade. A pontuação média do *Nursing Activities Score* foi 91,4 (variando de 32,9 a 155,7 pontos), indicando que são necessárias 21,8 horas de assistência no dia. Identificou-se que 40,2% dos pacientes tiveram média do *Nursing Activities Score* acima de 100 pontos, demandando mais de 24 horas de cuidado direto em um dia. A média diária do *Nursing Activities Score* nas unidades variou de 82,79 a 128,64 pontos, sem diferença estatística entre elas. A razão ideal de paciente:profissional de enfermagem foi de 1:1. **Conclusão:** o estudo identificou uma elevada demanda assistencial do trabalho de enfermagem, tanto por paciente quanto por unidade.

Descritores: Enfermagem; COVID-19; Cuidados críticos; Carga de trabalho; Dimensionamento de pessoal; Unidades de terapia intensiva.

INTRODUCTION

The year 2020 was chosen by the International Council of Nurses and the World Health Organization (WHO) as the International Year of Nursing. The *Nursing Now* campaign was launched, which was attended by 30 countries. Worldwide, some of the main objectives of the campaign were to improve education, stimulate professional development and regularize

nursing working conditions, bringing global political influence through visibility⁽¹⁾. This same year, WHO declared the New Coronavirus disease pandemic, with different moments (COVID-19)^(2,3). With the advance of the second wave of the New Coronavirus (SARS-CoV-2) in Brazil, with predominance of the gamma variant, there were changes in the characteristics of individuals considered at risk in the first wave. During this period, in the country, there was an increase in 19% of death cases in patients without previous comorbidities, in addition to the increase in 13% of cases of severe infection. With the viral adaptations, the Delta variant appeared in the second half of 2021, a strain with greater virulence than the gamma. It is estimated that in August 2021, 70% of COVID-19 cases in Brazil were due to the Delta variant. Due to the high virulence, it caused the supplanting of the cases of the previous variant^(2,3).

In Brazil, until March 2023, there were more than 37 million cases diagnosed and more than 690 thousand deaths, with a lethality rate of about 1.9%⁽⁴⁾. However, the data may be underestimated. Vaccination proved to be effective worldwide, with a decrease in the number of cases and deaths in the proportion that vaccination coverage advanced, in addition to changing the profile of inpatients, with cases of lower severity⁽⁵⁾.

During the SARS-CoV-2 pandemic, the need to open new beds demanded changes in hospital care worldwide, especially regarding the physical structure, which needed to be changed quickly. Severely ill patients brought new challenges to bedside performance and management of health teams. In order to provide a rapid response to the global demand for COVID-19 patients, new beds were created in hospital and in Intensive Care Units (ICU) and adaptations were made that included the need to relocate teams from other services to intensive care beds⁽⁶⁾.

Nursing, a larger number of workers in health establishments, gained worldwide prominence, acting with excellence, management capacity, teaching and scientific knowledge. It also stands out for being the professional category that provides uninterrupted care in the 24 hours of care, with specialized technical capacity and holistic view of the patient⁽⁷⁾.

Especially in the first year of the pandemic, in which there was no vaccine, several professionals were removed from their activities because they contracted COVID-19 and others died. Concomitant to the increase in the rate of absenteeism due to disease and number of ICU beds,

there was work overload, as a reflection of the previous inadequacy of professional sizing^(7,8). In this regard, studies have related a longer stay in a hospital, greater exposure to infections related to care, as well as a greater number of unfavorable outcomes with the increase in the work demand of the nursing team⁽⁸⁾. In Brazil, Resolution 543/2017 of the Federal Nursing Council (COFEN) deals with the dimensioning of human resources, aiming to maintain the adequate quantity of professionals in the various care areas⁽⁹⁾. However, inadequacy and overload of nursing are often seen, which justifies the daily use of instruments for measuring nursing workload⁽⁷⁾.

With the evolution of the pandemic and the high complexity of patients with COVID-19, the Federal Nursing Council brought, at the time, new recommendations to the sizing of staff in ICUs that served patients with COVID-19. COFEN's Normative Opinion 02/2020 recommended the adequacy of one nurse every five beds that served patients with COVID-19, or fraction, a nursing technician every two beds, or fraction, in addition to one nursing technician every five beds for support services at each shift⁽¹⁰⁾.

Some studies conducted in Europe have shown a significantly higher demand for work in patients with COVID-19 when compared to those without comorbidity. This increase was evaluated from the *Nursing Activities Score* (NAS). In patients with COVID-19, an increase of 33% of the score was recorded, pointing to the 1:1 ratio between nursing professionals and patients^(11,12).

Given the pandemic context, the need for management and sizing of nursing staff and the complexity of COVID-19 patients in the first years of the pandemic, the following research question arose: what is the demand for nursing work in patients with COVID-19 hospitalized in intensive care units when there was predominance of the gamma variant in Brazil?

In view of the above, the study is justified by the need to analyze the nursing workload through validated instruments, in order to dimension the nursing personnel, with a view to worker health and patient safety. After the moments of greater severity of COVID-19, the study also serves as a historical record of the labor demand that the nursing team was submitted to during the pandemic.

Therefore, the objective of the study herein was to identify the nursing work demand and the staff in two intensive care units that provide care for patients with New Coronavirus Disease.

METHOD

This is a study of a retrospective cohort, documentary type, guided by the *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE) tool.

It was carried out in two exclusive ICUs for COVID-19 patients from a hospital complex in the city of Porto Alegre, southern Brazil. These units did not serve patients in intensive care, but were transformed into ICUs by the demand for the COVID-19 pandemic.

Units A and B each had 16 beds, 12 nurses (three per shift) and 60 nursing technicians (15 per shift) in activity (total of 144 professionals). The shifts are divided in morning, afternoon and nights A and B. Therefore, per day, each unit had 9 nurses and 45 nursing technicians (total of 108 professionals/day in the 32 beds of the two units).

The study population included all medical records of patients admitted to Units A and B in the period between July 01st and September 01st, 2021, considering as inclusion criteria: to have positive reverse transcription result followed by polymerase chain reaction (RT-PCR) for COVID-19 and/or positive reverse transcription loop-mediated isothermal amplification (RT-LAMP) positive test; be older than or equal to 18 years. In the end, 107 medical records were eligible. The follow-up was carried out for 63 days (nine full weeks) and data collection was stopped on September 01st due to the low number of cases of patients with COVID-19 and planning of closure of the two units.

The data were collected from the patients' electronic medical records, via the hospital's electronic bed management system. The following variables were investigated: unit, outcome (death or discharge), total days of hospital stay, sex, age, presence of comorbidities - systemic arterial hypertension (SAH), *diabetes mellitus* (DM) and liver, renal or cardiac disease - and daily score of NAS. All the NAS scores that were recorded by nurses in the daily evaluation of ICU patients between the nine weeks of the study were extracted. The variables length of hospital stay and death were followed/considered even after discharge of ICU patients.

NAS began to be used in the ICU of the hospital complex in June 2021, after individual and collective training of nurses by the study team. It covered the correct application of the scale, as well as clarification of doubts and the insertion of NAS as an instrument for dimensioning the nursing team in the institution. It was subse-

quently carried out an *on-site* audit of data, as well as feedback for managers and care nurses, in order to standardize the collection, increase accuracy and decrease collection and measurement errors.

NAS was filled in by the nurses of the night shift, through the analysis of the activities carried out in the last 24 hours, according to the care scale, using the electronic instrument available in the hospital management system. In total, 986 NAS scores were collected from the electronic medical records of the 107 patients who composed the population.

NAS stands out among the instruments used to measure the workload, being created by Miranda and collaborators⁽¹³⁾ and translated and validated in Brazil by Queijo^(14,15). Developed from the *Therapeutic Intervention Scoring System* (TISS-28), NAS consists of seven categories, divided into 23 items that include basic, managerial, family support, among other nursing activities. Each item has a score that must be added in order to establish the patient's score according to the time of assistance demanded by him or her in the last 24 hours, with a maximum of 176.8%. Each point of NAS corresponds to 14.4 minutes, therefore, a daily score of 100 means uninterrupted nursing care, suggesting an exclusive professional for the care of this patient^(13,15). To stipulate the sizing of personnel, the 20% safety index recommended by COFEN in the Normative Opinion 02/2020⁽¹⁰⁾ was taken into account. Thus, the following calculation was used: $PE = (E \cdot (u \text{ NAS}/100)) + 20\%$. It should be noted that: PE = number of nursing professionals needed; E= number of nursing teams; u NAS = mean of NAS points of the Unit^(8,10-16). Data on the number of professionals working in the ICUs were provided by the management of ICUs.

After the raw data collection in the electronic medical records, they were tabulated in Excel software (year 2019, Microsoft Office Professional Plus, release 2305, United States of America) and were later analyzed in the *Statistical Package for the Social Sciences* program (year 2021, IBM Corporation, release 20, United States of America). The following statistical tests were used: Pearson's chi-square test to compare categorical variables, Mann Whitney test for independent variables and Student's T test for difference between means. Values with $p < 0.05$ were considered statistically significant.

This study respected the ethical aspects of Resolution 466/2012 of the National Health Council. Commitment term for data use was used

and there was no waiver of a Free and Informed Consent Term, given the characteristics of data collection. In addition, the researchers of the study have an institutional commitment on what refers to the use of patient data according to the General Law on Protection of Personal Data. The research project was submitted to evaluation by a research ethics committee under the Certificate of Presentation of Ethical Appreciation No. 45203121.6.0000.5335, with approval in August 2021 (Opinion 4.935.618).

RESULTS

According to the values expressed in Table 1, it was observed that 67.3% of the population

was composed of male patients with a considerable percentage of individuals with a history of smoking 30.4%, SAH 53.3% and DM 32.7%. The mean age of the sample was 59.3 ± 16.8 years (minimum 19 and maximum 96) and 25% of the patients were admitted to the hospital for at least 22 days (ranging from 01 to 70 days) and 63 (58.9 %) died.

As for NAS, the mean score was 91.4, similar between the two units (90.9 and 92.5). Also, among the 107 patients, 43 (40.2%) presented final NAS average greater than 100 points, with the minimum score of 32.9 points and the highest score of 155.7 points.

Table 1 – General characterization of the sample and by intensive treatment units(n=107). Porto Alegre/RS, Brazil, 2021

Variables	A (n=70)	B (n=37)	p value
General (n=107)			
Male Sex*	47(67.1)	25(67.6)	0.964
72 (67.3)			
Age**	61.8(16.5)	54.8(16.6)	0.041
59.3 (16.8)			
History of Smoking****	19(37.3)	5(17.9)	0.073
24 (30.4)			
History of Pulmonary Disease*	10(14.3)	4(10.8)	0.612
14 (13.1)			
History of Cancer*	13(18.6)	6(16.2)	0.762
19 (17.8)			
History of Hypertension*	38(54.3)	19(51.4)	0.772
57 (53.3)			
History of Diabetes Mellitus*	26(37.1)	9(24.3)	0.179
35(32.7)			
History of Renal Disease*	14(20.0)	7(18.9)	0.893
21(19.6)			
History of Liver Disease*	4(5.7)	4(10.8)	0.340
8 (7.5)			
History of Cardiac Disease*	14(20.0)	7(18.9)	0.893
21 (19.6)			
Days of hospitalization***; *****	7(11.5 21.25)	7(14-22.5)	0.663
13 (7-22)			
Outcome*			0.250
Hospital discharge*	26(37.1)	18(48.6)	
44(51.1)			
Death	44(62.9)	19(51.4)	
63 (58.9)			
NAS**	90.9(22.5)	92.5(18.4)	0.720
91.4 (21.1)			

Note: *Variables expressed as absolute frequency (relative frequency), *Pearson's chi-square test* ; **mean ($\pm$ standard deviation), *Student's T-test* ; *** median (percentile 25-percentile 75). ****n<107; ***** Mann-Whitney test. *Nursing Activities Score(NAS)*

Table 2 shows the average NAS scores according to sample characteristics. There was no statistically significant difference in the NAS mean in

relation to demographic and health variables. However, a significantly higher value was found in patients who died (95 versus 86.3).

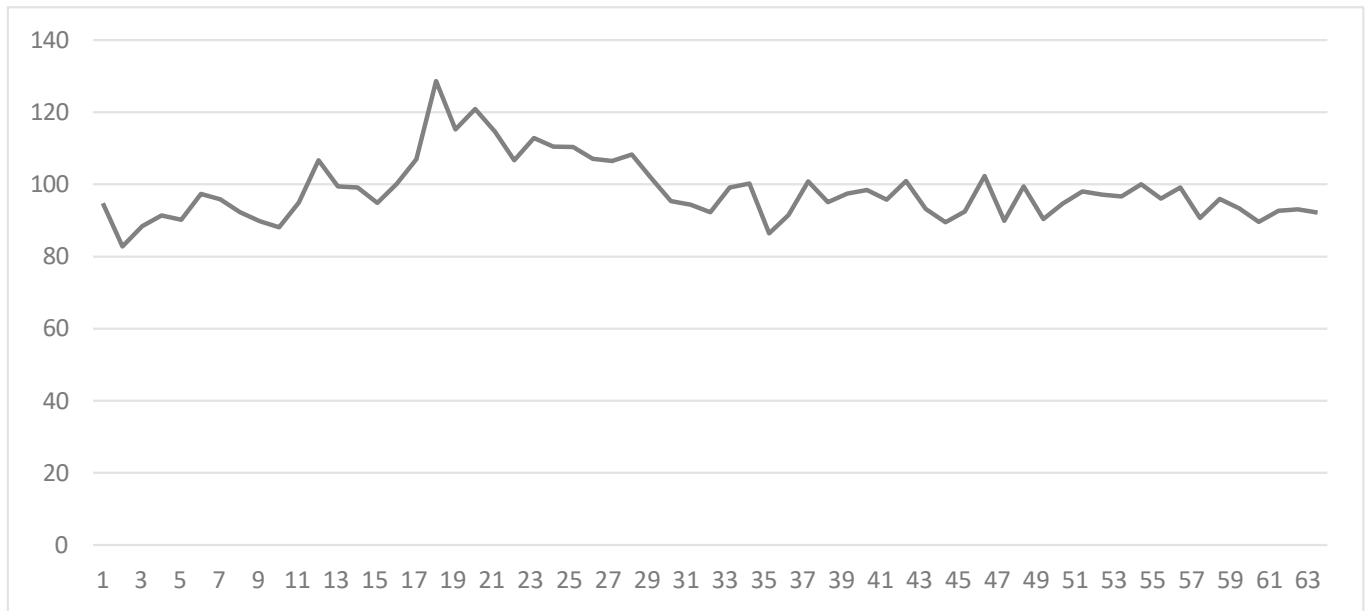
Table 2 – NAS mean according to the sample characteristics(n=107). Porto Alegre/RS, Brazil, 2021

Variables	mean($\pm$ SD)	p value
Sex		0.804
Male	91.1(21.5)	
Female	92.2(20.5)	
History of Smoking		0.941
Yes	91.1(22.9)	
No	90.7(21.7)	
History of Pulmonary Disease		0.429
Yes	95.6(21.7)	
No	90.8(21.0)	
History of Cancer		0.934
Yes	90.5(19.0)	
No	91.6(21.6)	
History of Hypertension		0.874
Yes	91.1(21.5)	
No	91.8(20.8)	
History of Diabetes Mellitus		0.802
Yes	90.8(18.0)	
No	91.8(22.6)	
History of Renal Disease*		0.452
Yes	94.6(24.2)	
No	90.7(20.3)	
History of Liver Disease		0.874
Yes	92.6(14.5)	
No	91.4(21.6)	
History of Cardiac Disease		0.333
Yes	87.4(25.0)	
No	92.4(20.1)	
Outcome		0.036
Hospital discharge	86.3(21.3)	
Death	95.0(20.4)	

Note: *Standard deviation(SD). Student's T-test

Figure 1 shows the values for the NAS daily mean for the 63 days of follow-up. The maxi-

mum NAS mean was 128.64 points on day 18 and the minimum mean of 82.79 on day two.

Figure 1 – Daily mean of NAS in the 63 days (9 weeks) of follow-up(n=107). Porto Alegre/RS, Brazil, 2021

Still, no significant correlation was found between the NAS mean and the number of days of hospitalization, according to the *Spearman test* ($rs= 0.139;p=0.153$);).

Upon performing the sum of the NAS daily means in the two units of the study, it was reached 96,164.5 points. By dividing the 63 days of the study, a mean daily score of 1,526.4 points was identified. Therefore, the calculation of the sizing was $PE = (4. (1526.4/100)) + 20\%$, resulting in a need of 73.27 nursing professionals in the 24 hours.

DISCUSSION

Over the past few years, the use of instruments capable of measuring workload in intensive care units (ICU) has been the focus of continuous study. It is believed that about 40% of the financial revenue of these units is intended to the nursing team. Therefore, a correct sizing, in addition to ensuring quality and safe care, also culminates in economic outcomes favorable to the health institution⁽¹⁴⁾.

In a systematic review published in 2020, covering 71 articles, 27 systems were found to measure nursing workload in intensive care. There was a significant increase in these instruments from 1974, year of publication of the *Therapeutic Intervention Scoring System* (TISS), originally developed to evaluate the patients' degree of severity, but later became a sizing tool for nursing. Currently, NAS that had its elaboration through its predecessor TISS, is the widely used

instrument for staff sizing, being based on the duration of nursing activities, without necessarily reflecting on the patients' severity of ^(13,14). With the COVID-19 pandemic, there was an increase in the demand for critical care to patients using mechanical ventilation, renal replacement therapy, in addition to the prone position, requiring several health professionals to perform it. Such characteristics influence the nursing workload^(11,12).

In the present study, male gender was predominant, with a mean age of 59.3 years, data that corroborate a Brazilian study of national scope, where 31,968 individuals hospitalized for severe acute respiratory syndrome caused by COVID-19⁽¹⁷⁾ were evaluated. According to the study, 60% of patients hospitalized for COVID-19 were male with predominance among the elderly (45.2%) and the age group between 40 and 59 years (37.7%). Scientific findings have associated male sex with more serious outcomes ^(17,18). In the Brazilian study, 24.7% of the hospitalized individuals had a diagnosis of DM and 41% of the sample had cardiovascular disease, similar to the data of the present study ⁽¹⁷⁾. In another study published in 2020, with a sample of 5,700 hospitalized individuals in New York, similar results were found regarding the demographic characteristics of the sample, with predominance of the male population (60.3%), mean age of 63 years and patients diagnosed with SAH (56.6%) and DM (33.8%) ⁽¹⁹⁾. Thus, the results of this study are a reflection of the general population hospitalized with severe acute respiratory syndrome due to COVID-19.

Patients with diagnoses of DM and SAH have presented a high predominance for unfavorable outcomes, a fact that may be related to the pathophysiology of these chronic diseases. DM is a chronic inflammatory disease, which implies a greater propensity for infections. In addition, studies highlight that the angiotensin converting enzyme 2 (ACE2) acts as a receptor for coronavirus infection. In these studies, it is related that the expression of ACE2 is increased in DM, determining in a decreased viral elimination and increased hyperinflation. As for SAH, it is believed that equally gravity is related to ACE2 expression⁽²⁰⁻²²⁾. The mean NAS score was 91.4 points per patient and 40.2% of the sample had a mean score above 100 points, indicating more than 24 hours of direct nursing care on the day. The maximum NAS mean was 128.64 points on day 18 and the minimum of 82.79 on day two. Still, the highest NAS score of a patient was 155.7. It was also identified a significantly NAS higher mean in patients who died compared to those who were discharged from hospital (95 versus 86.3 points). According to studies that analyzed the value of NAS in patients with and without COVID-19, NAS is between 20%-33% higher in patients with COVID-19^(11,12,23).

In a study conducted in three Belgian hospitals, with 95 patients with COVID-19 and 1,604 without COVID-19, the NAS mean value found in patients with the disease was 92 points, versus 71 points. In about 30% of COVID-19 patients, the NAS value was greater than 100 points⁽¹²⁾.

In an Italian study comparing the NAS of the first 15 COVID-19 patients in the unit with the NAS value of 474 patients who were treated in 2019 in the same unit, the mean NAS value was 84 points in patients with the disease, versus 63 points⁽¹¹⁾. Also, in two studies in Belgium, the value of NAS was significantly increased in patients who died during hospitalization^(12,23).

Regarding the sizing of nursing staff, the NAS mean score found in this study suggests a patient/nursing team ratio of 1:1, since a score of points suggests that, considering that a score of 91 points suggests that, in a whole day, it was necessary for 21.8 hours to have at least one bedside nursing professional with that patient. These data corroborate with other studies on the subject, but differs from the Brazilian legislation on nursing sizing in force at the time of the study^(11,12,23).

Resolution No. 543/2017 of the Federal Nursing Council recommends a ratio of 2:1 patient/nursing technician and 10:1 patient/nurse. COFEN's Normative Opinion 02/2020 recommends

that the nursing quantitative in care for patients with COVID-19 in intensive care should be of a nursing technician every 2 beds, one nurse for every five beds, in addition to a nursing technician every five beds for care support services in each shift. According to the opinion, the Technical Safety Index (IST) should be 20% in units that serve patients with COVID-19⁽⁹⁻¹⁰⁾.

It is noteworthy that the workload of the nursing team is related to the increase of health care-related infections (HAI), increased adverse events, as well as an increase in mortality^(24,25). It is also worth mentioning the need for new studies to discuss the issue of increasing adverse events in the pandemic, such as increased IRAS.

The adequate sizing of the units would be 73.27 nursing professionals in 24h, through the dimensioning performed by the NAS value. According to the recommendation of the Normative Opinion 02/2020, in an ICU with 16 beds, already added to the IST of 20%, the nursing sizing for the units would be four nurses, 10 nursing technicians and four nursing technicians for support services, per shift, totaling 72 professionals. It is noteworthy that the nurse must have the technical capacity to evaluate the complexity of the patient, designating that a nursing technician should be exclusively with one patient, in the cases that are applied (pronation, hemodialysis, among others)⁽¹⁰⁾.

Based on the dimensioning data provided by the coordination of the ICUs, there is an oversizing of the scale of nursing technicians (real value 60 technicians, dimensioned value 56) and under sizing for nurses (real value 12, dimensioned value 16), when related to Resolution COFEN 543/2017 and Opinion Normative 02/2020, since NAS does not bring differentiation between members of the nursing team. However, it should be noted that in a study prior to the pandemic, carried out in São Paulo, an STI value of 40% was suggested, due to the high rate of absenteeism of the category, suggesting that there may be an under sizing at the national level^(9,10,26).

As limitations, it should be noted that NAS was implemented in the units studied during the pandemic period and was not applied yet in the ICUs as a sizing tool, and may influence its filling. In addition, the instrument was filled by different nurses, and may result in different scores for the same patient, due to the time of experience in intensive care. The findings should be interpreted with caution, because they refer to the outlines of a single hospital, a reference in high complexity care.

This research contributes to the management of nursing and safety of the patient and nursing worker, by analyzing labor demand in intensive care units and adequate staff sizing during the COVID-19 pandemic. In addition, it brings the historical record of the nursing workload during the coronavirus Delta variant, reflecting the load dimensioned by the care team itself.

CONCLUSION

The study showed a high mean NAS score per patient and per unit. There was an association of high NAS scores with mortality. Given the above, it is evident that there is an increased demand for nursing care in patients with COVID-19, and therefore the ration 1:1 of patient: ideal nursing team for the care of these, due to the NAS high values.

It is noteworthy that the adequate team sizing increases the quality of care provided, in addition it brings to the professional a safe working environment, with lower risk of failures, contributing to the reduction of occupational diseases and remoteness.

CONFLICT OF INTERESTS

The authors have declared that there is no conflict of interests.

REFERENCES

1. Cassiani SHB, Lira Neto JCG. Nursing perspectives and the "Nursing Now" campaign. *Rev Bras Enf.* 2018;71(5):2351-2. <https://doi.org/10.1590/0034-7167.2018710501>
2. Freitas ARR, Beckedorff OA, Cavalcanti LPG, Siqueira AM, Castro DB, Costa CF, et al. The emergence of novel SARS-CoV-2 variant P.1 in Amazonas (Brazil) was temporally associated with a change in the age and sex profile of COVID-19 mortality: A population based ecological study. *The Lancet Regional Health - Americas.* 2021 Sept 1;2:100021. <https://doi.org/10.1016/j.lana.2021.100021>
3. Tao K, Tzou PL, Nouhin J, Gupta RK, Oliveira T, Pond SLK, et al. The biological and clinical significance of emerging SARS-CoV-2 variants. *Nat Rev Genet.* 2021 Sept 17;22(12):757-73. <https://doi.org/10.1038/s41576-021-00408-x>
4. Coronavírus Brasil. Painel Coronavírus [Internet]. [citado em 2023 Mar 23]. Disponível em: <https://covid.saude.gov.br/>
5. Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. *Lancet Infect Dis.* 2020;20(5):533-4. [https://doi.org/10.1016/s1473-3099\(20\)30120-1](https://doi.org/10.1016/s1473-3099(20)30120-1)
6. Bambi S, Iozzo P, Lucchini A. New Issues in Nursing Management During the COVID-19 Pandemic in Italy. *Am J Crit Care.* 2020 July 1;29(4):e92-3. <https://doi.org/10.4037/ajcc2020937>
7. Nishiyama JAP, Moraes RMR, Magalhães AMM, Nicola AL, Trevilato DD, Oliveira JLC. Dimensões laborais, éticas e políticas do dimensionamento de pessoal de enfermagem diante da COVID-19. *Esc Anna Nery Rev Enferm.* 2020. 24(spe):e20200382 <https://doi.org/10.1590/2177-9465-EAN-2020-0382>
8. Borges F, Bohrer CD, Bugs TV, Nicola AL, Tonini NS, Oliveira JLC. Dimensionamento de pessoal de enfermagem na UTI-Adulto de hospital universitário público. *Cogitare Enferm.* 2017;22(2):01-08. <http://dx.doi.org/10.5380/ce.v22i2.50306>
9. Resolução Nº 543 do Conselho Federal de Enfermagem, de 16 de maio de 2017 (BR) [Internet]. Atualiza e estabelece parâmetros para dimensionamento do quadro de profissionais de enfermagem nos serviços/locais em que são realizadas atividades enfermagem. Brasília (DF): COFEN. 2017 May 16 [citado 2021 Nov 23]. Disponível em: http://www.cofen.gov.br/resolucao-cofen-5432017_51440.html
10. Parecer normativo Nº 002 do Conselho Federal de Enfermagem, de 28 de maio de 2020 (BR) [Internet]. Exclusivo para vigência da pandemia- COVID-19. Brasília (DF): COFEN. 2020 May 28 [citado 2021 Nov 23]. Disponível em: http://www.cofen.gov.br/parecer-normativo-no-002_2020_79941.html#:~:text=Estabelece%2C%20na%20forma%20deste%20Parecer,Unidades%20de%20Terapia%20Intensiva%20DUTI
11. Lucchini A, Giani M, Elli S, Villa S, Rona R, Foti G. Nursing Activities Score is increased in COVID-19 patients. *Intensive Crit Care Nurs.* 2020;102876. <https://doi.org/10.1016/j.iccn.2020.102876>
12. Bruyneel A, Gallani MC, Tack J, d'Hondt A, Canipel S, Franck S, et al. Impact of COVID-19 on nursing time in intensive care units in Belgium. *Intensive Crit Care Nurs.* 2021;102967. <https://doi.org/10.1016/j.iccn.2020.102967>
13. Miranda DR, Nap R, de Rijk A, Schaufeli W, Iapichino G. Nursing activities score (NAS). *Crit Care Med.* 2003;31(2):374-82. <http://doi.org/10.1097/01.CCM.0000045567.78801.CC>

14. Hoogendoorn ME, Margadant CC, Brinkman S, Haringman JJ, Spijksstra JJ, Keizer NF. Workload scoring systems in the Intensive Care and their ability to quantify the need for nursing time: A systematic literature review. *Int J Nurs Stud*. 2020;101:103408. <https://doi.org/10.1016/j.ijnurstu.2019.103408>
15. Queijo AF, Padilha KG. Nursing Activities Score (NAS): adaptação transcultural e validação para a língua portuguesa. *Rev Esc Enferm USP*. 2009;43(spe):1018-25. <https://doi.org/10.1590/S0080-62342009000500004>
16. Inoue KC, Matsuda LM. Dimensionamento de pessoal de enfermagem em Unidade de Terapia Intensiva para adultos. *Acta Paul Enferm*. 2010;23(3):379-84. <https://doi.org/10.1590/S0103-21002010000300011>
17. Niquini RP, Lana RM, Pacheco AG, Cruz OG, Coelho FC, Carvalho LM, et al. SRAG por COVID-19 no Brasil: descrição e comparação de características demográficas e comorbidades com SRAG por influenza e com a população geral. *Cad Saúde Pública*. 2020;36(7):e00149420. <https://doi.org/10.1590/0102-311X00149420>
18. Grasselli G, Zangrillo A, Zanella A, Antonelli M, Cabrini L, Castelli A, et al. Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the Lombardy Region, Italy. *JAMA*. 2020;323(16):1574-81. <http://doi:10.1001/jama.2020.53944>
19. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, et al. Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area. *JAMA*. 2020;323(20):2052-9. <http://doi:10.1001/jama.2020.6775>
20. Prasad R, Floyd JL, Dupont M, Harbour A, Adu-Agyeyiwaah Y, Asare-BediaKo B, et al. Maintenance of Enteral ACE2 Prevents Diabetic Retinopathy in Type 1 Diabetes. *Circ Res*. 2022 Nov 30;132(1):e1-21. <https://doi.org/10.1161/CIRCRESAHA.122.322003>
21. Liu M, Wang T, Zhou Y, Zhao Y, Zhang Y, Li J. Potential role of ACE2 in coronavirus disease 2019 (COVID-19) prevention and management. *J Transl Int Med*. 2020 May 9;8(1):9-19. <https://doi.org/10.2478/jtim-2020-0003>
22. Bhalla V, Blish CA, South AM. A historical perspective on ACE2 in the COVID-19 era. *J Hum Hypertens*. 2020 Dec 14;35:935-9. <https://doi.org/10.1038/s41371-020-00459-3>
23. Reper P, Bombart MA, Leonard I, Payen B, Darquennes O, Labrique S. Nursing Activities Score is increased in COVID-19 patients: comments. *Intensive Crit Care Nurs*. 2020;60:102891. <https://doi.org/10.1016/j.iccn.2020.102891>
24. Jansson MM, Syrjälä HP, Ala-Kokko TI. Association of nurse staffing and nursing workload with ventilator-associated pneumonia and mortality: a prospective, single-center cohort study. *J Hosp Infect*. 2019;101(3):257-63. <https://doi.org/10.1016/j.jhin.2018.12.001>
25. Ball JE, Bruyneel L, Aiken LH, Sermeus W, Sloane DM, Rafferty AM, et al. Consortium. Post-operative mortality, missed care and nurse staffing in nine countries: A cross-sectional study. *Int J Nurs Stud*. 2018;78:10-5. <https://doi.org/10.1016/j.ijnurstu.2017.08.004>
26. Trettene AS, Razera APR, Beluci ML, Prado PC, Mondini CCSD, Spiri WC. Absenteeism and the Technical Safety Index of a tertiary hospital nursing team. *Rev Esc Enferm USP*. 2020;54:e03585. <https://doi.org/10.1590/S1980-220X2018036003585>

AUTHORSHIP CONTRIBUTIONS

Project design: Mendes TO, Somensi RM, Pires RN, Caregnato RCA, Souza LM

Data collection: Mendes TO, Santos RK, Silva AM,

Data analysis and interpretation: Mendes TO, Somensi RM, Pires RN, Souza LM

Writing and/or critical review of the intellectual content: Mendes TO, Santos RK, Pires RN, Caregnato RCA, Souza LM

Final approval of the version to be published: Mendes TO, Somensi RM, Santos RK, Silva AM, Pires RN, Caregnato RCA, Souza LM

Responsibility for the text in ensuring the accuracy and completeness of any part of the paper: Mendes TO, Souza LM



Copyright © 2024 Online Brazilian Journal of Nursing

This is an Open Access article distributed under the terms of the Creative Commons Attribution License CC-BY, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.