

Líliã de Souza Nogueira<sup>1</sup>, Karina Mitie Koike<sup>1</sup>,  
Débora Souza Sardinha<sup>1</sup>, Katia Grillo Padilha<sup>1</sup>,  
Regina Marcia Cardoso de Sousa<sup>1</sup>

## Nursing workload in public and private intensive care units

*Carga de trabalho de enfermagem em unidades de terapia intensiva públicas e privadas*

1. Escola de Enfermagem, Universidade de São Paulo - USP - São Paulo (SP), Brazil.

### ABSTRACT

**Objective:** This study sought to compare patients at public and private intensive care units according to the nursing workload and interventions provided.

**Methods:** This retrospective, comparative cohort study included 600 patients admitted to 4 intensive care units in São Paulo. The nursing workload and interventions were assessed using the Nursing Activities Score during the first and last 24 hours of the patient's stay at the intensive care unit. Pearson's chi-square test, Fisher's exact test, the Mann-Whitney test, and Student's t test were used to compare the patient groups.

**Results:** The average Nursing Activities Score upon admission to the intensive care unit was 61.9, with a score of 52.8 upon discharge. Significant differences were found among the patients at public and private intensive care units relative to the average Nursing Activities Score upon admission, as well

as for 12 out of 23 nursing interventions performed during the first 24 hours of stay at the intensive care units. The patients at the public intensive care units exhibited a higher average score and overall more frequent nursing interventions, with the exception of those involved in the "care of drains", "mobilization and positioning", and "intravenous hyperalimentation". The groups also differed with regard to the evolution of the Nursing Activities Score among the total case series as well as the groups of survivors from the time of admission to discharge from the intensive care unit.

**Conclusion:** Patients admitted to public and private intensive care units exhibit differences in their nursing care demands, which may help managers with nursing manpower planning.

**Keywords:** Workload; Nursing staff, hospital; Hospitals, private/manpower; Hospitals, public/manpower; Intensive care units

This study was conducted at the Escola de Enfermagem of the Universidade de São Paulo - São Paulo (SP), Brazil.

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### Corresponding author:

Líliã de Souza Nogueira  
Escola de Enfermagem da Universidade de São Paulo  
Avenida Doutor Enéas de Carvalho Aguiar, 419  
Zip code: 05403-000 - São Paulo (SP), Brazil  
E-mail: [lilianogueira@usp.br](mailto:lilianogueira@usp.br)

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### INTRODUCTION

The costs associated with intensive care units (ICUs) are high because they require specific physical room, high technology, and staff trained and qualified to assist critically ill individuals. In the hospital setting, the nursing staff represents the largest division compared to other healthcare professions and therefore requires considerable expenditures.

As a function of such high expenses, assessment of the cost of nurses has been a focus of interest for managers. Within this context, the nursing workload is considered a significant parameter used to define the staff composition, as oversized staffs increase costs and represent a misuse of

resources, while undersized staffs exert a negative impact on the quality of intensive care and also lead to professional dissatisfaction and burnout.<sup>(1-4)</sup>

The workload and allocation of human resources can be assessed using scores, such as the Nursing Activities Score (NAS), which measures the nursing time required by patients admitted to the ICU. The NAS comprises 23 items, the scores of which vary from 1.2 to 32.0. The total score is calculated by adding these item scores and is expressed as the percentage of time spent by one nursing staff member in the care of a critically ill individual, with a maximum value of 176.8%.<sup>(5)</sup> Thus, a nurse or nurse technician may tend to up to 2 patients with an NAS of 50.0% per shift.

Originally formulated in English, the NAS was translated and adapted to Portuguese by Queijo and Padilha.<sup>(6)</sup> This scale was shown to be adequate for measuring nursing workload, as the estimated number of professionals calculated using the NAS is similar to that found in ICUs considered to provide adequate nursing care.<sup>(7)</sup>

The results of Brazilian studies conducted at general ICUs are similar to the NAS averages, with a range from 62.9 to 69.9.<sup>(7-12)</sup> Using the NAS, greater nursing care demands were reported by studies that analyzed special populations, such as older adults (72.9)<sup>(13)</sup> and patients requiring postoperative care after heart surgery (73.7).<sup>(14)</sup>

One previous study conducted in Spain reported an average NAS value (66.2) compatible with that previously reported in Brazil.<sup>(15)</sup> In contrast, a study conducted at 4 Norwegian ICUs reported a much higher NAS average value (96.2), and these authors related the high care demand to the time spent with the patients' relatives, as there are no limits on visits, and with intra-hospital transport, which are performed by the ICU nursing staff.<sup>(16)</sup>

In Brazil, the Unified Health System (*Sistema Único de Saúde* - SUS) declared the mandatory assistance of all citizens in the public healthcare setting, based on the principles of universality, equity, and comprehensiveness of health services and actions. Nevertheless, the private sector, which mostly comprises healthcare insurance and plans, represents a significant complementary source of assistance with the large demand for services.<sup>(17)</sup>

As a function of this program for healthcare assistance in Brazil, some authors have investigated the clinical characteristics of critically ill individuals admitted to private and public ICUs and have found significant differences.<sup>(18-20)</sup>

One study conducted at 14 public and private ICUs in the city of São Paulo found that patient mortality and the scores for the Therapeutic Intervention Scoring System-28 (TISS-28) were higher among patients admitted to public ICUs. Additionally, the patients' origin and the interventions to which they are subjected vary as a function of the hospital type.<sup>(18)</sup>

Another study analyzed 5 Brazilian ICUs and found significant differences between the patients admitted to public or private hospitals relative to the following variables: age, mortality, and severity as measured by Sepsis-related Organ Failure Assessment (SOFA). In particular, it is worth noting that the mortality and severity scores were higher among patients admitted to public facilities.<sup>(19)</sup> Another study found that the odds of dying were higher in public compared to private hospitals.<sup>(20)</sup>

Although the above mentioned studies found differences between the public and private hospitals, there is a gap in the comparative knowledge relative to the nursing workload demanded by patients admitted to public and private ICUs.

In the clinical setting, nursing professionals experience a considerably higher care demand from ICU patients in the public compared to the private setting, and this observation may have repercussions in both healthcare assistance and managerial practice, as there may be a need for an increased number of nursing professionals among the ICU staffs of public institutions.

Therefore, based on the need to identify and consolidate evidence on the differences in the demand of nursing care made by patients admitted to public and private ICUs, and taking into consideration the relevance of providing accurate information to ICU nursing professionals and to managers of human resources in the intensive care setting, the aim of the present study was to compare patients assisted at public and private ICUs according to the nursing workload required and the nursing interventions performed.

## METHODS

This was a retrospective, comparative cohort study. The primary data source for the present study was an electronic file that had been elaborated for previously published studies.<sup>(21,22)</sup>

The data registered in this file were prospectively collected by 6 previously trained collectors and included information on patients admitted to 4 ICUs, including 2 at public and 2 at private hospitals. The criteria for hospital selection included a location in São Paulo City, number of ICU beds >6% of the total number of hospital beds, and the availability of semi-ICU. The criteria for patient inclusion in the case series were as follows: age  $\geq 18$  years and ICU stay >24 hours. For the purpose of selection, the public and private institutions were analyzed separately, and in each group, the 2 hospitals with the highest number of semi-intensive care beds were selected. The collected data concerned the first and last 24 hours of the patients' stay in the ICU; for that purpose, the patients were followed up until discharge from the ICU. This study was approved by the research ethics committees of the participating institutions (rulings SMS52/2006; HU650/06; HSL2006/03 and AE06/510). Informed consent was requested for only 1 of the participating institutions, as the institutional ethics committees of the remaining 3 institutions waived this requirement.

To calculate the Logistic Organ Dysfunction Score (LODS)<sup>(23)</sup> and the Simplified Acute Physiology Score II (SAPS II),<sup>(23,24)</sup> clinical and laboratory data were collected from the patients' clinical or computed records. In addition to assessing the patients' severity and risk of death, LODS also enables identification of dysfunction affecting any of the following systems: neurological, cardiovascular, renal, pulmonary, hematologic, and hepatic. Therefore, the LODS can be used to establish the number and type of organ dysfunction.

The nursing workload was measured using the NAS,<sup>(5,6)</sup> which scores the nursing care demands of ICU patients. The evolution of patients' workload (NAS evolution) was calculated as the difference in the NAS scores between the first and last day of stay in the ICU (NAS score at admission - NAS score at discharge). Therefore, positive values indicated workload reduction, and negative values indicated increased care demands.

In the analysis of nursing interventions included in the NAS, items 2, 3, 5, and 9 to 23 were considered as dichotomous variables, and the patients were distributed according the performance or not of such interventions. With regard to items 1, 4, 6, 7, and 8, which include mutually exclusive sub-items, correlations were tested as follows: sub-item 1a versus 1b and 1c; 4a versus 4b and 4c; 6a versus 6b and 6c; 7a versus 7b; and 8a versus 8b and 8c.

The qualitative variables were described as absolute and relative frequencies. With regard to the continuous and discrete quantitative values, the mean, standard deviation (SD), median, and variation were calculated.

Pearson's chi-square test of association was used to compare the nominal variables between the patients at public and private ICUs. Whenever the expected frequency in at least 1 of the contingency table cells was  $\leq 5$ , Fisher's exact test was used. With regard to the continuous variables, the Student's *t* test or Mann-Whitney test was used as a function of the pattern of the distribution, as identified by the Kolmogorov-Smirnov test.

Inferential analysis was performed using the Statistical Package for the Social Science® (SPSS®) software, version 13. The significance level was established as 5%.

## RESULTS

The sample comprised 600 individuals, including 301 from private and 299 from public hospitals. These patients were consecutively admitted to the investigated ICUs from August 2006 to January 2007.

Approximately 56.5% of the sample consisted of males. The average age of the sample was  $60.8 \pm 18.7$  years, ranging from 18 to 97 years. Most patients came to the ICU from surgical centers (36.1%) or emergency departments (35.4%). The average stay at the ICU was 9 days, ranging from 1 to 79 days. According to the LODS, most patients exhibited signs of 1 (34.7%) or 2 (38.5%) types of organ dysfunction on the first day at the ICU, with kidney failure representing the most frequent type of organ dysfunction (69.7%). The average risk of death, as calculated using the SAPS II and LODS, was 25.5% and 21.4% upon admission and 23.1% and 20.7% at discharge, respectively, and the mortality rate at the ICU was 20.0%.

Relative to the total sample, the average nursing workload, as measured by the NAS, was 61.9 at admission and 52.8 at discharge. Table 1 describes the distribution of the results according to the type of institution. There was statistically significant difference in the nursing workload between patients in public and private ICUs for the first 24 hours of stay in the ICU (admission), with the highest NAS scores exhibited by patients in public ICUs.

The nursing interventions performed within the first 24 hours of stay in the ICU were analyzed based on the significant difference found in the NAS scores upon admission.

**Table 1** - Comparison of the nursing workload at the time of admission and discharge of patients (N=600) at public and private intensive care units

Variables	Institution type				p value
	Public		Private		
	Mean (SD)	Median (Variation)	Mean (SD)	Median (Variation)	
NAS admission	68.1 (24.5)	61.4 (28.2-138.4)	56.0 (16.1)	53.6 (25.6-122.5)	<0.001
NAS discharge	54.7 (16.4)	52.3 (8.4-119.8)	51.0 (15.1)	49.3 (14.1-116.5)	0.10

SD - standard deviation; NAS - Nursing Activities Score. Mann-Whitney test.

Table 2 shows that among 23 nursing interventions performed within the first 24 hours of stay in the ICU, more than half (12) exhibited significant differences between the patients in public and private ICUs. With the exception of the “care of drains”, “mobilization and positioning”, and “intravenous hyperalimentation”, nursing interventions were more frequently performed to patients in public ICUs.

**Table 2** - Comparison of the interventions performed upon admission in patients (N=582\*) at public and private intensive care units

Type of intervention - admission	Categories	Institution type		p value
		Public N (%)	Private N (%)	
1. Monitoring and titration	1a	113 (39.2)	181 (61.6)	<0.001
	1b and c	175 (60.8)	113 (38.4)	
2. Laboratory investigations	Y	287 (99.7)	294 (100.0)	0.49
	N	1 (0.3)	-	
3. Medication	Y	286 (99.3)	294 (100.0)	0.24
	N	2 (0.7)	-	
4. Hygiene procedures	4a	233 (80.9)	225 (76.5)	0.20
	4b and c	55 (19.1)	69 (23.5)	
5. Care of drains	Y	134 (46.5)	239 (81.3)	<0.001
	N	154 (53.5)	55 (18.7)	
6. Mobilization and positioning	6a	155 (53.8)	118 (40.1)	<0.001
	6b and c	133 (46.2)	176 (59.9)	
7. Support and care of relatives and patient	7a	253 (87.9)	291 (99.0)	<0.001-
	7b	35 (12.1)	3 (1.0)	
8. Administrative and managerial tasks	8a	161 (55.9)	247 (84.0)	<0.001
	8b and c	127 (44.1)	47 (16.0)	
9. Respiratory support	Y	238 (82.6)	198 (67.4)	<0.001
	N	50 (17.4)	96 (32.6)	
10. Care of artificial airways	Y	109 (37.9)	105 (35.7)	0.59
	N	179 (62.1)	189 (64.3)	
11. Treatment for improving lung function	Y	145 (50.4)	60 (20.4)	<0.001
	N	143 (49.6)	234 (79.6)	

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12. Vasoactive medication	Y	91	85	0.48
	N	197	209	
13. Intravenous replacement of large fluid losses	Y	50	2	<0.001
	N	238	292	
14. Left atrium monitoring	Y	2	7	0.10
	N	286	287	
15. Cardiopulmonary resuscitation	Y	5	2	0.28
	N	283	292	
16. Hemofiltration techniques	Y	14	24	0.11
	N	274	270	
17. Quantitative urine output measurement	Y	266	279	0.21
	N	22	15	
18. Measurement of intracranial pressure	Y	4	9	0.17
	N	284	285	
19. Treatment of complicated metabolic acidosis/alkalosis	Y	13	-	<0.001
	N	275	294	
20. Intravenous hyperalimentation	Y	9	27	<0.001
	N	279	267	
21. Enteral feeding	Y	62	80	0.11
	N	226	214	
22. Specific interventions in the intensive care unit	Y	36	12	<0.001
	N	252	282	
23. Specific interventions outside the intensive care unit	Y	26	1	<0.001
	N	262	293	

Y - yes; N - no; \*Missing: 11 public, 7 private hospitals; Pearson's chi-square test or Fisher's exact test.

As a function of the significant difference in the NAS, and for differences in certain nursing interventions between patients in public and private ICUs upon admission, it was decided that the score evolution in the total sample as well in specific groups (survivors and non-survivors) would be assessed. The data described in table 3 show that with regard to the evolution of NAS in the total sample as well as the survivors, the patients in public institutions exhibited a greater reduction in the nursing workload throughout their stay in the ICU compared to those in private ICUs. With regard to the group of non-survivors, the patients from both types of ICUs both required an increased nursing workload.

Furthermore, the NAS progression exhibited statistically significant difference between the patients in public and private institutions in the analysis of the total sample ( $p<0.001$ ) and the group of survivors ( $p<0.001$ ).

**Table 3** - Comparison of Nursing Activities Score evolution between patients admitted to public and private intensive care units corresponding to the total sample (N=600), survivors (N=480) and patients who died at the intensive care unit (N=120)

NAS evolution	Institution type				p value
	Public		Private		
	Mean (SD)	Median (Variation)	Mean (SD)	Median (Variation)	
NAS (survivors and non-survivors)	+13.3 (24.2)	+6.8 (-51.8/+83.2)	+5.0 (16.9)	+1.5 (-64.4/+69.9)	<0.001
NAS (survivors)	+17.9 (23.5)	+10.6 (-38.3/+83.2)	+6.3 (15.8)	+1.8 (-64.4/+69.9)	<0.001
NAS (non-survivors)	-0.1 (21.1)	-1.4 (-51.8/+55.3)	-2.8 (21.1)	0.0 (-64.1/+47.4)	0.51

NAS - Nursing Activities Score; SD - standard deviation. Mann-Whitney test; Student's *t* test.

## DISCUSSION

In the present study, the average NAS scores at public and private ICUs, both at the time of admission (68.1 and 56.0, respectively) and discharge (54.7 and 51.0, respectively), were intermediate compared to the results of previous studies that assessed the nursing workload in ICUs, which reported scores raging from 41.4 to 96.2.<sup>(7,9,11-14,16,25-27)</sup> In our study, the NAS total scores showed that patients at public institutions demanded a greater nursing workload on the first day of their ICU stay as compared to those at private ICUs.

No studies were found in the literature comparing the nursing workload as measured by the NAS between public and private ICUs. However, the TISS-28 was the precursor to the NAS, and using this scoring system, a previous study analyzed 200 patients admitted to ICUs belonging to various Health Regional Centers in São Paulo City. These results showed that the patients admitted to public hospitals exhibited significantly higher TISS-28 scores compared to those admitted to private institutions,<sup>(18)</sup> and these findings highlight the greater need for nursing care among patients admitted to ICUs in public hospitals compared to private ones.

The lack of intensive care beds is a problem in several parts of the world, including Brazil, where the space available at public facilities does not suffice to meet the full demand,<sup>(28)</sup> thus delaying patient admission. Moreover, this delay is compounded by the concomitant delay in the onset of interventions that could prevent deterioration of the patients' clinical condition and improve their prognosis. Thus, the greater nursing

workload associated with the care of such patients might be due to the inability to satisfy the existing demand.

The nursing interventions most frequently performed during the first 24 hours of stay in the ICU in both public and private institutions were in agreement with those reported in the literature.<sup>(7,10,12)</sup> In particular, "monitoring and titration" (item 1), "laboratory investigations" (item 2), "medication" (item 3), "hygiene procedures" (item 4), "mobilization and positioning" (item 6), "support and care of relatives and patient" (item 7), "administrative and managerial tasks" (item 8), and "quantitative urine output measurement" (item 17) were the most prevalent interventions recorded in the care of critically ill patients. Additionally, the less commonly performed interventions in the present study were also in agreement with the literature.

Five interventions were performed in 100.0% of the patients in either public or private ICUs, corresponding to NAS items 1, 4, 6, 7, and 8, which include sub-items denoting various degrees of task complexity, with adjusted estimations of the time required to perform them. Such sub-items follow a hierarchy of exclusive levels, in which sub-item "a" represents the intervention standard routine performed in any ICU; sub-item "b" denotes an increased level of complexity for that same intervention, which requires additional time and thus it is beyond the typical ICU routine; and sub-item "c" denotes an even higher level of complexity, which also requires significantly more time to accomplish the task.<sup>(5,29)</sup>

As a consequence, one would expect that upon admission to the ICU, all patients from both public and private ICUs would have scores corresponding to sub-item "a" of the 5 above mentioned tasks, as this is the lowest level in the hierarchy of interventions and corresponds to the standard ICU routine. However, the patients at the public ICUs exhibited a higher frequency of more complex interventions related to "monitoring and titration" (item 1), "support and care of relatives and patient" (item 7), and "administrative and managerial tasks" (item 8), whereas patients in the private ICUs required more complex interventions related to "mobilization and positioning" (item 6).

The nursing workload demanded by patients in public ICUs exhibited greater reduction throughout the patient's stay in the ICU compared that observed for private facilities, as evidenced by the NAS evolution. In addition, this statistically significant difference remained when only the survivors were compared.

A previous study conducted in Spain showed that the nursing workload as measured by the NAS upon admission to ICU (41.4) was higher than that at the time of discharge (38.8), when the full sample was analyzed. However, when only the patients who died at the ICU were analyzed, the NAS corresponding to the last day at the ICU was higher compared to that exhibited by the same patients upon admission (48.6).<sup>(27)</sup> A similar result was found in the present study in both the public and private ICUs, i.e., the nursing workload associated with the patients who died increased during their stay in the ICU, while the NAS of the overall case series decreased during the same period.

For patients admitted to the ICU to be discharged, they must achieve a level of clinical stability that ensures their safety outside of the critical care environment. Premature discharge is associated with higher intra-hospital lethality as well as higher readmission rates.<sup>(30)</sup> For that reason, the nursing care demand at discharge was similar in both public and private ICUs.

The results of the present study provide an objective view on the nursing workload associated with the care of patients admitted to public and private ICUs. Therefore, these findings may support healthcare management in its quest to establish an adequate nursing staff to ensure the best care practices, without increased risk to critically ill individuals.

In this regard, it is worth stressing that high nursing workload associated with undersized staffs exerts a strong negative impact on the quality of the care provided. For example, high workload can result in more frequent adverse events<sup>(3,8)</sup> and can produce psychological

conditions deleterious to the healthcare staff, which may result in burnout and professional dissatisfaction.<sup>(2,4)</sup>

Among the limitations of the present study, the rigorous criteria applied to the selection of institutions, as described in the methods section, should be noted. All of the included hospitals contain semi-intensive care units, the ratio of the ICU to hospital beds was adequate, and all of the institutions are located in the city of São Paulo, which is the Brazilian state with the largest number of hospitals with ICUs.<sup>(31)</sup> Therefore, the results do not represent the overall Brazilian situation, which includes several poor areas that do not have adequate intensive care. In addition, the patients' progression was established based on 2 assessment time-points (first and last 24 hours of stay in the ICU), and these measurements therefore did not permit further inquiry into the nursing care demands throughout the full stay in the ICU.

## CONCLUSION

The results of the present study revealed statistically significant differences between the patients assisted at public and private institutions. According to the Nursing Activities Score, the patients at the public institutions demanded a greater nursing workload upon admission to the intensive care unit, although such demand exhibited a greater reduction during intensive care unit stay among the surviving patients at those institutions. Additionally, differences in the type of intervention required by the patients at the public and private intensive care units were observed.

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## RESUMO

**Objetivo:** Comparar pacientes de unidades de terapia intensiva públicas e privadas segundo carga de trabalho e intervenções de enfermagem.

**Métodos:** Estudo comparativo, tipo coorte retrospectivo, com 600 pacientes internados em 4 unidades de terapia intensiva localizadas em São Paulo. A carga de trabalho e as intervenções de enfermagem foram identificadas pelo *Nursing Activities Score* nas primeiras e últimas 24 horas de permanência do paciente

na unidade de terapia intensiva. Os testes do qui-quadrado de Pearson, exato de Fisher, *t* de Student e Mann-Whitney foram utilizados na comparação dos grupos.

**Resultados:** A média do *Nursing Activities Score* calculado na admissão das unidades de terapia intensiva foi 61,9 e, na saída, de 52,8. Diferenças significativas foram encontradas entre os pacientes admitidos nas unidades de terapia intensiva públicas e privadas em relação ao *Nursing Activities Score* médio na admissão e em 12 das 23 intervenções de enfermagem realizadas nas primeiras 24 horas de internação na unidade crítica. Os

pacientes internados nas unidades de terapia intensiva públicas apresentaram maior valor médio do escore e, em geral, tiveram maior frequência de intervenções, exceto àquelas relacionadas a “cuidados com drenos”, “mobilização e posicionamento”, e “hiperalimentação intravenosa”. Os grupos também diferiram em relação à evolução do *Nursing Activities Score* entre admissão e saída da unidade de terapia intensiva na casuística total e entre os sobreviventes.

**Conclusão:** Pacientes internados em unidades de terapia intensiva públicas e privadas apresentam particularidades em relação à demanda de cuidados requerida e tal achado pode subsidiar os gestores na busca de um adequado dimensionamento da equipe de enfermagem.

**Descritores:** Carga de trabalho; Recursos humanos de enfermagem no hospital; Hospitais privados/recursos humanos; Hospitais públicos/recursos humanos; Unidades de terapia intensiva

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