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Type of admission and nursing workload of critical patients: a cross-sectional study

Juliana Lemos Romano, Paulo Carlos Garcia, Daniela Vieira Silva, Bruna Roberta Siqueira Moura and Lilia de Souza Nogueira

ABSTRACT

Background: According to the perception of nurses in the intensive care unit (ICU), surgical patients need more nursing care, thus requiring higher nursing workloads for these patients than those admitted as clinical patients. However, some study results on the relationship between the type of admission and the nursing workload are considered contradictory.

Aims and objectives: To identify if the type of admission (clinical, emergency surgery or elective surgery) is a predictive factor of the nursing workload required by patients on the first day or throughout their stay in the ICU.

Design: This was a quantitative cross-sectional study comprised of a retrospective analysis of clinical records of critical patients.

Methods: Data were collected from 1 May 2015 to 30 September 2015 in a hospital located in São Paulo, Brazil. Nursing workload was measured using the Nursing Activities Score. The type of admission and the demographic and clinical variables of the patients were investigated. Multiple linear regression was used to identify nursing workload predictive factors, with 5% significance level.

Results: In the analysed sample ($n = 211$; mean age of 60·3 ± 18·7 years), there was a prevalence of male gender (56·9%). A statistically significant difference ($p = 0·025$) was found between the type of admission and the nursing workload required for patients on the first ICU day. The Simplified Acute Physiologic Score ($p = 0·009$) was a predictor of nursing workload on the first day in the ICU, and the Logistic Organ Dysfunction System ($p = 0·026$) and mortality ($p < 0·001$) were predictors throughout the ICU stay.

Conclusions: The type of admission was not a predictive factor of the nursing workload required by critical patients.

Relevance to clinical practice: Identifying the predictive factors of nursing workload favours the appropriate staffing of the critical unit by nurses. However, nurses should not consider the type of admission in predicting the nursing workload required by patients in the ICU.

Key words: Critical care • Intensive care units • Nursing • Patient admission • Workload

INTRODUCTION

Some patients, considering the case severity and the complexity of treatment as well as the need for specialized therapeutic support and continuous monitoring, may require admission into the intensive care unit (ICU). The nurses who work in the critical care unit provide constant care to severely ill patients, especially those who are more complex, which requires specific technical knowledge and skills, such as critical thinking, the ability to define priorities rapidly and to establish good communication and the ability to work in a team and to use technology and other skills.

An exploratory survey showed that ICU nurses perform many functions, such as care, education, coordination, collaboration and supervision, but coordination, supervision and technical care are the most important functions (Cenedési *et al.*, 2012). Thus, it is essential to have an adequate critical care nursing staff with nursing educational qualifications to ensure the quality of care, patient safety and cost reduction (Aiken *et al.*, 2014; Oliveira *et al.*, 2016; Penoyer, 2010).

Therefore, some nursing workload tools have been developed in different countries to facilitate the clinical practice of nursing staff, the definition of the real need of care for ICU patients and the correct team sizing, that is, the nurse/patient ratio (Vincent and Moreno, 2010). One of these tools is the Nursing Activities Score (NAS) (Miranda *et al.*, 2003), which was validated in ICUs in different countries (Fajardo Quintana *et al.*, 2017; Macedo *et al.*, 2016; Nieri *et al.*, 2018; Queijo and Padilha, 2009; Quintana *et al.*, 2017).

According to the perception of nurses in the ICU, surgical patients need more nursing care, which requires higher nursing workloads for these patients than those admitted as clinical patients. This perception has been validated in a study carried out in an ICU in Northwest Parana State, Brazil. Surgical patients were approximately three times more likely to require high nursing workloads during the first 24 h in the ICU than those undergoing clinical treatment (Inoue *et al.*, 2011). In addition, an investigation analysed 437 patients and detected significant differences in the NAS score according to the type of admission, granting the highest score to emergency surgical admissions (Altafin *et al.*, 2014).

The possible influence of the type of admission (medical or surgical) in nursing care has also been analysed by other studies, whose results have shown that the nursing workload measured by the NAS was similar in both clinical and surgical patients (Coelho

Authors: JL Romano, RN, Department of Medical-Surgical Nursing, School of Nursing, University of São Paulo, São Paulo, Brazil; PC Garcia, RN, PhD, Department of Nursing, University Hospital, University of São Paulo, São Paulo, Brazil; DV Silva, RN, MSc, Department of Medical-Surgical Nursing, School of Nursing, University of São Paulo, São Paulo, Brazil; BRS Moura, RN, Department of Nursing, University Hospital, University of São Paulo, São Paulo, Brazil; Assistant Professor LS Nogueira, RN, PhD, Department of Medical-Surgical Nursing, School of Nursing, University of São Paulo, São Paulo, Brazil

Address for correspondence: LS Nogueira, Avenida Doutor Enéas de Carvalho Aguiar, 419, São Paulo, SP 05403-000, Brazil

E-mail: lilianogueira@usp.br

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et al., 2011) and that the type of treatment (clinical or surgical) was not a predictor of high demand for nursing care (Gonçalves and Padilha, 2007; Padilha *et al.*, 2008).

Therefore, we have realized that the results of these studies, concerning the types of treatment and/or the types of admission as well as their relationship with the NAS, are contradictory. The motivation for the present study came from both these data as well as the scarcity of other studies that analysed the influence of the type of admission, including clinical, emergency surgical or elective surgical cases, on the demand for nursing care. The results of the present study may contribute to nursing clinical practice, especially for measuring the nursing workload, and to the appropriate sizing and capacity building of ICU nursing teams, focusing on the provision of quality care and the safety of patients, professionals and organizations.

AIM

The aim of the present study was to identify if the type of admission, categorized as clinical, emergency surgery or elective surgery, was a predictive factor of the nursing workload required by patients on the first day or throughout their stay in the ICU.

METHODS

Design

This was a quantitative cross-sectional study comprised of a retrospective analysis of clinical records of patients admitted to the adult ICU from 1 May 2015 to 30 September 2015.

Setting

The study was carried out at a public university hospital located in the city of São Paulo, Brazil. The hospital had 236 beds, 12 of which were adult ICU beds. In Brazil, according to the Federal Nursing Council, the ratio between the number of patients and nursing professionals should be at least 1·33, or 18 h per patient day, in the critical care unit.

Sample

The sample included all the patients admitted to the adult ICU during the study period who met the following inclusion criteria: patients aged 16 or over admitted to the ICU for clinical, emergency or elective surgical treatment. Patients readmitted to the ICU or transferred from critical units of other hospitals were excluded from the sample.

Data collection

The nursing workload required for patients on the first day and throughout the ICU stay was measured by the NAS. Resulting from multiple moments of observation during 1 week in a sample of 99 ICUs located in 15 countries, the NAS is comprised of seven categories (basic activities, ventilation support, cardiovascular support, renal support, neurological support, metabolic support and specific interventions) and a total of 23 nursing activities, weighted from 1·2 to 32·0. The sum of the activities defines the score that represents the percentage of time spent by a nurse, by shift, in terms of direct patient care. The highest score possible is 176·8% (Miranda *et al.*, 2003).

In addition to the NAS and the type of admission (clinical, emergency surgery or elective surgery), other variables that were analysed in the study include the following: age, gender, Charlson comorbidity index (Charlson *et al.*, 1987), severity according to the risk of death, calculated by the index, Simplified Acute Physiologic Score 3 (SAPS 3) (Moreno *et al.*, 2005), Logistic Organ Dysfunction System (LODS) (Le Gall *et al.*, 1996) and length of stay and clinical outcome in the ICU (survival or non-survival).

The Charlson comorbidity index includes 19 clinical conditions, and each one receives a score that ranges from one to six, if present. The value of the score, originated from the sum of these points, indicates the importance of comorbidities on mortality, that is, the higher the score, the higher the likelihood of death (Charlson *et al.*, 1987).

SAPS 3 is a severity index based on the analysis of European and North-American populations in which 20 variables are scored, addressing patient characteristics before ICU admission, addressing the circumstances of admission into the critical unit and assessing the presence and level of physiological dysfunction at the time of ICU admission. When calculating the SAPS 3, each variable receives a score, and the sum generates the total score, which is converted into the likelihood of hospital mortality by logistic regression (Moreno *et al.*, 2005).

The severity index LODS analyses 12 physiological variables and identifies levels of dysfunction for six organic systems: neurological, cardiovascular, renal, pulmonary, haematological and hepatic. The final score is converted into the likelihood of death, and the higher the number of organ failures, the higher the risk of death (Le Gall *et al.*, 1996). Thus, more points on the SAPS 3 or LODS score increases the likelihood of a patient's death.

Data collection was performed by the researchers through the analysis of patient records and the application of two data collection tools (identification and patient admission form and a list of variables for the calculation of SAPS 3 and LODS). Information concerning nursing workload was collected from the organization computer-based system that contained the NAS, whose values were calculated daily by the ICU nurses.

Data analysis

Descriptive statistics were performed for all the variables in the present study. Analysis of variance (ANOVA), Kruskal Wallis and Tukey tests were performed to compare the following groups: clinical, emergency surgery or elective surgery. Multiple linear regression was used to identify the predictive factors of nursing workload within the first 24 h and throughout the patient stay in the ICU. The variance inflation factor (VIF) was applied to check the multiple co-linearity among the variables that remained in the model, which were present if the VIF values were ≥ 5. The level of statistical significance was 5%.

Ethical approval

The study was approved by the Research Ethics Committee of the organization (Protocol n° 1 363 959). All the data from patient records were saved in a protected computer, with access restricted only to the researchers of this study, ensuring the security of the collected information.

RESULTS

From the 252 patients admitted to the ICU during the present study, 25 patients were excluded because they did not meet the inclusion criteria (15 were readmitted to the ICU, and 10 were younger than 16 years old). Sixteen of the patients were also excluded because their records had incomplete information, which was an

impediment to identifying the research variables.

The final sample was comprised of 211 patients, with a mean age of 60·3 years (±18·7), who were mostly male (56·9%) and were admitted to the ICU for clinical treatment (56·4%). Concerning the Charlson comorbidity index, patients had an average score of 1·9 points (±2·2), and 65 patients (30·8%) did not present any comorbidity. The mean risk of death calculated by the SAPS 3 (34·1 ± 27·9) was higher than that of the LODS (20·9 ± 18·3). The patients presented a reduced nursing workload measured by the NAS during the ICU stay compared with the first day of admission in the critical unit: 60·0 (±12·9) and 75·7 (±18·7), respectively. The mean ICU length of stay was 6·6 days (±8·7), and seven patients (3·3%) remained in the ICU for more than 30 days. Forty-two patients (19·9%) died in the ICU.

There was a statistically significant difference between the type of admission and the nursing workload required by patients on the first ICU day ($p = 0·025$). According to Tukey's test, this difference occurred between elective surgery versus clinical ($p = 0·028$) admissions and between elective surgery versus emergency surgery ($p = 0·050$) admissions, and the lowest and highest NAS scores were observed for the patients admitted after elective and emergency surgeries, respectively.

Table 1 shows that only the risk of death variable, according to the SAPS 3 ($p = 0·009$), was a predictive factor of the nursing workload (NAS) required by patients on the first day of ICU stay.

On the other hand, the LODS ($p = 0·026$) and the clinical outcome in the critical care unit ($p < 0·001$) were predictors of nursing workload required by patients throughout their stay in the ICU (Table 2).

The data from Tables 1 and 2 show that the type of admission was not a predictive factor of the nursing workload required by the patient both on the first day and throughout the ICU stay ($p > 0·05$). In addition, the VIF values (<1·6) indicate that there was no multiple co-linearity among the variables that remained in the final models.

DISCUSSION

With respect to the results of this investigation regarding age and the prevalence of men admitted to the ICU for clinical treatment, our results confirm those of other investigations, which measured the nursing workload in accordance with the NAS in a Brazilian ICU (Altafin *et al.*, 2014; Inoue *et al.*, 2011) and a European ICU (Carmona-Monge *et al.*, 2013; Lucchini *et al.*, 2014).

In terms of the severity of patients in the sample, the risk of death calculated by the SAPS 3 (34·1 ± 27·9) was superior to that identified by the LODS (20·9 ± 18·3), and the LODS value was closer to the mortality rate observed in the ICU (19·9%). Researchers have shown that the SAPS 3 score provides good discrimination of mortality rates in ICU patients (Serpa Neto *et al.*, 2015). According to the current data, two assumptions can be considered: the LODS index better reflects the severity of patients in the sample or the excellent quality of care provided by the nursing unit resulted in lower mortality compared with that estimated by the SAPS 3.

The NAS score of patients in the first 24 h after ICU admission was 75·7 (±18·7), and the NAS score throughout admission was 60·0 (±12·9); i.e. there was a decrease in the demand for nursing care during the stay in the critical care unit, which is related, in most cases, to the clinical improvement of patients during the intensive treatment, thus requiring less nursing care. It is important to note that the mean NAS score, referring to the first 24 h in the ICU, as well as the number for the total period of ICU stay identified by the present study fall within the range of values reported by other studies (Inoue *et al.*, 2011; Altafin *et al.*, 2014; Luchini *et al.*, 2014; Carmona-Monge *et al.*, 2013; Nogueira *et al.*, 2013).

In the comparison of the groups (clinical, elective surgical or emergency surgical), the results of the study showed statistically significant group differences in comparison with the NAS calculated on the first ICU day, and the highest scores were observed for patients admitted after emergency surgeries. Among the studies that compared nursing workload according to the type of admission/treatment, two studies assessed only clinical and surgical groups (Coelho *et al.*, 2011; Inoue *et al.*, 2011), and one study subdivided the patients into three categories (clinical, elective surgery and emergency surgery) (Altafin *et al.*, 2014), similar to the present investigation.

A study that analysed 100 patients admitted to the ICU of a hospital in the state of Parana, located in Northwest Brazil, identified a significant association between workload and the type of treatment ($p = 0·0143$), in which most of the surgical cases (65%) needed high nursing workloads (NAS > 107), whereas patients admitted for clinical treatment (60%) required low nursing workloads (NAS ≤ 107) (Inoue *et al.*, 2011).

In a study carried out in the cardiology ICU of a private hospital, it was identified that the nursing workload measured by the NAS was similar ($p = 0·52$) between clinical and surgical patients (67·6 versus 66·3) (Coelho *et al.*, 2011).

Another investigation showed that the type of ICU admission, subdivided into clinical, elective surgery or emergency surgery, was one of the variables associated with the differences in nursing workload ($p = 0·014$), and the highest NAS values were identified for patients admitted after emergency surgery (Altafin *et al.*, 2014).

Despite the fact that the reported studies presented conflicting results, there is a trend towards higher demand for nursing care for surgical patients (Altafin *et al.*, 2014; Inoue *et al.*, 2011), especially if admitted in situations of emergency (Altafin *et al.*, 2014), compared with clinical cases. Such results confirm the findings of the present study.

The risk of death, calculated by the SAPS 3, was a predictive factor of the NAS on the first day of ICU admission and on the risk of death according to the LODS, and the clinical outcomes of patients were predictors of workload during ICU admission. This finding means that the type of admission did not influence the NAS in this sample. The variables of patient severity (Nogueira *et al.*, 2014) and ICU mortality (Coelho *et al.*, 2011; Padilha *et al.*, 2008) are frequently identified as associated factors with the NAS; thus, more severe patients who evolve to death in the ICU require more nursing workloads than those who are less severe and survive their intensive care stay.

Only one study that analysed elderly patients alone showed that, in patients older than 70 years of age, high severity according to the SAPS II as well as the type of admission (surgical reason) had an independent effect on the determination of high nursing demand (Sousa *et al.*, 2008). Thus, we can assume that the type of admission influences the NAS when the elderly population is considered.

Table 1 Linear regression model of the predictive factors of the nursing workload required by patients on the first day of ICU admission

Variables	β	Standard error (β)	CI 95%	*p-Value*	VIF
Linear coefficient	71·7	7·0	58·0–85·5	<0·001	
Age	−0·1	0·1	−0·2 to 0·1	0·300	1·1
Gender (reference female)	−3·8	2·5	−8·8 to 1·2	0·136	1·0
Type of ICU admission (reference elective surgery)					1·1
Emergency surgery	2·9	4·0	−5·1 to 10·8	0·479	
Clinical	0·9	3·7	−6·4 to 9·3	0·801	
LODS (risk of death)	0·1	0·1	−0·1 to 0·2	0·450	1·3
SAPS 3 (risk of death)	0·2	0·1	0·1–0·3	**0·009***	1·5
Charlson comorbidity score	0·7	0·6	−0·4 to 1·9	0·221	1·1
ICU length of stay (in days)	0·2	0·1	−0·1 to 0·5	0·168	1·0
ICU clinical outcome (reference Non-surviving patient)	−0·5	3·8	−8·1 to 7·0	0·885	1·2

CI, confidence interval; ICU, intensive care unit; LODS, Logistic Organ Dysfunction System; SAPS 3, Simplified Acute Physiologic Score 3; VIF, variance inflation factor.
* Significant at $p < 0·05$ level.

Table 2 Linear regression model of the predictive factors of the nursing workload required by patients during ICU stay

Variables	β	Standard error (β)	CI 95%	*p-Value*	VIF
Linear coefficient	66·3	4·5	57·4–75·2	<0·001	
Age	0·0	0·1	−0·0 to 0·1	0·951	1·1
Gender (reference female)	−3·0	1·6	−6·2 to 0·2	0·064	1·0
Type of admission (reference elective surgery)					1·1
Emergency surgery	0·5	2·6	−4·6 to 5·6	0·843	
Clinical	−0·8	2·4	−5·6 –to 3·9	0·737	
LODS (risk of death)	0·1	0·1	0·0–0·2	**0·026***	1·3
SAPS 3 (risk of death)	0·1	0·0	−0·0 to 0·1	0·291	1·5
Charlson comorbidity score	0·2	0·4	−0·6 to 0·9	0·613	1·1
ICU length of stay (in days)	−0·1	0·1	−0·3 to 0·1	0·227	1·0
ICU clinical outcome (reference non-surviving patient)	−10·0	2·4	−14·8 to −5·10	**<0·001***	1·2

CI, confidence interval; ICU, intensive care unit; LODS, Logistic Organ Dysfunction System; SAPS 3, Simplified Acute Physiologic Score 3; VIF, variance inflation factor.
* Significant at $p < 0·05$ level.

In the present study, using univariate analysis, it was possible to observe the influence of the type of admission on the NAS within the first 24 h of ICU stay. However, when this variable was analysed together with other data (multiple linear regression analysis), the variable did not remain in the final model as a predictor of the demand of nursing care. Thus, ICU nurses should not consider the type of admission in predicting the nursing workload required by patients.

Limitations

When applying the data from this study, it is important to consider that the ratio of staff to patients was not investigated and that this information can be relevant in how staff perceive and experience heavy workloads. Furthermore, other limitations must be considered, such as the sample size and the fact that the research was performed in a centre in Brazil, where resources as well as the organization of health care may be different from other countries.

The low scientific production comparing the types of admission considered in this study makes it difficult to discuss, which denotes the importance of the present investigation.

IMPLICATIONS AND RECOMMENDATIONS FOR PRACTICE

- This study expanded the knowledge about the types of admission and the nursing workload required by ICU patients, and it showed that there is no relationship between the two.
- However, nurses should consider the influence of ICU patient severity on the nursing workload to define the correct nursing staff for providing quality and safe care to critical patients.

CONCLUSION

In the analysed sample, there was a significant difference among the groups (clinical, elective surgical or emergency surgical admission) related to the nursing workload required by patients on the first day of ICU stay. However, the type of admission was not a predictive factor for nursing workload on the first day or throughout the ICU stay.

WHAT IS KNOWN ABOUT THIS TOPIC

- According to the nursing team perception in the ICU, surgical patients require higher nursing team workloads during intensive treatment than do clinical patients.
- Some of the literature about the types of admission and their relationships with nursing workload are contradictory.

WHAT THIS PAPER ADDS

- The severity of patients and mortality are both predictors of nursing workload in the ICU.
- The type of admission, when analysed with other variables, was not a predictive factor for nursing workload in the ICU; for that reason, nurses must not consider this variable to size the nursing team that will provide care in the ICU.
- Knowing the factors that demand more time for nursing care is important for identifying the adequate minimum registered nurse-to-patient ratios and for optimizing the human resource presence, without overloading one or many employees; in addition, more nurses can provide better patient care.

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