NURSING WORKLOAD AND PATIENT MORTALITY AT AN INTENSIVE CARE UNIT

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ABSTRACT

Objective: to verify if the nursing workload is a predictor of mortality at an Intensive Care Unit.

Method: cross-sectional and retrospective documentary study, developed at the Intensive Care Unit of a tertiary university hospital. The Receiver Operator Characteristic Curve was used, consisting of the Nursing Activities Score and the APACHE severity score, using logistic regression to analyze the prediction of mortality.

Results: the sample included 324 patients, 214 (66%) of whom survived. The mean Nursing Activities Score during the first 24 hours of hospitalization was 79.3 points, ranging from 34.8 to 134.2 points, and the median APACHE II was 24.5 (2-42). In the analysis of the Receiver Operator Characteristic Curve, the Nursing Activities Score evidenced an area under the curve corresponding to 0.626; CI between 0.570 and 0.678 and an APACHE II score of 0.721, with a 95% confidence interval from 0.669 to 0.769.

Conclusion: the nursing workload did not serve as a mortality predictor at the Intensive Care Unit, as the patients who demand the main nursing workload are not necessarily the patients who evolve to death.

DESCRIPTORS: Workload. Nursing staff. Intensive Care Units. Mortality. Severity of illness index.

CARGA DE TRABALHO DE ENFERMAGEM E MORTALIDADE DOS PACIENTES EM UNIDADE DE TERAPIA INTENSIVA

RESUMO

Objetivo: verificar se a carga de trabalho de enfermagem é um preditor de mortalidade em Unidade de Terapia Intensiva.

Método: estudo documental, retrospectivo, corte transversal, desenvolvido na Unidade de Terapia Intensiva de um hospital universitário terciário. Utilizou-se a curva *Receiver Operator Characteristic Curve* composta pelo *Nursing Activities Score* e índice de gravidade APACHE e regressão logística para análise da predição de mortalidade.

Resultados: compuseram a amostra 324 pacientes, sendo 214 (66%) sobreviventes. A média *Nursing Activities Score* das primeiras 24 horas de internação foi de 79,3 pontos, variando de 34,8 a 134,2 pontos e o APACHE II mediano foi 24,5 (2-42). Na análise da curva *Receiver Operator Characteristic Curve* o *Nursing Activities Score* evidenciou uma área sobre a curva de 0,626; IC 0,570 a 0,678 e o APACHE II de 0,721 com intervalo de confiança IC 95% de 0,669 a 0,769.

Conclusão: a carga de trabalho de enfermagem não foi um preditor de mortalidade em Unidade de Terapia Intensiva, pois os pacientes que demandam a maior carga de trabalho de enfermagem não necessariamente são aqueles que evoluem para o óbito.

DESCRITORES: Carga de trabalho. Recursos humanos de enfermagem. Unidades de Terapia Intensiva. Mortalidade. Índice de gravidade de doença.

CARGA DE TRABAJO DE ENFERMERÍA Y LA MORTALIDAD DE LOS PACIENTES EN UNIDAD DE TERAPIA INTENSIVA

RESUMEN

Objetivo: verificar si la carga de trabajo de enfermería es um como predictor de mortalidad en Unidad de Terapia Intensiva.

Método: estudio documental, retrospectivo, corte transversal, desarrollado en la Unidad de Terapia Intensiva de un hospital universitario terciario. Se utilizó la curva Receiver Operator Characteristic Curve compuesta por el Nursing Activity Score y índice de gravedad APACHE y regresión logística para análisis de la predicción de mortalidad.

Resultados: compusieron la muestra 324 pacientes, siendo 214 (66%) sobrevivientes. El promedio *Nursing Activities Score* de las primeras 24 horas de internación fue de 79,3 puntos, variando de 34,8 a 134,2 puntos y el APACHE II mediano fue de 24,5 (2-42). En el análisis de la curva *Receiver Operator Characteristic Curve* o *Nursing Activities Score* evidenció un área sobre la curva de 0,626; IC 0,570 a 0,678 y el APACHE II de 0,721 con intervalo de confianza IC 95% de 0,669 a 0,769.

Conclusión: la carga de trabajo de enfermería no fue un predictor de mortalidad en Unidad de Terapia Intensiva, pues los pacientes que demandan la mayor carga de trabajo de enfermería no necesariamente son aquellos que evolucionan a muerte

DESCRIPTORES: Carga de trabajo. Personal de enfermería. Unidades de cuidados intensivos. Mortalidad. Índice de severidad de la enfermedad.

INTRODUCTION

The performance assessment of Intensive Care Units (ICU) based on parameters related to the nursing workload and quantitative severity prognoses permits optimizing financial resources and offers support for the allocation of human resources in these services, thus prioritizing the quality and safety of care.[1]

The nursing workload consists of all activities that are direct or indirectly performed in patient care, with direct interference from the patient's degree of dependency.[2] One of the measures is the Nursing Activities Score (NAS), a classification system that has been translated and validated for the Brazilian reality. This tool has demonstrated satisfactory reliability, criterion and construct validity to measure the nursing workload at ICU and to justify the need for additional staff in case of increased workload.[3-4]

Likewise, evaluating the severity of the disease permits not only analyzing the patients' clinical conditions and their prognosis, but also guiding and analyzing the impact of the new therapeutic interventions. Among the main prognostic score systems in ICUs, the Acute Physiology and Chronic Health Evaluation (APACHE) stands out which, although more complex, is more precise when compared to the other instruments.[5]

The literature does not present solid evidence that more severe patients demand a higher workload, but it is observed that, in patients who presented a higher NAS, the mortality rate was also higher, demonstrating these indices.[6-7]

Corroborating these data, a study indicates that patients who evolved to death and stayed at the ICU more than six days required more hours of nursing care when compared to the survivors and patients who spent less time at the ICU.[8]

Research conducted at a cardiology ICU demonstrated a weak correlation between workload and the Simplified Acute Physiology Score II (SAPS) and Logistic Organ Dysfunction System (LODS) and their respective mortality risks, and it can be affirmed that they did not influence the care length.[9]

In this context, the research hypothesis can be raised that the workload, although intended to quantify the nursing care hours needed, when exhaustive, can also serve as a mortality predictor.

That assumption guided this research, aiming to verify if the nursing workload is a predictor of mortality in the Intensive Care Unit.

METHOD

This is a cross-sectional and retrospective documentary study. The study was developed in the ICU of a tertiary university hospital.

The exclusive focus of the ICU is care for adult patients from different medical specialties. It offers nine beds for clinical and surgical patients. The nursing team consists of 14 nurses, 18 technicians and 29 nursing assistants with a weekly workload of 30 hours, and the uninterrupted work is organized so that each professional is responsible for all care.

The eligible population consisted of adult patients admitted to the ICU in 2014, aged 18 years or older, regardless of gender, type of treatment or diagnosis, and with at least 24 hours of hospitalization in the unit, and readmissions were excluded.

The data collection was carried out from October to December 2015 and the information regarding

clinical/demographic characteristics and workload - NAS were collected from the database extracted from the reports of the Institution's Information and Analysis Center and registered in a script developed by the authors.

The nurses apply the NAS index daily to all patients, during the period of hospitalization, and later registered in the institution's electronic system. The data used were NAS values for the first 24 hours of hospitalization.

To conduct the study, we chose to use a severity index as a parameter of comparison to the result obtained by the NAS analysis. Thus, the severity of the patients included in the study was identified by calculating APACHE II, using clinical and laboratory data for the first day of hospitalization of each patient, being a score commonly used in ICU.[10]

The data ordered and stored in spreadsheets developed in Microsoft® Excel 2010 were analyzed using descriptive statistics and the ROC - Receiver Operator Characteristic Curve,[11] using Stata (version 14 for Windows®) to determine the ability of NAS and APACHE to predict mortality.

In addition, a logistic regression model was developed, with mortality as the dependent variable. The nursing workload was included in the final model, as well as other variables associated with mortality in the univariate analysis with p-values inferior to 0.20.

The project received approval from the Research Ethics Committee under protocol 51458615.3.0000.5393, with exemption from the Informed Consent Form.

RESULTS

In total, 324 patients were included in the study, whose demographic and clinical characteristics have been described in table 1.

The mean age found at the ICU was 56.9 years, standard deviation 16.19 years, median 59 years, and minimum and maximum ages of 19 and 89 years, respectively.

Regarding the origin, 49.7% (=161) of the patients came from the ward, 15.4% (n=50) from the surgical center, 14.5% (n=47) from other hospitals, 10.9 % (n=35) from the recovery unit, 8% (n=26) from outpatient clinics at the hospital where the study was conducted and 1.5% (n=5) from the obstetric center. The mean length of stay was 8.02 days (standard deviation 10.45 days), median five days, with a minimum of one and a maximum of 87 days.

Table 1 – Distribution of patients hospitalized at the Intensive Care Unit according to demographic and clinical characteristics. Ribeirão Preto, SP, Brazil, 2014. (n=324)

Demographic and clinical characteristics	n	%
Sex		
Female	154	47.5
Male	170	52.5
Age range		
Under 60 years	169	52.2
60 years or older	155	47.8
Exit condition		
Discharge	214	66
Death	110	34
Type of hospitalization		
Clinical	179	55.2
Surgical	145	44.8

Among the causes of hospitalization, sepsis was observed in 43.8% (n=142) of the patients, followed by patients hospitalized in the immediate postoperative period for ventilatory support and intensive nursing care, representing 20.7% % (n=67). Patients hospitalized for hemodynamic monitoring were also included, corresponding to 20.7% (n=67), as in cases of arrhythmias and outpatient procedures, while patients hospitalized for pulmonary respiratory failure accounted for 8.6% (n=28) and patients after cardiopulmonary arrest 6.2% (n = 20).

The mean NAS for the first 24 hours of hospitalization was 79.3, standard deviation 16.7, median 80.55 points (34.8-134.2). For the surviving patients, it was 76.5 and, for non-survivors, 84.6 points.

In order to measure the predictive capacity of the selected variables NAS and APACHE II in relation to patient mortality, in figure 1, the ROC curve of the indices used in the sample of ICU patients studied is displayed.

For the NAS, the area above the curve was 0.626, with a 95% confidence interval (CI) from 0.570 to 0.678; and for APACHE II, it was 0.721; 0.669 to 0.769, revealing that NAS was not a good predictor of mortality.
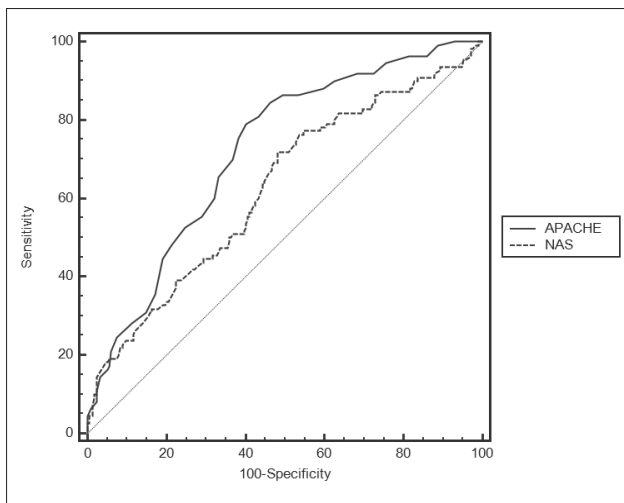
Figure 1 – Receiver Operator Characteristic Curve (ROC Curve) – Nursing Activities Score (NAS) and Acute Physiology and Chronic Health Evaluation (APACHE II) of Intensive Care Unit. Ribeirão Preto, SP, Brazil, 2015

The variables that were associated with patient mortality in the univariate analysis are presented in table 2. This analysis identified that the variables that were associated with mortality were: length of hospital stay prior to the intensive care unit, diagnosis of sepsis, NAS and APACHE II.

Table 2 – Univariate analysis of independent variables related to dependent variable (mortality). Ribeirão Preto, SP, Brazil, 2015

Variable	p value
Sex	0.52
Age	0.45
Type of patient	0.052
Length of hospitalization at intensive care unit	0.63
Length of hospitalization prior to intensive care unit	0.0001
Sepsis diagnosis	>0.0001
Nursing Activities Score	0.0002
Acute Physiology and Chronic Health Evaluation II	>0.0001

In view of these results, the variables with p inferior to 0.20 were chosen and the final model was developed, which is presented in table 3.

It can be observed that only the sepsis diagnosis and APACHE II were associated with mortality. Despite the association of the nursing workload measured by means of the NAS in the univariate analysis, this was not confirmed in the multivariate analysis. In addition, a small gain was verified in the variables, based on which it can be concluded that a confounding variable influences this result.

Table 3 – Multivariate analysis of independent variables related to dependent variable (mortality). Ribeirão Preto, SP, Brazil, 2015.

Variable	Odds Ratio	95% confidence interval
Type of patient	0.92	0.52–1.6
Length of hospitalization at intensive care unit	1.01	0.99–1.03
Sepsis diagnosis	2.74	1.6–4.8
Nursing Activities Score	1.01	1.0–1.02
Acute Physiology and Chronic Health Evaluation II	1.08	1.1–1.2

For this patient group analyzed, the hypothesis that the high nursing workload serves as a mortality predictor was rejected.

DISCUSSION

For the NAS, the mean score found was higher than that of other investigated units, where the means ranged from 62.2% to 71.3 points.[2,6,8,12] A high NAS can be associated with a high volume of therapeutic procedures, as patients considered to be severe and unstable require a greater load of monitoring and invasive treatments, consequently demanding a greater nursing workload.[13]

Regarding the severity index, the median APACHE II found was 24 and the mean was 23, and the mean risk of death of these patients was 43% (standard deviation 38) and median 33% (maximum 96 and minimum 1.24%). A study developed at a Brazilian ICU was aimed at describing the epidemiological data and main outcomes of admitted patients and at evaluating variables associated with mortality, revealing an average APACHE II of 31.6. Another aspect that deserves to be highlighted from the results of this same study was the higher APACHE II in patients who required invasive mechanical ventilation, equal to 34, and in patients with more than two weeks of ICU hospitalization, with an APACHE II of 34.4.[14]

A prospective study to verify the correlation between APACHE II and NAS values concluded that APACHE II presented positive values with NAS (R=0.82), indicating that mortality was higher in patients with NAS above the mean of 51.5%. It should be emphasized that the mean NAS was much lower than other values in the Brazilian literature,

which may have influenced this result.[15]

Another investigation at a clinical emergency and trauma ICU showed a moderate correlation of 0.45 between workload and patient severity. The authors point out the sample of only 32 patients as a considerable limitation though, a factor that weakens the correlation between NAS and APACHE.[16]

In an exploratory, prospective study, conducted with 200 intensive care unit patients, an association was shown between NAS and mortality, with an odds ratio of 2.65 (Confidence Interval 1.11-6.34). The author mentions that he did not consider some important confounding variables though, such as the reason for hospitalization,[13] which in this study was the main factor associated with mortality.

Evaluating the ROC curve found for the scores studied, it is observed that the APACHE has better sensitivity and specificity when compared to the NAS. In this perspective, the composition of the evaluated indices deserves a differential analysis, as the APACHE is composed of clinical patient variables and the NAS of nursing interventions. As a result of this structure, the strength of the APACHE is greater, positively predicting mortality in ICU patients.

In the multivariate analysis, it can be identified that the NAS was not a predictive variable of mortality, which can be explained by the fact that the degree of disease of a patient does not necessarily reflect the need for care. The clinical severity indices reflect the patient's condition, and not the dependency on the length of nursing care.[17]

Patients at high risk of death are not always those who require a high level of nursing activity and the patient's life expectancy can be strongly related to the amount of nursing activity. In addition, clinical severity scores do not necessarily encompass the complexity of nursing activities, which means that aspects of nursing work not directly related to the care for an individual patient are not taken into account.[18]

A study that aimed to identify the nursing workload through the NAS and to verify its relationship with clinical and demographic variables of the patients revealed a weak correlation between workload (NAS) and severity index / risk of mortality through SAPS II (R=0.26), similar to the correlation shown here.

Research correlating severity and workload in different subgroups of patients showed a moderate correlation only in the subgroup of neurological patients compared to those in the clinical-surgical subgroup. The author emphasizes that this correlation is due to the profile of the neurological patient, admitted to the unit in the postoperative period of elective surgeries though, which implies a short stay in the ICU and a higher workload during the first 24 hours of hospitalization.[6]

There are few studies in the literature that have been able to demonstrate that more severe patients demanded longer nursing care, translated by higher NAS scores. In this sense, a survey conducted in the ICU of two public and two private hospitals indicates that the one-point increase in the NAS score in the past 24 hours at the ICU increased the patients' chance of death by 5 to 8%. These indices were applied at the moment of the patient's discharge, differently from the previously cited studies, which may explain this association.[19]

The average length of stay in the ICU found indicates a severe patient profile, which requires an appropriate critical care environment. In a prospective study conducted in the ICU of four hospitals, however, it was identified that each day of hospitalization in the ICU increased the patients' chance of death by 3%.

Evidence indicates that hospitalization time was not associated with mortality, a fact that can be explained if we consider that, in the univariate analysis, this variable was associated with mortality, losing its effect when adding variables such as APACHE II, which may be a confounding variable when considering that patients with a higher severity score may have a longer hospitalization time.[19]

Sepsis was the main variable associated with mortality, similar to the findings in another study developed at a general ICU, in which it was revealed that patients with sepsis/septic shock presented the highest predicted and observed hospital mortality rate.[20]

These research results reflect the reality of a single general intensive care unit, which limits the generalization of the findings, although the representativeness of the sample needs to be considered, which permitted robust statistical analyses.

CONCLUSION

Different study variables, such as the patients' age, cause of hospitalization, length of hospitalization and mean NAS during the first 24 hours of hospitalization indicate that the NAS did not serve as a good mortality predictor, as the patients who demand the main nursing workload are not necessarily the patients who evolve to death.

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