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Nursing Activities Score and workload in the intensive care unit of a university hospital

Nursing Activities Score e carga de trabalho em unidade de terapia intensiva de hospital universitário

ABSTRACT

Objective: The nursing workload consists of the time spent by the nursing staff to perform the activities for which they are responsible, whether directly or indirectly related to patient care. The aim of this study was to evaluate the nursing workload in an adult intensive care unit at a university hospital using the Nursing Activities Score (NAS) instrument.

Methods: A longitudinal, prospective study that involved the patients admitted to the intensive care unit of a university hospital between March and December 2008. The data were collected daily to calculate the NAS, the Acute Physiology and Chronic Health Evaluation (APACHE II), the Sequential Organ Failure Assessment (SOFA) and the Therapeutic Intervention Scoring System (TISS-28) of patients until they left the adult intensive care unit or after 90 days of hospitalization. The level of significance was set at 5%.

Results: In total, 437 patients were evaluated, which resulted in an NAS of 74.4%. The type of admission, length of stay in the intensive care unit and the patients' condition when leaving the intensive care unit and hospital were variables associated with differences in the nursing workload. There was a moderate correlation between the mean NAS and APACHE II severity score ($r=0.329$), the mean organic dysfunction SOFA score ($r=0.506$) and the mean TISS-28 score ($r=0.600$).

Conclusion: We observed a high nursing workload in this study. These results can assist in planning the size of the staff required. The workload was influenced by clinical characteristics, including an increased workload required for emergency surgical patients and patients who died.

Keywords: Workload; Nursing, team; Severity of illness index; Hospitals, university; Intensive care units

INTRODUCTION

The nursing workload in hospitals has been discussed globally because of its implications on the quality of patient care.⁽¹⁾ In intensive care units (ICU), concern is increasing because of the effect of new technologies on care, the changing profile of critically ill patients and the need for skilled labor.⁽¹⁾

In an ICU, nurses note daily whether critical patients will require prolonged assistance regarding the performance of routine procedures both upon admission and during their stay because organ instability can occur at any time over the course of the patients' stays in these units.⁽²⁾ This variability challenges the balance between an adequate delivery of care and the rational use of resources.⁽³⁾

Nursing workload consists of the time spent by nursing staff to perform the activities for which they are responsible, whether directly or indirectly related to patient care. These activities can change depending on the patient's degree of dependency, the complexity of the disease, the characteristics of the institution, work processes, the physical layout and the nature of the professional team.⁽⁴⁾

The nursing workload also includes other factors in which certain activities unrelated to the patient or his/her family become a component of the responsibilities of nurses during their work shifts. These activities include nursing education (monitoring students, training staff) and organizational and administrative work.⁽⁵⁾ Thus, the nursing workload is the total of all of the needs that must be fulfilled relative to the nursing staff available to fulfill them, which ultimately translates into time of care.

The various studies that have described nursing workloads have shown that the demographic and clinical characteristics of severely ill patients were not associated with differences in measuring the nursing work.^(1,6-8) When evaluating nursing work in terms of patient severity, some authors reported that the Nursing Activities Score (NAS) at admission was associated with longer stays in the ICU.^(6,7) In addition, there was an association between mortality and NAS, thus showing that patients who did not survive resulted in an increased nursing workload.⁽⁸⁾

To optimize financial resources and to properly allocate human resources in an ICU, thus prioritizing quality and safety of care, ICU performance must be evaluated using prognostic indices and by measuring the nursing workload. The latter is important because among the healthcare teams working in ICU, it is the nursing staff that spends the most time at a patient's bedside, performing procedures and therapeutic interventions.⁽⁹⁾ Thus, the aim of this study was to evaluate the nursing workload in an adult ICU of a university hospital using the NAS instrument and to analyze the effects that demographic and clinical characteristics have on their workload.

METHODS

This study was approved by the Human Research Ethics Committee of the *Universidade Estadual de Londrina/Hospital Universitário Regional Norte do Paraná* based on opinion 217/07 from October 24, 2007, and the need for informed consent was waived.

The present study was a longitudinal, prospective study involving patients admitted to the adult ICU of the *Hospital Universitário* of the *Universidade Estadual de*

Londrina between March 10, 2008 and December 31, 2008. The *Hospital Universitário* is directly affiliated with the *Universidade Estadual de Londrina*. This public, tertiary and large hospital has 316 beds. The clinical-surgical ICU has 17 beds, including 10 beds that are designated for surgical inpatients and clinical patients not infected with multi-drug resistant bacteria. The remaining seven beds are intended for patients who may be infected with and/or colonized with multi-drug resistant bacteria who require isolation. The adult ICU nursing staff consists of one nurse for every ten beds and a nursing technician for every two beds.

The sample included all patients admitted consecutively to the ICU during the study period. Patients under 18 years old or whose stay in the ICU was less than 24 hours were excluded. For patients who had more than one ICU admission (readmission), only the first admission was considered for the analysis. The patients transferred from the ICU to another hospital/service were considered lost in the follow-up.

To characterize the patients, identification and ICU stay data were collected. The identification data included initials, gender, date of birth, clinic, medical record number and service number. The data collected on adult ICU stay included the date and time of admission, origin (ward, emergency room or surgical center), type of admission (medical, elective surgery or emergency surgery), admission diagnosis, date and time of discharge from the ICU, condition at discharge from the ICU (alive or deceased) and condition at discharge from the hospital (alive or deceased).

The institution where the study was performed routinely applies the Therapeutic Intervention Score System (TISS 28) to measure and characterize the nursing workload in the ICU, in addition to the Acute Physiology and Chronic Health Evaluation (APACHE II) severity score and Sequential Organ Failure Assessment (SOFA) organ dysfunction score to characterize patient severity. The routine data were evaluated for the study patients and added to the data collected for the NAS. These data were obtained daily from the patient's medical records. The data were collected until the patient was discharged from the adult ICU or until the patient reached 90 days of hospitalization.

The NAS instrument is divided into 7 major categories and 23 activities. These categories include basic activities (monitoring and controls, laboratory tests, medication, hygiene procedures, drain care, mobilization and positioning, support and care for families and patients and administrative and managerial tasks), ventilatory support,

cardiovascular support, renal support, neurological support, metabolic support and specific interventions.⁽⁶⁾

To evaluate the nursing workload in the adult ICU, the TISS-28⁽¹⁰⁾ and NAS instruments were applied.⁽⁶⁾ In applying these instruments, some observations were considered: a 24-hr period was considered from 7 am until 7 am the following day; on the first day of hospitalization, the activities performed were computed from the time of ICU admission until 7 am the following day; on the day of discharge, interventions were considered from their last application until the time of discharge; and items that did not occur during the application of the instrument received a score of zero.

In this study, the SOFA, TISS-28 and NAS scores were initially measured on the day of ICU admission, designated as SOFA-admission, TISS-28-admission and NAS-admission, respectively.

The APACHE II score⁽¹¹⁾ was collected to characterize the study population based on patient severity and mortality risk. The calculation for this score was based on data obtained over the initial 24 hours following admission to the ICU. The definition of chronic disease followed the criteria described by this score.

To detect changes in organ function, all patients received a SOFA evaluation score,⁽¹²⁾ which included an assessment of the six major organ systems: respiratory, renal, hepatic, coagulation, cardiovascular and central nervous. Organ dysfunction was quantified using scores ranging from zero to four, and the worst values over that 24-hr period for each organ were used.

Statistical analysis

Continuous quantitative variables were described after assessing whether they were normally distributed. For this evaluation, the Shapiro-Wilks test was used. For variables with a normal distribution, the means and standard deviations were calculated. The nominal categorical variables were described using the absolute and relative frequencies (%) of each variable.

The continuous variables were compared and correlated after assessing whether they were normally distributed. For normally distributed data, Student's *t*-test was used for comparisons between two groups, and analysis of variance was used for comparisons between more than two groups. For data with a non-normal distribution, a Mann-Whitney test was used for comparisons between two groups, and a Kruskal-Wallis test was used for comparisons between more than two groups.

Pearson's correlation coefficients were used to assess the correlations between the continuous variables. To analyze the magnitude of the correlations, the following reference values were adopted: weak <0.30; moderate 0.30 to 0.60; strong >0.60 to 0.99 and perfect=1.00. The level of significance was set at 5%.

RESULTS

During the study period, 622 patients were admitted to the ICU, and 19 patients were excluded from the study because they were under 18 years of age; 35 readmissions and 131 patients who remained in the ICU for less than 24 hours were also excluded. None of the patients were transferred to another hospital/service. Thus, a total of 437 patients were evaluated.

The demographic and clinical characteristics of these 437 patients evaluated using the NAS during the study period are shown in table 1.

The results of the comparisons between the mean NAS according to the demographic and clinical characteristics of the patients are described in table 2, which shows that the type of admission, length of stay in the ICU and condition at discharge from the ICU and hospital were the variables associated with differences in nursing workload.

The analysis in table 3 shows that the results generated for the correlation between the mean NAS-Admission with the APACHE II, mean SOFA-Admission and mean TISS-28-Admission were significant ($p < 0.001$). There was also a moderate correlation in the analysis of these scores.

DISCUSSION

This study evaluated the nursing workload described by the NAS for patients admitted to a medical-surgical ICU. The high mean NAS observed in the study reflects that each patient required more than half of the nursing workload, thus suggesting an ideal proportion of one nurse professional per ICU bed.

This issue is of fundamental interest because an oversized staff results in higher costs.⁽⁵⁾ Conversely, smaller teams tend to impair the quality of care, interfering with patient safety,⁽⁹⁾ prolonging hospitalization and generating higher costs.⁽¹³⁾

The indices that measure the nursing workload provide an adequate assessment of the complexity of the patient, the nursing time required to provide care, the number of nurses necessary per shift and the material resources required.⁽¹⁾ The index most described in the literature is a simplified version of the TISS-28.⁽¹²⁾ Despite the

Table 1 - The clinical and demographic characteristics of patients admitted to the intensive care unit

Variables	Total (n=437)
Male	249 (57.0)
Age (years)	58.2±18.9
Emergency room origin	222 (50.8)
Type of hospitalization	
Clinical	249 (57.0)
Elective surgery	118 (27.0)
Emergency surgery	70 (16.0)
Admission diagnosis	
Sepsis	162 (37.1)
PO neurosurgery	47 (10.7)
Post-cardiac arrest	29 (6.6)
PO thoracic surgery	24 (5.5)
PO cardiac surgery	23 (5.2)
Intracranial hemorrhage	19 (4.3)
PO gastrointestinal surgery	17 (3.9)
Stroke	13 (3.0)
PO peripheral vascular surgery	13 (3.0)
Heart failure	9 (2.1)
Other	81 (18.5)
Chronic disease	
Immunosuppression	24 (5.5)
Liver cirrhosis	14 (3.2)
Chronic obstructive pulmonary disease	7 (1.6)
Heart failure	5 (1.1)
Chronic renal failure	3 (0.7)
APACHE II score	21.71±9.51
SOFA score at admission	7.24±4.41
SOFA score (mean)	6.90±4.45
TISS-28 at admission	25.77±7.19
TISS-28 (mean)	25.78±6.64
NAS at admission	87.54±8.26
NAS (mean)	74.47±8.77
Length of stay in ICU	9.16±11.35
ICU mortality rate	179 (41.0)
Hospital mortality rate	215 (49.2)

PO - post-operative; APACHE II - Acute Physiology and Chronic Health Evaluation; NAS - Nursing Activities Score; SOFA - Sequential Organ Failure Assessment; TISS-28 - Therapeutic Intervention Scoring System; ICU - intensive care unit. The results are expressed as the number (%) or mean±standard deviation.

importance of this instrument, its practical application showed structural failures for fully measuring nursing workloads because the activities related to indirect patient care, such as organizational tasks, were not included in its composition.⁽¹⁴⁾

Table 2 - Comparisons of the nursing workload (Nursing Activities Score) according to the demographic and clinical variables of the patients admitted to the intensive care unit

Variables	N	NAS*	Test	p value
Male	249	74.32 (8.51)	T=0.407	0.684
Age range (years)				
18-40	86	74.08 (9.35)	F=0.399	0.754
41-59	124	75.18 (8.92)		
60-79	174	74.31 (8.15)		
80-100	43	73.99 (9.56)		
Origin				
Emergency room	222	74.92 (9.17)	T=1.085	0.279
Ward	215	74.01 (8.34)		
Type of hospitalization				
Clinical	249	72.08 (10.83)	H=8.511	0.014
Surgery - elective	118	73.23 (6.63)		
Surgery - emergency	70	75.24 (11.07)		
Sepsis				
Yes	318	73.10 (10.64)	U=2.966	0.085
No	119	72.57 (6.87)		
Length of stay in the ICU (days)				
Up to 2	87	74.87 (11.47)	H=54.782	<0.001
3 to 10	235	74.42 (9.25)		
11 or more	115	69.05 (7.38)		
Condition upon leaving the ICU				
Alive	258	71.14 (7.17)	U=62.925	<0.001
Deceased	179	77.83 (12.21)		
Condition upon leaving the hospital				
Alive	222	71.61 (7.03)	U=33.378	<0.001
Deceased	214	75.51 (13.33)		

T - Student's *t*-test statistic for two independent samples; F - F-test statistic from the analysis of variance; H - Kruskal-Wallis test statistic; U - Mann-Whitney test statistic; NAS - Nursing Activities Score; ICU - intensive care unit. * Mean values (SD) of the NAS.

Table 3 - Correlations between the mean Nursing Activities Score and Acute Physiology and Chronic Health Evaluation II scores, Therapeutic Intervention Scoring System scores and Sequential Organ Failure Assessment scores of patients admitted to the intensive care unit

	r*	p value
NAS and APACHE II	0.329	<0.001
NAS and TISS-28	0.600	<0.001
NAS and SOFA	0.506	<0.001

NAS - Nursing Activities Score; APACHE II - Acute Physiology and Chronic Health Evaluation; TISS-28 - Therapeutic Intervention Scoring System; SOFA - Sequential Organ Failure Assessment. * Pearson's correlation coefficient.

The NAS was developed by Miranda et al.⁽⁶⁾ and has been increasingly used in the ICU. This score includes a large number of activities performed by the nursing staff,⁽¹⁵⁾ primarily in the category “basic activities”, with

greater detail for the items “monitoring and control”, “hygiene procedures” and “mobilization and positioning the patient” and the inclusion of items for “support and care for family members/patients” and “administrative and managerial tasks”.

The score generated using the NAS scoring system directly expresses the percentage of time spent by the nursing staff caring for critically ill patients and can range from zero to 176.8%,⁽⁶⁾ i.e., it represents how much of a staff member’s working time was required by a patient over the last 24 hours. Thus, a score of 100 points indicates that a patient required 100% of the nurse’s time in the past 24 hours.⁽¹³⁾ Each point in the NAS is equivalent to providing 14.4 minutes of nursing care.⁽¹⁾

With respect to the study population, the demographic and clinical characteristics of our patients were comparable to recent studies conducted on critically ill patients, although our average age was slightly higher compared to that of a study performed in a teaching hospital⁽¹⁶⁾ but similar to that of a study conducted in an ICU of a large hospital.⁽¹⁷⁾ The mean APACHE II scores were higher in our study compared to those obtained in a study conducted in a general ICU of a university hospital.⁽¹⁸⁾ The balanced ratio between the surgical and clinical patients observed in our study was similar to that in a study conducted in a gastroenterology unit⁽¹⁹⁾ but differed from the data reported in other studies, including a reported predominance of surgical patients in a study conducted in a ICU of a large hospital⁽¹⁷⁾ and a predominance of clinical patients in a study that included elderly patients.⁽²⁰⁾

In a recent study, Nogueira et al. described differences in how the NAS was measured between patients treated in public and private institutions, in which patients in public institutions had a higher mean NAS at admission (68.1) compared to that of patients in private institutions (56.0).⁽²¹⁾ Our patients were admitted to a public hospital and had a high mean NAS score at admission (87.5), which was consistent with the data in the literature.

Few studies^(22,23) attained mean NAS scores similar to our data, which indicates an increased demand for nursing care. Resolution 26 of the National Health Surveillance Agency (*Agência Nacional de Vigilância Sanitária - ANVISA*)⁽²⁴⁾ of May 11, 2012, which established the minimum operation requirements for an ICU and made other provisions, recommended a ratio of one nurse technician for every two beds and a ratio of one clinical nurse for every ten beds or a fraction thereof for each work shift. This proportion of staff per bed may be considered

inadequate for the care of patients in this study because a high nursing workload can affect the safety and quality of care provided to patients.

The workload assessed by the overall mean of the NAS over the course of hospitalization was not influenced by differences in demographic characteristics, such as gender, age range or patient origin. These results were similar to those reported in other studies^(25,26) that evaluated the performance of the NAS in patients admitted to an ICU.

The patient admitted for post-operative care following emergency surgery required a higher workload in our study, which was a result that slightly differed from other reports in the literature.^(25,26) Regarding the length of stay in the ICU, various studies have shown that workload is directly associated with the ICU stay, i.e., patients who required a higher workload at the beginning of their stay had a longer overall stay in the ICU.^(26,27) Notably, in our case series, patients with shorter stays (up to two days) required the highest nursing workload. From analyzing this group of patients, we observed that the majority of patients did not survive; therefore, this result was likely influenced by the outcome of the patient.

Regarding the discharge condition of patients from the ICU and hospital, higher workloads were associated with deceased patients, i.e., patients who died required a higher workload than those who survived, which were results consistent with the literature.⁽²⁸⁾ This result was likely because the dysfunction of multiple organs and systems is a frequent cause of death for ICU patients,⁽²⁹⁾ and this clinical condition requires establishing several alternative therapies, which thus increases the nursing workload.

The moderate correlation observed between the NAS and the APACHE II disease severity and SOFA organ dysfunction scores reinforced the concept that the nursing workload was not only associated with patient severity, intensity of interventions and procedures performed but also covered a broader array of activities that involved the clinical, administrative, educational and organizational dimensions of an ICU. Higher degrees of correlation have been described by other authors both for patient severity^(30,31) and the presence of organ dysfunction.⁽²⁵⁾

For the moderate correlation between the NAS and TISS-28, the results in the literature are largely conflicting, with one study⁽³²⁾ reporting a strong and significant correlation and another study⁽⁶⁾ reporting a significant yet moderate correlation between the NAS and TISS-28. These results reflect that although these two instruments measure the nursing workload, the TISS-28 measures the nursing

work that involves direct patient contact, and the NAS more fully evaluates the nursing activities and functions in an ICU. Because the research institution exclusively applied the TISS 28 score to evaluate the nursing workload, the results of this study suggested that the routine incorporation and collection of NAS data in this field would result in a more accurate assessments of staff size.

Some limitations should be considered. The primary limitation of this study was that the data originated from a single ICU; thus, caution should be used in extrapolating the results to other institutions with similar characteristics. In addition, the study population was a

case-mix population; therefore, these results should be interpreted with caution for specific patient groups.

CONCLUSION

This research study conducted in a general intensive care unit had a higher average Nursing Activities Score, which indicated that there was a high nursing workload at this research hospital. The characteristics associated with an increased nursing workload included the type of admission (emergency surgery) and patient outcome (deceased). Patient severity and organ dysfunctions were moderately correlated with nursing workload.

RESUMO

Objetivo: A carga de trabalho de enfermagem é constituída pelo tempo dispendido pela equipe de enfermagem para realizar as atividades de sua responsabilidade, relacionadas direta ou indiretamente ao atendimento do paciente. O objetivo deste estudo foi avaliar a carga de trabalho de enfermagem em uma unidade de terapia intensiva adulto de hospital universitário com o uso do instrumento *Nursing Activities Score* (NAS).

Métodos: Estudo longitudinal, prospectivo, envolvendo pacientes admitidos na unidade de terapia intensiva de um hospital universitário no período de março a dezembro de 2008. Foram coletados dados para o cálculo do NAS, do *Acute Physiology and Chronic Health Evaluation* (APACHE II), do *Sequential Organ Failure Assessment* (SOFA) e do *Therapeutic Intervention Scoring System* (TISS-28), diariamente até a saída da unidade de terapia intensiva adulto ou 90 dias de internação. O nível de significância adotado foi de 5%.

Resultados: Foram avaliados 437 pacientes, resultando em NAS de 74,4%. O tipo de internação, tempo de permanência na unidade de terapia intensiva e condição de saída do paciente da unidade de terapia intensiva e do hospital foram variáveis associadas a diferenças na carga de trabalho da enfermagem. Houve correlação moderada do NAS médio com o escore de gravidade APACHE II ($r=0,329$), com o escore de disfunção orgânica SOFA médio ($r=0,506$) e com o TISS-28 médio ($r=0,600$).

Conclusão: Encontramos elevada carga de trabalho de enfermagem no estudo. Esse resultado pode subsidiar planejamento para dimensionamento da equipe. A carga de trabalho sofreu influência de características clínicas, sendo observado aumento do trabalho nos pacientes cirúrgicos de urgência e nos não sobreviventes.

Descritores: Carga de trabalho; Equipe de enfermagem; Índice de gravidade de doença; Hospitais universitários; Unidades de terapia intensiva

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