

## Severity and workload related to adverse events in the ICU

*Gravidade e carga de trabalho relacionadas a eventos adversos em UTI*

*Gravedad y carga de trabajo relacionadas a eventos adversos en UTI*

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### ABSTRACT

**Objective:** To analyze whether an increase in patient severity and nursing workload are correlated to a greater incidence of adverse events (AEs) in critical patients. **Method:** A prospective single cohort study was performed on a sample of 138 patients hospitalized in an intensive care unit (ICU). **Results:** A total of 166 AEs, occurred, affecting 50.7% of the patients. Increased patient severity presented a direct relationship to the probability of AEs occurring. However, nursing workload did not present a statistically significant relationship with the occurrence of AEs. **Conclusion:** The results cast light on the importance of using evaluation tools by the nursing personnel in order to optimize their daily activities and focus on patient safety.

**Descriptors:** Nursing Care; Patient Severity; Workload; Safety Management; Patient Safety.

### RESUMO

**Objetivo:** Analisar se o aumento da gravidade do paciente e a carga de trabalho de enfermagem está relacionado à maior incidência de Eventos Adversos (EAs) em pacientes críticos. **Método:** Estudo de coorte única, prospectivo, com amostra de 138 pacientes internados em uma Unidade de Terapia Intensiva (UTI). **Resultados:** Ao todo, foram evidenciados 166 EAs, que acometeram 50,7% dos pacientes. O aumento da gravidade do paciente apresentou relação direta com a chance de ocorrência de EAs. Entretanto, a carga de trabalho de enfermagem não apresentou relação estatisticamente significativa, na ocorrência de EAs. **Conclusão:** Os resultados permitem refletir acerca da importância da equipe de enfermagem, em utilizar instrumentos de avaliação, com o objetivo de melhorar e planejar suas ações diárias, com foco na segurança do paciente.

**Descritores:** Cuidados de Enfermagem; Gravidade do Paciente; Carga de Trabalho; Gestão da Segurança; Segurança do Paciente.

### RESUMEN

**Objetivo:** Analizar si el aumento de la gravedad del paciente y la carga de trabajo de enfermería está relacionada con mayor incidencia de Eventos Adversos (EAs) en pacientes críticos. **Método:** Estudio de cohorte única, prospectivo, con muestra de 138 pacientes internados en una Unidad de Terapia Intensiva (UTI). **Resultados:** En total, fueron evidenciados 166 EAs, incidiendo sobre 50,7% de los pacientes. El aumento de la gravedad del paciente mostró relación directa con la posibilidad de ocurrencia de EAs. Sin embargo, la carga de trabajo de enfermería no demostró relación estadísticamente significativa en la ocurrencia de EAs. **Conclusión:** Los resultados permiten reflexionar sobre la importancia del equipo de enfermería, en utilizar instrumentos de evaluación, con el objeto de mejorar y planificar sus acciones diarias, enfocándose en la seguridad del paciente.

**Descriptores:** Atención de Enfermería; Gravedad del Paciente; Carga de Trabajo; Gestión de la Seguridad; Seguridad del Paciente.

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## INTRODUCTION

A constant emphasis on patient safety and quality in the health sector services has become a reality in Brazil and the world as a whole. In the XXI century, the high number of publications covering this field has demonstrated the great interest among numerous researchers to seek further knowledge and means to ensure quality health services.

In 2002, the World Health Organization (WHO) allocated a priority status to problems related to patient safety. The World Alliance for Patient Safety was launched in 2004, with the objective of outlining key actions in this area and contribute to a global research agenda<sup>(1)</sup>.

In Brazil 2008, the first initiative focused on promoting safe nursing care was created by the *Rede Brasileira de Enfermagem e Segurança do Paciente* [Brazilian Network for Nursing and Patient Safety]. In 2013, the creation of the *Programa Nacional de Segurança do Paciente* [National Program for Patient Safety] has strengthened initiatives promoting this theme among health care institutions via governmental action<sup>(1)</sup>.

Within this context, the incidence of AEs has been widely used by various institutions as a performance indicator to measure the quality of their health-care services. This offers the possibility of continuous monitoring of health care services with a view to safe care.

According to the WHO, adverse events are defined as undesirable incidents arising from health services which may or may not result in harm to the patient, prolonged hospital stay and which were not related to the underlying disease<sup>(2)</sup>.

In this scenario, the Intensive Care Unit (ICU) merits special attention, since it involves the care of critical patients that require specialized and complex human resources, equipment and work processes in addition to a high number of procedures; consequently this environment is subject to the occurrence of AEs<sup>(3)</sup>.

In view of nurses' work processes, nursing staff play a key role in the field of patient safety, since, besides having the largest number of health professionals working under their clinical coordination, they maintain a direct and uninterrupted contact with the patients. Thereby making the nursing team co-responsible for their safety<sup>(3)</sup>.

Considering that the quality of health care is directly related to patient safety, it is considered that not only qualifications of the healthcare professional involved, but also patient severity and nursing workload are relevant factors for the effective and efficient development of activities by the team.

The literature shows that there have been few studies relating nursing workload and patient severity with the incidence of AEs, even though the available studies have reported distinct results. Thus, this study aims to evaluate this correlation, using the Nursing Activities Score (NAS) to analyze the nursing workload, and the Simplified Acute Physiology Score 3 (SAPS 3) to evaluate patient severity<sup>(3-5)</sup>.

The use of NAS on a daily basis, has demonstrated the benefits of optimizing human resources and quality of patient care, as observed by reduced hospital stay and lower incidence of complications. This has a direct impact on the expenses of health institutions and consequently is an important tool in the care providing and management of work processes<sup>(6-8)</sup>.

The NAS score determines the nursing workload by summing those activities realized by the nursing personnel that involve critical patients, as defined in the tool. The score represents the percentage of time spent by each member of the nursing staff per patient over a 24-hour period, with each point corresponding to 14.4 minutes of nursing care<sup>(6-7)</sup>.

There are findings in the literature inferring that nursing workload becomes greater when there is greater patient severity, since these patients require more care and a higher number of procedures<sup>(3-4, 9-10)</sup>.

Evaluating the severity of a patient's condition at ICU admittance enables the optimization of activities realized during their stay, with a view to achieving the proposed objectives of the correct treatment.

There are various severity indices to classify patients. For this study we opted to use the SAPS 3 model, which is designed to evaluate the risk of mortality and patient severity at admission to the ICU. It is recognized internationally for its effective performance in this area<sup>(11-14)</sup>.

Thus, this study asks whether patient severity and nursing workload is associated with a high incidence of AEs in the ICU?"

As the study hypothesis, we considered that elevated nursing workload and patient severity could increase the incidence of AEs.

## OBJECTIVE

Conduct a prospective analysis to determine whether increased patient severity and nursing workload are related to a higher incidence of AEs in critical patients.

## METHOD

### Ethical aspects

The study was conducted in accordance with Resolution 446/12 of the *Conselho Nacional de Saúde* [National Health Council] and was approved by the Research Ethics Committee of the Botucatu Medical School.

### Study design, place and period

A single cohort prospective study was conducted from June 1 to July 31, 2014, at the Adult Intensive Care Service of a tertiary hospital in São Paulo State.

The time period was chosen after analyzing average monthly hospitalization figures over the previous five years. In order to maximize study sample size, data collection was performed during the months with the highest rate of hospitalizations.

### Sample population and inclusion and exclusion criteria

We enrolled those patients admitted to the ICU during the study period, who were over 14 years of age and remained hospitalized for a minimum of 24 hours. Regarding those patients that presented multiple hospitalizations, we only considered the first since the additional hospitalizations may or may not have been related to the occurrence of AEs arising from the initial hospitalization.

### Study protocol

Each patient was followed from day 1 to day 10 of hospitalization in order to minimize effects from length of hospital

stay on the incidence of AEs and also to take into consideration the average stay in the ICU in Brazil which is five days<sup>(15)</sup>.

Data collection was realized by the researcher together with two nurses who were duly trained to collaborate with the study and who worked mornings each day in the ICU under study.

The data was collected without interruptions via daily clinical visits to the ICU at the time when the day shift took over from the night shift. The patients' electronic medical records were consulted to determine the incidence of AEs and the characteristics of the patients. The data were registered in a tool that was specifically designed for the study.

An AE during the stay in the ICU was recorded whenever one of the following occurred: fall, unplanned nasogastric enteral feeding tube removal, pressure ulcers, skin lesion, medication error, phlebitis, and Central Venous Catheter (CVC) loss. These AEs were selected according to the Manual of Nursing Indicators from the Commitment to Hospital Quality Program (CQH) in the State of São Paulo, as applicable to the study scenario<sup>(16)</sup>.

The independent variables analyzed to characterize the patients were sex, age, type of admission (Urgent/Emergency) and hospital stay.

The nursing workload was determined by means of the mean daily score on the NAS scale, as provided by the collaborators during the day shift.

The NAS was published in 2003 by Miranda and translated and validated to Portuguese in 2002. It comprises 23 activities divided into seven major categories, as follows: 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<sup>(7)</sup>.

The SAPS 3 was applied during the first 24 hours of hospitalization for each patient by the researcher during daily clinical visits to the ICU. This instrument enables analysis of the patient's conditions prior to institutional inferences. Created in 1984 and updated by a world cohort in 2005, it is characterized by the evaluation of 20 easily measured variables, collected within the first hour of hospitalization. Theoretically the values vary between 16 to 217, where the higher the score, the greater the patient severity<sup>(12,17)</sup>.

### Statistical analysis

The statistical analysis was realized with an estimated test power between 0.70 to 0.85, in bivariate associations between each potential predictor and the occurrence of AEs. Next, multiple logistic regression adjustments were realized with the predictors statistically most associated in the bivariate analysis. The analysis was performed using the ©SPSS 21.0 Inc., software and the significance level was set at  $p < 0.05$ .

In order to avoid systematic information bias, independent variables and outcome were measured by workers who were unaware of the study hypothesis, such that the

tools used were considered to be independent from the subjectivity of those responsible for their measurement.

## RESULTS

A total of 138 patients were included in the study, of which 50.7% presented one or more AEs (see Table 1).

**Table 1** – Sample profile, Simplified Acute Physiology Score 3 and Nursing Activities Score and adverse events, Botucatu, São Paulo, Brazil, 2014

Variable	Summary
Sex	
Female	58 (42%)
Male	80 (58%)
Age (years)*	61 (15-91)
Hospital stay (days)*	5 (1-10)
Type of admission	
Elective	31 (22.5%)
Urgent	107 (77.5%)
Mean daily NAS score	63.6 (39.9-111.9)
SAPS 3 score	64.5 (16.0-110.0)
Adverse events	70 (50.7%)
Pressure Ulcer	29.5%
Skin Lesion	27.1%
Unplanned Oro/Nasogastric Enteral Tube Removal	20.0%
Unplanned Endotracheal Extubation	4.2%
Central Venous Catheter Loss	4.0%
Fall	3.2%
Phlebitis	3.0%
Medication error	9.0%

Note: \*Summary in median (minimum-maximum); Normality rejected by the Shapiro-Wilk test ( $p < 0.05$ ); NAS - Nursing Activities Score; SAPS 3 - Simplified Acute Physiology Score 3.

A total of 166 AEs were recorded, predominately related to Pressure Ulcers (29.5%), Skin Lesions (27.1%) and Unplanned Oro/Nasogastric Enteral Feeding Tube Removal (20%).

Bivariate analysis determined that the following variables presented a statistically significant relationship to the occurrence of AEs: age ( $p = 0.003$ ), hospital stay ( $p < 0.001$ ), SAPS 3 ( $p < 0.001$ ) and urgent admission ( $p < 0.001$ ) (see Table 2).

**Table 2** – Bivariate analysis of each exposure against the occurrence of adverse events, Botucatu, São Paulo, Brazil, 2014

Variable	B*	SD*	Wald	p value*	OR*	95%CI*
Male sex	0.17	0.35	0.24	0.624	1.18	0.60 2.33
Age (years)	0.04	0.01	8.92	0.003	1.04	1.01 1.06
Hospital stay (days)	0.42	0.07	37.00	<0.001	1.53	1.33 1.75
Mean daily NAS* score	0.00	0.01	0.03	0.863	1.00	0.97 1.02
SAPS 3* score	0.06	0.01	25.59	<0.001	1.06	1.03 1.08
Urgent admission (Ref.: Elective)	1.59	0.47	11.35	0.001	4.91	1.95 12.39

Note: \*B - Beta; SD - Standard Deviation; p value < 0.05; OR - Odds Ratio; CI - Confidence Interval; NAS - Nursing Activities Score; SAPS 3 - Simplified Acute Physiology Score 3.

However, when the significant variables were tested using multiple logistic regression, it was observed that only hospital stay ( $p < 0.001$ ) and SAPS 3 score ( $p = 0.004$ ) maintained a significant relation to the occurrence of AEs (see Table 3).

**Table 3** – Multiple Logistic Regression for the probability of an adverse event, in function to the exposures selected by bivariate analysis, Botucatu, São Paulo, Brazil, 2014

Variable	B*	SD*	Wald	p value*	OR*	95%CI*
Age (years)	0.02	0.02	1.30	0.255	1.02	0.99 1.05
Hospital stay (days)	0.39	0.08	25.90	<0.001	1.48	1.27 1.72
SAPS 3* score	0.04	0.01	8.45	0.004	1.04	1.01 1.07
Urgent admission (Ref.: Elective)	0.06	0.67	0.01	0.928	1.06	0.29 3.96
Constant	-5.97	1.26	22.55	<0.001	0.00	

Note: \* B - Beta; SD - Standard Deviation; p-Value  $p < 0.05$ ; OR - Odds Ratio; CI - Confidence Interval; SAPS 3 - Simplified Acute Physiology Score 3.

Analysis of the interactions between exposures selected by bivariate analysis did not demonstrate any statistically significant interactions.

## DISCUSSION

Based on the above results, it was observed that 50.7% of the individuals suffered one or more AEs, predominantly Pressure Ulcers (29.5%), Skin Lesions (27.1%) and Unplanned Oro/Nasogastric Enteral Feeding Tube Removal (20%).

The incidence of pressure ulcers is reported in the literature to be of great value for evaluating health care quality and especially regarding ICUs, in which the patients attended present specific characteristics related to complex health conditions making them susceptible to developing these and other complications<sup>(18-19)</sup>.

In corroboration with this data, several studies have demonstrated that the incidence of pressure ulcers is high, reporting that in Brazil it can vary between 26.83% to 62.5%, while international studies have demonstrated a range of 38% to 124%. This high variation between indices found could suggest that there are difficulties in gathering precise information regarding this type of event<sup>(17,20)</sup>.

Regarding skin lesions, which include dermatitis and rashes, no studies were found which were directly related. However, a Brazilian study which included dermatitis, rashes and pressure ulcers in the same sphere found an incidence of 60.45%. Likewise, if we sum both indicators in the present study the rate obtained of 56.6% is close to the findings of other researchers<sup>(21)</sup>.

Including both indicators in the same rate of incidence is viable because the methods of care and prevention for skin lesions and pressure ulcers are directly related; consequently the high number of patients presenting these types of AE requires special attention. This demonstrates the importance of preventive action, such as the creation of protocols and programs of continuing education, since these are a financial burden on the health services. These AEs also cause nursing time constraints, leading to a significant increase in nursing workload and implications for the quality of healthcare provided<sup>(19,22)</sup>.

The incidence of unplanned oro/nasogastric enteral feeding tube removal also demonstrated a high rate of incidence. A Brazilian study reported that this condition is directly related to the constant handling of patients during activities such as transporting and bed to chair transfers and obstruction and incorrect fixation of the tube, together with the intrinsic conditions of the patient, such as agitation and mental confusion<sup>(23)</sup>.

It is important to consider unplanned oro/nasogastric enteral feeding tube removal as a highly relevant indicator of quality, because insufficient or inadequate nutrition can prolong the hospital stay and aggravate the patients' clinical picture leading to irreversible harm.

When the skills and knowledge of health-care providers have a direct influence on the occurrence of AEs, as in the handling of the patient, transferring and intubation, it is important to regulate these activities by means of stan-

dardized protocols and operational procedures in order to guide how these procedures are performed correctly to prevent AEs.

Events related to the incidence of Unplanned Endotracheal Extubation (4.2%) and Loss of Central Venous Catheter (4%) were cited in lesser quantities; which corroborates the findings in the literature<sup>(20,23)</sup>.

The prevention of unplanned extubation among critical patients by means of risk evaluation, taking into consideration agitation, insufficient sedation, incorrect pressure cuff and incorrect fixation, is necessary since these are directly related to an increase in morbidity, mortality and hospital stay. It is also important to cite that there is a direct relationship between unplanned oro/nasogastric enteral feeding tube removal and unplanned extubation, such that both should be monitored and considering to be AEs of major value for programs to improve quality in health care<sup>(3,23)</sup>.

The AEs related to phlebitis and falls had a lower incidence in this study, but were of no less importance; other workers have cited these events to be of great relevance for evaluating the quality of health care, since they are easily detected and recorded, thereby providing highly sensitive and effective indicators for evaluation of the health care provided and are used routinely as tools in quality programs<sup>(20,24)</sup>.

The number of falls in the ICU studied was low, corroborating the data found, in that ICUs exclusively attend critical patients that are generally unable to walk or look after themselves, in combination with a continuous monitoring and constant presence of the nursing staff at the bedside constituting factors that prevent the occurrence of falls<sup>(21,24)</sup>.

Errors related to medication therapy were cited in only 9% of the AEs, this rate was below expected. The literature reports that these are the main AEs in the ICU; however, only 5% to 10% are reported. Consequently the data presented probably does not reflect the real number of AEs related to medication error<sup>(25-26)</sup>.

The low number of notifications is a worldwide characteristic. Studies have shown that under reporting is a consequence of a lack of knowledge among the health-care professionals as to its importance in combination with a lack of interest and fear of legal repercussions<sup>(25)</sup>.

The culture of intrinsic punishment for the health institutions and its healthcare professionals inevitably causes under reporting of the AEs. In the majority of health services the nursing staff is responsible for notifying AEs and identifying the healthcare professional involved. Even when the institution has no policy of punitive action, this fact nevertheless generates feelings of shame and guilt and as such is one of the causes of under reporting<sup>(26)</sup>. The incidence of AEs should be managed with the objective of creating a climate that is neither threatening nor punitive, but anonymous and efficient while providing constant training programs especially for those working in ICUs.

In view of the data presented here, it is suggested that alternatives are sought to reduce AEs, taking into consideration that studies have indicated the majority of these are due to a lack of knowledge among health-care professionals; as such this reiterates that it is important to invest in continuing and permanent health education programs<sup>(25-26)</sup>.

On analyzing the relationship between the variables of sex and age with the incidence of AEs, it was found that sex had no influence, however older age was related to a higher occurrence of AEs (see Table 2). This confirms data in the literature referring to a higher incidence of AEs among elderly individuals<sup>(18-19)</sup>.

Regarding hospital stay, it has been shown that the longer the hospitalization, the greater the incidence of AEs. In the same way, a study performed in the city of São Paulo, has demonstrated that patients with over four days of hospitalization present an eleven times greater probability of suffering AEs related to nursing care<sup>(21)</sup>.

A recently published integrative revision affirmed that the occurrence of AEs, not only increases the duration of hospital stay, but causes an extremely high financial burden on the health system that can increase expenses by up to 200.5%<sup>(27)</sup>.

With regard to the mean variation of the NAS score, this study has demonstrated a median value of 63.6%. Other national studies have reported percentages that vary between 51% to 74.4%<sup>(4,10,19,21,28)</sup>. From an international perspective, Spanish studies have reported a lower mean NAS (55%), while a Polish study reported a higher figure (84.4%).

These variations in the findings could be explained by the intrinsic characteristics of each unit and also by the nature of the hospitals (public or private); thus, it has been shown that the ICU in this study has a nursing workload corresponding to the national levels<sup>(4,19,21,28-29)</sup>.

The relationship between the occurrence of one or more AEs and nursing workload was not statistically significant. This was not in agreement with the initial hypothesis nor with the findings of various other studies which affirmed that the higher the NAS score, the greater the number of AEs related to providing healthcare. A study performed in 2011, demonstrated that an increase in the nursing workload, as measured by the mean NAS score during the period of hospitalization, can increase the probability of AEs occurring<sup>(29)</sup>.

However, a Brazilian study reporting the incidence of pressure ulcers in relation to NAS score, did not find a statistically significant correlation and attributed this to the fact that the NAS score was being measured on a daily basis in the unit

studied, showing that the team allocated was sufficient for the health care provided<sup>(19)</sup>.

Likewise, in the ICU studied, the NAS score has been measured on a daily basis for seven years by means of a digital system which could suggest the nursing team has effective management and coordination<sup>(8)</sup>.

Thus, it is necessary to realize further studies related to this precise theme in order to investigate whether daily analysis of the NAS score could generate improvements in the quality of health care for the patient by lowering the incidence of AEs.

Regarding patient severity, the variation in SAPS 3 was 16 to 110 points with a median value of 64.5 points, where a higher score represents greater severity. National and international ICUs have mean SAPS 3 indices of between 48 to 64 points. The present study corroborates these indices, demonstrating that even though the research was performed in a single unit the study reflects the reality of Brazilian ICUs<sup>(14,17,30)</sup>.

The relationship between the occurrence of one or more AE and patient severity using multivariate analysis, demonstrated statistically significant results, corresponding to the study hypothesis that the greater the severity, the higher the incidence of AEs, irrespective of age, type of admission or hospital stay.

Few studies related to this theme are cited in the literature; however a Brazilian study reported that each point of greater severity in the SAPS II score represented a 2% higher probability of at least one AE occurring per day of hospitalization in an ICU<sup>(29)</sup>.

Given the above data, we infer that patient severity is a relevant factor in the incidence of AEs, in addition to hospital stay, as cited previously.

### Limitations of the study

The present research was limited by the small number of patients followed, such that further studies are necessary to cast light on this theme.

### Contribution to nursing

We highlight the importance of these results for both nurses and managers with a view to strengthening the use of evaluation tools in the development of programs to improve patient safety.

### CONCLUSION

This study demonstrated that the incidence of AEs is directly related to the duration of hospital stay and patient severity, thereby reinforcing the importance for nursing staff to use evaluation tools in order to optimize and plan their daily activities.

The relationship between the incidence of AEs and nursing workload did not present the expected statistically significant relationship. The fact that the occurrence of AEs in the ICU was measured on a daily basis may have had a positive influence on preventing these AEs. Consequently, we suggest the need for further studies that are multi-centric and with a larger sample size in order to investigate this question.

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