

Analysis of adverse events in patients admitted to an intensive care unit

Análise de eventos adversos em pacientes internados em unidade de terapia intensiva

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Abstract

Objective: To assess the incidence of adverse events and associate them with nursing workload, nursing team staffing and the severity of the patients.

Method: A quantitative, cross-sectional, prospective study was conducted with 304 consecutive patients admitted to the General Intensive Care Unit of a private hospital between September and December 2013 (four months).

Results: There were 39 adverse events, and the most prevalent was pressure sore. Patients who presented an event had a higher mean age, higher prevalence of clinical admissions, longer hospital stay, higher scores in the *Acute Physiology and Chronic Health Evaluation* (APACHE) II and in the *Nursing Activities Score* (NAS) and lower score in the Braden scale and in the Glasgow scale. There was no significant difference regarding nursing team staffing.

Conclusion: There was a higher incidence of adverse events in patients who presented a profile of greater risk and severity identified by predictive scales.

Resumo

Objetivo: Avaliar a incidência de eventos adversos e associá-los com a carga de trabalho de enfermagem, o dimensionamento da equipe de enfermagem e o perfil de gravidade do paciente.

Métodos: Foi realizado um estudo transversal, prospectivo, com abordagem quantitativa, em 304 pacientes consecutivos internados em Unidade de Terapia Intensiva geral de um hospital privado, admitidos entre setembro e dezembro de 2013 (quatro meses).

Resultados: Ocorreram 39 eventos adversos sendo a lesão por pressão a mais prevalente. Os pacientes que apresentaram algum evento tiveram maior média de idade, maior prevalência de internações clínicas, internações mais prolongadas, maior escala *Acute Physiology and Chronic Health Evaluation* (APACHE) II, maior pontuação do *Nursing Activities Score* (NAS), menor escore na escala de Braden e menor escala de Glasgow e não tiveram diferenças significantes em relação ao dimensionamento da equipe de enfermagem.

Conclusão: Houve maior incidência de eventos adversos em pacientes que exibiram um perfil de maior risco e gravidade identificados por meio de escalas preditoras.

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Introduction

Adverse events (AE) are unexpected and undesirable incidents directly associated with patient care.

⁽¹⁾ It is estimated that preventable AEs affect one in 10 patients worldwide during care and illness treatment.⁽²⁾

AE are especially alarming in Intensive Care Units (ICU), since the characteristics of clinical severity, greater demand for medications and need for invasive procedures and devices lead to a greater risk for the patient. Therefore, the outcomes of AE may lead to increased mortality and longer hospital stays.⁽³⁾

Strategies to evaluate and monitor patients have been adopted in order to assure the quality of care and even reduce the incidence of undesirable events.⁽⁴⁾

In ICUs different scales are used to measure clinical and prognostic parameters and the demand for care. One of them is the prognostic index *Acute Physiology and Chronic Health Evaluation II* (APACHE II), developed to estimate severity of disease and predict hospital mortality.⁽⁵⁾

Another instrument is the *Nursing Activities Score* (NAS), which measures the nursing workload including direct care actions, family support and management activities.⁽⁶⁾ NAS monitoring allows determining the nursing team staffing in order to provide the necessary care.⁽⁴⁾ An inadequate allocation of nursing staff is associated with an increase in the occurrence of AEs in ICUs.^(7,8) Studies show an association between nurse staffing and adverse outcomes, such as infections, increased mortality, postoperative complications, unplanned extubation and medication errors.^(8,9)

Considering the importance of preventing AEs and the need to offer a safe nursing care to the patient, we ask: what are the factors that influence the occurrence of AEs in ICU? The objective of this study was to assess the incidence of AEs and to associate them with the nursing workload, the nursing team staffing and the severity of disease measured by predictive scales.

Methods

Quantitative, cross-sectional, prospective study, conducted at a general ICU of a private hospital in the city of São Paulo, Brazil, accredited by Brazil's National Accreditation Organization and by Accreditation Canada International.

The sample calculation was based on the statistical data of the unit for the year 2012, considering the mean of monthly admissions and the number of AEs reported. The minimum frequency rate of the event was set at 5% and the maximum at 15%, with a risk $\alpha \leq 5\%$ for error Type I and risk $\beta \leq 20\%$ for error Type II, besides a 20% loss in data collection. The study population consisted of 304 adult patients, admitted in the period from September 1st to December 31st 2013, and that remained in the unit for at least 12 hours.

The AEs addressed in the study were those managed by nursing: pressure sore (PS), loss of nasogastric tube (NT), loss of peripherally inserted central catheter (PICC), loss of central venous catheter (CVC), loss of orotracheal intubation (OTI) and fall.

For the daily data collection, a structured instrument was used to register information obtained from electronic medical records, changes of shift, AE reports available in the computer system and the nursing scale. The variables related to the patient were: gender, age, origin [emergency care (EC), surgery center (SC), admission unit (AU)], type of hospitalization (clinical or surgical), reason for hospitalization, date and period of ICU admission (morning, afternoon or night), severity of disease measured by the APACHE II scale, level of consciousness by the Glasgow Coma Scale, risk of developing PS assessed by the Braden Scale, risk of fall according to institutional protocol (sum of factors such as age, history of fall, use of medications, mobility, cognitive function and use of devices), NAS score, date of discharge and destination or death. The variables related to the unit were: number of patient per nurse and per nurse technician.

To analyze the categorical variables, descriptive statistics with absolute (n) and relative (%) frequencies, mean and standard deviation were used. To verify the association between the numerical variables, according to the groups of patients with and without AE, the Student's t-test was applied. To verify the normality of the data, the Shapiro-Wilk test was used and when no normal distribution of the data was observed, the non-parametric Mann-Whitney U test was applied. To compare categorical variables, the chi-square test was applied and when at least one expected frequency was less than 5, Fisher's exact test was adopted. All statistical analyzes were done in the *Stata® Statistical Software*, version 7.0 (Stata Corp LP, College Station, Texas, USA) by a specialist in statistics. The significance level was set at 5% for all statistical tests.

The research was approved (record number 319.805) by the Research and Ethics Committee of the Federal University of São Paulo and co-participant institution. There was a formal exemption from the elaboration and application of a Consent Form.

Results

In the population studied, there was a slight prevalence of women (52%) over men (48%) with a mean age of 70 years (14-108) and a higher concentration in the age group between 61 and 80 years (35%).

Patients coming from EC were predominant (57%) and most of the admissions occurred at night (64%) and in the afternoon (23.5%). Clinical hospitalizations (66%) exceeded surgical hospitalizations (34%) and all deaths in the period (3.5%) were in the clinical treatment group.

Among the causes for ICU admission, respiratory tract diseases were the main clinical reason (37.3%), followed by sepsis (20%). Among the surgical admissions, surgeries of the gastrointestinal tract (36%) and orthopedic (33%) were predominant.

The mean length of stay in the ICU was 6.0 days (± 7.3), slightly higher in clinical admissions than in surgical (respectively 7.5 days (± 8.3) and 3.3 days (± 3.5)).

APACHE II score ranged from 2 to 33, with a mean score of 13.9 (± 6.0). Glasgow scale scores ranged from 3 to 15, with a mean score of 14.4 (± 1.7). Braden scale scores ranged from 7 to 20, with a mean score of 13 (± 2.7). There was a prevalence of high risk of fall (75.7%), followed by moderate (18.6%) and low risk (5.7%). The NAS score in the admission ranged from 32% to 114% with a mean of 65.6% (± 16.2). The patient/nurse ratio was 6.7 and the patient/nursing technician ratio was 1.9.

25 patients (8.2%) presented an AE, 76% of which presented a single AE and 24% presented two to five different events. The total number of events for this population was 39 and the most frequent event was PS (43.6%), followed by loss of NT (30.8%) (Table 1). A mean of 1.5 events per patient was found.

Table 1. Distributions of the types of adverse events

Type	n(%)
Pressure sore	17(43.6)
Loss of nasogastric tube	12(30.8)
Loss of peripherally inserted central catheter	5(12.8)
Loss of central venous catheter	4(10.3)
Fall	1(2.5)
Loss of orotracheal intubation	-(-)
Total	39(100)

When analyzing the variables that characterized the patients hospitalized, there was a significant difference ($p < 0.001$) between those who suffered an AE and those that did not, namely: higher age, longer hospital stay, higher APACHE score II, higher risk by the Braden scale and lower Glasgow scale score. There was no difference regarding nurse or nursing technician staffing and the groups with and without AE (Table 2).

Table 2. Characteristics of hospitalization of patients admitted to the intensive care unit, according to the occurrence of adverse events

Characteristics	No adverse event	With adverse event	p-value ^a
n	279	25	<0.001
Age (years)			
Mean (SD)	63.9(20.6)	78.6(12.4)	
Gender			0.209
Female	142(50.9)	16(64.0)	
Male	137(49.1)	9(36.0)	
Origin			
Surgery Center	95(34.1)	4(16.0)	
Emergency Care	156(55.9)	18(72.0)	NA
Admission Unit	28(10.0)	3(12.0)	
Type of hospitalization			0.049**
Clinical	180(64.5)	21(84.0)	
Surgical	99(35.5)	4(16.0)	
Length of stay (days)			
Clinical	n=180	n=21	<0.001
Mean (SD)	5.7(5.8)	22.4(11.5)	
Surgical	n=99	n=4	0.002
Mean (SD)	3.1(3.3)	9.0(3.4)	
APACHE II ^b	n=275	n=25	<0.001
Mean (SD)	13.7(5.9)	17.1(5.8)	
Risk of fall ^c			
Low	17(6.2)	0(0.0)	
Moderate	54(19.6)	2(8.0)	NE
High	204(74.2)	23(92.0)	
NAS	271 ^c	25 ^c	0.011
Mean (SD)	64.8(16.0)	73.6(16.6)	
Braden Scale	n=276 ^c	n=17 ^c	<0.001
Mean (SD)	13.2(2.7)	10.5(1.5)	
Glasgow Scale	n=258 ^c	n=19 ^c	<0.001
Mean (SD)	14.5(1.6)	13.2(2.4)	
Patient/nurse ratio	n=278 ^c	n=25 ^c	0.686
Mean (SD)	6.7(1.3)	7.2(1.2)	
Paciente/nursing technician ratio	n=279 ^c	n=25 ^c	0.855
Mean (SD)	1.9(0.4)	2.0(0.3)	

^ap-value obtained by the Mann-Whitney U test; ^bp-value obtained by the chi-square test; ^con patient

great variation. A study assessing AE in an ICU also showed a predominance of older patients,⁽¹⁰⁾ although other studies showed different results with a median age under 65 years.^(3,7) Other studies found higher age mean and longer hospital stays for the patients who had an AE, compared to those who did not.⁽¹¹⁾

Most patients admitted came from Emergency Care for clinical reasons, which is in agreement with other studies,⁽¹¹⁾ pointing out the importance of having units prepared for the admission of serious patients in hospitals.

The death rate and length of stay in the ICU encountered may be considered low, since the literature shows higher results.⁽¹²⁾ However, the values found are in agreement with another study that addressed AE in ICUs.⁽⁷⁾ These variables depend on several factors, such as severity of disease and therapeutic requirements resulting from eventual complications.

Studies show APACHE II values higher than the ones found in this study.^(5,13) One of the reasons that may justify this result is the lack of a semi-intensive unit in the hospital assessed, which means that less critical patients are admitted in the ICU. However, the most severe patients assessed by APACHE II experienced more AE, a similar result to the ones found in national literature.⁽¹⁴⁾

Considering the nursing team in the ICU assessed, it can be stated that the number of nurses does not meet the recommendations of the council. This is a relevant aspect, since it is known that a proper number of nursing personnel contributes to the quality of care.⁽⁹⁾ Other Brazilian studies conducted in ICUs confirm this finding, indicating that the nurse staffing is not enough to meet the care demands.^(4,13)

A lower mean in the NAS was found, compared to other Brazilian studies, which found results ranging from 73.4 to 87.5%.⁽¹⁵⁾ However, other studies showed similar NAS means, ranging from 52.7% to 66.1%. These results probably reflect a profile of the patients similar to the ICU in this study.^(6,7)

In this study, no significant difference was observed in the patient/nurse and patient/nursing technician ratio in relation to patients who devel-

Discussion

Despite the improvements in the quality of health care, the knowledge and the use of instruments for identifying risks, AE continue to occur in hospitalized patients, even in places of intensive monitoring such as ICUs.

The frequency of AE in ICUs is influenced by several factors, including severity of disease, profile of the patient, complexity of the unit and characteristics of the health care professionals.^(7,10)

In this study, the profile of the patients was characterized by a more advanced age, despite the

oped AE. However, when assessing the workload measured by the NAS instrument, a higher prevalence of AE was found in the cases with higher scores, a result similar to another national study.⁽¹⁴⁾ Similar results were also found in a study that identified a positive correlation between the nursing workload measured by NAS and the severity of disease measured by APACHE II, which means more severe patients generate higher workload.⁽¹⁶⁾ Also, a study that analyzed the time of the nursing care and the incidence of accidental extubation found a lower incidence of this AE linked to a longer time of nursing care.⁽⁴⁾

The most prevalent AE in relation to the population exposed to the risk was loss of NT followed by loss of PPIC. A retrospective study also found a 56% prevalence of AEs related to therapeutic devices, followed by medication errors (43%) and fall (1%).⁽¹⁶⁾ Another study, conducted in two ICUs in a university hospital, analyzed the loss of therapeutic devices such as probes, drains and catheters in a period of 40 days and found a loss rate ranging from 5.2% to 8.9%.⁽⁷⁾

Regarding the Braden scale, the mean risk score found was similar to other researches that found scores ranging from 12.1 to 14.9.^(13,17) The occurrence of PS, even though it was the most frequent AE found in this study, similar to another Brazilian study,⁽⁷⁾ can be considered low compared to other studies. These studies addressed factors associated to the development of PS in patients hospitalized in ICU, and found higher age mean, longer hospitalization time, a lower Braden score and higher clinical severity in the group of patients that developed sores.^(13,17)

There was only one case of fall in this study, a rate much lower than the ones found in other studies that also addressed this event.^(6,8)

This study has some limitations, mostly regarding the low risk profile of the patients admitted in the ICU studied. This is associated with a more frequent admission of less severe and complex cases, such as patients in the postoperative period of low risk elective surgeries, and also with the lack of a semi-intensive unit in the hospital assessed.

The occurrence of at least one AE in 8% of the hospitalizations can be considered low when com-

pared to other studies that found rates between 23% and 32%.⁽¹⁰⁾ This study focused on the analysis of six specific AE, which certainly underestimated the rate of events as a whole, especially those related to drugs that were not the subject of the research. However, it is necessary to consider that the institution is accredited with managing work processes and monitoring AE. Therefore, it was possible to study a significant number of adverse events and their relation with several clinical parameters and with the work of the nursing team, in detail and in a sufficient period of time.

Conclusion

Adverse events were verified in the hospitalizations assessed, with a prevalence of the loss of the nasoenteric catheter and the development of pressure sores. There was a higher incidence of adverse events in patients with higher age and longer hospitalization time, besides higher severity of disease, higher risk for pressure sores and higher workload. However, the nurse staffing did not influence the occurrence of events in the studied groups.

Collaborations

Ortega DB, D'Innocenzo M, Silva LMG and Bohomol E declare that they contributed to the study design, data analysis and interpretation, writing of the article, critical review of the intellectual content and final approval of the version to be published.

References

1. World Health Organization, World Alliance for Patient Safety. Conceptual framework for the International Classification for Patient Safety (ICPS); technical report [Internet]. Geneva: World Health Organization; 2009 [cited 2016 Oct 31]. Available from: http://www.who.int/patientsafety/taxonomy/icps_full_report.pdf
2. World Health Organization (WHO). World Alliance for Patient Safety. WHO patient safety curriculum guide: multi-professional edition [Internet]. Geneva: WHO; 2011 [cited 2016 Oct 31]. Available from: http://apps.who.int/iris/bitstream/10665/44641/1/9789241501958_eng.pdf.
3. Roque KE, Tonini T, Melo EC. Adverse events in the intensive care unit: impact on mortality and length of stay in a prospective study. *Cad Saúde Pública*. 2016;32(10): e00081815.

4. Garcia PC, Fugulin FM. Nursing care time and quality indicators for adult intensive care: correlation analysis. *Rev Lat Am Enfermagem*. 2012; 20(4): 651-8.
5. Freitas ER. Profile and severity of the patients of intensive care units: prospective application of the APACHE II index. *Rev Lat Am Enfermagem*. 2010; 18(3):317-23.
6. Diccini S, Pinho PG, Silva FO. Assessment of risk and incidence of falls in neurosurgical inpatients. *Rev Lat Am Enfermagem*. 2008; 16(4):752-7.
7. Gonçalves LA, Andolhe R, Oliveira EM, Barbosa RL, Faro AC, Gallotti RM, et al. Nursing allocation and adverse events/incidents in intensive care units. *Rev Esc Enferm USP*. 2012; 46(Spec):71-7.
8. Kang JH, Kim CW. Nurse-perceived patient adverse events depend on nursing workload. *Osong Publ Health Res Perspect*. 2016; 7(1):56-62.
9. Penoyer DA. Nurse staffing and patient outcomes in critical care: a concise review. *Crit Care Med*. 2010; 38(7):1521-8.
10. Pagnamenta A, Rabito G, Arosio A, Perren A, Malacrida R, Barazzoni F, et al. Adverse event reporting in adult intensive care units and the impact of a multifaceted intervention on drug-related adverse events. *Ann Intensive Care*. 2012; 2(1):47.
11. Beccaria LM, Pereira RA, Contrin LM, Lobo SM, Trajano DH. Nursing care adverse events at an intensive care unit. *Rev Bras Ter Intensiva*. 2009; 21(3):276-82.
12. Hyun S, Vermillion B, Newton C, Fall M, Li X, Kaewprag P, et al. Predictive validity of the Braden scale for patients in intensive care units. *Am J Crit Care*. 2013; 22(6):514-20.
13. Fugulin FM, Rossetti AC, Ricardo CM, Possari JF, Mello MC, Gaidzinski RR. Nursing care time in the intensive care unit: evaluation of the parameters proposed in COFEN Resolution Nº 293/04. *Rev Lat Am Enfermagem*. 2012; 20(2):325-32.
14. Novaretti MC, Santos EV, Quiterio LM, Daud-Gallotti RM. Nursing workload and occurrence of incidents and adverse events in ICU patients. *Rev Bras Enferm*. 2014; 67(5):692-9.
15. Altafin JA, Grion CM, Tanita MT, Festti J, Cardoso LT, Veiga CF, et al. Nursing Activities Score and workload in the intensive care unit of a university hospital. *Rev Bras Ter Intensiva*. 2014; 26(3):292-8.
16. Cruz CW, Bonfim D, Gaidzinski RR, Fugulin FM, Laus AM. The use of Nursing Interventions Classification (NIC) in identifying the workload of nursing: an integrative review. *Int J NursKnowl*. 2014; 25(3):154-60.
17. Simão CM, Caliri MH, Santos CB. Agreement between nurses regarding patients' risk for developing pressure ulcer. *Acta Paul Enferm*. 2013; 26(1):30-5.