

Analysis of deaths among critical patients: a comparison of estimated mortality by saps-3 and observed mortality

Análise dos óbitos entre pacientes críticos: comparação da mortalidade estimada pelo saps-3 e mortalidade observada

Análisis de las muertes entre pacientes críticos: comparación de la mortalidad estimada por el saps-3 y mortalidad observada

RESUMO

Objetivo: comparar a mortalidade estimada pelo SAPS-3 com a mortalidade observada entre os pacientes críticos admitidos em uma Unidade de Terapia Intensiva e identificar os fatores associados ao óbito. **Métodos:** estudo longitudinal realizado com dados secundários de 400 pacientes críticos. Realizou-se a comparação da mortalidade estimada e observada, e os fatores associados ao óbito. **Resultados:** houve predomínio de pacientes idosos (média de 65,5 anos) do sexo masculino (50,5%), com internação financiada pelo Sistema Único de Saúde (78,0%). Os pacientes que apresentaram maior pontuação no escore de gravidade e maior mortalidade estimada foram os que evoluíram a óbito ($p < 0,001$). O óbito esteve associado às internações por doenças infecciosas e parasitárias ($p < 0,001$), enquanto a maior parte dos pacientes internados por causas externas receberam alta ($p < 0,001$). **Conclusão:** os pacientes com maior gravidade pelo SAPS-3 foram os que evoluíram a óbito, predominando o desfecho negativo entre os internados por doenças infecciosas e parasitárias.

Descritores: Indicadores de Morbimortalidade; Mortalidade Hospitalar, Unidades de Terapia Intensiva; Enfermagem.

ABSTRACT

Objective: to compare the mortality estimated by the SAPS-3 with the observed mortality among critically ill patients admitted to an Intensive Care Unit and to identify the factors associated with death. **Methods:** longitudinal study performed with secondary data from 400 critically ill patients. Estimated and observed mortality and the factors associated with death were compared. **Results:** there was a predominance of elderly patients (mean age 65.5 years) male (50.5%), with hospitalization financed by the Unified Health System (78.0%). The patients with the highest severity score and the highest estimated mortality were those who died ($p < 0.001$). Death was associated with hospitalizations for infectious and parasitic diseases ($p < 0.001$), while most patients hospitalized for external causes were discharged ($p < 0.001$). **Conclusion:** the patients with the highest severity by SAPS-3 were those who died, with a predominant negative outcome among those hospitalized for infectious and parasitic diseases.


Keywords: Morbidity-mortality Indicators; Hospital Mortality, Intensive Care Units; Nursing.

RESUMEN


Objetivo: comparar la mortalidad estimada por el SAPS-3 con la mortalidad observada en pacientes críticos ingresados en una Unidad de Cuidados Intensivos e identificar los factores asociados a la muerte. **Métodos:** estudio longitudinal realizado con datos secundarios de 400 pacientes críticos. Se comparó la mortalidad estimada y observada y los factores asociados a la muerte. **Resultados:** hubo predominio de pacientes adultos mayores (edad media 65,5 años) del sexo masculino (50,5%), con hospitalización financiada por el Sistema Único de Salud (78,0%). Los pacientes con mayor puntuación de gravedad y mayor mortalidad estimada fueron los que fallecieron ($p < 0,001$). La muerte se asoció con las hospitalizaciones por enfermedades infecciosas y parasitarias ($p < 0,001$), mientras que la mayoría de los pacientes hospitalizados por causas externas fueron dados de alta ($p < 0,001$). **Conclusión:** los pacientes con mayor gravedad por SAPS-3 fueron los que fallecieron, con desenlace negativo predominante entre los hospitalizados por enfermedades infecciosas y parasitarias.

Descriptores: Indicadores de Morbimortalidad; Mortalidad Hospitalaria; Unidades de Cuidados Intensivos; Enfermería

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INTRODUCTION

The Intensive Care Unit (ICU) is an inpatient sector for critically ill patients who require permanent medical and nursing care. This sector requires qualified professionals and equipment with high technological density, intended for the diagnosis and treatment of seriously ill patients, who are at imminent risk of death due to the instability of organic systems⁽¹⁾.

Given the complexity of ICU care, the use of instruments that can promote an initial assessment of patients with an indication of their severity becomes relevant. With this, it will be possible to help define strategies that can improve the quality of care offered by the team and, consequently, obtain better results⁽²⁻³⁾.

One of the ways to carry out such an assessment is based on prognostic scores that predict hospital mortality, allowing the assessment of the quality of the service provided and comparing results with those of other centers with patients of similar severity⁽⁴⁾. Mortality rates established by prognostic scores have been widely used to assess the quality of care provided by different services. In several countries, successful database projects have contributed to improved care⁽⁵⁾.

Research on prognostic models began in the 1980s and since then, different scores have been used in clinical practice⁽⁶⁾. Among them, the Simplified Acute Physiology Score 3 (SAPS-3) stands out, which covers sociodemographic variables, reasons for patient admission to the ICU and physiological conditions⁽⁷⁾.

SAPS-3 variables must be collected within the first 24 hours of ICU admission. Each patient's score can range from 16 to 217 points, depending on the severity of the physiological disorder. In addition to the severity score, the system calculates, based on an equation validated worldwide, the estimated mortality (in percentage) of the patient during hospitalization⁽⁷⁾. This mortality estimate can be used as a parameter to assess the severity of patients at admission, in addition to being used at the end of hospitalization, for comparison with patients who, in fact, died, that is, the real mortality observed in the ICU⁽⁸⁾.

The SAPS-3 has been the severity score used in most Brazilian ICUs⁽⁸⁾. However, there are still uncertainties about its performance in different contexts. Some studies identified that this instrument was able to accurately predict patient mortality⁽⁸⁻⁹⁾. On the other hand, others show an overestimation of patient mortality based on the

SAPS-3^(4,6). Such findings reinforce that the interpretation of the results of this score must be performed carefully, taking into account regional and institutional specificities, as well as the characteristics of the patients.

The findings of a survey carried out in a hospital in Teresina-PI, demonstrated that the SAPS-3 presented good discriminatory power, but overestimated mortality among critically ill patients. The mortality predicted by the index was 49.12%, while the observed mortality was 33.64%⁽⁴⁾. From the validation study of this tool in Brazil, it is observed that the calibration results vary according to the population studied⁽⁸⁾. In this context, given that critical ill patients from different services may have different characteristics, and that the initial assessment of their severity is seen as a relevant assistance tool for team planning, there is a need for new studies that comparatively assess the observed mortality and the mortality estimated by the SAPS-3, in order to ensure the reliability of the model in the prediction of hospital mortality⁽⁴⁾. Based on this assessment, it will be possible to support health professionals in planning actions aimed at the different severities presented by patients, in order to achieve positive care results, which imply a reduction in the number of preventable deaths.

Thus, it is proposed to carry out this research, which seeks to answer the following guiding question: is there any difference between the observed mortality and the mortality estimated by the SAPS-3 among critically ill patients admitted to an ICU?

This study aims to compare the mortality estimated by the SAPS-3 with the mortality observed among critically ill patients admitted to an ICU and to identify the factors associated with death.

METHODS

Study Design

This is a longitudinal study based on secondary data available in the monthly care indicator reports referring to patients hospitalized in an ICU of a medium-sized hospital in Zona da Mata Mineira.

Context

This hospital was accredited as a teaching hospital and serves patients from the Unified Health System (SUS), health plans and private consultations. The ICU consists of six beds and serves critically ill patients who require continuous

specialized professional attention, specific materials and technologies necessary for diagnosis, monitoring and therapy.

Data collection was carried out between the months of July and November 2021, based on the analysis of the reports of care indicators referring to hospitalizations that occurred throughout 2020. The care indicators are collected daily in the ICU, by nurses, and comprise reliable data on the health condition of patients, use of invasive devices, occurrence of infectious and non-infectious incidents and clinical evolution. At the end of each month, the data are consolidated by the coordinating nurse and transformed into monthly indicator reports.

Participants

In this study, the data available in the reports of care indicators referring to all critically ill patients admitted to the ICU from 01/01/2020 to 12/31/2020 were included, using convenience sampling.

Exclusion criteria were patients who remained in the ICU for less than 24 hours and had no SAPS-3 data record. However, no patient was excluded, as all remained hospitalized for a longer period than determined in the criterion and all medical records presented the data of the assessed score.

Variables

In this study, sociodemographic, clinical and information related to the outcome of the ICU stay were obtained, such as: age (years); sex (male/female); score on the SAPS-3 prognostic index (values between 16 and 217, collected in the first 24 hours of hospitalization); mortality estimated by SAPS-3 (recorded as a percentage); medical diagnosis on admission (classified according to the International Statistical Classification of Diseases and Related Health Problems [ICD-10], considering the first ICD notified by the physician who admitted the patient); date of admission and outcome of ICU

stay (day/month/year); length of stay in the ICU to outcome (calculated based on day of admission and outcome, recorded in days); and hospitalization outcome (ICU discharge or death).

The primary outcomes of the study were the mortality estimated by the SAPS-3 and the observed mortality, obtained from the number of deaths that occurred in the period assessed.

Data analysis

Data were double-entered using Microsoft Excel® software. Data were checked by a third researcher and transferred to the Statistical Package for the Social Sciences (SPSS) version 20, where the analysis was performed. Descriptive data were presented through tables of frequency, measures of central tendency (mean or median) and variability (standard deviation or interquartile range). The Kolmogorov-Smirnov test was applied to assess the normality of the distribution of continuous variables. To compare the estimated mortality between patients who survived or not, Student's T test was performed for independent samples. Factors associated with patient death were assessed using Pearson's chi-square test, or Fisher's exact test, in cases where the values were lower than five.

Ethical aspects

The research was developed respecting the ethical aspects according to Resolution 466/2012 and Resolution 510/2016, of the National Health Council. The project was approved by the Ethics Committee in Research with Human Beings of the proposing institution, under opinion number 4,214.221, CAAE: 34029120.2.0000.5153.

RESULTS

In 2020, 400 patients were admitted to the ICU. There was a predominance of elderly patients, whose mean age was 65.5 years, male (50.5%), hospitalized by the SUS (78.0%) and who evolved positively with the outcome of ICU discharge (80.2%), as shown in Table 1.

Table 1 – Characteristics of patients admitted to the ICU in 2020. Viçosa, MG, Brazil, 2020 (n=400).

Variable	Parameters (n=400)
Age m* (±sd) [†]	65.5 (19.8)
Gender n [‡] (%) [§]	
Female	198 (49.5)
Male	202 (50.5)
Funding Source n [‡] (%) [§]	
Unified Health System (SUS)	312 (78.0)
Health plan/Private	88 (22.0)
Medical Diagnosis of Hospitalization (ICD-10) n [‡] (%) [§]	
I. Some infectious and parasitic diseases	22 (5.5)
II. Neoplasms (tumors)	6 (1.5)
III. Blood and hematopoietic organ disorders and some immune disorders	2 (0.5)
IV. Nutritional and metabolic endocrine disorders	25 (6.3)
VI. nervous system diseases	12 (3.0)
IX. Circulatory system diseases	131 (32.8)
X. Diseases of the respiratory system	40 (10.0)
XI. Digestive system diseases	20 (5.0)
XII. Skin and subcutaneous tissue diseases	2 (0.5)
XIII. Osteomuscular and connective tissue diseases	2 (0.5)
XIV. Diseases of the genitourinary system	25 (6.3)
XV. Pregnancy, childbirth and puerperium	7 (1.8)
XVIII. Symptoms, signs, and abnormal clinical and laboratory examination findings	10 (2.5)
XIX. Injury, poisoning and some other consequences of external causes	88 (22.0)
XX. External causes of morbidity and mortality	4 (1.0)
XXI. Contacts with health services	4 (1.0)
Length of Hospitalization in days m* (±sd) [†]	5.8 (7.7)
Severity Score	
Simplified Acute Physiology Score 3 (SAPS-3) score m* (±sd) [†]	51.6 (14.1)
Mortality Estimated by the Simplified Acute Physiology Score 3 (SAPS-3) n [‡] (%) [§]	26.5 (40.1)
Outcome of Hospitalization n [‡] (%) [§]	
Discharge	321 (80.2)
Death	79 (19.8)

m* - mean; ±sd[†] - standard deviation; n[‡] - absolute frequency; %[§] - percentage/relative frequency; ICD-10^{||} - International Statistical Classification of Diseases and Related Health Problems

Source: Research data

Regarding the mortality estimated by the SAPS-3 and the observed mortality, it was found that the highest scores in the prognostic score and

the highest estimated mean mortality were from patients who did not survive, as shown in Table 2.

Table 2 – Comparison of estimated mortality between patients admitted to the ICU in 2020 who survived or not. Viçosa, MG, Brazil, 2020 (n=400).

Variable	Survivors (n=321)	Non survivors (n=79)	p-value
Score obtained by SAPS-3* m [†] (±sd) [‡]	47.5 (10.9)	68.6 (13.2)	<0.001 [§]
Estimated Mortality by SAPS-3* m [†] (±sd) [‡]	20.3 (41.1)	51.6 (21.8)	<0.001 [§]

SAPS-3* - Simplified Acute Physiology Score 3; m[†] - mean; ±sd[‡] - standard deviation; [§]Student T test for independent samples.

Source: Research data

It was found that among patients who died, there was a higher proportion of those hospitalized due to infectious and parasitic diseases, specifically sepsis (17.7% versus 2.5% - p<0.001). On the other

hand, death was less frequent among patients hospitalized for injuries, poisoning and some other consequences of external causes (5.1% versus 26.2% - p<0.001), as shown in Table 3.

Table 3 – Factors associated with death among ICU patients in 2020. Viçosa, MG, Brazil, 2020 (n=400).

Variable	Survivors (n=321)	Non survivors (n=79)	p-value
Age m* (±sd) [†]	65.1 (20.3)	66.9 (17.9)	0.445 [‡]
Gender n [§] (%) [§]			
Female	165 (51.4)	33 (41.8)	0.125 [¶]
Male	156 (48.6)	46 (58.2)	
Funding Source n [§] (%) [§]			
Unified Health System (SUS)	248 (77.3)	64 (81.0)	0.471 [¶]
Health plan/Private	73 (22.7)	15 (19.0)	
Medical Diagnosis of Hospitalization (ICD-10) n [§] (%) [§]			
I. Some infectious and parasitic diseases	8 (2.5)	14 (17.7)	<0.001 [¶]
II. Neoplasms (tumors)	5 (1.6)	1 (1.3)	0.999 [¶]
III. Blood and hematopoietic organ disorders and some immune disorders	1 (0.3)	1 (1.3)	0.713 [¶]
IV. Nutritional and metabolic endocrine disorders	20 (6.2)	5 (6.3)	0.974 [¶]
VI. nervous system diseases	10 (3.1)	2 (2.5)	0.999 [¶]
IX. Circulatory system diseases	104 (32.4)	27 (34.2)	0.762 [¶]
X. Diseases of the respiratory system	33 (10.3)	7 (8.9)	0.706 [¶]
XI. Digestive system diseases	14 (4.4)	6 (7.6)	0.238 [¶]
XII. Skin and subcutaneous tissue diseases	2 (0.6)	-	0.999 [¶]
XIII. Osteomuscular and connective tissue diseases	2 (0.6)	-	0.999 [¶]
XIV. Diseases of the genitourinary system	19 (5.9)	6 (7.6)	0.581 [¶]
XV. Pregnancy, childbirth and puerperium	7 (2.2)	-	0.423 [¶]
XVIII. Symptoms, signs, and abnormal clinical and laboratory examination findings	6 (1.9)	4 (5.1)	0.228 [¶]
XIX. Injury, poisoning and some other consequences of external causes	84 (26.2)	4 (5.1)	<0.001 [¶]
XX. External causes of morbidity and mortality	2 (0.6)	2 (2.5)	0.352 [¶]
XXI. Contacts with health services	4 (1.2)	-	0.826 [¶]
Length of Hospitalization in days m* (±sd) [†]	5.5 (7.6)	6.8 (8.0)	0.197 [‡]

m* - mean; ±sd[†] - standard deviation; [‡] - Student T test for independent samples; n[§] - absolute frequency; (%)^{||} - percentage/ relative frequency; [¶] - Pearson Chi-square test or Fisher's Exact, in cases where the values were less than 5; ICD-10^{**} - International Statistical Classification of Diseases and Health-Related Problems.

Source: Research data

DISCUSSION

Regarding the age of the patients, a similar result was observed in a study conducted in an ICU in the Brazilian Northeast, where most patients were elderly people⁽¹⁰⁾. This finding can be justified by the demographic transition that the country has been undergoing in recent years, with an increase in the population's life expectancy and by the physiological changes typical of aging, which make the elderly susceptible to certain diseases and complications and, consequently, contribute to the greater need for hospitalization in intensive care beds⁽¹¹⁾.

A study conducted with patients hospitalized in an ICU in the Federal District also confirms the result of a higher prevalence of elderly people, as well as male patients⁽¹²⁾. The latter can be justified by the lower demand and adherence of men to health promotion and prevention services, so when they are affected by a disease or when they seek care, it is already more advanced and even critical, requiring some type of hospitalization⁽¹¹⁾.

Another characteristic assessed in this study refers to the source of funding for hospitalizations, in which the SUS predominated, considered a single, universal and free system. It is noticed that the SUS has been responsible for most of the hospitalizations carried out in Brazil, becoming even more evident during the COVID-19 pandemic period, in which there was an expansion of the care network, including ICU beds, in order to meet to all the demand caused by the spread and contagion of the new coronavirus⁽¹³⁾. In this context, the importance of strengthening and valuing the SUS becomes evident, so that surveillance, promotion and health care actions are developed for the population with a view to reducing inequalities⁽¹⁴⁾.

It is noteworthy that the death outcome in the sample/population of this study was lower than in another one conducted in Fortaleza, whose observed mortality was 24.5% of the patients⁽¹⁵⁾. It is believed that this difference can be justified by the fact that it is a small ICU, with only six beds, located in a medium-sized city, which does not have a semi-intensive care unit, therefore, the

severity profile of the patients it is not always the most severe, which can be confirmed by the score obtained by the SAPS-3, considered lower than that of other national and international studies⁽¹⁶⁻¹⁷⁾.

When assessing the severity of patients shortly after admission to the ICU, it was found that patients who had a higher score on the SAPS-3 severity score and higher estimated mortality ended up dying. This finding demonstrates consistency between the estimated mortality and the actual observed mortality, similar to the findings of other studies^(4,16-17). Thus, it is clear that the SAPS-3 can be considered a useful instrument to guide the planning and decision-making of professionals, with good sensitivity for detecting the severity of patients in the studied sample⁽¹⁷⁾.

With regard to the characteristics of patients who died, it is evident that chronic non-communicable diseases are the most frequent among the elderly people hospitalized in ICUs and contribute to higher mortality⁽¹²⁾. However, in this study, despite being predominant among the causes of hospitalization, they were not related to death. Among the patients who did not survive, there was a higher proportion of patients with infectious and parasitic diseases. It is noteworthy that these include sepsis, considered an important public health problem, with high mortality, especially among the elderly⁽¹⁸⁻¹⁹⁾.

Sepsis is defined as dysfunctional organic changes resulting from a deregulated response of the host to an infectious agent. Early identification and correct management of the patient can influence better prognoses⁽²⁰⁾. However, for this assistance to be performed satisfactorily, nurses and other health professionals must have extensive knowledge about sepsis, such as its definition, signs and symptoms, early interventions and adequate treatment, in order to contribute to better outcomes of patients decreasing disease progression and mortality. All this reinforces the importance of training the team in relation to the management of septic patients⁽²¹⁾.

On the other hand, among the patients who survived, most were hospitalized due to injuries, poisoning and some other consequences of external causes. External causes include acute conditions such as injuries, wounds, burns and accidents. In this category, accidents with motorcyclists have been associated with higher mortality; however, considering all the possible conditions categorized in this topic, in Bahia, only 2.6% of hospitalizations evolved to death,

corroborating the results found in our study⁽²²⁾. It is believed that the lower occurrence of deaths in this category may also be related to the profile of ICU care and hospitalized patients, considering that the ICU is not specific for trauma patients and that the population studied was mostly elderly, differing from younger people, commonly associated with mortality due to external causes⁽²³⁾.

Although it was demonstrated that patients who did not survive were those with the highest score and highest mortality estimated by the SAPS-3, the results of this study should be interpreted with caution, due to its limitations, especially as it was carried out in a single ICU, subject to possible biases related to the type of patients and treatment received. In addition, secondary data already available in the indicator report were used, with direct observation of patients not being carried out and it was not possible to verify the accuracy of the data. However, it is noteworthy that the ICU is a reference for the health micro-region composed of eight municipalities and that the sample of this study comprises patients admitted over a period of one year, being superior to other studies with the same design. It is also worth noting that all medical records showed completeness of data referring to SAPS-3 variables, which demonstrates the team's care in providing information about the patients seen.

CONCLUSION

Among the profile of patients assessed, it was concluded that the patients with the highest score on the SAPS-3 and the highest estimated mortality were those who did not survive, allowing us to infer that the severity score can be a useful tool to guide planning and decision making of the ICU professionals by allowing the identification of the severity of the patients and the greater possibility of evolution to death.

In addition, it was found that there was a higher proportion of hospitalizations for infectious and parasitic diseases among patients who had the outcome of death, which draws the attention of professionals to the correct management of these patients, intervening early in order to contribute to the reduction of negative outcomes between them.

For nurses, information about the severity of patients and the main causes associated with death obtained during data collection, are essential to guide the other stages of the Nursing Process. Considering that the highest mortality was related to infectious and parasitic diseases,

especially sepsis, efforts should be directed towards training the team in relation to the importance of adopting infection prevention bundles, as well as greater surveillance of patients' vital signs, incorporating these interventions systematically into care practice.

It is believed that the results of the present study may contribute to the knowledge of the applicability of the SAPS-3 among professionals and researchers, making it not only seen as a theoretical instrument. It is expected that the information obtained can help in the performance of an individualized assistance, directed to the severity profile of the patients, with a view to minimizing avoidable deaths from specific actions.

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