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Desempenho de índices de gravidade para estimar risco de morte em Unidades de Terapia Intensiva  
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# The use of severity indexes to estimate the risk of death in Intensive Care

DESEMPENHO DE ÍNDICES DE GRAVIDADE PARA ESTIMAR RISCO DE MORTE EM UNIDADES DE TERAPIA INTENSIVA

DESEMPEÑO DE ÍNDICES DE GRAVEDAD PARA ESTIMAR RIESGO DE MUERTE EN UNIDADES DE TERAPIA INTENSIVA

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## ABSTRACT

The Simplified Acute Physiology Score II (SAPS II) and Logistic Organ Dysfunction System (LODS) are instruments used to classify Intensive Care Unit (ICU) inpatients according to the severity of their condition and risk of death, and evaluate the quality of nursing care. The objective of this study is to evaluate and compare the performance of SAPS II and LODS to predict the mortality of patients admitted to the ICU. The participants were 600 patients from four ICUs located in São Paulo, Brazil. Receiver Operator Characteristic (ROC) curves were used to compare the performance of the indexes. Results: The areas under the ROC curves of LODS (0.69) and SAPS II (0.71) indicated moderate discriminatory capacity to identify death or survival. No statistically significant differences were found between these areas ( $p=0.26$ ). In conclusion, there was equivalence between SAPS II and LODS to estimate the risk of death of ICU patients.

## DESCRIPTORS

Mortality  
Intensive Care Units  
Severity of Illness Index  
Nursing care

## RESUMO

O Simplified Acute Physiology Score II (SAPS II) e o Logistic Organ Dysfunction System (LODS) são instrumentos utilizados para classificar pacientes internados em Unidades de Terapia Intensiva (UTI) conforme a gravidade e o risco de morte, sendo um dos parâmetros da qualidade da assistência de enfermagem. Este estudo teve por objetivo avaliar e comparar as performances do SAPS II e do LODS para prever mortalidade de pacientes admitidos em UTI. Participaram do estudo 600 pacientes de quatro diferentes UTIs de São Paulo, Brasil. A curva Receiver Operator Characteristic (ROC) foi utilizada para comparar o desempenho discriminatório dos índices. Os resultados foram: as áreas sob a curva do LODS (0.69) e do SAPS II (0.71) apresentaram moderada capacidade discriminatória para prever mortalidade. Não foi encontrada diferença estatisticamente significativa entre as áreas ( $p=0.26$ ). Concluiu-se que houve equivalência entre SAPS II e LODS para estimar risco de morte de pacientes em UTI.

## DESCRIPTORES

Mortalidade  
Unidades de Terapia Intensiva  
Índice de Gravidade de Doença  
Cuidados de enfermagem

## RESUMEN

El Simplified Acute Physiology Score II (SAPS II) y el Logistic Dysfunction System (LODS) son instrumentos utilizados para clasificar pacientes internados en Unidades de Terapia Intensiva (UTI), conforme a la gravedad y riesgo de muerte, constituyéndose en uno de los parámetros de la calidad de atención de enfermería. Se objetivó evaluar y comparar la performance del SAPS II y del LODS para predicción de mortalidad de pacientes admitidos en UTI. Participaron del estudio 600 pacientes de cuatro UTI de São Paulo, Brasil. La curva Receiver Operator Characteristic (ROC) fue utilizada para comparar el desempeño discriminatorio de los índices. Resultados: las áreas bajo la curva del LODS (0.69) y del SAPS II (0.71) presentaron moderada capacidad discriminatoria para predecir mortalidad. No se encontró diferencia estadísticamente significativa entre las áreas ( $p=0.26$ ). Se concluyó en que existió equivalencia entre SAPS II y LODS para estimar riesgo de muerte para pacientes de UTI.

## DESCRIPTORES

Mortalidad  
Unidades de Cuidados Intensivos  
Índice de Severidad de la Enfermedad  
Atención de enfermería

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## INTRODUCTION

Severity indexes emerged at the end of the 20<sup>th</sup> century to evaluate the efficiency and quality of care provided to critical patients. Through a standardized language, these scores enable one to establish how severe the conditions of patients hospitalized in Intensive Care Units (ICU) are, and also establish a pattern of progression among similar patients undergoing diverse treatments, in addition to estimating survival, length of hospital stay, and the use of material resources, in order to evaluate the performance of a critical care unit<sup>(1)</sup>.

Two severity indexes used for ICU patients were analyzed in this study: the Simplified Acute Physiology Score II (SAPS II)<sup>(2)</sup> and the Logistic Organ Dysfunction System (LODS)<sup>(3)</sup>. Both were created by Le Gall and collaborators based on a database of European and American ICUs, using logistic regression analysis to select statistically significant variables to preview mortality. The higher the total score of these indexes, the more severe condition is expected. Additionally, these severity indexes can be translated into the probability of death for patients. LODS differs from SAPS II because it identifies, in addition to the probability of death, the severity and degree of impairment of six organic systems: neurological, cardiovascular, renal, pulmonary, hematological and hepatic systems.

Severity indexes are essential for nurses working in ICUs since they help to analyze the quality of care delivery. Additionally, both SAPS II and LODS are indexes of rapid and easy application and interpretation that can help nurses in clinical decision-making and in the management of an ICU.

Approximately 15 years after the creation and application of SAPS II and LODS and considering their large use in different groups of severe patients, it is interesting to evaluate the performance of these indexes to estimate mortality in order to provide additional information to nurses who want to use these indexes. Therefore, this study's objective was to compare the performance of SAPS II and LODS to predict mortality in patients admitted to general ICUs.

## METHOD

This descriptive, cross-sectional study with a quantitative approach gathered information from four general ICUs (two public and two private hospitals) located in the city of São Paulo, SP, Brazil, totaling 600 inpatients between, 2006 and 2007.

The selected ICUs met the following criteria: belonging to medium-sized, large or extra large hospitals with general ICUs. The number of beds in ICUs should be above 6% of the total number of hospital beds and Semi-Intensive Care Units should have more than five beds<sup>(4)</sup>.

Patients were selected according to the following inclusion criteria: being 18 years old or older and remaining in the unit for at least 24 hours.

The sample's demographic and clinical characterization was performed through the analysis of the following variables: age, gender, origin, and comorbidities according to the International Classification of Diseases (ICD), duration of hospitalization and mortality in ICUs. The risk of death among patients was estimated by SAPS II and LODS and computed in the first 24 hours of hospitalization in the ICU, according to the indication of the authors of these indexes in their original publications<sup>(2-3)</sup>.

Stata 8,0 for Windows and SPSS 13,0 for Windows were used to analyze and interpret the results. The sample characterization was performed through descriptive statistics. Receiver Operator Characteristic (ROC) Curve was constructed to evaluate the capacity of SAPS II and LODS to predict mortality. The comparison test of the areas under the curve (AUC) was based on the Z test and the level of significance was fixed at 5%.

This study was approved by the Ethics Research Committees at the studied institutions (Protocols No, SMS 52/2006; HU 650/06; HSL 2006/03 and HE 06/510).

## RESULTS

In relation to the patients' demographic characteristics, presented in Table 1, we observed that most participants were older than 60 years of age (53,34%). The average and median ages were 60,7 and 61,5 years old, respectively. In relation to gender, male patients predominated (56,70%).

**Table 1** – Demographic and clinical characteristics of patients admitted into ICUs – São Paulo, SP Brazil, 2006/2007

Idade	N (%)
> 18 and < 40 years old	92 (15.33)
> 40 and < 60 years old	188 (31.33)
> 60 and < 80 years old	215 (35.84)
> 80 years old	105 (17.50)
Gender	N (%)
Male	340 (56.70)
Female	260 (43.30)
Origin	N (%)
Ward	55 (9.17)
Intermediate Unit	68 (11.33)
Emergency Department	213 (35.50)
Surgical Room	218 (36.33)
Other	46 (7.67)
Duration of Hospitalization in ICU	N (%)
1 to 2 days	199 (33.17)
3 to 4 days	100 (16.66)
5 to 9 days	130 (21.67)
10 to 29 days	132 (22.00)
≥ 30 days	39 (6.50)

Most patients came from the surgical room (36,33%) and the emergency department (35,50%); 46 (7,67%) were included in the category *other*, mainly composed of patients from other hospitals and procedure rooms.

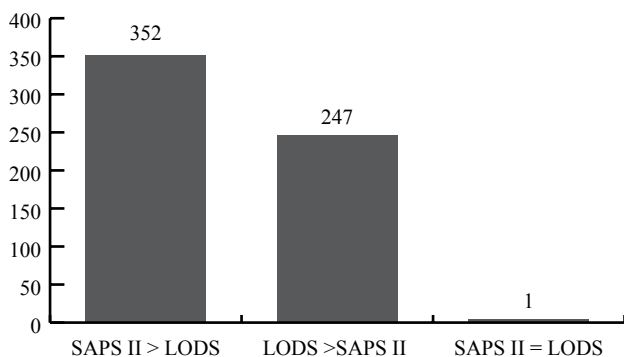
The average time of stay in the ICU was 8,9 ( $\pm 10,9$ ) days, with a median stay of five days. Patients hospitalized for one or two days (33,17%) were the most frequent, although more than one quarter of the patients (28,50%) stayed 10 or more days in the ICU, while 39 individuals stayed more than 30 days in this unit.

In the analysis of comorbidities, the most frequent antecedents were related to the circulatory system (58,00%), followed by endocrine, nutritional and metabolic diseases (28,66%), neoplasms (18,17%), diseases of the respiratory tract (13,33%), and of the genitourinary tract (13,00%).

**Table 2** – Descriptive measures of variables indicating risk of death in ICU patients (SAPS II and LODS) – São Paulo, SP, Brazil, 2006/2007

SAPS II	%
Average	25.49%
Standard Deviation	22.12%
Mode	10.60%
Median	18.10%
<b>LODS</b>	
Average	21.43%
Standard Deviation	18.66%
Mode	10.40%
Median	15.00%

The mortality rate observed in the studied ICUs was 20%. The average risk of death in the unit computed by SAPS II and LODS is described in Table 2. According to SAPS II and LODS, the risk of death among patients who died during hospitalization in ICUs was 40,00% and 31,38%, respectively.



**Figure 1** – ICU inpatients according to comparison of risk of death provided by SAPS II and LODS – São Paulo, Brazil, 2006/2007 (n=600)

Figure 1 shows that the risk of death indicated by SAPS II was higher than that indicated by LODS in 58,67% of the patients, while LODS exceeded SAPS II in 41,17% of the cases, and in only one case did both indexes present the same probability of death. Analyzing the patients indi-

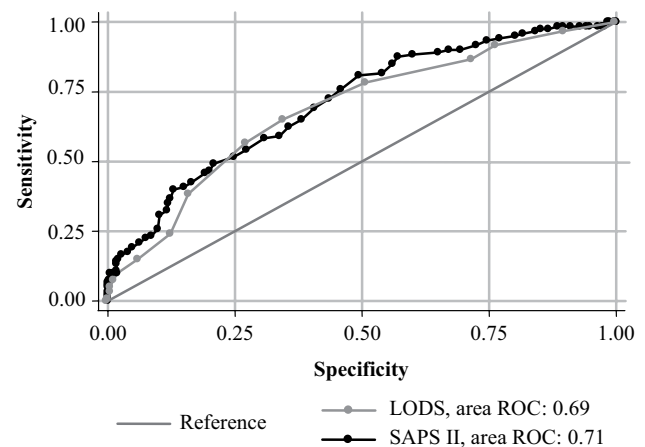
vidually, we observed that the difference of risk of death between these two indexes ranged from 0% to 70,70%.

**Table 3** – Comparison of the ability of LODS and SAPS II to predict mortality in ICU according to ROC curve – São Paulo, SP, Brazil, 2006/2007

Variável	Área sob a curva ROC	Intervalo de confiança de 95% para OR	Valor p <sup>§</sup>
LODS (risco de morte)	0.69	0.63 - 0.74	0.264
SAPS II (risco de morte)	0.71	0.66 - 0.76	

§ Z test

According to the p value identified in the comparison of areas under the ROC curve, there was no significant difference between SAPS II and LODS in predicting mortality of ICU inpatients (Table 3). The curves of both indexes are very close to each other (Figure 2).



**Figure 2** – ROC curve of SAPS II and LODS to predict mortality in ICU patients – São Paulo, SP, Brazil, 2006/2007

## DISCUSSION

The analysis of the age and gender of the study's participants corroborate the findings observed in the literature that indicate the patients hospitalized in ICUs are predominantly older and male<sup>(5-9)</sup>.

Patients coming from the emergency department and the surgical room were about 70% of the sample, a percentage similar to that found in other studies addressing patients in general<sup>(10-12)</sup> and specific ICUs<sup>(13)</sup>.

The average duration of hospitalization in ICUs was high compared to the results of other studies<sup>(7-10,12)</sup>. Among the comorbidities more frequently observed in the studied patients are those present in the Brazilian population's profile of morbidity and mortality<sup>(14)</sup>.

The frequency of deaths in ICUs is greatly variable in the literature<sup>(6,8-10,13,15-18)</sup> and the result concerning mortality in this study is an intermediate value among those observed in the remaining studies. These differences in mortality can be attributed to the characteristics of both ICUs

and patients. Comparative analysis of general and specialized ICUs strengthening such an assumption to indicate a greater mortality in the general ICU, 17,0%, against 3% and 6% in specialized units<sup>(5)</sup>.

The average risk of death predicted by SAPS II in this study was 25,49%, which is equivalent to 40 points. The average SAPS II score obtained in this study, when compared to scores reported by Brazilian and international studies, is sometimes similar<sup>(8,15)</sup>, sometimes lower<sup>(5,16)</sup>, and sometimes higher<sup>(6,17,19-20)</sup>. Two investigations addressing large samples stand out among those using SAPS II: one study addressing 16,646 patients admitted into 17 English ICUs reported an average of 34 points<sup>(19)</sup>. Another study addressing a group of 14,400 patients admitted into ICUs, in addition to 780 readmitted into these units, reported the following SAPS II scores: 25 and 28, respectively<sup>(20)</sup>. Therefore, the average risk of 25,49% observed in the admission of this study's participants into the ICU, and equivalent to 40 points on SAPS II, was higher than the results reported by the two studies conducted with large samples.

The average risk of death after admission into an ICU according to LODS was 21,43%. It is equivalent to the score of 5 in this instrument, higher than that observed in studies conducted in French<sup>(9)</sup>, English<sup>(20)</sup>, and Austrian ICUs<sup>(16)</sup>.

The average LODS score obtained in this study was equivalent only to the score observed in a study conducted with 312 patients hospitalized in an ICU for more than 72 hours<sup>(15)</sup>. In general, the results obtained from LODS in this study indicated a greater risk of death compared to that observed in studies conducted in other studies.

International studies use SAPS II and LODS as a measure to predict risk of death among ICU inpatients and analyze the mortality rate observed in their samples<sup>(8-9,15-17,19,21)</sup>. In this study, the mortality rate (20,0%) observed in the ICUs was compatible with the average risk of death in the sample when SAPS II (25,50%) and LODS (21,40%) were used.

The following areas under the ROC curve were observed when the discriminatory ability of SAPS II and LODS to predict mortality in ICUs was analyzed: 0,71 (CI 95%: 0,66-0,76) and 0,69 (CI 95%: 0,63-0,74), respectively. These values indicate the instruments have moderate discriminatory ability to identify the percentages of those who die and those who survive. Additionally, similarity of areas under the ROC curve indicated by the p value suggests that the instruments present equivalent performance in the prediction of mortality.

As observed in this study, other investigations analyzing these indexes also verified their moderate discriminatory ability to predict mortality: the AUC obtained by LODS was 0,60 to 0,72<sup>(9,15,21-22)</sup> and SAPS II was 0,72 to 0,75<sup>(15,17, 21-22)</sup>.

On the other hand, studies reporting AUC values above 0,80, which indicate excellent discriminatory performance, were also observed in the scientific literature in relation to SAPS II and LODS. For SAPS II, such values were found in two studies analyzing the discriminatory power of this index in the face of mortality in general ICUs<sup>(8,18)</sup>, and in a study addressing neurological patients<sup>(19)</sup>. In relation to LODS, excellent performance was reported in a prospective study conducted with 2,893 patients admitted into clinical, surgical, and mixed ICUs<sup>(16)</sup>.

Only one study was found in the literature addressing SAPS II and LODS that compared the AUC of the two indexes. The study identified an excellent discriminatory ability for both SAPS and LODS in predicting mortality (AUC > 0,80) in trauma victims, with no significant difference between the AUC observed<sup>(13)</sup>.

Even though there are few studies comparing SAPS II and LODS through statistical methods, the results presented so far show that these instruments have similar performance in estimating the risk of mortality and, therefore, there is no indication one should be preferred over another.

Nonetheless, when different studies were compared, an indication of different performance (moderate or excellent) was observed in relation to the isolated discriminatory capacity of SAPS II and LODS, and such a difference may be related to the characteristics of the studied patients and ICUs. Therefore, it would be interesting to continue studying these indexes, detailing the characteristics of patients and ICUs and also compare them in terms of their different performances.

## CONCLUSION

This study's results enabled us to conclude that SAPS II and LODS each present moderate discriminatory capacity in predicting mortality in general Intensive Care Units and both present equivalent performance in estimating the risk of death among patients admitted into these units.

The predictive values of SAPS II and LODS found in this study and in other studies are acceptable and refer to the possibility of nurses using them in clinical practice to differentiate groups of patients with different risks of death. Additionally, the results indicate that professionals can use either of the two indexes when the intention is to categorize the severity of the population of patients in the unit or to evaluate the quality of care delivery.



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