Open Access Original

Journal of Renal Endocrinology

J Ren Endocrinol 2024;10:e25163.
https://www.jrenendo.com
doi: 10.34172/jre.2024.25163

Nickan Research Institute

Comparison of four severity-of-disease scores in predicting mortality of trauma patients in ICU; a cross-sectional study

Mohsen Jafari[1*], Ali Rastegar-Kashkouli[1], Pourya Yousefi[1], Hossein Mahjobipoor[2*], Mohammadreza Jafari[3], Shirin Fattahpour[4]

Abstract

Introduction: Forecasting mortality among trauma patients in the intensive care unit (ICU) is crucial for advancing treatment approaches and elevating the standard of patient care.

Objectives: The purpose of this research was to compare well-known severity-of-disease scores in predicting the mortality of trauma patients in the ICU.

Materials and Methods: This cross-sectional study was conducted from 2016 to 2017 at the ICU of Amin Hospital, which is affiliated with a university in Isfahan, Iran. Information for calculating the Acute Physiology and Chronic Health Evaluation II (APACHE II), Sequential Organ Failure Assessment (SOFA) score, Injury Severity Score (ISS), and M Score was extracted from patients' files and compared with their mortality using receiver operating characteristic (ROC) curves.

Results: Our study showed that the M Score and SOFA Score have sensitivities of 94.5 and 88.29, and specificities of 88.9 and 80.14, respectively. When comparing the AUC of mean SOFA, mean M Score, APACHE II, and ISS across different age groups and the entire study population, we found that the M Score and SOFA significantly better predict mortality than APACHE II and ISS.

Conclusion: This study showed that the M Score and SOFA Score predict the mortality of trauma patients admitted to the ICU better than APACHE II, and that ISS is not appropriate for this task.

Keywords: APACHE II, SOFA Score, Mortality, Intensive care unit

Citation: Jafari M, Rastegar-Kashkouli A, Yousefi P, Mahjobipoor H, Jafari M, Fattahpour Sh. Comparison of four severity-of-disease scores in predicting mortality of trauma patients in ICU; a cross-sectional study. J Ren Endocrinol. 2024;10:e25163. doi: 10.34172/jre.2024.25163.

Introduction

Florence Nightingale initiated medical treatment outcome assessment in 1863 (1). Before her efforts, outcome predictions in critical illness relied on clinicians' subjective judgments (2). Patients, their families, and medical professionals are concerned about the chances of recovery, but predicting outcomes in the intensive care unit (ICU) can be challenging (3). Mortality prediction in the ICU for trauma patients is crucial for enhancing treatment strategies and improving the quality of patient care (4).

In a medical setting, severity-of-disease scores objectively measure the extent of an illness and classify patients based on their prognosis and risk. In the ICU, these scores help assess how factors like organization, staffing, and changes in treatment plans affect patient outcomes(5). The rapid development of ICUs has increased the demand for quantitative and clinically meaningful outcome metrics to evaluate the success of treatment procedures, leading to the development and use of severity-of-disease scores (3).

These scores are conducted to predict mortality, assess risk levels, manage resources, and improve patient outcomes, provided they are implemented with the patient groups for which they were developed and validated (2). The prognosis of intensive care patients depends on several factors during the first 24 hours in the ICU and subsequently on their progress throughout their ICU stay (2).

The following severity-of-disease scores use information gathered on the first day in the ICU to predict patient outcomes (1); The Acute Physiology and Chronic Health Evaluation (APACHE II) and Injury Severity Score (ISS)

Acute Physiology and Chronic Health Evaluation (APACHE II)

In ICUs around the world, APACHE II is the most widely utilized severity-of-disease score (6). Developed four years after the original APACHE using a larger sample size (n = 5815), APACHE II reduced the number of subjective

Received: 24 June 2023, Accepted: 6 October 2024, ePublished: 17 December 2024

[1]Isfahan University of Medical Sciences and Health Services, Isfahan, Iran. [2]Department of Anesthesiology, Isfahan University of Medical Sciences, Isfahan, Iran. [3]Shiraz University of Medical Sciences, Shiraz, Iran. [4]Craniofacial and Cleft Research Center, Isfahan University of Medical Sciences, Isfahan, Iran.
*Corresponding Authors: Mohsen Jafari, Email: dr.mohsenjafari97@gmail.com; Hossein Mahjobipoor, Email: dr.mahjobipoor@yahoo.com

Implication for health policy/practice/research/ medical education

Predicting the mortality of trauma patients is crucial for effective treatment strategies. In this study, we compared four severity-of-disease scores and concluded that the Sequential Organ Failure Assessment (SOFA) score and M score predict mortality more accurately than APACHE II and Injury Severity Score (ISS).

variables to 12 and required a principal diagnosis for ICU admission (1). APACHE II is calculated from information gathered in the first 24 hours of ICU admission (score range: 0-71) and is used for mortality prediction along with the main diagnosis of hospitalization (7). Studies have demonstrated that APACHE II has good calibration and discrimination across various diseases and diagnostic categories. Despite the development of newer APACHE models, it continues to be the most widely used severity-of-disease score globally due to its simplicity of use (8).

Injury Severity Score (ISS)

Introduced in 1974, the ISS is the most popular trauma severity score based on anatomical characteristics, providing a general assessment of individuals with multiple injuries. The ISS divides the body into six regions: head and neck, face, thorax, abdomen, extremities (including pelvis), and external (9). Each injury is assigned an Abbreviated Injury Scale (AIS) score, and for each region, only the highest score is used. The ISS is calculated by adding together the squares of the three highest AIS scores, with a maximum possible score of 75. Conventionally, an ISS of 75 is assigned to a patient with an AIS score of 6 in one body region (10). However, only one score is given for multiple injuries in the same body area, which can understate the severity of trauma in patients (11).

The following predictive severity-of-disease scores use information gathered from the first day to the last day in the ICU and are calculated daily (12): Sequential Organ Failure Assessment (SOFA) and M Score.

Sequential Organ Failure Assessment (SOFA)

The SOFA score was first introduced by the European Society of Intensive Care and Emergency Medicine in the 1990s (12) and has since been improved for daily use in anticipation mortality trauma patient in ICU (13). Each of the six parts of the SOFA system, which include the respiratory, cardiovascular, liver, coagulation, kidney, and nervous systems, is given a score between 0 and 4 (14). Originally developed to predict mortality in sepsis patients, SOFA has been refined to predict mortality in all critically ill patients receiving ICU care (15,16). According to study findings, a 30% rise in the SOFA score is associated with at least a 50% increase in mortality (15).

M Score

The primary purpose of the M Score checklist is to provide an accurate clinical and paraclinical evaluation of the patient, completed by the physician and nurse during each shift. Unlike other checklists that only estimate and predict the patient's condition, the M Score checklist is multi-purpose. It not only predicts the patient's condition but also offers a comprehensive evaluation. This severity-of-disease score comprises 11 different parts: age, neurological system, head and neck, respiratory system, cardiovascular system, digestive system, organs, infection, urogenital system, skin, and patient laboratory tests (17). The score ranges from 0 to 120, with an increase indicating the deterioration of the patient's condition. A reduction in this score from a certain value can indicate that the patient is ready for discharge (17).

The most accurate prediction score should be tested in the targeted demographic and the area where it will be deployed (6). To this end, this study examined the effectiveness of four prognostic severity-of-disease scores in anticipation mortality results in trauma patients in ICU.

Objectives

This research was conducted using data from the trauma registry system of Amin hospital in Isfahan, Iran that had been prospectively recorded over a two-year period.

Materials and Methods

Study design

This was a cross-sectional study conducted from January 2016 to December 2017. This research was conducted at Amin hospital ICU center affiliated with medical university in Isfahan, Iran.

Data collection

The medical records of 620 ICU trauma patients admitted to the ICU center were carefully examined under desired protocol. Data from 511 patients from research sampling were included, while 109 patients were excluded for the reasons include: age limit as younger than 18 years; injuries like burn; death at the first 24 hours of being admitted to the ICU; previous arrest or myocardial infarction; and missing data. The medical records were meticulously reviewed for the parameters such as: clinical data and demographic, systolic and mean arterial blood pressure (mm Hg), heart rate, body temperature, respiratory rate, oxygen saturation, arterial blood gas analysis (pH, PaO2, PaCO2, and base excess), FIO2, initial Glasgow Coma Scale (GCS), score laboratory data (White blood cell, platelets, hematocrit, and serum levels of, sodium, potassium, creatinine and bilirubin), amount of vasopressor, urine output, presence of immune-compromised state or chronic diseases, abbreviated injury scales, revised trauma score, first-day ISS, mean SOFA score, first-day APACHE II score, and mean M Score.

Statistical analysis

Research Data were analyzed in MATLAB (version R2022) and SPSS (version 25). Univariate analysis was conducted using the Receiver Operating Characteristic (ROC) curve. The area under the curve (AUC) was computed to assess the scores' effectiveness in predicting mortality as an independent variable. To compare the AUCs, tests for the curves were performed using MATLAB software. All tests were reported with a 5% error rate, and statistical significance was accepted at $P<0.05$.

Results

A total of 511 patients were enrolled in this study and sufficient information was recorded in their files. Their demographic information is presented in Table 1.

In this study, daily average scores for the M Score and SOFA, as well as the first-day APACHE II and ISS, were calculated, compared, and analyzed in relation to the mortality rate of trauma patients admitted to the ICU at Amin hospital. ROC curves were used to evaluate the true positive rate (longitudinal axis) versus the false positive rate (horizontal axis) at various cut-off points. After constructing the ROC curves for each severity-of-disease score, the cut-off points were identified to assess the sensitivity and specificity of predicting patient mortality.

As the cut-off point for continuous variables increases, the sensitivity (true positives) and specificity (true negatives) decrease. The effectiveness of a test is measured by calculating the area under the ROC curve (AUC), where an AUC of 1 represents a perfect test and an AUC of 0.5 represents a random test. A higher AUC indicates that the ICU system can more accurately and sensitively treat patients (18).

Comparisons were made separately between males and females, different age groups, and individuals with or without underlying diseases.

The AUCs for the M Score, SOFA score, APACHE II, and ISS are 0.922, 0.901, 0.660, and 0.501, respectively (Figure 1). The AUC for the ISS is close to 0.5, indicating that this severity-of-disease score does not predict patient mortality effectively. The AUCs for the M Score and SOFA score are significantly higher ($P<0.05$) than those for APACHE II and ISS, but there is no significant difference between the M Scor and SOFA score ($P=0.39$). Additionally, the difference between the AUCs of APACHE II and ISS is significant ($P<0.05$).

Table 1. Demographic information

Variable	Value
Age (y), mean ± SD	43.27 ± 23.13
BMI (kg/m^2), mean ± SD	25.13 ± 3.21
Length of administration in ICU, mean ± SD	12.55 ± 8.27
APACHE II, mean ± SD	9.91 ± 8
ISS, mean ± SD	23.25 ± 10.36
First-day M Score, mean ± SD	15.4 ± 9.43
Daily M Score, mean ± SD	15.04 ± 9.33
First-day SOFA Score, mean ± SD	3.75 ± 3.05
Daily SOFA Score, mean ± SD	4.23±3.06
Female, No. (%)	119 (23.3)
Male, No. (%)	392 (76.7)
Mortality, No. (%)	84 (16.43)

BMI: Body mass index, ICU: Intensive care unit, APACHE II: Acute physiology and chronic health evaluation, ISS: Injury severity score, SOFA: Sequential organ failure assessment.

The AUCs for the M Score, SOFA score, APACHE II, and ISS are 0.928, 0.925, 0.879, and 0.734, respectively (Figure 2). The AUCs for the M Score and SOFA score are significantly higher ($P<0.05$) than that for the ISS, but there is no significant difference between the M Score and SOFA score ($P=0.96$).

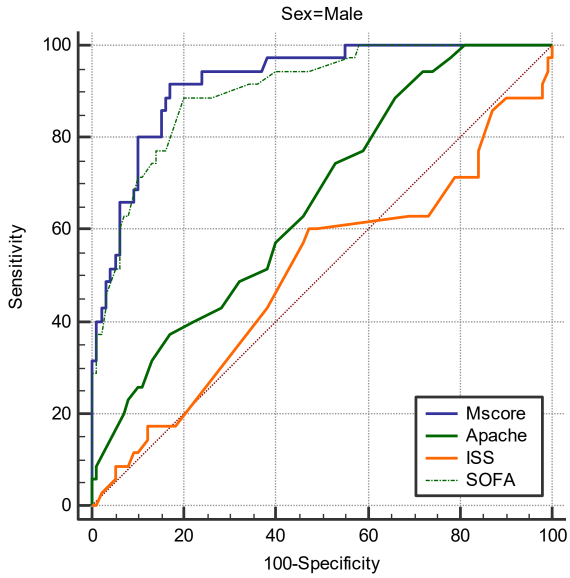

Figure 1. ROC curves showing prediction of mortality based on SOFA Score, APACHE II, ISS, and M score for males' group.

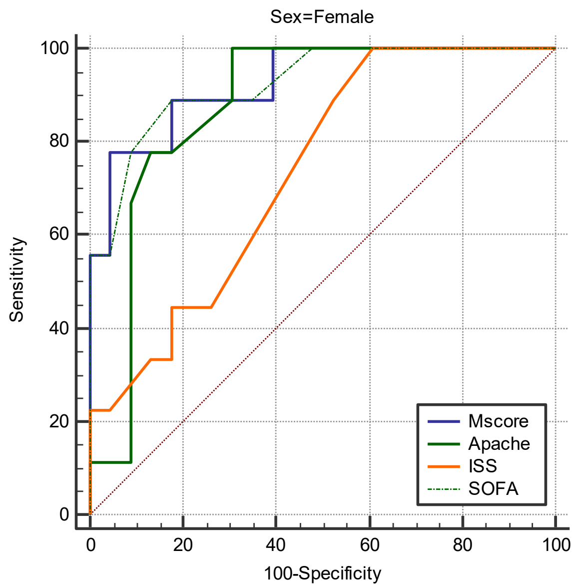

Figure 2. ROC curves showing prediction of mortality based on SOFA Score, APACHE II, ISS, and M score for females' group.

The AUCs for the M Score, SOFA score, APACHE II, and ISS are 0.974, 0.941, 0.762, and 0.738, respectively (Figure 3). The AUCs for the M Score and SOFA score are significantly higher ($P<0.05$) than those for APACHE II and ISS, and there is no significant difference between the M Score and SOFA score ($P=0.18$).

The AUCs for the M Score, SOFA score, APACHE II, and ISS are 0.864, 0.883, 0.656, and 0.542, respectively (Figure 4). The AUC for the M Score is significantly higher ($P<0.05$) than those for APACHE II and ISS, but there is no significant difference between the M Score and SOFA score ($P=0.75$). The difference in AUCs between the SOFA score and ISS is significant ($P<0.05$), while no meaningful difference was observed between the SOFA score and APACHE II ($P=0.06$).

The AUCs for the M Score, SOFA score, APACHE II, and ISS are 0.890, 0.776, 0.638, and 0.740, respectively (Figure 5). The difference between the AUCs of the M Score and APACHE II is significant ($P<0.05$), while no substantial differences are observed between the other systems.

The AUCs for the M Score, SOFA score, APACHE II, and ISS are 0.857, 0.893, 0.726, and 0.500, respectively (Figure 6). The AUC of the ISS is 0.500, indicating that this severity-of-disease score does not predict patient mortality effectively. The difference between the AUCs of the SOFA score and the ISS is significant ($P<0.05$), while there are no substantial differences between the other systems.

The AUCs for the M Score, SOFA score, APACHE II,

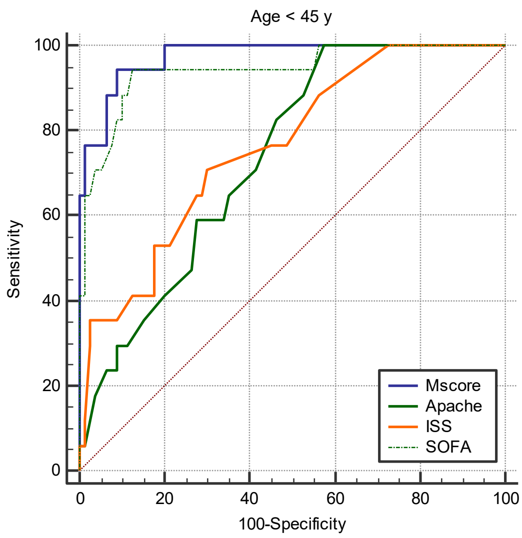

Figure 3. ROC curves showing the prediction of mortality based on the SOFA Score, APACHE II, ISS, and M score (Age < 45).

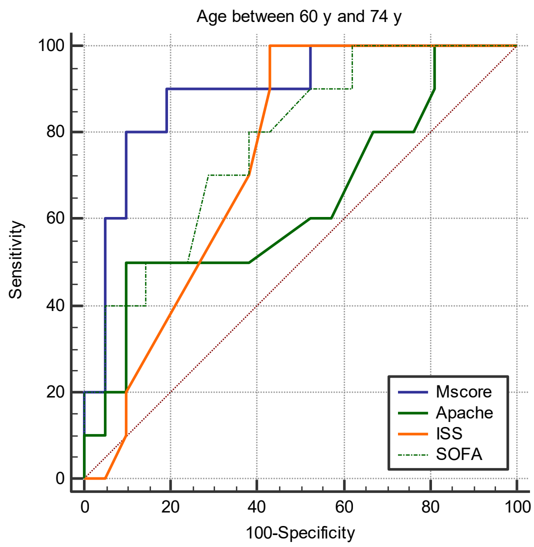

Figure 5. ROC curves showing the prediction of mortality based on the SOFA Score, APACHE II, ISS, and M score (60 < Age < 75 years).

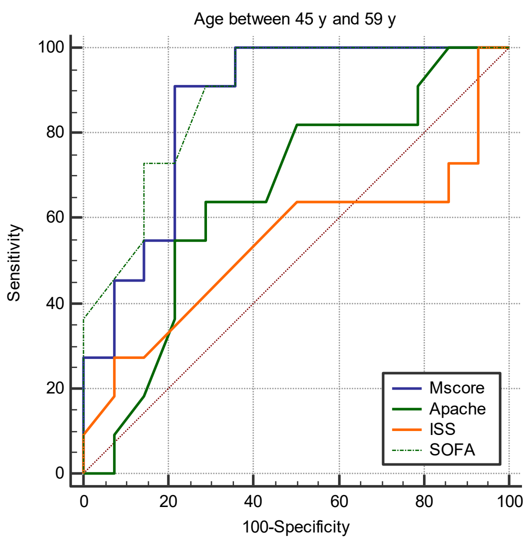

Figure 4. ROC curves showing the prediction of mortality based on the SOFA Score, APACHE II, ISS, and M score (45 < Age < 59 years).

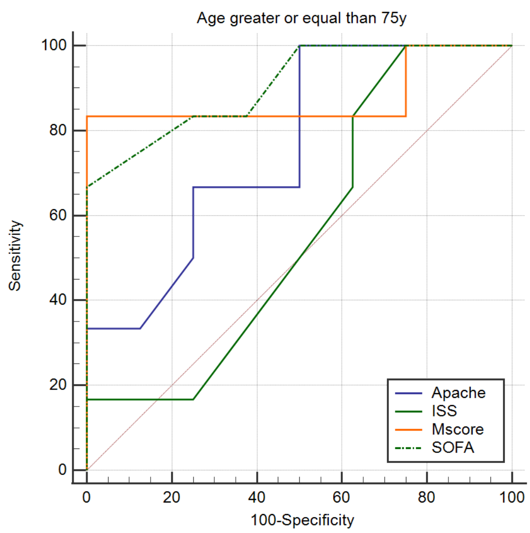

Figure 6. ROC curves showing the prediction of mortality based on the SOFA Score, APACHE II, ISS, and M score (Age ≥ 75 years).

and ISS are 0.914, 0.867, 0.689, and 0.503, respectively (Figure 7). The AUCs of the M Score and SOFA score are significantly greater than those of the other systems ($P<0.05$), with no significant difference between them ($P=0.14$). Additionally, the difference between the AUCs of APACHE II and ISS is significant ($P<0.05$).

The AUCs for the M Score, SOFA score, APACHE II, and ISS are 0.929, 0.920, 0.742, and 0.596, respectively (Figure 8). The AUCs of the M Score and SOFA score are significantly greater than those of the other systems ($P<0.05$), with no significant difference between them ($P=0.84$).

The AUCs for the M Score, SOFA score, APACHE II, and ISS are 0.923, 0.904, 0.731, and 0.500, respectively (Figure 9). The AUC of the ISS is exactly 0.5, indicating that it cannot determine a cut-off point and is not meaningful for predicting mortality in the ICU. The AUCs of the M Score and SOFA score are significantly greater than that of APACHE II ($P<0.05$), with no significant difference between the M Score and SOFA score ($P=0.37$).

The best cut-off points for the M Score, SOFA score, and APACHE II are 19.17, 4.67, and 11, respectively (Table 2).

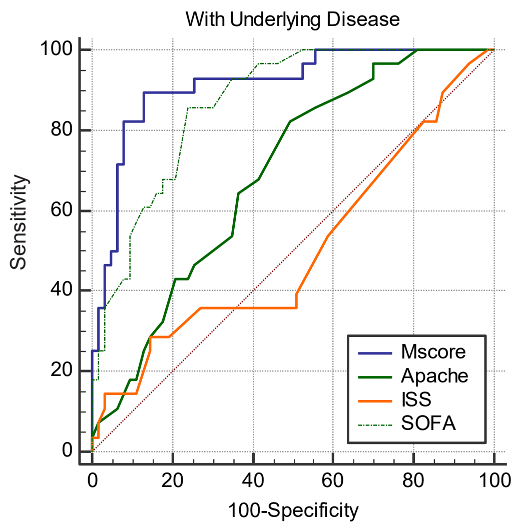

Figure 7. ROC curves showing the prediction of mortality based on the SOFA Score, APACHE II, ISS, and M score (With underlying disease).

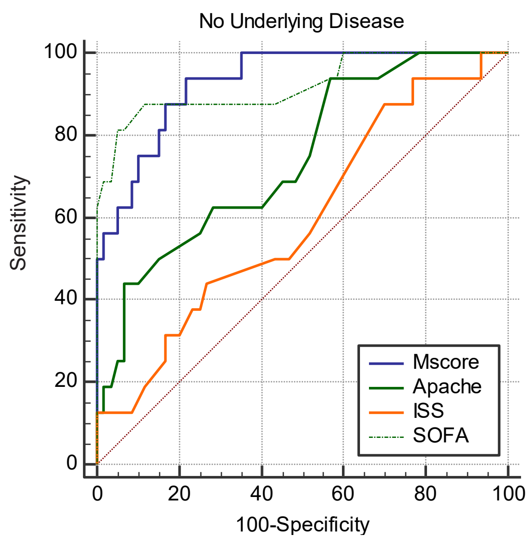

Figure 8. ROC curves showing the prediction of mortality based on the SOFA Score, APACHE II, ISS, and M score (Without underlying disease).

Discussion

Prognostic assessments remain estimates, regardless of the number of cases analyzed. Providing intensive medical care necessitates expert clinical judgment, the meticulous blending of objective data with other relevant details—like a patient's response to treatment and their personal preferences—and a high level of professional skill.

To accurately predict outcomes for trauma patients, many severity-of-disease scores have been developed, with mortality typically being the primary outcome measured. Numerous studies have evaluated the predictive power of these scores, often reporting contradictory results (19,20). For example, despite its high accuracy, the APACHE II score does not predict outcomes consistently well for all patients.

A study by Romo Gonzales et al comparing the SOFA score and APACHE II reported that APACHE II performed significantly better (21). While several studies have also shown the superiority of APACHE II over the SOFA score, research by Oliver et al and Lee et al found no significant difference between these two scores, deeming both suitable for predicting patient mortality (22,23). Conversely, Vassar et al discovered that the ISS and APACHE II systems were ineffective in anticipation mortality rates among trauma patients in the ICU (7). Additionally Ho et al demonstrated that while APACHE II is easy to use and calculated only once, it can still predict mortality well (24).

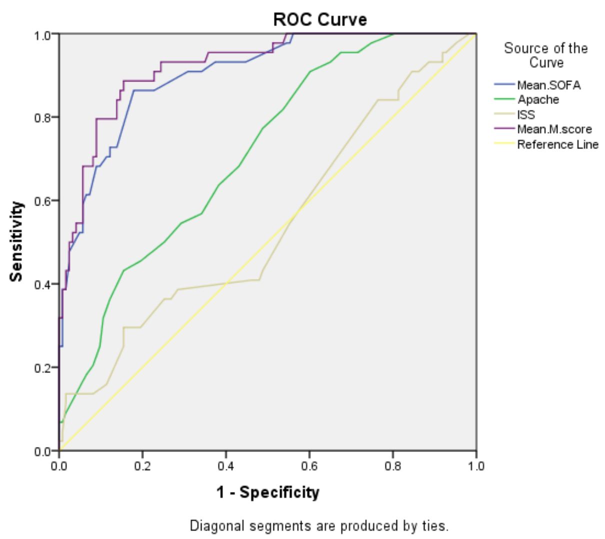

Figure 8. ROC curves showing the prediction of mortality based on the SOFA Score, APACHE II, ISS, and M score (Without underlying disease).

Table 2. Severity-of-disease scores best cut off

Scoring system	Cut off	Sensitivity	Specificity	*P* value
M Score	19.17	94.5	88.29	<0.0001
SOFA Score	4.67	86.54	80.14	<0.0001
APACHE II	11	86.90	75	<0.0001
ISS	The cut-off point cannot be calculated			

In a study comparing the SOFA score, APACHE II, and M Score for non-trauma patients, no significant differences were found between the scores (17). Meanwhile Fueglistaler et al showed no difference between the SOFA score and ISS in predicting mortality (25).

In our study, severity-of-disease scores were compared across different groups: In males, the M Score and SOFA score predicted mortality better than other systems, with APACHE II outperforming ISS. In females, the M Score and SOFA score were superior to ISS. In patients under 45 years old, the M Score and SOFA score performed best. In the 45-59 age group, the M Score was better than APACHE II and ISS, while the SOFA score was better than ISS only. In the 60-75 and over 75 age groups, the M Score was superior to APACHE II, and the SOFA score was superior to ISS, respectively. In patients with and without underlying diseases, the M Score and SOFA score provided the best mortality predictions for trauma patients. Across the entire studied population, the ISS was excluded due to an AUC of 0.5, with the M Score and SOFA score outperforming APACHE II. There was no significant difference between the M Score and SOFA score in any group or the overall population. These results indicate that the M Score and SOFA score are equally reliable in predicting mortality for trauma patients whom admitted to the ICU. However, as this was a single-center research, the generalizability of these conclusions is limited.

Conclusion

The study concluded that the M Score and SOFA score predict trauma patient mortality in the ICU better than APACHE II, with respective sensitivities of 94.5% and 88.29%, and specificities of 88.9% and 80.14%. The ISS was found to be unsuitable for this purpose.

Limitations of the study

This study was conducted at a single center, which may limit the generalizability of the findings. Future research should include multiple centers to enhance the robustness and applicability of the results. Additionally, some patient records contained deficiencies, which could affect the completeness and accuracy of the data analysis.

Authors' contribution

Conceptualization: Mohsen Jafari.
Data curation: Mohsen Jafari.
Formal analysis: Ali Rastegar-Kashkouli.
Investigation: Mohsen Jafari.
Methodology: Ali Rastegar-Kashkouli.
Project administration: Pourya Yousefi.
Resources: Pourya Yousefi, Shirin Fattahpour.
Software: Mohammadreza Jafari.
Supervision: Hossein Mahjobipoor.
Validation: Pourya Yousefi.
Visualization: Mohammadreza Jafari.
Writing–original draft: Mohsen Jafari.
Writing–review & editing: Mohammadreza Jafari, Ali Rastegar-Kashkouli.

Conflicts of interest

The authors declare that they have no competing interests.

Ethical issues

The research conducted in this study adhered to the principles outlined in the Declaration of Helsinki and was approved by the Ethics Committee of Isfahan University of Medical Sciences (Ethical code #IR.MUI.MED.REC.1400.473). The study was extracted from Hossein Mahjoobi pour's thesis in the department of Anesthesiology at this university. Prior to any intervention, all participants provided written informed consent. This study protocol was registered on the Research Registry website with the unique identification number (UIN) researchregistry10011. The authors have observed ethical issues (including plagiarism, data fabrication, and double publication.

Funding/Support

None.

References

1. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. Crit Care Med. 1985;13:818-29. doi: 10.1097/00003246-198608000-00028
2. Bouch DC, Thompson JP. Severity scoring systems in the critically ill. Continuing education in anaesthesia. Crit Care Pain. 2008;8:181-5. doi: 10.1093/bjaceaccp/mkn033
3. Miranda DR, Ryan DW, Schaufeli W, Fidler V. Organisation and management of intensive care: a prospective study in 12 European countries. Springer Sci Business Media; 2012 Dec 6.
4. de Munter L, Polinder S, Lansink KW, Cnossen MC, Steyerberg EW, de Jongh MA. Mortality prediction models in the general trauma population: A systematic review. Injury. 2017;48:221-229. doi: 10.1016/j.injury.2016.12.009.
5. Moreno R, Miranda DR, Matos R, Fevereiro T. Mortality after discharge from intensive care: the impact of organ system failure and nursing workload use at discharge. Intensive Care Med. 2001;27:999-1004. doi: 10.1007/s001340100966.
6. Salluh JI, Soares M. ICU severity of illness scores: APACHE, SAPS and MPM. Curr Opin Crit Care. 2014;20:557-65. doi: 10.1097/MCC.0000000000000135.
7. Vincent JL, Moreno R. Clinical review: scoring systems in the critically ill. Crit Care. 2010;14:207. doi: 10.1186/cc8204.
8. Vincent JL, Ferreira F, Moreno R. Scoring systems for assessing organ dysfunction and survival. Crit Care Clin. 2000;16:353-66. doi: 10.1016/s0749-0704(05)70114-7.
9. Eid HO, Abu-Zidan FM. New Injury Severity Score is a better predictor of mortality for blunt trauma patients than the Injury Severity Score. World J Surg. 2015;39:165-71. doi: 10.1007/s00268-014-2745-2.

10. Li H, Ma YF. New injury severity score (NISS) outperforms injury severity score (ISS) in the evaluation of severe blunt trauma patients. Chin J Traumatol. 2021;24:261-265. doi: 10.1016/j.cjtee.2021.01.006.
11. Kuo SCH, Kuo PJ, Chen YC, Chien PC, Hsieh HY, Hsieh CH. Comparison of the new Exponential Injury Severity Score with the Injury Severity Score and the New Injury Severity Score in trauma patients: A cross-sectional study. PLoS One. 2017;12:e0187871. doi: 10.1371/journal.pone.0187871.
12. Vincent JL, Moreno R, Takala J, Willatts S, De Mendonça A, Bruining H, et al. The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure. On behalf of the Working Group on Sepsis-Related Problems of the European Society of Intensive Care Medicine. Intensive Care Med. 1996;22:707-10. doi: 10.1007/BF01709751.
13. Seymour CW, Liu VX, Iwashyna TJ, Brunkhorst FM, Rea TD, Scherag A, et al. Assessment of Clinical Criteria for Sepsis: For the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016;315:762-74. doi: 10.1001/jama.2016.0288.
14. Shankar-Hari M, Phillips GS, Levy ML, Seymour CW, Liu VX, Deutschman CS, et. al Sepsis Definitions Task Force. Developing a New Definition and Assessing New Clinical Criteria for Septic Shock: For the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016;315:775-87. doi: 10.1001/jama.2016.0289.
15. Ferreira FL, Bota DP, Bross A, Mélot C, Vincent JL. Serial evaluation of the SOFA score to predict outcome in critically ill patients. JAMA. 2001;286:1754-8. doi: 10.1001/jama.286.14.1754.
16. Tran DD, Groeneveld AB, van der Meulen J, Nauta JJ, Strack van Schijndel RJ, Thijs LG. Age, chronic disease, sepsis, organ system failure, and mortality in a medical intensive care unit. Crit Care Med. 1990;18:474-9. doi: 10.1097/00003246-199005000-00002.
17. Mahjobipoor H, Jahanian A. The Precision of Mortality Prediction by a Novel Checklist (M Score) Compared with Well-Known Scoring Systems in Non-trauma Patients in Intensive Care Unit. J Isfahan Med Sch. 2019;37:342-349. doi: 10.22122/jims.v37i522.11393.
18. Hoo ZH, Candlish J, Teare D. What is an ROC curve? Emerg Med J. 2017;34:357-359. doi: 10.1136/emermed-2017-206735.
19. Beck DH, Smith GB, Pappachan JV, Millar B. External validation of the SAPS II, APACHE II and APACHE III prognostic models in South England: a multicentre study. Intensive Care Med. 2003;29:249-56. doi: 10.1007/s00134-002-1607-9.
20. Minne L, Abu-Hanna A, de Jonge E. Evaluation of SOFA-based models for predicting mortality in the ICU: A systematic review. Crit Care. 2008;12:R161. doi: 10.1186/cc7160.
21. Romo Gonzales JE, Silva Obregón J, Martin Dal Gesso C, Gallardo Culebradas P, Saboya Sanchez S, Torralba M. Evaluation of APACHE II, SAPS II and sofa as predictors of mortality in patients over 80 years admitted to ICU. Intensive Care Med Exp. 2015;3:A343. doi: 10.1186/2197-425X-3-S1-A343.
22. Lee H, Shon YJ, Kim H, Paik H, Park HP. Validation of the APACHE IV model and its comparison with the APACHE II, SAPS 3, and Korean SAPS 3 models for the prediction of hospital mortality in a Korean surgical intensive care unit. Korean J Anesthesiol. 2014;67:115-22. doi: 10.4097/kjae.2014.67.2.115.
23. Oliver AC, Peixoto A, Ranero S, Anturiano R, Guillermo C, Díaz L. Apache II and Sofa Scores Predict mortality in hematologic malignancies patients at intensive care unit admission. Blood. 2017 8;130:4677.
24. Ho KM, Lee KY, Williams T, Finn J, Knuiman M, Webb SA. Comparison of Acute Physiology and Chronic Health Evaluation (APACHE) II score with organ failure scores to predict hospital mortality. Anaesthesia. 2007;62:466-73. doi: 10.1111/j.1365-2044.2007.04999.x.
25. Fueglistaler P, Amsler F, Schüepp M, Fueglistaler-Montali I, Attenberger C, Pargger H, et al. Prognostic value of Sequential Organ Failure Assessment and Simplified Acute Physiology II Score compared with trauma scores in the outcome of multiple-trauma patients. Am J Surg. 2010;200:204-14. doi: 10.1016/j.amjsurg.2009.08.035.