

Integration of biochemical parameters into mortality prediction scores for burn patients: a step toward a new scoring system

Integración de parámetros bioquímicos en los puntajes de predicción de mortalidad para pacientes con quemaduras: un paso hacia un nuevo sistema de puntuación

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Abstract

Objectives: This study aimed to evaluate and compare the performance of five prognostic scoring systems for predicting burn mortality: chronic health evaluation II (APACHE II), abbreviated burn severity index (ABSI), Ryan score, rBaux, and Belgium outcome in burn injury, alongside the influence of initial laboratory analyses. **Methods:** A retrospective clinical study analyzed 343 patients hospitalized for moderate to severe burn injuries at a major clinical Center in Serbia. Data were extracted from medical records, and logistic regression assessed the impact of laboratory results on mortality. Sensitivity, specificity, and area under the curve were calculated for each scoring system. **Results:** The overall mortality rate was 11.4%. Non-survivors were significantly older (60.87 ± 15.72 years) and had a higher median total body surface area burned (40%) compared to survivors (6%). Inhalation injuries were more common in non-survivors (53.8%). Higher potassium levels were significantly associated with mortality ($p < 0.001$; odds ratio = 3.624). The APACHE II score demonstrated the highest accuracy (89.7%), while the ABSI score had the lowest (71.8%). **Conclusion:** In this cohort, the APACHE II score showed the highest discriminative accuracy. However, its performance may vary in other populations. Incorporating potassium levels into future scoring systems may improve mortality prediction.

Keywords: Burn injury. Prediction. Mortality. Blood count. Scores.

Resumen

Objetivo: El objetivo de este estudio fue analizar y comparar cinco de los sistemas pronósticos más utilizados para evaluar la mortalidad por quemaduras, junto con el impacto de los análisis de laboratorio iniciales. **Métodos:** Estudio clínico retrospectivo de 343 pacientes hospitalizados por quemaduras de moderadas a graves en un centro clínico de Serbia. Se extrajeron datos de los registros médicos y se utilizó regresión logística para evaluar la mortalidad. Se calcularon la sensibilidad, la especificidad y el AUC para cada sistema de puntuación. **Resultados:** La tasa de mortalidad global fue del 11.4%. Los no sobrevivientes eran significativamente mayores (60.87 ± 15.72 años) y tenían una TBSA mediana más alta (40%) en comparación con los sobrevivientes (6%). Las lesiones por inhalación fueron más frecuentes en los no sobrevivientes (53.8%). Los niveles elevados de potasio se asociaron significativamente con mortalidad ($p < 0.001$; OR: 3.624). La puntuación APACHE II mostró la mayor precisión (89.7%) y ABSI la menor (71.8%). **Conclusiones:** En esta cohorte, la puntuación APACHE II

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demostró la mayor precisión discriminativa. Sin embargo, su rendimiento puede variar en otras poblaciones. Futuras puntuaciones podrían beneficiarse al incluir los niveles de potasio para mejorar la predicción de la mortalidad.

Palabras clave: Quemadura. Predicción. Mortalidad. Análisis de sangre. Puntuaciones.

Introduction

Burn injuries are among the most prevalent forms of trauma worldwide, posing a significant public health issue both historically and today. Globally, it is estimated that 11 million cases of burn injuries occur annually, with approximately 300,000 of them resulting in death. The majority of deaths occur in low- and middle-income countries, though burn injury is a major problem in developed countries as well. In 2019, approximately 414,000 burn injuries occurred in the United States, with approximately 10% requiring hospitalization.^{1,2} Nowadays, burns are a key focus for both scientific workers and clinicians as well. Recent comparative studies from diverse healthcare settings reinforce the need for local validation of prognostic scores. For example, a systematic review (2019-2023) reported area under the curve (AUCs) for major burn mortality scores ranging from 0.70 to 0.94, with no single score universally superior, highlighting substantial variation by geography, burn etiology, and healthcare resources. Studies from high-human development index (HDI) countries have shown that modified abbreviated burn severity index (ABSI) is better calibrated than the original in certain contexts, whereas the original ABSI retains predictive strength in low- and middle-HDI environments. These differences emphasize the necessity of interpreting prognostic score performance within each specific population context.

The medical and socioeconomic influence of this type of injury is largely determined by the severity of the burn injury. Most burns are minor or mild, and can resolve without need for hospitalization. However, hospitalized patients carry a high mortality risk, making survival a critical outcome measure for this type of injury. According to the American Burn Association (ABA), the overall mortality rate for burn patients, regardless of size, is 3.1%, but it rises to 8.6% for burns covering at least 20% of the total body surface area (TBSA).³

The outcome of treatment after a burn injury depends on numerous factors, including initial treatment approach to the injured. Therefore, it would be useful to introduce treatment protocols according to ABA recommendations into clinical practice.⁴

Numerous factors associated with mortality in patients with severe burn injuries are described in the literature.⁵ The factors that primarily determine the severity of a burn injury are the depth of the burn wound and the TBSA. In addition to TBSA and burn depth, numerous factors can contribute to injury severity and poor treatment outcome such as: age of the patient, associated chronic diseases, inhalation injury, electrical injury, male sex, delayed fluid replacement, value of biochemical parameters, associated infections, and others. There are also studies with results showing that patients with two or more comorbidities have a higher risk of death after a burn injury.⁶ Considering these factors, the ABA classifies burns into minor or mild, moderate, and severe with varying treatment needs ranging from outpatient care to specialized burn centres.⁷ Inhalation injury was defined by clinical criteria (facial burns, carbonaceous sputum, and stridor) and confirmed where possible by bronchoscopy findings or elevated carboxyhemoglobin levels.

Nowadays, predicting treatment outcomes for critically ill patients, including burn victims, is crucial for effective care.⁸ Prognostic models for trauma, both general and burn-specific, have been developed to classify patients and assess risks.⁹ The models most used today are the Baux score, Ryan, Smith, McGwin, ABSI, Bobby and the Fatality by Longevity, chronic health evaluation II (APACHE II) score, measured extent of burn, and sex (FLAMES). The large number of different models suggests that no single model achieves consistent accuracy across different populations, healthcare systems, and countries. There are several studies also with different results regarding the accuracy and validity of existing models for predicting treatment outcomes after burn injury.¹⁰⁻¹² Similarly, none of the predictive scores currently available consider certain biochemical parameters that may impact the likelihood of a poor outcome.

Predicting mortality and morbidity in severe burns offers serious benefits to clinicians in both patient management, as well as providing information to families. Most existing scoring systems were developed in highly industrialized countries, making it crucial to evaluate their accuracy in medium- and low-income

settings. Despite this, there is limited research on the role of laboratory values in risk stratification for burn patients. Therefore, we hypothesized that abnormalities in laboratory results observed at admission could serve as predictors of mortality in burn patients, as well as suggest that these laboratory parameters at hospital admission could potentially be used to create a new scoring system for assessing the risk of mortality.

Methods

A retrospective clinical study was conducted at the Clinic for Plastic and Reconstructive Surgery and the Emergency department of the University Clinical Center of Vojvodina, Serbia. The study analyzed 343 patients who were treated due burn injury for 7 years (2015-2022). The patients were divided into two groups, the group of surviving patients (304) and the group of deceased patients (39). All data was obtained from medical documentation and the local electronic data-base. Authors collected sociodemographic and clinical data such as anamnestic data, mechanism of injury, physical findings (size and depth of the burn), initial results of blood hemogram and biochemical tests, information on the existence of chronic diseases, the need for mechanical ventilation immediately after the patient's admission, and the outcome of the treatment (survived, died).

The study included adult patients treated in our institution, male or female persons, over 18 years of age with a burn injury whose severity requires hospital treatment (epidermal burns > 10% TBSA, dermal burns > 5% TBSA, subdermal > 2% TBSA, electrical injury, inhalation injury, chemical burn, circumferential burn, burn in patients with comorbidity, and burns of functional regions [face, hands, feet, genitals, major joints-knee, and elbow]).¹³

Criteria for exclusion from the research were as follows: patients with an associated injury or disease of another organ system which itself would require hospital treatment, patients with hematological diseases, patients with minor burn injuries (epidermal burn < 10% TBSA, dermal burn < 5% TBSA, as well as subdermal burn < 2% TBSA), and patients whose treatment was not completed in our institution.

Anamnestic data were taken from the medical records: age, sex, chronic diseases, mechanism of injury, presence of inhalation injury, the time elapsed from injury, and need for mechanical ventilation during transport or immediately after admission to the

hospital. Inhalation injury was defined by clinical criteria (facial burns, carbonaceous sputum, and stridor) and confirmed where possible by bronchoscopy findings or elevated carboxyhemoglobin levels. Vital parameters at admission (heart rate, arterial blood pressure, number of respirations, and body temperature) and examination of the burned region (assessment of the surface and depth of the injury) were noted from the physical findings. Atmospheric pressure data were taken from the Republic Hydrometeorological Institute of Serbia, which was used to calculate the APACHE II score.

Scores (APACHE II, ABSI, Ryan, Revised Baux, and Belgium outcome in burn injury [BOBI]) for predicting the severity of the injury and the expected outcome were calculated for each patient. The value of each score was calculated based on the recorded variables in the burn database.

Statistical analysis

Data are presented as mean $\pm$ standard deviation or median with interquartile range (P25-P75) for continuous variables and as frequency with associated percentage for categorical variables. The difference between two groups of continuous variables was determined using the t-test or the Mann-Whitney U-test depending on the normality of the distribution, which was determined using the Shapiro-Wilk test. Categorical variables were tested using the χ^2 test. For all tests, $p < 0.05$ was considered significant. The impact of laboratory analyzes on the death outcome was determined using logistic regression analysis. To determine the independent laboratory and clinical factors associated with mortality, multivariate logistic regression was used. The Hosmer-Lemeshow Test was employed to assess model calibration. The predictive power of the death outcome of the tested scores was determined using the receiver operating characteristics (ROC) curve. Limit values, sensitivity, specificity, positive, and negative predictive value (respectively) were determined. Statistical analyses were performed using the IBM Statistical Package for the Social Sciences Statistics 23 package.

Results

This study included 343 patients with burn injury treated at the University Clinical Center of Vojvodina during the 2015-2022 period. The mortality rate was

11.4%, so 39 of 343 patients in our study died. Characteristics of patients are presented in table 1.

The patients were 225 males (65.6%) and 118 females (34.4%), with an average age of 54 years. Survivors were statistically significantly ($t_{341} = -2.762$; $p = 0.006$) younger (52.91 ± 17.08 vs. 60.87 ± 15.72 years), with significantly lower ($Z = -6.655$; $p < 0.001$) TBSA (6% [3-11] vs. 40% [10-70]%) of those who died. About 94.9% deceased had full-thickness burn injury, which was substantially higher than those who survive ($p < 0.001$). In our research, there was no gender difference in relation to mortality ($\chi^2 = 0.022$; $df = 1$; $p = 0.881$). Inhalation injury had 11.7% of all patients. The rate of inhalation injury in surviving patients was 6.3%, which is significantly lower ($p < 0.001$) compared to those who died with inhalation injury with a rate of 53.8% (Table 1). Inhalation injury was defined by clinical criteria (facial burns, carbonaceous sputum, and stridor) and confirmed where possible by bronchoscopy findings or elevated carboxyhemoglobin levels.

Patients with a fatal outcome exhibited substantially higher levels of platelets, urea, and potassium, with a statistically significant difference ($Z = -3.235$; $p = 0.001$). Other laboratory indicators were similar between the groups (Table 2).

The results of the univariate logistic regression analysis of the impact of significant laboratory analyzes on the death outcome after burns presented in table 3 indicate that leukocytes, platelets, and potassium have a significant individual factor. The Hosmer–Lemeshow Test indicates good calibration for all three univariate models ($p > 0.05$) (Table 3).

Due to clinical relevance, we included significant variables from the univariate logistic regression analysis along with %TBSA and inhalation injury in the multivariate model. Significant predictors of mortality in the multivariate logistic regression are potassium (odds ratio [OR] = 2.661; 95% confidence interval [CI]: 1.532-4.621), %TBSA (OR = 1.093; 95% CI: 1.056-1.131), and inhalation injury (OR = 0.164; 95% CI: 0.051-0.533) (Table 4). The Hosmer–Lemeshow Test showed good calibration of the model ($\chi^2 = 5.588$; $p = 0.693$).

The mean scores of burn mortality scores presented in table 5 show a statistically significant higher value of all examined patients ($p < 0.001$) in the non-survivor group compared to the survivor group.

To determine the predictive abilities of the tested scores, ROC analysis was used, the results are presented in table 5, and the ROC curve is presented in figure 1.

Table 1. Characteristics burn patients

Characteristics	All (n = 343)	Survivor (n = 304)	Deceased (n = 39)	p
Age (years)*	53.82 $\pm$ 17.10	52.91 $\pm$ 17.08	60.87 $\pm$ 15.72	0.006
Gender#				0.881
Male	225 (65.6)	199 (65.5)	26 (66.7)	< 0.001
Female	118 (34.4)	105 (34.5)	13 (33.3)	< 0.001
TBSA (%)†	7 (3-13)	6 (2.5-11)	40 (10-70)	< 0.001
Full-thickness burn#				0.002
Yes	248 (72.3)	211 (69.4)	37 (94.9)	< 0.001
No	95 (27.7)	93 (30.6)	2 (5.1)	< 0.001
Inhalation injury#				< 0.001
Yes	40 (11.7)	19 (6.3)	21 (53.8)	< 0.001
No	303 (88.3)	285 (94.1)	18 (46.2)	< 0.001

*N (%): χ^2 test.

†Mean (SD): t-test.

‡Median (P25-P75): Mann–Whitney U-test.

p: significance level; SD: standard deviation; TBSA: total body surface area.

Table 2. Laboratory values; median (P25-P75)

Laboratory factors	Deceased (n = 39)	Survivor (n = 304)	p [#]
Leukocytes	10.51 (8.15-13.33)	11.54 (8,17-13,60)	0.256
Platelets	313 (171.25-444.25)	246 (201.50-279.50)	0.302
Hematocrit	0.38 (0.33-0.42)	0.37 (0.36-0.44)	0.445
Creatinine	80.5 (65.5-100.75)	80 (65-90)	0.800
Urea	6.25 (3.87-7.68)	5.50 (4.10-7.00)	0.449
Sodium	139 (137-141)	140 (138-142)	0.398
Potassium	4.40 (4.20-5.00)	4.11 (3.80-4.50)	0.001
Total bilirubin	9.00 (6.20-11.98)	9.10 (6.30-12.70)	0.540
Direct bilirubin	2.75 (1.95-3.90)	2.80 (1.70-3.90)	0.965

Mann–Whitney U-test.

P25-25: percentile; P75-75: percentile. Bolded values are statistically significant.

APACHE II score had an excellent predictive value with AUC = 0.915. Other scores had very good prediction with AUC > 0.800. Ryan score with AUC = 0.812 had the worst prediction of mortality. ABSI score and BOBI score better predicted surviving patients, because their specificity was higher than sensitivity (Table 6).

Discussion

This study compared the predictive accuracy of five commonly used burn mortality scores - APACHE II, ABSI, Ryan, rBaux, and BOBI and initial values of

Table 3. Univariate regression analysis of the impact of significant laboratory analyzes on the death outcome

Significant laboratory factors	Wald	p	OR	95% CI for OR		HL test (p)
				Lower	Upper	
Leukocytes	8.956	0.004	1.113	1.024	1.178	0.094
Platelets	11.734	0.000	1.016	1.009	1.027	0.076
Potassium	12.525	0.000	3.624	1.771	6.426	0.641

Wald: contribution of the predictor variable; p: statistical significance.

OR: odds ratio; 95% CI: 95% Confidence interval; HL: Hosmer-Lemeshow test.

Table 4. Multivariate regression analysis of predictors of mortality in burn patients

Significant factors	B	Wald	p	OR	95% CI for OR	
					Lower	Upper
Potassium	0.979	12.081	0.001	2.661	1.056	1.131
%TBSA	0.089	26.135	0.000	1.093	1.056	1.131
Inhalation injury	-1.807	9.050	0.003	0.164	0.051	0.533
Constant	-3.300	23.003	0.000	0.037		

B: regression coefficient; Wald: contribution of the predictor variable; p: statistical significance.

OR: odds ratio; 95% CI: 95% confidence interval; TBSA: total body surface area.

Table 5. Values of burn scores in relation to mortality; median (P25-P75)

Scor	All (n = 343)	Survivor (n = 304)	Deceased (n = 39)	p [†]
APACHE II	4 (2-8)	3 (2-6)	13 (10-17)	< 0.001
ABSI scor	6 (5-7)	6 (4-7)	9 (7-12)	< 0.001
Ryan	1 (0-1)	0 (0-1)	1 (1-2)	< 0.001
Revised Baux	66 (48-81)	63 (48-75)	97 (87-139)	< 0.001
BOBI	1 (0-2)	1 (0-2)	4 (3-7)	< 0.001

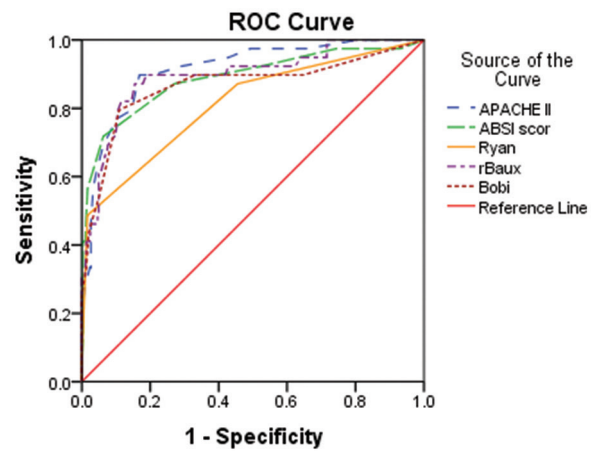
[†]Mann-Whitney U-test.

p: significance level.

APACHE II: chronic health evaluation II; ABSI: abbreviated burn severity index;

BOBI: Belgium outcome in burn injury.

biochemical parameters in one of the largest clinical centers in Serbia. The findings contribute valuable insights into the applicability of these models outside highly developed healthcare contexts, highlighting their strengths and limitations in predicting in-hospital mortality for burn patients. Furthermore, the results identify which initial values of the observed biochemical parameters may influence outcomes following



Diagonal segments are produced by ties.

Figure 1. Area under the curve curve for APACHE II, abdominal risk stratification index, Ryan, Revised Baux and Bobi score.

burn injuries. This information may guide clinicians in stratifying risk and optimizing treatment protocols based on individual patient profiles.

In our research, we found that among the initial median values of the analyzed parameters routinely assessed during the initial evaluation of burn patients, deceased individuals had elevated levels of potassium, platelets, and urea.

The only significant finding was the potassium level, which was significantly higher in deceased patients (4.40 vs. 4.11, $p = 0.001$). Elevated potassium levels may indicate extensive tissue (muscle) destruction, erythrocyte hemolysis, as well as impaired kidney function with poor clearance. This can make treatment more difficult and increase the risk of adverse outcomes.¹⁴

Interestingly, we found that the median platelet count was higher in deceased patients 313 (171.25-444, 25) compared to survivors 246 (201.50-279.50), although this difference did not reach statistical significance ($p = 0.302$).

This finding contrasts from previous studies suggesting that lower platelet counts might be indicative of septicemia or other pathologies.^{15,16} In our population, it may reflect a complex interaction between hemostatic responses and intravascular volume status, particularly as these patients had not yet undergone volume resuscitation, which can lead to hypovolemia and hemoconcentration.

Higher values of urea in the initial blood count 6.25 (3.87-7.68) in our results may be the reason for inadequate restitution of circulatory volume as well as

Table 6. Diagnostic performance assessment of revised APACHE II, ABSI, Ryan, Revised Baux, and Bobi score to predict mortality

Discriminant ability indicators	APACHE II	ABSI	Ryan	rBaux	BOBI
AUC	0.915	0.888	0.812	0.896	0.867
SE	0.024	0.035	0.042	0.031	0.040
P	0.000	0.000	0.000	0.000	0.000
95% CI	0.867-0.963	0.819-0.956	0.731-0.894	0.836-0.956	0.789-0.945
Cut-off value	7.5	7.5	0.5	81.5	2.5
Sensitivity	0.897	0.718	0.872	0.872	0.795
Specificity	0.832	0.937	0.545	0.845	0.891
PPV	0.743	0.636	0.950	0.696	0.773
NPV	0.970	0.986	0.984	0.987	0.982

AUC: area under the curve; SE: standard error; P: significance level CI: confidence interval; NPV: negative predictive value; PPV: positive predictive value; APACHE II: Chronic Health Evaluation II; ABSI: abbreviated burn severity index; Bobi: Belgium outcome in burn injury.

reduced renal filtration. In addition, in the initial hours after a burn injury, hypovolemia leads to tissue hypoperfusion, causing a shift from aerobic to anaerobic metabolism, with urea produced as a byproduct.

With univariate regression analysis, we evaluate the impact of significant laboratory values on mortality outcomes. Each analyzed laboratory parameter reveals distinct associations with the likelihood of death, highlighting critical markers that may aid clinicians in assessing patient prognosis. Potassium, platelets, and leukocytes were shown to have a statistically significant effect on the death outcome according to our results.

The relationship between leukocyte levels and thermal injury can be explained by the fact that an intense inflammatory reaction takes place shortly after the injury, which influences leukocyte numbers. A study by Osuka et al. further demonstrates that leukocyte levels can impact outcomes following major burns, showing that all blood cell counts were elevated on admission but subsequently decreased.¹⁷ Our findings indicate a significant association between serum potassium levels and mortality, with an OR of 3.624 (95% CI: 1.771-6.426).

In the multivariate regression analysis, a significant association was found between serum potassium (OR = 2.661), burn surface area (OR = 1.093), and inhalation injury (OR = 0.164).

In terms of scores, our results indicated that the APACHE II score demonstrated the highest accuracy among the models evaluated, although its complexity and reliance on numerous parameters, including hemodynamic and ventilation status, may limit its bedside

practicality in resource-constrained environments. Other models we compared had very good predictive power with AUC values ranging from 0.812 to 0.896, and prediction of mortality with statistical significance between the results of surviving and deceased patients ($p < 0.001$). Similar results regarding the predictive power of the scores were obtained in a study conducted in Croatia, a country that borders Serbia.¹⁸

The APACHE II score predicts mortality well, this finding aligns with numerous studies, such as those by Hassan et al. and other authors, who have observed.^{3,19,20} Many authors obtained worse values of this score.^{5,10} Although APACHE II score is not validated in burn injuries, its applicability to all critically ill patients provides a standardised objective assessment tool and can be useful in clinical decision-making.²¹ The rBaux score exhibited strong discriminative power (AUC of 0.896), comparable to findings by studies like Halgas et al., and other studies.^{3,9,10} The variability across different studies emphasizes the necessity of validating the predictive accuracy of the rBaux score.^{16,22,23} The ABSI score, while effective at predicting survivorship, demonstrated limited accuracy in predicting mortality within our cohort from the autonomous province of Vojvodina, which, according to 2022 data, had an HDI of 0.799.²⁴ This finding contrasts with studies by Wardhan and others, who reported excellent predictive power.^{5,9,25,26} This discrepancy suggests potential variability in outcomes based on population characteristics and the health-care context. In addition, other studies have reported

lower values of the AUC, indicating varying levels of predictive power.^{10,27}

Recent studies have highlighted the enhanced predictive accuracy of the modified abdominal risk stratification index (mABSI) in assessing mortality risk following burn injuries. By omitting gender as a contributing factor, the mABSI underscores the pivotal role of age in determining survival outcomes.²⁸ A comprehensive investigation conducted across five continents reveals that this refined scoring system is particularly effective in countries with a very high HDI. In contrast, in resource-limited settings, the original ABSI demonstrates superior predictive capabilities.²⁹

The BOBI score performed better than the Ryan score but still fell short of the APACHE II and rBaux scores in predicting mortality, which aligns with findings from Salehi and Wardhan's research.^{10,26} The Ryan score, heavily influenced by inhalation injury, often demonstrates reduced predictive accuracy due to variability in defining and diagnosing inhalation injuries, as shown in studies such as those by Pantet et al. and other studies.^{25,27} Mortality in our patient sample was 11.4%. There are studies in which this percentage is higher,^{9,10} but also studies in which the mortality of hospitalized patients after a burn injury is lower.²² Age, TBSA, and inhalation injury emerged as the most significant predictors of mortality. Our results confirmed that deceased patients had significantly higher values for these factors, consistent with established literature.^{30,31} As observed by Wardhana and supported by numerous studies, older age correlates with higher mortality risk.³² Patients with inhalation injuries (11.7%) exhibited notably higher mortality rates (53.8% vs. 6.3%), emphasizing the critical importance of accurate diagnosis and management of this factor. However, inconsistencies in defining inhalation injuries across studies may impact predictive accuracy and model performance.²³

The cutoff points for discrimination of high and low probability of mortality in this study are 7.5 for APACHE II and ABSI, 0.5 for Ryan, 81.5 for rBaux and 2.5 for BOBI score. Pantet et al. in a retrospective study obtained higher cutoff values of 8, 1, 93, and 4 for ABSI, Ryan, rBaux, and BOBI.²⁵ In our study, APACHE II score (89.7% vs. 83.2%), Ryan (87.2% vs. 54.5%), and rBaux (87.2% vs. 84.5%) were better in evaluating deceased patients, and ABSI and BOBI scores were better in evaluating surviving patients (93.7% vs. 71.8% and 89.15% vs. 79.5%).

The strength of this study resides in its comprehensive comparison of both older and newer scoring

models within a specific medium-income population. Most previous research has typically limited its analysis to three or four models, making our evaluation of five models particularly noteworthy. Furthermore, we investigated the biochemical parameters that are associated with poor outcomes in our cohort. Based on the results of this study, we concluded which model offers the greatest accuracy for routine clinical practice in our population and identified a laboratory parameter that could potentially inform the development of a new predictive score. While the retrospective nature of our data collection is recognized as a limitation, it concurrently reflects the realities of clinical practice.

In addition, large-scale meta-analyses indicate that AUC alone may not be sufficient for model comparison; statistical tests for correlated ROC curves (e.g., DeLong's test) and calibration analyses are recommended for definitive ranking. Future prospective research should incorporate these methods alongside net reclassification improvement and integrated discrimination improvement to assess whether biochemical parameters, such as potassium, provide incremental prognostic value beyond established scoring models. Ultimately, such parameters could serve as foundational data for the development of new scoring models.

Future research should concentrate on the prospective validation and adaptation of these models to accurately represent diverse healthcare settings and populations. In addition, efforts should be made to create a new scoring system that integrates relevant biochemical parameters for specific populations. This would improve their clinical utility and guide effective patient management, resource allocation, and enable clinicians to more adequately answer the family's first question, "how severe is the injury?"

Despite extensive research, there remains no clear consensus on the optimal predictive model for mortality following burn injury. This underscores the critical need for ongoing research to develop a more universal and accurate scoring system that can reliably predict outcomes across diverse populations and healthcare settings. In addition, this study places emphasis on the exploration of the initial values of biochemical parameters that could ultimately hold significance in the formulation of a novel predictive score.

Conclusions

The APACHE II score in this cohort showed the highest discriminative accuracy, other scores also had

very good prediction. Based on the analysis results, it is crucial to note that serum potassium levels, TBSA percentage, and the presence of inhalation injury are significant independent predictors of mortality in burn patients. These findings underscore the necessity for meticulous monitoring of these clinical parameters. Incorporating serum potassium levels into future scoring systems may enhance the accuracy of mortality predictions following burn injuries, ultimately improving patient outcomes.

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Conflicts of interest

The authors declare no conflicts of interest.

Ethical considerations

Protection of human subjects and animals. The authors declare that no experiments on humans or animals were performed for this research.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from all patients, and secured approval from the Ethics Committee. SAGER guidelines have been followed as applicable to the nature of the study.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing or creation of the content of this manuscript.

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