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Comparison of APACHE II and APACHE IV Scores in Predicting Mortality in the Surgical ICU (SICU) of a Tertiary Care Hospital - A Prospective Study

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ABSTRACT

Background: The postoperative surgical outcome in terms of serious complications and mortality remains a major challenge for operating surgeons. Severity scoring systems, such as APACHE II and APACHE IV, provide objective assessment of mortality risk and outcomes in critically ill patients. Most studies focus on medical ICUs, and calibration and discrimination of these scores vary across populations, highlighting the need for evaluation in surgical ICU patients.
Objectives: To evaluate APACHE II and APACHE IV in predicting mortality among Surgical ICU (SICU) patients and compare their accuracy in discrimination and calibration.
Methods: This prospective study included 50 SICU patients admitted to a tertiary hospital in Hassan in 2025. APACHE II and IV scores were calculated within 24 hours of ICU admission. Mortality prediction, discrimination, calibration and standardized mortality ratio (SMR) were assessed.
Results: Mean age was 49.5±12.4 years; 62% were male; mortality was 20%. Mean APACHE II and IV scores were 18.1 ± 12.96 and 65.2 ± 34.33. SMRs were 0.505 and 0.769, indicating lower-than-expected mortality. APACHE IV showed slightly better discrimination (AUC 0.994) than APACHE II (AUC 0.975). Both scores had excellent calibration (Hosmer–Lemeshow χ^2: II = 2.38, p = 0.969; IV = 5.26, p = 0.729). Logistic regression showed each unit increase in APACHE II increased odds of death by 54%, while APACHE IV increased odds by 32%.
Conclusion: Both APACHE II and IV reliably predict mortality in SICU patients, with APACHE IV showing slightly superior discrimination, supporting their use for risk stratification and clinical decisions.

Keywords: APACHE II, APACHE IV, Surgical ICU, Mortality Prediction, Calibration, Discrimination.

INTRODUCTION

The postoperative surgical outcome in terms of serious complications and mortality has been a major issue for the operating surgeons.[1] Hospitals and surgical teams try hard to improve the clinical outcome following surgery by minimizing postoperative complications and mortality. Marked variability in outcomes is inevitable because of differences in patients' preoperative risk factors, and the extent to which patients respond to surgical stress during the procedure further contributes to variation in patients' outcome.[2]

The implementation of a severity scoring system to assess the risk of mortality and outcomes in critically ill patients is a crucial component of contemporary evidence-based medicine, as these patients require continuous care and vigilant monitoring.[3] Predicting their conditions in a systematic manner based on specific objective factors is a crucial element of care quality in the ICU.[4] An adequate scoring system must be capable of identifying critically ill patients, assessing their prognosis, and establishing a standard for the upkeep of care standards in the ICU.[5]

For many years, surgical teams have depended on subjective evaluations of patients, leading to the creation of numerous physiology-based severity scoring systems to meet these objectives. [5] The challenges of calculating these scores at the bedside and the inconsistency in gathering the necessary data have made the Acute Physiology and Chronic Health Evaluation (APACHE) scoring systems the most widely utilized method for assessing in-hospital mortality.[6] The main feature of these scores is that, as these factors indicate organ insufficiency, the likelihood of hospital survival is determined by the worst physiological derangement identified in the first 24 hours following admission to an intensive care unit.[7]

APACHE-I was introduced in 1981 and encompassed 34 physiological metrics that are routinely collected in hospitals.[5] However, it was considered too complicated for practical use due to the multitude of variables it included. Knaus revised APACHE I, simplifying it to form a more straightforward and objective mortality prediction score, known as APACHE II, in 1985.[8] The assessment relies on twelve standard physiological metrics (temperature, heart rate, respiratory rate, mean arterial pressure, arterial pH, PaO_2, serum sodium levels, serum potassium levels, serum creatinine, hematocrit, leukocyte count, and the Glasgow Coma Scale), age, and chronic health points.[9] The overall physiological derangement score is calculated by adding up the individual scores (ranging from 0 to 4) for each metric, with the exception of the Glasgow Coma Scale (GCS), for which the score is determined by subtracting the GCS value (from 0 to 15) from 15. The most abnormal value observed during the initial 24 hours of ICU admission is what is recorded for each metric. To the total physiological derangement score, an age score (from 0 to 6) and chronic health points for patients facing severe organ failure are included (2 to 5 based on whether they are admitted for a nonoperative condition, elective, or emergency operation).[10]

Then APACHE III system with 0 to 299 score was designed, but the APACHE III calculator was expensive software and had many pitfalls, leading to its limited clinical utility.[11] The APACHE IV scoring system was launched in 2006 as an enhanced and updated model for forecasting hospital mortality in critically ill patients and represents the latest refined version of the APACHE scoring system.[12]This model encompasses new predictor variables such as mechanical ventilation, thrombolysis, the PaO_2/FiO_2 ratio, the effects of sedation on the Glasgow Coma Scale, the duration of hospital stay before ICU admission, and disease-specific subgroups, along with the changes made in the APACHE III model.[13]

To date, most studies comparing these two scoring systems have been conducted in Western countries, and there is limited data on the performance of APACHE II and APACHE IV in predicting mortality among

ICU patients in India. Research from the USA has shown that the APACHE IV model provides excellent discrimination and calibration. Studies from other Western populations have reported that APACHE IV offers better discrimination but somewhat lower calibration compared to APACHE II. Most of the existing literature has focused primarily on Medical ICUs. Therefore, this study aims to evaluate the effectiveness of APACHE II and APACHE IV in predicting mortality among patients in the Surgical ICU.

Objectives

1. To evaluate APACHE II and APACHE IV scoring systems in predicting mortality among Surgical Intensive Care Unit (SICU) patients.
2. To compare the relative accuracy and performance of APACHE II and APACHE IV in predicting mortality in SICU patients, with emphasis on discrimination and calibration.

MATERIALS & METHODS

This prospective observational study was conducted in 2025 at Hassan Institute of Medical Sciences (HIMS), Teaching Hospital, Hassan, and included all patients admitted to the Surgical Intensive Care Unit (SICU). Patients undergoing elective or emergency surgery under general, spinal, or epidural anaesthesia requiring postoperative ICU care, as well as those admitted directly to the SICU, were included. Patients who were unwilling to participate, pregnant patients, or those with incomplete data required for APACHE scoring were excluded. The initial sample size was calculated as 47 using online software,[14] based on an area under the ROC curve of 0.74 and a mortality rate of 49% from a previous study by Varghese et al. [15] Accounting for 5% attrition, the final derived sample size was 49, and a total of 50 patients were included. Consecutive sampling was applied, including all eligible patients admitted during the study period until the target sample size was achieved. The study was conducted after obtaining approval from the Institutional Ethics Committee and informed consent from participants or their attendants.

Each patient underwent detailed history taking, clinical examination, and routine and special laboratory investigations. Pre-existing organ dysfunctions such as chronic renal failure, cirrhosis, hepatic failure, metastatic carcinoma, lymphoma, myeloma, leukaemia, heart disease, immunosuppression, and AIDS, as well as comorbidities including pneumonia, stroke, diabetes mellitus, and hypertension, were documented. Surgical procedures were performed according to clinical findings and the surgeon's discretion.

APACHE II scores were recorded during the first 24 hours of SICU admission and calculated using Clincalc.com.[16] The score included the Acute Physiological Score (APS), age points, and chronic health points. APS comprised twelve physiological variables: temperature, heart rate, respiratory rate, mean arterial pressure, arterial pH, PaO2, serum sodium, serum potassium, serum creatinine, hematocrit, leukocyte count, and Glasgow Coma Scale (GCS).

APACHE IV scores were recorded during the first 24 hours of ICU admission and calculated using IntensiveCareNetwork.com.[17] It included additional predictors such as mechanical ventilation, thrombolysis, PaO2/FiO2 ratio, serum albumin, bilirubin, blood sugar level, urine output, effects of sedation on GCS, and duration of hospital stay prior to ICU admission.

Investigations performed for each patient included complete blood count (CBC) and hematocrit, blood grouping and Rh typing, bleeding and clotting times, HIV and HBsAg screening, blood urea, serum creatinine, blood sugar, serum electrolytes, albumin, bilirubin, urine analysis (albumin, sugar, microscopy), chest X-ray, abdominal and pelvic ultrasound when indicated, and arterial blood gas (ABG) analysis.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Jamovi version 2.7.12. Continuous variables were summarized as mean ± standard deviation (SD) with 95% confidence intervals (CI), and categorical variables were expressed as frequencies and proportions with 95% CI. Associations between diagnosis and mortality were assessed using the Chi-square test. Independent t-test was used to compare mean APACHE II and APACHE IV scores between survivors and non-survivors. The accuracy of each scoring system was evaluated using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the receiver operating characteristic curve (AUC). Calibration and discrimination were assessed using the Hosmer–Lemeshow goodness-of-fit test and ROC curves, and standardized mortality ratio (SMR) was calculated to compare observed and predicted mortality. All tests were two-tailed, and $p < 0.05$ was considered statistically significant

RESULT

Patient Characteristics and Descriptive Statistics

Among the 50 SICU patients, the mean age was 49.5 ± 12.4 years (median 49.0, range 22–74). The majority were male (62.0%, 95% CI: 47.2–75.3), and 46.0% (95% CI: 31.8–60.7) required mechanical ventilation during their ICU stay. ICU readmission occurred in 12.0% (95% CI: 4.5–24.3) of patients. Overall, 20.0% (95% CI: 10.0–33.7) of patients died, and 80.0% (95% CI: 66.3–90.0) survived. Most admissions were emergency surgeries (88.0%, 95% CI: 75.7–95.5), while 2.0% were elective and 10.0% were direct SICU admissions.

The mean APACHE II score was 18.1 ± 12.96, and the mean APACHE IV score was 65.2 ± 34.33, Predicted mortality by APACHE II averaged 39.5% ± 33.8, while APACHE IV predicted 26.1% ± 25.1. The mean hospital stay was 6.32 ± 2.71 days, ICU stay 2.92 ± 1.29 days, and days on mechanical ventilation 1.26 ± 1.77 days. (Table 1)

Table 1: Baseline Characteristics of Study participants.

Variables	Mean ± SD / n (%)	95% CI	Median	Range
Age (years)	49.5 ± 12.4	46.0 – 53.0	49.0	22 – 74
Sex				
Female	19 (38.0)	24.7 – 52.8		
Male	31 (62.0)	47.2 – 75.3		
Ventilation				
Yes	23 (46.0)	31.8 – 60.7		
No	27 (54.0)	39.3 – 68.2		
ICU Readmission				
Yes	6 (12.0)	4.5 – 24.3		
No	44 (88.0)	75.7 – 95.5		
Outcome				
Died	10 (20.0)	10.0 – 33.7		
Survived	40 (80.0)	66.3 – 90.0		
Type of Surgery				
Elective	1 (2.0)	0.05 – 10.6		
Emergency	44 (88.0)	75.7 – 95.5		
Direct SICU Admission	5 (10.0)	3.3 – 21.8		
APACHE Score				
II	18.06 ± 12.96	14.38 – 21.74	14.0	2 – 46
IV	65.2 ± 34.33	55.45 – 74.96	55.0	20 – 139
Expected Mortality By APACHE				
II	39.54 ± 33.80	29.93 – 49.14	22.75	4.10 – 97.60
IV	26.07 ± 25.10	18.93 – 33.20	13.95	1.40 – 87.60
Hospital Stay (days)	6.32 ± 2.71	5.55 – 7.09	6.5	1 – 12
ICU Stay (days)	2.92 ± 1.29	2.55 – 3.29	3.0	1 – 8
Days on Ventilator	1.26 ± 1.77	0.76 – 1.76	0.0	0 – 8

Diabetic Foot / Diabetic Wet Gangrene was the most common diagnosis (30% of cases) with no deaths, while peritonitis secondary to perforation accounted for 28% of cases and had the highest number of deaths (40% of total deaths). Obstruction (20% of cases) and other miscellaneous diagnoses contributed smaller proportions of mortality. But it was not found statistically significant (p>0.05). (Table 2)

Table 2: Association between Patient Diagnosis and Mortality.

Diagnosis	No. of cases (%)	No. of deaths (%)
Diabetic Foot / Diabetic Wet Gangrene	15 (30)	0 (0)
*Peritonitis secondary to perforation (Appendicular, Hollow Viscus, Post Cholecystectomy bile leak, Ruptured Gallbladder)	14 (28)	4 (40)
Obstruction	5 (10)	2 (20)
Trauma (Multi trauma with head injury and Extremities/Chest/Abdomen)	4 (8)	1 (10)
Necrotising Fascitis	4 (8)	1 (10)
Severe Pancreatitis	3 (6)	1 (10)
**Other Miscellaneous (Hernias, Carbuncle, Volvulus, Multinodular Goitre)	5 (10)	1 (10)
Total	50 (100)	10 (100)

Chi-square Test: χ^2=4.3942, df=6, p=0.6235

[*Died: 1Ruptured gall bladder with biliary peritonitis, 1Bull Gore Abdominal Penetration with intestinal perforation,2 Hollow viscous perforation. ** Died: Strangulated Incisional Hernia]

Table 3 shows the comparison of mean and median APACHE II and APACHE IV scores between survivors and non-survivors in the SICU. Non-survivors had substantially higher scores than survivors for both APACHE II (36.4 vs. 13.5) and APACHE IV (117 vs. 52.2), reflecting greater illness severity. The differences were statistically significant (p <0.05) indicating that both scoring systems effectively distinguish between survivors and non-survivors.

Table 3: Mean Score Comparison of APACHE II and APACHE IV Between Survivors and Non-Survivors.

Score	Outcome	Mean ± SD	Median	Mean Difference (95% CI)
APACHE II	Died (10)	36.4 ± 4.67	36.5	22.9 (16.4–29.4)
	Survived (40)	13.5 ± 9.90	10.0	
APACHE IV	Died (10)	117 ± 14.2	115	65.0 (49.1–80.9)
	Survived (40)	52.2 ± 23.8	45.0	

Independent t-test: APACHE II: t (48) = 7.08, p < 0.001, APACHE IV: t (48) = 8.23, p < 0.001

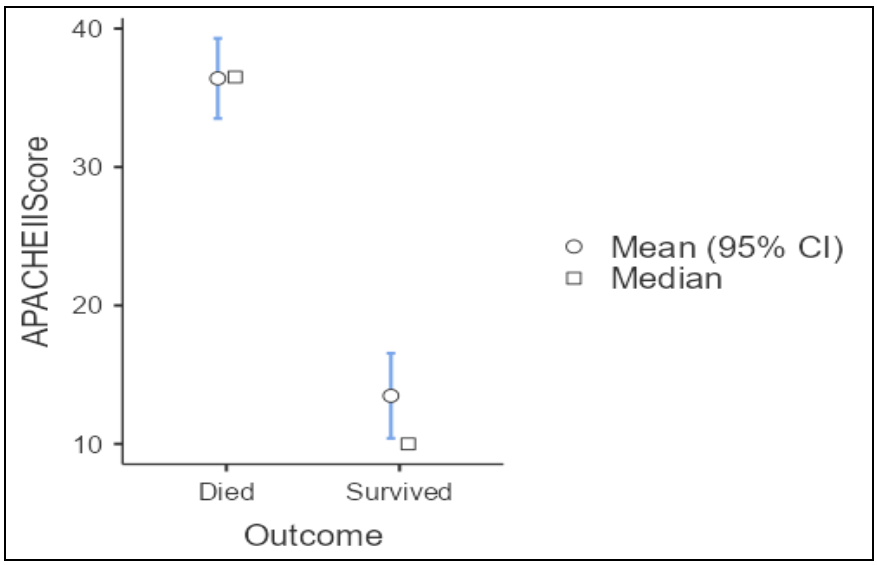

Figure 1: Interval Plot showing median and mean APACHE II scores with 95% confidence intervals (CI).

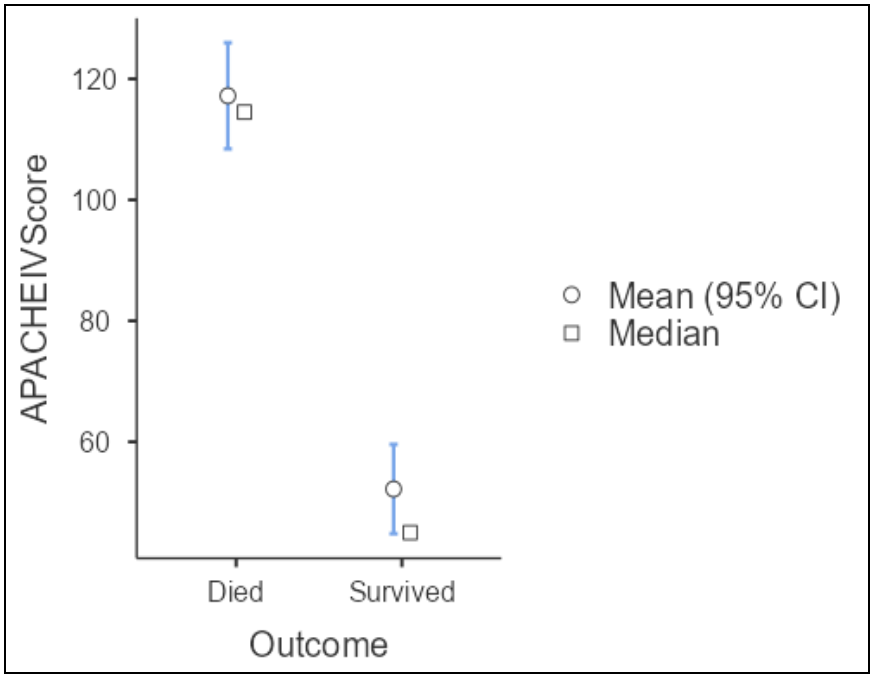

Figure 2: Interval Plot showing median and mean APACHE IV scores with 95% confidence intervals (CI).

Mortality Prediction for APACHE II and IV

Among the 50 SICU patients, 10 died (20.0%, 95% CI: 10.0–33.0) and 40 survived (80.0%, 95% CI: 66.3–90.0). The mean expected mortality was 0.395 for APACHE II (sum = 19.8) and 0.261 for APACHE IV (sum = 13.0). The Standardized Mortality Ratios (SMR) were 0.505 for APACHE II and 0.769 for APACHE IV, indicating lower-than-expected mortality for both systems in this cohort (Table 4).

Mean predicted mortality increased with higher APACHE II and APACHE IV score categories. For APACHE II, it ranged from 10.4% in the low category to 92.2% in the very high category. For APACHE IV, it ranged from 5.45% in the low category to 76.3% in the very severe category. Differences across categories were statistically significant for both scores ($p < 0.005$). (Table 5)

Univariate binary logistic regression was performed to assess the predictive ability of each score. APACHE II demonstrated a stronger and statistically significant association with mortality (Exp(B) = 1.544, 95% CI: 1.064–2.241), indicating that each one-unit increase in the score increased the odds of death by approximately 54%. APACHE IV showed a 32% increase in the odds of death per unit increase (Exp(B) = 1.316, 95% CI: 0.975–1.777), although this association did not reach statistical significance. (Table 6)

Table 4: Mortality Prediction and Standardized Mortality Ratio (SMR).

Score	Mean ± SD	Observed Deaths	Expected Deaths	SMR
APACHE II	0.395 ± 0.338	10	19.8	0.505
APACHE IV	0.261 ± 0.251	10	13.0	0.769

Table 5: Predicted Mortality Across APACHE II and APACHE IV Score Categories.

Score	n	Mean ± SD	SE	p-value
APACHE II				
Low (<10)	21	10.4 ± 3.59	0.78	<0.001
Mild (10–19)	8	22.5 ± 8.91	3.15	<0.001
Moderate (20–29)	5	53.1 ± 18.90	8.45	<0.001
High (30–39)	14	80.5 ± 16.58	4.43	<0.001

Very High (40-49)	2	92.2 ± 7.71	5.45	<0.001
APACHE IV				
Low (<40)	14	5.45 ± 3.37	0.90	<0.001
Medium (40-79)	20	16.77 ± 12.84	2.87	<0.001
Severe (80–119)	12	48.86 ± 17.02	4.91	<0.001
Very Severe (120-139)	4	76.30 ± 11.64	5.82	<0.001

Table 6: Univariate Binary Logistic Regression Analysis of APACHE II and APACHE IV

Score	B	SE	Exp(B)	95% CI for Exp(B)
APACHE II	0.434	0.190	1.544	1.064 – 2.241
APACHE IV	0.275	0.153	1.316	0.975 – 1.777

Discrimination of APACHE II and IV

The ability of APACHE II and APACHE IV to distinguish between survivors and non-survivors was evaluated using Receiver Operating Characteristic (ROC) curves. The Area Under the Curve (AUC) reflects overall discriminatory performance, with values ranging from 0.5 (no discrimination) to 1.0 (perfect discrimination). APACHE IV achieved an AUC of 0.994, while APACHE II had an AUC of 0.975, both indicating excellent discriminatory ability (Table 7, Fig.3).

The diagnostic accuracy of the two scoring systems is summarized below. APACHE IV demonstrated slightly higher sensitivity (92.5% vs. 90.0%), negative predictive value (76.9% vs. 71.4%), and overall accuracy (94.0% vs. 92.0%) compared to APACHE II. Both scores showed perfect specificity and positive predictive value (100%), suggesting that when mortality was predicted, it was highly reliable with no false positives in this dataset. (Table 8)

Table 7: Discriminatory Ability of APACHE II and APACHE IV Using AUC.

Score	AUC	Std. Error	95% Confidence Interval	p-value
APACHE IV	0.994	0.007	0.980 – 1.00	<0.001
APACHE II	0.975	0.018	0.940 – 1.00	<0.001

Figure 3: Receiver Operating Characteristic (ROC) Curves for APACHE II and APACHE IV

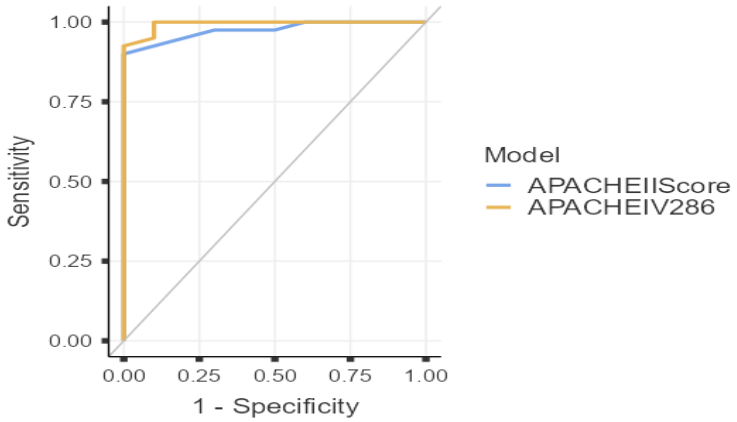

Table 8: Diagnostic Accuracy Metrics of APACHE II and APACHE IV.

Metric	APACHE II Value		APACHE IV	APACHE IV
	%	95%CI	%	95% CI
Sensitivity	90.00	76.34 – 97.21	92.50	79.61 – 98.43
Specificity	100.00	69.15 – 100.00	100.00	69.15 – 100.00
PPV	100.00	—	100.00	—
NPV	71.43	49.66 – 86.37	76.92	52.89 – 90.82
Accuracy	92.00	80.77 – 97.78	94.00	83.45 – 98.75
Prevalence	80.00	66.28 – 89.97	80.00	66.28 – 89.97

Calibration of APACHE II and IV

Both APACHE II and APACHE IV showed excellent calibration. The Hosmer–Lemeshow chi-square was 2.38 (p = 0.969) for APACHE II and 5.26 (p = 0.729) for APACHE IV, indicating no significant difference between observed and predicted mortality. This demonstrates that both models reliably estimated mortality across low-, medium-, and high-risk patient groups. (Table 9)

Table 9: Hosmer–Lemeshow Goodness-of-Fit Test

Scores	Chi-square (χ^2)	df	p-value
APACHE II	1.121	8	0.976
APACHE IV	0.330	7	1.000

DISCUSSION

Patient Characteristics and Observed Mortality

In the present SICU cohort of 50 patients, the mean age was 49.5 ± 12.4 years, 62% were male, and 46% required mechanical ventilation. Overall mortality was 20%. These findings align with prior studies. For example, Venkataraman et al. [9] reported 1,670 ICU patients with similar mortality (22.4%), and Moses et al. [18] observed 15.8% mortality in abdominal trauma patients.

Nagar VS et al. [12] reported a higher mortality rate of 44.66%. Non-survivors consistently had higher severity scores and required more intensive ICU support. Internationally, Karami Niaz et al. [19] reported excellent APACHE IV discrimination (AUC 0.902) in trauma and non-trauma ICU patients, particularly strong in non-trauma cases, while Ghazaly et al. [20] found APACHE IV (AUC 0.766) outperformed SAPS III and SOFA for mortality prediction in surgical/trauma critical care patients.

Predicted Mortality and Standardized Mortality Ratios (SMR)

Predicted mortality increased progressively with higher APACHE II and APACHE IV categories in the present study (10.4–92.2% for APACHE II; 5.45–76.3% for APACHE IV), with SMRs of 0.505 and 0.769, indicating lower-than-expected mortality. This aligns with Venkataraman et al. [9] where APACHE IV predicted mortality more accurately than APACHE II (29.1 ± 28.5% vs. 44.8 ± 26.7%), with SMRs closer to 1. Choi et al. [21] also reported an SMR of 1.00 for APACHE IV.

Smaller cohorts, such as Kavitha and Mayi (n=57),[22] showed that APACHE IV better separated survivors and non-survivors, although local calibration limitations affected predictive accuracy. Shukla S et al. [11] demonstrated that APACHE IV predicted mortality more accurately than APACHE II in SICU patients, with cutoffs of II > 12 and IV > 54, further supporting APACHE IV's superior predictive ability. International surgical and mixed ICU studies, including those by Karami Niaz et al. [19] and Ghazaly et al. [20] also demonstrated reliable mortality prediction with APACHE IV.

Discrimination of APACHE II and IV

APACHE IV generally demonstrated superior discrimination in the present study (AUC 0.994 vs. 0.975). Similar trends were observed in other studies: Nagar et al. [12] (AUC 0.832 for IV vs. 0.805 for II), Varghese et al. [15] (AUC 0.82 for IV vs. 0.75 for II), and Siddiqui et al. [23] (AUC 0.73 for APACHE IV with good calibration in a medical-surgical ICU cohort).

Dronamraju et al. [24] reported that while APACHE IV was associated with mortality, it was outperformed by the PIRO score in sepsis patients. Kalarickal et al. [25] found an AUC of 0.811 for APACHE IV in surgical subgroups, better than in the overall medical cohort. Shukla S et al [11] found AUCs of 0.987 (II) and 0.994 (IV), confirming APACHE IV's higher accuracy. Karami Niaz et al. [19] observed AUC 0.902 in trauma and non-trauma ICU patients, while

Ghazaly et al. [20] reported AUC 0.766 in surgical/trauma ICUs. Bloria et al. [13] noted slightly better discrimination with APACHE II in septic shock patients (0.78 vs. 0.74).
Overall, APACHE IV tends to be superior in heterogeneous surgical or mixed ICU populations, while APACHE II may perform comparably in high-risk subgroups or smaller cohorts.

Calibration and Risk Stratification

Calibration analysis in the present study showed excellent agreement between predicted and observed mortality for both APACHE II and IV based on the Hosmer–Lemeshow (HL) goodness-of-fit test. Siddiqui et al. [23] reported good APACHE IV calibration (HL p = 0.723) in a cancer ICU cohort. Venkataraman et al. [9] and Nagar et al. [12] also found APACHE IV calibration better than APACHE II, though local recalibration was recommended. Shukla S et al. [11] confirmed that APACHE IV predictions aligned closely with observed mortality in SICU patients. International studies in surgical and mixed ICUs, including those by Karami Niaz et al. [19] and Ghazaly et al. [20] also demonstrated good APACHE IV calibration. Other cohorts, such as Varghese et al. [15] and Kalarickal et al. [25] emphasized that mixed or medical-heavy populations may require population-specific recalibration.

Predictive Association and Clinical Utility

Univariate logistic regression in the present study showed that each unit increase in APACHE II increased the odds of death by 54% (Exp(B) = 1.544, 95% CI: 1.064–2.241), whereas APACHE IV increased the odds by 32% (Exp(B) = 1.316, 95% CI: 0.975–1.777). These results align with Kavitha and Mayi.[22] Moses et al. [18] and international cohorts such as Karami Niaz et al. [19] and Ghazaly et al. [20] where APACHE IV effectively stratified risk but required local calibration for accurate mortality prediction. Shukla S et al. [11] demonstrated strong predictive association for APACHE IV in SICU patients, with improved discrimination compared to APACHE II. The slightly better discrimination of APACHE IV and the strong predictive association of APACHE II indicate that both systems remain useful for mortality prediction and clinical decision-making in SICU and mixed ICU settings.

CONCLUSION

In this prospective study of 50 SICU patients, both APACHE II and APACHE IV scoring systems effectively predicted postoperative mortality. APACHE IV demonstrated slightly superior discrimination, as evidenced by a higher AUC, while both scores showed excellent calibration, indicating accurate alignment between predicted and observed outcomes.
The standardized mortality ratios suggested lower-than-expected mortality in this cohort, highlighting potential improvements in perioperative care. Logistic regression analysis confirmed that increasing APACHE II and IV scores were associated with higher mortality risk, with APACHE II showing a statistically significant predictive association.
These findings support the use of both scoring systems for risk stratification, guiding clinical decision-making, and optimizing postoperative management in surgical ICU patients. Incorporating these objective tools into routine ICU practice may enhance early identification of high-risk patients and improve resource allocation, ultimately contributing to better patient outcomes.

Declaration by Authors

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