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Original Research Article

Clinical audit of a respiratory intensive care unit – evaluating outcomes via the acute physiology and chronic health evaluation II system

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ABSTRACT

Background: The acute physiology and chronic health evaluation II (APACHE II) score is widely used to assess illness severity and predict mortality in critically ill patients. This study evaluated its usefulness for mortality prediction in a respiratory intensive care unit (RICU).
Methods: A prospective observational study included 80 consecutive RICU admissions over six months at a tertiary-care hospital. APACHE II scores were calculated using the worst physiological values recorded during the first 24 hours of admission. Predicted mortality was compared with observed mortality, and associations with age, sex, APACHE II score, and diagnostic category were assessed.
Results: Of 80 patients, 54 survived and 26 died, giving an observed mortality of 32.5%. Mean age was 42.1±20.642.1/pm 20.642.1±20.6 years, mean APACHE II score was 12.43±10.812.43/pm 10.812.43±10.8, and mean predicted mortality was 23.9%. Non-survivors were older and had significantly higher APACHE II scores than survivors (p=0.0001, p=0.0001, p=0.0001 and p=0.001, p=0.001, p=0.001, respectively). Mortality increased with advancing age and higher APACHE II score categories, reaching 80% among patients with scores of 30–34 and >34. Male patients had higher observed mortality than female patients (44.68% versus 15.15%; p=0.006, p=0.006, p=0.006). Respiratory and trauma cases had the highest observed mortality (66.66% each).
Conclusions: APACHE II is a useful tool for early risk stratification of RICU patients. Higher APACHE II scores and older age were strongly associated with mortality; however, the score underestimated overall mortality in this cohort. Periodic local validation is recommended.

Keywords: APACHE II, Respiratory intensive care unit, Mortality, Severity scoring, Critical care

INTRODUCTION

The patients that intensive care units (ICU) deal with are those who experience fast changing physiological instability and thus, early and objective measurement of severity are the main factors that help in prognosis, triage, and rational utilization of limited critical care facilities. Severity scoring systems are thus common in quantifying the burden of illness, comparing groups of patients, aiding in audit, and assessing the performance of an ICU in different institutions.[1] The acute physiology and chronic health evaluation II (APACHE II) score is one of the most commonly used systems of available prognostic tools since the score is a practical summary of the severity of the disease in the first 24 hours of ICU admission by combining physiological variables measured routinely, age, and chronic health status. Modern reviews still refer

to APACHE II as a significant outcome-prediction tool to estimate mortality and risk stratification, particularly in the context where simpler and more established tools are to be used in the field.[2,3] Recent research has indicated that APACHE II continues to have clinically useful prognostic utility in contemporary ICU. A 2023 study based on real-world electronic medical record data found that APACHE II was good at in-hospital mortality, with an AUROC of 0.83, and increased scores also predicted longer ICU stay. In another 2023 validation study, APACHE II proved to be an important predictor of ICU mortality, as well as handy as a triage tool during critical care bed high demand. Meanwhile, existing literature also stresses that the level of severity scores can differ depending on the case-mix, disease category and region and that the severity scores should be periodically locally validated prior to their being used to benchmark or compare prognostic performance. A 2021 review of ICU scoring systems has reported that improper application or use in populations other than those in which the model was originally created may decrease calibration and give inappropriate mortality estimates. In a similar manner, a 2021 Lancet Digital Health study raised the issue of bias and inconsistent performance of ICU severity models in a heterogeneous population.[4] A number of recent studies have contrasted APACHE II with other severity measures like SOFA, SAPS II and APACHE IV. A 2022 randomized ICU patient study found that APACHE II was as discriminating of mortality as SAPS II and APACHE IV, but APACHE II-predicted mortality was lower than observed mortality in some subgroups. Another study in the ICU patients with neurological disorders (2024) also revealed that the outcome prediction may vary according to the patient population, which supports the necessity of context-related evaluation of the scoring tools.[5,6]

APACHE II remains popular in low- and middle-resource environments due to familiarity, feasibility, and reliance on standard clinical and laboratory parameters despite the advent of newer models. In a 2023 study, progressively more categories of APACHE II were found to correspond with a progressively higher rate of mortality, supporting its usefulness as a predictive tool in patients in critical conditions. Such stratification is of particular interest in respiratory critical care, where patients frequently present with acute ventilatory failure, severe infection, exacerbation of chronic lung disease, and multisystem complications, with the aim of outcome prediction and prioritization of care.[7] Nevertheless, the evidence on the particular respiratory ICU facilities in India is sparse and the variations in the admission patterns, disease burden, staffing, and resources could affect the correlation between the predicted and observed mortality.

The given study was thus conducted to evaluate the usefulness of the APACHE II scoring system in patients regardless of admission to a respiratory intensive care unit of a tertiary care hospital in South India and to compare the predicted mortality with clinical outcomes.

METHODS

Study design

The study was conducted as an observational research project which took place over a six-month period at the Sri Venkateswara Institute of Medical Sciences Tirupati South India respiratory intensive care unit (RICU). The research objective was to evaluate how effectively the APACHE II scoring system predicts RICU patient mortality.

Study setting

The RICU is a tertiary care teaching hospital with 14 beds that are all mechanically ventilated and continuously monitored. The unit consisted of a senior consultant, one senior resident, three junior residents, trained nursing staff, and bedside assistants, which guaranteed the standardized care and constant monitoring of patients.

Study population

Eighty patients who were either admitted to the RICU in a row and had been admitted at least two times were included in the study period. Patients under the age of 12, less than 24 hours hospital stay, and non-critically ill patients transferred on observations on administrative grounds were not considered. Sequential cases were included to minimize selection bias and were representative of the regular cases of the unit.

Data collection

The collection of clinical data was done by one investigator to ensure consistency. The APACHE II scoring has been computed with the most adverse values of 12 physiological and laboratory variables, observed in the first 24 hours of ICU admission. The total score also included age and chronic health status. Also, demographic information, ICU stay, and ultimate outcome were recorded in each patient.

Outcome measures and analysis

The main outcome was the survival to hospital discharge, which was categorized as survivor or expired. The APACHE II scoring formula was used to predict mortality which was compared with observed mortality. Subgroup analysis was also conducted using age and APACHE II score as the two basis for separation. The researchers conducted statistical analysis using suitable tests which included Student t-test and Chi-square test and Fisher exact test and analysis of variance. The results showed a p value which reached 0.05 thus researchers considered it to be statistically significant.

RESULTS

The RICU had 80 patients who were admitted in the six months study period. Out of these, 54 patients survived and

26 died leading to a general observed mortality of 32.5. The age of the patients admitted was 42.1±20.6 years and the mean APACHE II score on admission was 12.43±10.8. The mean duration of ICU stay was 12.81±12.27 days. The total predicted mortality was 23.9 which was less than the observed mortality which was 32.5 but this difference was not significant (p=0.137). These results indicate that whereas APACHE II underestimated the mortality in the current cohort; it still proved useful as a clinical severity measure.

Table 1: Baseline characteristics of patients admitted to the RICU.

Variables	Value
Total number of patients	80
Survivors	54 (67.5%)
Expired patients	26 (32.5%)
Mean age (years)	42.1±20.6
Mean APACHE II score	12.43±10.8
Mean ICU stay (days)	12.81±12.27
Mean predicted mortality (%)	23.9
Observed mortality (%)	32.5
P value	0.137

When comparing survivors and expired patients, there were great variations in terms of age and APACHE II score. The survivors had an average age of 36.1 years which included a standard deviation of 19.1 years and the deceased patients had an average age of 54.6 years with a standard deviation of 17.9 years which created a statistically significant difference between the two groups according to the result of (p=0.0001). The mean APACHE II score of survivors showed a statistical difference because their score of 11.44±8.7 points was lower than the score of expired patients who had 23.73±10.05 points and the difference between the two was significant (p=0.001). The two groups showed identical ICU stay patterns because survivors stayed for 12.76±13.11 days and expired patients stayed for 12.96±10.5 days which created no statistically significant difference according to (p=0.476). The research established a strong link between APACHE II score and age with mortality rates but ICU stay length showed no such connection.

Table 2: Comparison of survivors and expired patients.

Variables	Survivors	Expired patients	P value
Mean age (years)	36.1±19.1	54.6± 17.9	0.0001
Mean ICU stay (days)	12.76± 13.11	12.96± 10.5	0.476
Mean APACHE II score	11.44±8.7	23.73± 10.05	0.001

Predicted mortality was also significantly different between survivors and non-survivors. The average estimated mortality of the survivors was 14.79 and standard deviation was 17.2 and the average mortality of the expired patients was 42.81 and standard deviation was 27.8. This was a very significant difference (p =0.0001) whereby patients who died had significantly greater predicted mortality at admission. The observation confirms that the APACHE II scoring system is helpful in differentiating between low-risk and high-risk patients in the RICU.

Table 3: Comparison of predicted mortality between survivors and expired patients.

Variables	Survivors	Expired patients	P value
Predicted mortality (%)	14.79±17.2	42.81±27.8	0.0001

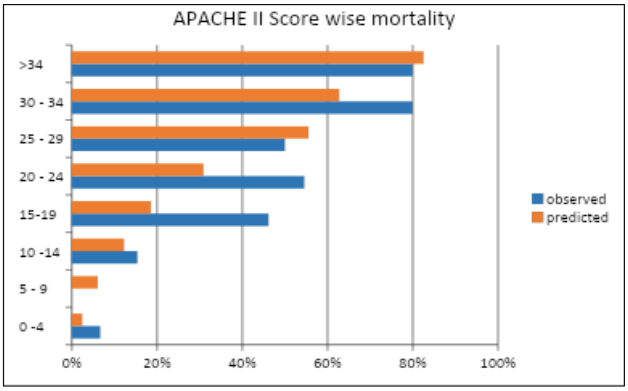

Figure 1: Comparison of predicted mortality between survivors and expired patients.

Sex-wise analysis revealed that majority of ICU admissions were of male patients. Of the 80 patients, 47 patients were male and 33 were female. The male population experienced 21 deaths while 26 males died which resulted in a mortality rate of 44.68. The female population experienced 5 deaths while 28 patients survived which resulted in a mortality rate of 15.15. The study results showed that male and female mortality rates showed statistical dissimilarity with a p value of 0.006. The two groups displayed no significant variation in their average expected death rates. The predicted male death rate stood at 25.03±26.4% whereas females showed a predicted death rate of 22.28±22.7% with a p value of 0.62. The APACHE II predicted mortality did not accurately reflect the increased male mortality which the study observed.

Additional comparison of baseline features of male and female patients showed that males were older than females significantly. The mean age of male patients was 47.5±21.04 years, whereas female patients had a mean age of 34.48±17.44 years (p=0.0017). The APACHE II score showed no significant difference between males and females because males scored 16.04±11.19 and females scored 14.57±10.32 (p=0.273). The ICU stay duration

which lasted 13.89±13.26 days for males and 11.27±10.71 days for females did not show any significant statistical difference (p=0.166). These findings suggest that the fact that the mortality of males is higher can be partially explained by the fact that they are older.

The age analysis showed that both the observed and the predicted mortality showed an upward trend as the age advances. There were 28 patients aged 1229 years and only 2 died giving an observed mortality of 7.14, predicted mortality of 8.03±8.3. Within 3060 years age bracket, 34 patients were admitted, 14 of which died, which gave an observed mortality of 41.17 and the predicted mortality of 28.66±25.7.

The highest mortality rate was 55.55 which was observed among patients aged over 60 years with a predicted mortality rate of 39.58±27.5 as there were 18 and 10 patients respectively. The age differences were statistically significant (p=0.001) which validates that mortality was more as age advanced.

A score-wise analysis of APACHE II displayed that there was a strong step-wise rise in observed and predicted mortality. The mortality rates increased to 6.66% in patients whose score was 0-4, as compared to 80% in patients who had a score of 30-34 and 34 and above. This trend was significant (p=0.001). The predicted mortality also ranged with increasing score categories with 2.47 0.9% in the lowest group but 82.54 10.2% in the highest group.

Diagnostic group analysis revealed that the largest category of admission was suicidal and envenomation cases with 31 patients (38.75) but their mortality was not high at 12.9. The highest mortality was observed in respiratory cases and trauma cases with 66.66% and 50% mortality respectively and nephrology and peripartum with 50% mortality each. Even though no statistically significant differences in observed mortality between diagnostic groups were found (p=0.064), predicted mortality differed significantly between groups (p=0.0001) with respiratory cases having a high predicted mortality of 52.93±28.4.

Table 4: Sex-wise distribution, predicted mortality, and observed mortality among patients admitted to the RICU.

Sex	Expired, N	Survived, N	Total, N	Predicted mortality (%)	Observed mortality (%)
Male	21	26	47	25.03±26.4	44.68
Female	5	28	33	22.28±22.7	15.15
P value	—	—	—	0.620	0.006

Table 5: Comparison of age, APACHE II score, and ICU stay between male and female patients.

Variables	Male patients	Female patients	P value
Mean age (years)	47.5±21.04	34.48±17.44	0.0017
Mean APACHE II score	16.04±11.19	14.57±10.32	0.273
Mean ICU stay (days)	13.89±13.26	11.27±10.71	0.166

Table 6: Age-wise distribution, APACHE II score, ICU stay, and mortality among RICU patients.

Age group (years)	Total cases, N	Expired, N	Survived, N	Mean age (years)	Mean APACHE II score	Mean ICU stay (days)	Predicted mortality (%)	Observed mortality (%)
12–29	28	2	26	20.6±4.1	7.78±6.09	11.85± 10.60	8.03±8.3	7.14
30–60	34	14	20	44.02± 9.4	17.08±10.54	12.82± 14.05	28.66±25.7	41.17
>60	18	10	8	72.05± 6.91	24.22±9.16	14.27± 11.52	39.58±27.5	55.55
P value	—	—	—	—	0.001	0.812	0.001	0.001

Table 7: APACHE II score-wise mortality in total cases.

APACHE II score	Total cases	Expired	Observed mortality (%)	Predicted mortality (%)
0–4	15	1	6.66	2.47±0.9
5–9	12	0	0	6.1±1.4
10–14	13	2	15.38	12.27±4.4
15–19	13	6	46.15	18.6±8.7

Continued.

APACHE II score	Total cases	Expired	Observed mortality (%)	Predicted mortality (%)
20–24	11	6	54.54	30.9±11.8
25–29	6	3	50	55.55±14.8
30–34	5	4	80	62.76±13.1
>34	5	4	80	82.54±10.2

Table 8: Diagnostic group-wise distribution and mortality.

Diagnostic group	Total cases	Expired	Observed mortality (%)	Predicted mortality (%)
Suicidal and envenomation	31	4	12.9	11.05±10.25
Neurology	17	6	35.29	20.82±29.8
Nephrology	12	6	50	48.83±24.9
Cardiology	4	1	25	23.0±25.6
Peripartum	6	3	50	26.81±21.25
Respiratory	6	4	66.66	52.93±28.4
Trauma	3	2	66.66	16.5±4.0
Gastroenterology	1	0	0	9.2

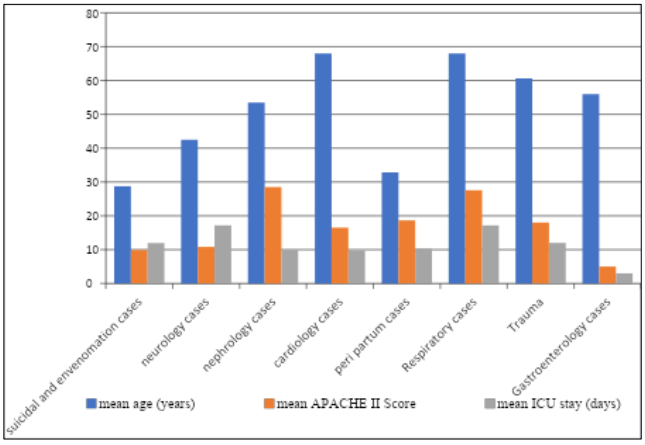

Figure 2: Comparison of mean age, mean APACHE II score and mean ICU stay in different diagnostic groups.

Overall, the results demonstrate that APACHE II score and age were the strongest predictors of mortality in this study. APACHE II categories and age were significantly associated with an increase in mortality and no significant correlation with outcome was seen with ICU stay. Diagnostic subgroup analysis further revealed that cases of respiratory, trauma, nephrology, and peripartum cases had especially high mortality but the largest proportion of admissions was suicidal and envenomation cases.

DISCUSSION

As shown in the current study, increased mortality rate among respiratory intensive care unit patients was linked with higher APACHE II scores and age. This result is consistent with the recent reports that indicate that APACHE II is still a practical bedside tool that can be used to identify the most at risk patients (critically ill) with higher chances of death. A 2023 study identified a positive correlation between rising APACHE II score and mortality in ICU patients, and a 2022 cohort study observed that APACHE II was a good predictor of mortality in various ICU patients.[7,8] The other significant result of the current research was that the APACHE II scores of non-survivors were significantly higher than those of survivors. A 2022 study of critically ill COVID-19 patients also reported similar observations, with APACHE II significantly higher in non-survivors and with significant prognostic predictive value. Moreover, a 2025 study of the dynamic APACHE score trends indicated that post-admission persistent or progressive deterioration in the scores of severity was linked to worse outcomes, which supported the association between physiological derangement and mortality further.[2,9] The current study also indicated a significant relationship between age and outcome with increasing mortality in the older patients. This is consistent with more recent validation studies which suggest that both the age at baseline and the severity of acute physiological disturbance has a strong role in mortality prediction. A validation study of critically ill patients in 2025 highlighted the potential variability in the performance of APACHE II across patient groups, especially when the age and comorbidity burden is great.[10] In the present study, the observed mortality was more than that of APACHE II-predicted mortality. This implies under-perfect calibration of the scoring system in the current environment, though the score continued to be helpful to stratify risk. Similar results have been documented in the recent literature. A 2019 prospective, ICU study of APACHE II versus APACHE IV found variability in the predicted and observed mortality, and a 2022 cohort study similarly found good discrimination but poor calibration of APACHE II to predict mortality.[8,11] Recent researches also show that APACHE II does not have to be used by itself but should be used together with other prognostic methods. A 2022 study comparing dynamic and admission assessment of APACHE II, concluded that serial scores were better than admission scores in predicting outcomes. Similarly, recent respiratory and critical care studies indicate that local validation and repeat assessment enhance clinical value of severity scoring systems.[12,13] Therefore, the results of the current study justify the

APACHE II to be used as a useful prognostic instrument in respiratory ICU patients, especially to identify the risks early. Nonetheless, the difference between the predicted and observed mortality indicates that the model performance could be influenced by the local population traits, disease spectrum, and institutional factors. Periodic re-evaluation of APACHE II and comparisons with new scoring systems may thus enhance prognostic accuracy in that environment.[14,15]

CONCLUSION

The current research shows that APACHE II is an efficient and convenient scoring tool to evaluate the severity and mortality risk of inpatients during the initial steps of their stay in respiratory intensive care unit. Increased APACHE II scores, older age, and specific types of diagnoses were related to a higher mortality rate, whereas the ICU stay was not significantly correlated with the outcome. The observed mortality was greater than the predicted mortality meaning that the APACHE II despite its good prognostic value; it has not been well calibrated across various institutional settings. The results justify the further use of APACHE II to risk stratify and make clinical decisions in respiratory ICU patients and it is advised that local validation be conducted on a regular basis to enhance predictive performance.

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