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A Retrospective Study Of Analysis Of Mortality And Apache Ii Score Of Patients Admitted In ICU

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Abstract

Background: The development of intensive care medicine has significantly improved the survival rates of critically ill patients. However, there is an increasing need to evaluate the effectiveness of care provided in Intensive Care Units (ICUs), particularly in predicting patient outcomes using scoring systems like the APACHE II.

Objective: This study aims to assess the performance of the APACHE II score in predicting hospital mortality among patients admitted to a tertiary care ICU and analyze the associated mortality factors.

Methods: A retrospective longitudinal study was conducted over 18 months at Sri Manakula Vinayagar Medical College and Hospital, Puducherry. The study included 153 patients who expired after being admitted to the General Medicine ICU. The APACHE II score was calculated based on 12 physiological variables, age, and chronic health status at admission.

Results: The mean age of the patients was 61.10 years, with a standard deviation of 12.07 years. The APACHE II score showed a significant correlation with mortality rates. Significant associations were also found between mortality and factors such as smoking, alcoholism, type 2 diabetes mellitus, and hypertension.

Conclusion: The APACHE II score stands out as the prime indicator for forecasting the outcomes of patients in the ICU. Analysing the factors of mortality will provide a basis for medical staff to adopt appropriate medical strategies.

Keywords: APACHE II , mortality , Intensive Care unit

Introduction

Advancements in modern medicine, particularly in intensive care medicine, have significantly improved the survival rates of critically ill patients since the mid-20th century.[1] Intensive Care Units (ICUs) have become crucial in managing severe medical conditions, allowing for continuous monitoring and advanced therapeutic interventions. Despite these advancements, ICU mortality remains a critical issue, with significant variations observed depending on the severity of illness, underlying comorbidities, and the quality of care provided.

One of the primary tools used to evaluate the severity of illness and predict outcomes in ICU patients is the Acute Physiology and Chronic Health Evaluation II (APACHE II) score. Developed in 1985, the APACHE II score integrates physiological data, age, and chronic health conditions to provide a comprehensive assessment of a patient's condition within the first 24 hours of ICU admission.[2] This scoring system has been widely adopted due to its ability to stratify patients based on their risk of mortality, thereby aiding

clinicians in making informed decisions regarding treatment strategies and resource allocation.

However, while the APACHE II score is well-established in clinical practice, there is ongoing debate about its accuracy and applicability across different patient populations and healthcare settings.[3] Numerous studies have evaluated the predictive value of the APACHE II score, but discrepancies in findings suggest that its performance may be influenced by factors such as regional variations in patient demographics, ICU practices, and the nature of underlying illnesses.[4]

This study aims to assess the performance of the APACHE II score in predicting hospital mortality among patients admitted to the ICU at a tertiary care center in South India. Additionally, the study seeks to analyze the specific factors contributing to mortality in this patient population, providing insights that could enhance prognostic evaluations and guide future research and clinical practice.

Materials and methods

Study Design and Setting: This retrospective longitudinal study was conducted at the General Medicine ICU of Sri Manakula Vinayagar Medical College and Hospital, Puducherry, India. The study spanned 18 months, from January 2020 to June 2022. This tertiary care center is a regional referral hub, providing advanced medical care to critically ill patients from diverse demographic backgrounds.

Study Population: The study population comprised patients admitted to the General Medicine ICU during the study period who subsequently expired. A total of 153 patients met the inclusion criteria. The study focused on adults aged 18 years and above, excluding those who were pregnant, lactating, or diagnosed with COVID-19 at the time of admission. These exclusions were made to avoid confounding factors that could influence the analysis of mortality and APACHE II scores.

Inclusion and Exclusion Criteria: Inclusion criteria for the study were patients aged 18 years and older who died after being admitted to the ICU during the specified period. Exclusion criteria were as follows:

1. Patients admitted with COVID-19 due to the unique pathophysiology and treatment protocols associated with the disease.
2. Pregnant and lactating women, due to the distinct clinical considerations and risk factors in these populations.

Data Collection: Data were collected retrospectively from patient medical records. This included a detailed history of the patients, documenting the symptoms leading to ICU admission, comorbidities such as cardiovascular diseases, diabetes mellitus, hypertension, and any relevant family history. The study also recorded data on physical and systemic examinations conducted at admission.

APACHE II Scoring: The APACHE II score was calculated for each patient within the first 24 hours of ICU admission. This score comprises three main components:

1. **Acute Physiology Score (APS):** This is based on 12 physiological variables, including body temperature, mean arterial pressure, blood pH, heart rate, respiratory rate, serum sodium, serum potassium, creatinine levels (with a double point score for acute renal failure), hematocrit, white blood cell count, and the Glasgow Coma Scale score.

2. **Age Points:** Age-specific points are added based on predefined age categories.

3. **Chronic Health Points:** Additional points are assigned for severe chronic organ insufficiencies or immunocompromised states (e.g., due to chemotherapy or advanced HIV).

The Acute Physiology Score, measured within the first 24 hours of admission, includes the following parameters: AaDO2 or PaO2 (depending on whether the FiO2 is ≥0.5 or <0.5, respectively), body temperature, mean arterial pressure, blood pH, heart rate, respiratory rate, serum sodium, serum potassium, creatinine (with double points assigned for acute renal failure), hematocrit, white blood cell count, and the Glasgow Coma Scale (calculated as 15 minus the actual GCS score).

If a patient has a history of severe organ system insufficiency (such as liver cirrhosis, portal hypertension, NYHA class IV heart failure, severe respiratory disease, or dialysis dependence) or is

Volume 7, Issue 5; September-October 2024; Page No 210-217

immunocompromised (due to chemotherapy, radiation, high-dose steroid therapy, or advanced leukemia, lymphoma, or AIDS), points are assigned as follows:

5 points for nonoperative or emergency postoperative patients.

2 points for elective postoperative patients.

This method is optimized for manual calculation by using integer values and limiting the number of options so that the data fits on a single-sheet paper form. The score is an admission score and is not recalculated during the patient's stay.

Table 1 : Normal referance range of APACHE II

APACHE II Score	Hospital mortality
0-4	4%
5-9	8%
10-14	15%
15-19	24%
20-24	40%
25-29	55%
30-34	73%
35-100	85%

Statistical Analysis:

The collected data were entered into Microsoft Excel and analyzed using SPSS version 26.0. Descriptive statistics were used to summarize baseline demographic and clinical characteristics. Categorical variables were presented as frequencies and percentages, while continuous variables were summarized using means (with standard deviations) and medians (with interquartile ranges). The primary outcome of interest was hospital mortality, and its association with the APACHE II score and other clinical variables was assessed using the Chi-square test for categorical variables and t-tests or Mann-Whitney U tests for continuous variables, depending on the data distribution. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations:

The study was approved by the Institutional Ethics Committee of Sri Manakula Vinayagar Medical College and Hospital. As this was a retrospective study, patient consent was waived, but confidentiality was strictly maintained, with data anonymized to protect patient identities.

Results

Baseline Demographics:

The study analyzed 153 patients who expired during their stay in the General Medicine ICU. The mean age of the patients was 61.10 years (SD ± 12.07), with a median age of 61 years. The age distribution was fairly broad, with an interquartile range (IQR) from 53 to 74 years, indicating that the majority of the patients were older adults, which is consistent with typical ICU populations.

APACHE II Scores:

Volume 7, Issue 5; September-October 2024; Page No 210-217

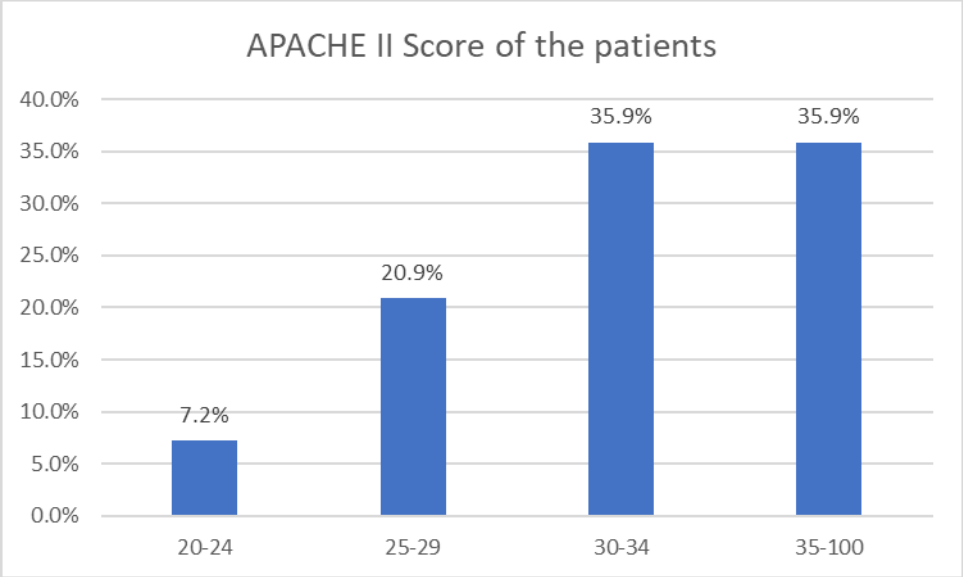
The mean APACHE II score among the study population was 33.59 (SD ± 5.89), with a median score of 34. The interquartile range for APACHE II scores was 28 to 37.5, demonstrating a high severity of illness among the patients included in the study. The distribution of APACHE II scores showed a strong positive correlation with mortality, indicating that higher scores were associated with increased risk of death.

Table 2 : Results of APACHE II score

APACHE II Score

	Frequency	Percent
20-24	11	7.2
25-29	32	20.9
30-34	55	35.9
35-100	55	35.9
Total	153	100.0

Figure 1 : Results of APACHE II score



Risk factors

Several key risk factors were identified in the study population. A significant proportion of the patients had a history of smoking and alcoholism. Statistical analysis revealed a significant association between smoking and Acute Coronary Syndrome (ACS) ($p < 0.05$). Similarly, there was a significant correlation between alcoholism and liver disease ($p < 0.05$).

Volume 7, Issue 5; September-October 2024; Page No 210-217

Figure 2 : Risk factors of patients

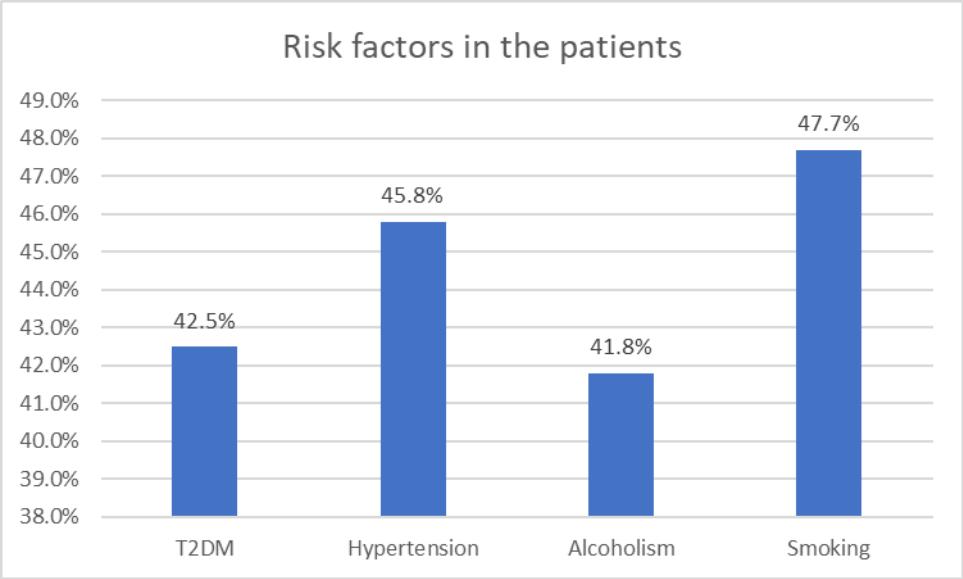


Table 3 : Patients with ACS in the study

ACS	Frequency	Percent
Yes	25	16.3
No	128	83.7
Total	153	100.0

Table 4 : Patients with CAD / Heart faliure in the study

CAD HF	Frequency	Percent
Yes	56	36.6
No	97	63.4
Total	153	100.0

Comorbidities:

The study also identified significant associations between mortality and certain comorbidities. Patients with type 2 diabetes mellitus and hypertension were found to have a statistically significant higher mortality rate ($p < 0.05$). These findings highlight the impact of chronic conditions on ICU outcomes and underline the importance of managing comorbidities in critically ill patients.

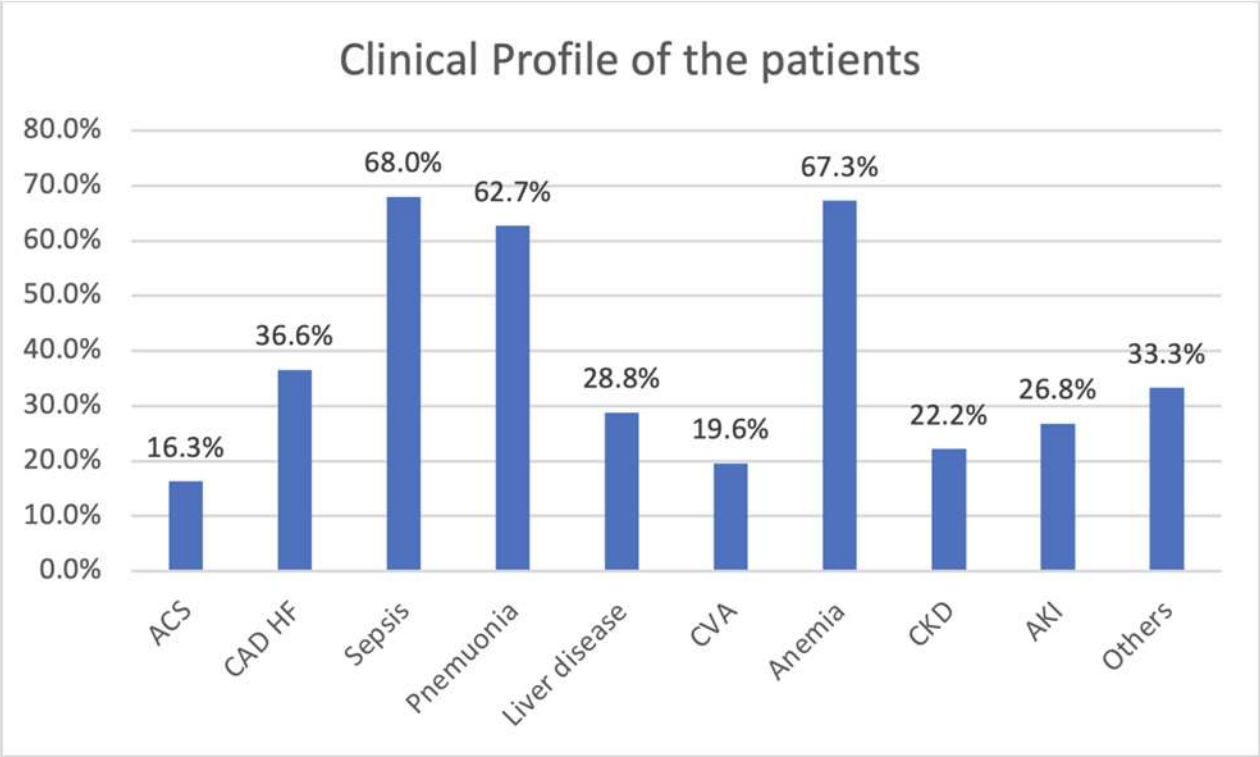
Outcome Correlation:

The APACHE II score demonstrated a strong predictive value for hospital mortality. Patients with higher APACHE II scores were more likely to have fatal outcomes, confirming the utility of the APACHE II scoring

Volume 7, Issue 5; September-October 2024; Page No 210-217

system in a tertiary care setting. This correlation supports the use of APACHE II as a benchmark for assessing patient severity and guiding clinical decisions in the ICU.

Figure 3 : Clinical profile of the pateints



Summary of Findings:

1. Age: Older age was prevalent among the deceased patients, with a mean of 61.10 years.
2. APACHE II Score: The high mean score of 33.59 underscores the severe condition of the patient population.
3. Significant Risk Factors: Smoking and alcoholism were strongly associated with mortality due to their impact on ACS and liver disease, respectively.
4. Comorbidities: Type 2 diabetes mellitus and hypertension were significant contributors to mortality.

Discussion

The findings of this retrospective study provide valuable insights into the utility of the APACHE II score as a predictor of mortality in ICU patients at a tertiary care center. The study confirmed that the APACHE II score is a robust tool for assessing the severity of illness and forecasting outcomes in critically ill patients. The mean APACHE II score of 33.59 observed in our patient cohort is notably high, reflecting the severe clinical conditions typically seen in an ICU setting. The strong correlation between higher APACHE II scores and increased mortality underscores the score's predictive validity.

One of the critical findings of this study is the significant association between certain risk factors and mortality. Smoking and alcoholism were found to be major contributors to adverse outcomes, specifically through their impact on conditions such as Acute Coronary Syndrome (ACS) and liver disease. These findings are consistent with existing literature, which has long recognized the detrimental effects of smoking and excessive alcohol consumption on cardiovascular and hepatic health [6].

The association between comorbidities such as type 2 diabetes mellitus and hypertension with higher mortality rates is particularly concerning. These chronic conditions are prevalent in ICU populations and significantly exacerbate the risks associated with acute illnesses. The findings of this study highlight the need for rigorous management of these comorbidities in critically ill patients. In clinical practice, this may

Volume 7, Issue 5; September-October 2024; Page No 210-217

involve more aggressive control of blood glucose levels, blood pressure, and other related parameters to mitigate their impact on patient outcomes.

Despite the strengths of the APACHE II score, it is essential to acknowledge its limitations. The score is calculated based on data from the first 24 hours of ICU admission and does not account for changes in patient condition over time.[7] This static nature means that the score may not fully capture the dynamic clinical course of critically ill patients, potentially leading to underestimation or overestimation of risk in certain cases. Furthermore, while the APACHE II score is a valuable tool for predicting mortality, it should be used in conjunction with clinical judgment and other prognostic indicators to guide patient management.

The study also has its limitations. The relatively small sample size and the focus on a single ICU within a regional tertiary care hospital limit the generalizability of the findings. The study was also retrospective, relying on the accuracy and completeness of medical records. Future studies should consider larger, multi-center cohorts and prospective designs to validate and extend these findings.

Conclusion

The APACHE II score remains a critical tool in the ICU for assessing patient severity and predicting mortality. However, the clinical management of ICU patients must also account for the presence of significant risk factors and comorbidities that can independently influence outcomes. This study reinforces the importance of comprehensive care strategies that address both the acute and chronic aspects of patient health to improve ICU outcomes.

The retrospective study demonstrated that the APACHE II score is a robust tool for predicting hospital mortality in ICU patients. The significant correlations between the score and mortality highlight its value in clinical practice. Moreover, the associations between specific risk factors and mortality underscore the need for comprehensive patient assessments upon ICU admission. This study contributes to the growing body of evidence supporting the use of the APACHE II score in intensive care settings and provides insights into the factors that may influence patient outcomes.

Strengths and Limitations

Strengths:

1. The study's findings are consistent with previous research, reinforcing the validity of the APACHE II score.
2. It provides valuable insights into the impact of pre-existing conditions and lifestyle factors on ICU mortality.
3. Limitations:
4. The study is limited by its small sample size (153 patients), which may affect the generalizability of the findings.
5. The data is derived from a single regional tertiary referral ICU, which may limit the applicability of the results to other settings.
6. Certain demographics and variables may not be fully represented or analyzed, suggesting a need for further research with a more diverse and comprehensive dataset.

By addressing these limitations and building on the strengths of the study, future research can enhance the understanding of mortality predictors in critically ill patients and improve outcomes in intensive care units.

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Volume 7, Issue 5; September-October 2024; Page No 210-217

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Volume 7, Issue 5; September-October 2024; Page No 210-217