Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2024i1.1321
*Biol. Clin. Sci. Res. J., Volume, **2024**: 1321*
Clinical Audit

RELIABILITY OF APACHE-II SCORING IN PREDICTING MORTALITY AT THE TIME OF ICU ADMISSION- A CLINICAL AUDIT

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(Received, 19th November 2024, Revised 24th December 2024, Published 30th December 2024)

Abstract: *Different scoring systems are used to predict ICU patients' health outcomes and mortality rates. APACHE-II score has been found to have a discriminative value in predicting the mortality rate. There are some limitations to this score, such as the patients with multiple comorbid conditions and the physiological variables are all dynamic, which may alter the predicted mortality rate.* ***Objective:*** *The rationale behind doing this study is to see if there is any difference between the observed mortality and predicted mortality per the APACHE-II scoring system and how the APACHE-II scoring system will help predict the length of hospital stay and mortality in ICU patients.* ***Methods:*** *This was a cross-sectional study. The study was conducted in the Surgical Intensive Care Unit (SICU) of Doctors Hospital and Medical Centre, Lahore, from 1st January 2022 to 31st December 2022.: Data were analyzed using IBM SPSS Software version 29.0. Descriptive statistics, including mean and standard deviation, were computed. The results from the SPSS software output file were included along with the text. A one-sample t-test was applied to assess the significance of the data. A p-value of less than 0.05 was considered statistically significant, with a 95% confidence interval.* ***Results:*** *A total of 305 patients were included in our study. The mean age of patients who were admitted was 53.6 years. The mean length of ICU stay over the study period was calculated to be 4.3 days. Of 305 patients, 66 expired, and 239 were stepped down to in-patient units. All groups of APACHE-II score have less observed mortality than actual mortality; only group 3(APACHE 20-30) has higher observed mortality than predicted mortality.* ***Conclusion:*** *The APACHE-II score effectively stratifies patients at the time of admission to ICU as having a higher or lower risk of mortality depending on the disease severity so that the treatment triage, end-of-life ICU-care, and other important decisions can be made. This scoring doesn't have a very high sensitivity and specificity, but with an increasing score, there is a higher mortality risk. We need to improve our ICU care for patients with APACHE-II scores between 20-30, as we have more observed mortality in that group. Hopefully, this study will help the practices in the ICU care region.*

Keywords: APACHE-II, ICU Mortality, Length of Stay, Mortality Prediction, Scoring Systems

Introduction

Clinical scoring systems are used to classify the risk, predict the health outcomes, and enhance other clinical activities. There is no specific agreed classification of these predicting scores (1). These scoring systems forecast the mortality, hence the disease's prognosis, which is very important in limited health resources and an increased cost of health management (2). The underlying reasons for not using these scoring systems vary from person to person, including complexity, inaccuracy, and limited external or internal model validation (3). The most commonly used scoring systems that are in use in intensive care unit (ICU) settings are APACHE (Acute physiology and chronic health evaluation), SAPS (Simplified acute physiology score), MPM (Mortality prediction model), ODIN (Organ dysfunction and infection system), SOFA (Sequential Organ Failure Assessment), MODS (Multi-organ dysfunction score) and TRIOS (Three day recalibrating ICU outcomes) (4).

The APACHE score was introduced in 1981, and it is the most commonly used score in intensive care settings to determine mortality at admission time (5). It was first upgraded to APACHE-II in 1985 and then modified to APACHE-III in 1991 (6). In 2006, it was further modified to APACHE-IV, but APACHE-II has better discriminative power (7). It is highly recommended that ICU staff and doctors be familiar with the implications of the APACHE-II score (8). The three main components of the APACHE-II score are Acute Physiology scores (APS), age scores, and chronic health scores, generating a score from 0 to 71 (9). These are 12 measurements that are measured within 24 hours of ICU admission. APACHE-II shows a better prediction of hospital outcomes than SAPS-II (10). So, the APACHE-II score can be used as an ICU standard.

The major limitation of this scoring system is that it is tough to select one diagnosis in patients with various comorbidities. Multiple factors affect the dynamic variables of APACHE-II, hence an overestimation of predicted mortality. A study done by Meyer et al. (11) showed that clinical assessment has an accuracy of 95.2% and that the APACHE-II score is 90.9%. As per this study, neither the clinical judgment nor the APACHE-II score is accurate when predicting which ICU patient will expire.

The rationale behind this study is to see if there is any difference between the observed mortality and predicted mortality as per the APACHE-II scoring system and to see how the APACHE-II scoring system will be helpful in

[Citation: Rehman, S.U., Saeed, U., Malik, M., Rehman, A., Rehman, E., Khan, A.H. (2024). Reliability of APACHE-II scoring in predicting mortality at time of ICU admission- a clinical audit. *Biol. Clin. Sci. Res. J.*, **2024***: 1321*. doi: https://doi.org/10.54112/bcsrj.v2024i1.1321]

predicting length of hospital stay and mortality in ICU patients.

Methodology

This retrospective cross-sectional study was done at the surgical ICU of Doctors Hospital and Medical Centre, Lahore, Pakistan, during the one year from 1st December 2022 to 30th November 2023. Data was collected using non-probability consecutive sampling. Measuring variables include demographics of the patients (Age, Gender, etc.), APACHE-II score measured at the admission time in the ICU, length of ICU stay, and mortality rate.

Data was entered in the Excel spreadsheet in the ICU system. Permission was granted to collect data from the hospital's ethical review committee. Data was later moved to the SPSS Software 29.0 version. Exclusion criteria for this study were patients aged less than 16 years, with a stay of less than 24 hours, and those who didn't have all 19 physiological parameters. All patients over 16 years who remained in the ICU for more than 24 hours were included in this study.

Data was analyzed using IBM SPSS Software 29.0 version. Descriptive statistics like standard deviation and mean were used using the SPSS Software. The SPSS output file and text were also provided. A one-sample t-test was applied. The P-value was set at <0.05, and the confidence interval was set at 95%.

Results

During the twelve months from 1st January 2023 to 31st December 2023 in the Surgical ICU (SICU) of Doctors Hospital and Medical Centre, Lahore, 305 patients met the inclusion criteria. The mean age of patients who were admitted was 53.6 years. Among the 305 patients, 227 were male, while 78 were female. Most patients were under surgical specialty, making several 212, and 78 were admitted under medical specialty. The mean length of ICU stay over the study period was calculated to be 4.3 days. Out of 305 patients, 66 expired, and 239 were stepped down to in-patient units (Table 1). Table 2 and Figure 1 show the classification of patients into five groups and the relation of predicted mortality with actual observed mortality.

Table 1: Showing characteristics of the study population and findings.

Characteristics	Categories	N (%)
Mean Age		53.6 years
Gender	Male	227 (74.2%)
	Female	78 (25.57%)
Admission under which specialty	Medical	93(30.49%)
	Surgical	212 (69.50%)
Mean ICU length of stay.	----	4.3 days
Mean APACHE-II Score		14.42
Fate of patients	Expired	66 patients(21.6%)
	Survived	239 patients (78.3%)

Table 2 shows the relationship between predicted mortality by the APACHE-II score and actual observed mortality.

APACHE-II Score	Number of patients	Predicted Mortality	Observed Mortality	Difference in mortality
3-10	108 (35.4%)	7.7%	3.7%	**4**
11-20	102 (33.4%)	19.3%	14%	**5.3**
21-30	68 (22.51%)	45.2%	53.2%	**-8**
31-40	19 (6.22%)	76.73%	73.68%	**3.05**
>40	3 (0.98%)	85.2%	66%	**19.2**

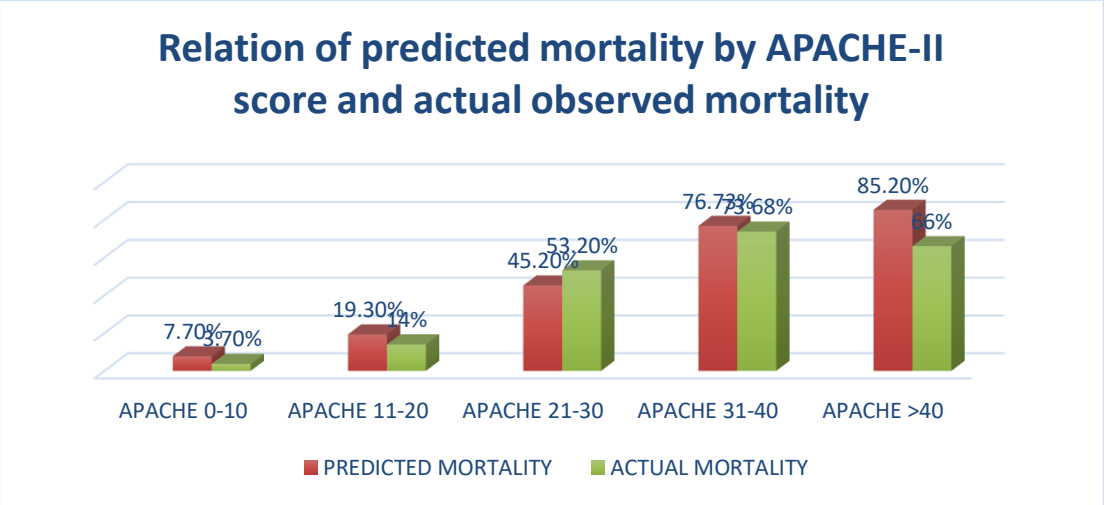

Figure 1 shows the relation between predicted mortality and actual mortality.

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Discussion

The use of scores predicting mortality in ICU patients has become very common in the previous few years as these scores help the intensivist in various ways, including treatment triage, end-of-life ICU care, and many more. These scores are also used to compare the effectiveness of two different ICUs (12). APACHE-II score has a sensitivity of 89.9% and a specificity of 97.6% (13). There are various limitations to the APACHE-II score depending on the type of health system and study population. The validity of the APACHE-II scoring system in the ICU population of Pakistan was proved in a study done by Saad et al. (14). Average age in our study is 53.6 years, which is comparable to 53 years in Hongkong (15) and 56 years in Netherland (16). As per a study by Eunki Chang et al. (17), age has no impact on ICU mortality. Still, as per another study by Mahul et al. (18), increasing age is associated with increased mortality.

The mean APACHE-II score in our study is 14.42, which is comparable to 10.7 and 16.5 in the United States of America and 14.2 in New Zealand (19). In our study, 170 patients have APACHE-II scores between 11-30 at the time of admission, which correlates with a study done by Saeed et al. (14), but there is a large number of patients (108 patients) in the first group (APACHE-II 3-10).

Overall mortality in our study is 21.6%, which is lower than a study done by Melaku et al. (20). APACHE-II scores have a meaningful correlation with ICU mortality. Our research shows more observed mortality than predicted mortality in group 3 (APACHE-II 20-30), which contradicts a study in Hong Kong (15). All other groups have findings from Knaus et al. (19) and other available literature. So, our study has a meaningful correlation between APACHE-II score and mortality prediction.

The average ICU stay was 4.3 days in our study, which is comparable to 4.2 days in a study done in Hong Kong (15). ICU length of stay is an important indicator of ICU resource consumption and financial strain on the health sector.

Our study shows that APACHE-II is significantly effective in predicting the risk of mortality and length of stay in ICU patients, so that treatment triage, end-of-care ICU care, and other decisions can be made accordingly. It doesn't give us the actual idea of mortality but points out the patients with an increased risk of mortality and those with a reduced risk of mortality.

A major limitation of our study is its retrospective nature. Secondly, it is a single-centre study with a limited sample size. Thirdly, our study doesn't compare the effectiveness of predicting ICU mortality using the APACHE-II score with other predicting scores used in the ICU.

Conclusion

APACHE-II score effectively stratifies patients at admission to the ICU as having a higher or lower risk of mortality depending on the disease severity so that the treatment triage, end-of-life ICU care, and other important decisions can be made. This scoring doesn't have a very high sensitivity and specificity, but with an increasing score, there is a higher mortality risk. We need to improve our ICU care for patients with APACHE-II scores between 20-30, as we have more observed mortality in that group, and hopefully, this study will help the practices in the ICU care of the region.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned.

Consent for publication
Approved

Funding
Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Data Collection and Analysis, Final approval of manuscript
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Coordinate collaborative efforts and Draft the article.
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