ORIGINAL ARTICLE:

PREDICTIVE EFFICASY OF APACHE IV AT ICU.s OF CHK

SHAGUFTA YAMIN, AMEET KUMAR VASWANI* DR. MASROOR AFREEDI**

ABSTRACT:

Introduction:

APACHE IV is a successful scoring system[1] for assessing severity of illness[6] and prognosis of ICU patients[4, 10]. In some countries it is being used by intensivists after proved valid[7].Since no study has been conducted regarding APACHE IV in our setup. This study was conducted in our set up for the first time to see the applicability of APACHE IV in ICUs of civil hospital Karachi (CHK) to evaluate the predictive accuracy of apache IV scoring system, and to evaluate the prognostic outcome of scoring system in NICU, MICU and SICU patients at CHK. As the APACHE IV score increases the risk increases[3] and outcomes are measured as the death before the discharge from ICU[5].APACHE IV shows mortality prediction better than APACHE III[8] and APACHE II[9]. This scoring system is also used to evaluate efficacy of ICUs[2]

Patients and Method:

It is an Observational Prospective cohort study at CHK in its 3 ICUs. 163 patients were enrolled for the study: 69 patients of SICU, 37 patients of NICU and 55 patients of MICU). Included patients stayed more than 24 hours in ICUs. Study was conducted from 28th Jan, 2009 to 12th Sep, 2009. Data was collected from ICU database.

Results:

Among 163 enrolled patients average age was 38.024 years (63.6%), with minimum age of 9 months and maximum age of 90.0 years. 46.91% of patients were males and 53.08% were females. 147 (90.18%) have complete labs. 120 patients had complete data while 43 (26.38%) patients did not have complete data. The mean APACHE IV score was 63.78 having maximum APACHE IV score 150 and minimum 0, with standard deviation of 29.821.

Mean Predicted mortality of overall patient was found to be 25.7 % while observed mortality was 28.4% with SD of 0.439 and SMR=1.09. The no. of patients who survive were 104 (64.2 %) while the out come of remaining 12 (7.4 %) patient was not recorded by hospital whether they survived or not. Mean APACHE IV score of survivors was found to be 54.55, while mean APACHE IV score of non-survivor was 85.07 which is significantly higher. 63.9% patients have APACHE IV score <60, out of these 79.7% were discharged from ICU and 14.8% don't survive. 27.8% patients have APACHE IV score >81 out of these 31.7% were discharged from ICU and 65.8% do not survive ($p<0.001$). The 62.1% of overall population show the same outcome as predicted by APACHE IV ($p=0.61$).

**Dow Institute of Medical Technology, Dow University of Health Sciences Karachi*

Conclusion:

The present study demonstrates that the mortality prediction and LOS predicted by APACHE IV system performs acceptably in our patients and can be utilized as a performance assessment tool in our ICUs.

INTRODUCTION

Anatomical scoring systems assess the extent of injury whereas physiological systems assess the impact of injury on function. Scores from anatomical scoring systems, once assessed, are fixed whereas physiological scores may change as the physiological response to the injury or disease varies[9].Scoring systems used in Trauma can be classified into: 1) Physiologic such as the Trauma Score, and Glasgow Coma Scale. 2) Anatomical such as the Abbreviated Injury Scale and the Injury Severity Score. 3) Combined score such as the Trauma and Injury Severity Score (TRISS) method and A Severity Characterization of Trauma (ASCOT) [4, 5].

Clinicians can use these benchmarks to assess their unit's through efficiency and monitor the impact of protocols aimed at reducing ICU stay for specific patient groups.

A. The Acute Physiology and Chronic Health Evaluation

The death rate of patients admitted to intensive care units is much higher than that of other hospital patients.[9] ICU Patients are evaluated by physiologic scores and evaluation of chronic health status. Physiologic scores correlate with severity of illness. Results of the evaluation can be used to estimate the mortality rate for patients in the ICU and during the hospitalization.[1]

APACHE has two components: The chronic health evaluation, which incorporates the influence of co-morbid conditions (such as diabetes and cirrhosis) and Acute Physiology Score (APS).

Deviations from normal on 12 physiological variables like heart rate, blood oxygen level, or respiratory rate, Age of the patient, chronic illness include coma.

B. Physiologic classes of variables (total 8 classes with 34 variables):

(1) Cardiovascular: 7 variables, (2) Respiratory: 3 variables, (3) Renal: 3 variables, (4) Gastrointestinal: 6 variables, (5) Hematologic: 4 variables, (6) Septic: 4 variables, (7) Metabolic: 6 variables, (8) Neurologic: 1 variable[1].

C. SCORING:

The physiologic data is evaluated during the first 32 hours after admission to the ICU. Each variable is assigned a value of 0 to 4, based on significance of deviation from normal, with more severe deviations given higher values[1].

APACHE I:

The APACHE (Acute Physiology and Chronic Health Evaluation) prognostic scoring system was developed in 1981 at the George Washington University Medical Center as a way to measure disease severity[2].

The Intensive Care National Audit Research Centre (ICNARC) used APACHE score develop by Knauss to compare ICU mortality and total hospital mortality[17].

APACHE II:

APACHE II uses a point score based upon initial values of 12 routine physiologic measurements, age, and previous health status to provide a general measure of severity of disease. According to one of the research an increasing score (range 0 to 71) was closely correlated with the subsequent risk of hospital death for 5815 intensive care admissions from 13 hospitals. This relationship was also found for many common diseases. When APACHE II scores are combined with an accurate description of disease, they can prognostically stratify acutely ill patients and assist investigators comparing the success of new or differing forms of therapy. This scoring index can be used to evaluate the use of hospital resources and compare the efficacy of intensive care in different hospitals or over time[3].

APACHE II scoring is still appropriate in the severity assessment and stratification of sepsis patients as an indication for determining the appropriateness of the use of Activated Protein C for patients with severe sepsis.

APACHE II allows the probability of death before discharge from hospital to be estimated. The probability of death for each patient admitted to intensive care can be summed to give the expected hospital death rate for the whole group. The expected hospital death rate can then be compared with the actual hospital death rate[9].

APACHE III:

It is a refinement of APACHE II,[6] which was introduced in late 1990. Potential uses of APACHE III include the identification of factors in the ICU which contribute to outcome and assistance in individual patient decision-making.

APACHE III can provide initial risk stratification for severely ill hospitalized adult patients.[10]

APACHE IV:

Scoring systems represent classification systems or point systems that have been designed for making quantitative statements regarding the severity of a disease, its course and its prognosis[1]. These systems are based on physiologic abnormalities and have been successful in measuring severity of illness among critically ill patients[12]. This score is for the Non-CABG patients only. Dr. William Knaus, APACHE's original developer, recommends that researchers discontinue the use of APACHE II and move to the more contemporary and accurate APACHE IV, now that both the score and two of the predictions are in the public domain. The APS consists of weighted variables representing the major physiologic systems, including Neurological, Cardiovascular, Respiratory, Renal, Gastrointestinal, Metabolic, Hematological variables, Co-morbidies, admissions, admitting diagnosis. APACHE IV predictions of hospital mortality have good discrimination and calibration[8] and should provide useful benchmarks for evaluating efficiency in ICUs. Clinicians can use these benchmarks to assess their unit's through out efficiency and monitor the impact of protocols aimed at reducing ICU stay for specific patient groups[7]. APACHE IV mortality has good Physiology and

diagnosis of the model's predictive power[16]. The accuracy of predictive models is dynamic and should be periodically retested. When accuracy deteriorates they should be revised and updated.[8]

APACHE IV scores can be used as a clinical predictor for early tracheostomy in patients with respiratory failure in ICU. Patients with APACHE IV scores greater than eighty are less likely to be extubated successfully[11].

Outcome has usually been measured as death before discharge from hospital after intensive care[9]. As the acute physiology score rise there was a linear increase in ICU stay until the score exceeded 80, at which point ICU stay decreased[7].

APACHE IV is a successful scoring system assessing severity of illness and prognosis of ICU patients[12]. It has been evaluated and validated in our patients for mortality outcome[13].

The APACHE IV system has already been validated at King Faisal Specialist Hospital[13], this study was conducted to evaluate the performance of this system in a subset of patients with acute renal failure.

Scoring systems represent classification systems or point systems that have been designed for making quantitative statements regarding the severity of a disease, its prognosis, and its course. These systems are based on physiologic abnormalities and have been successful in measuring severity of illness among critically ill patients. Furthermore, scores may serve the purposes of assessing therapies, of quality control and of quality assurance, and of an economic evaluation of intensive care. We validated the APACHE IV benchmark for a subset of patients with severe acute pancreatitis (SAP) [12].

The critically ill obstetric population still search for a model that accurately predicts mortality. The study hypothesis was that APACHE IV predicts ICU mortality better than APACHE III[14] and APACHE II[15].

Disease Staging

Stage 1:- Conditions with no complications and minimal risk for the patient.

Stage 2:- problems which are contained in one organ or system.

Stage 3:- problems in multiple sites and general systemic problems.

Stage 4:- Death

PATIENTS AND METHODS: Since no study has been conducted regarding APACHE IV in our setup. We would like to see its applicability in ICUs. The APACHE IV score was recorded on the first day of admission in the ICU. The data for APACHE IV was calculated using the APACHE IV calculator and patient's data was analyzed in the SPSS 16. All the graphs were made using Microsoft Excel.

Study design: Prospective observational cohort study

Study population: Random selection of Patients of Surgical ICU, Medical ICU and neurocoma ICU of Civil Hospital Karachi

Inclusion criteria: All male and female patients were included in the study, which stayed in ICUs for more than 24 hours. Non CABG Patient

Exclusion criteria: All those Patients who stayed in ICU for less than 24 hours, CABG Patient,

Interventions: None

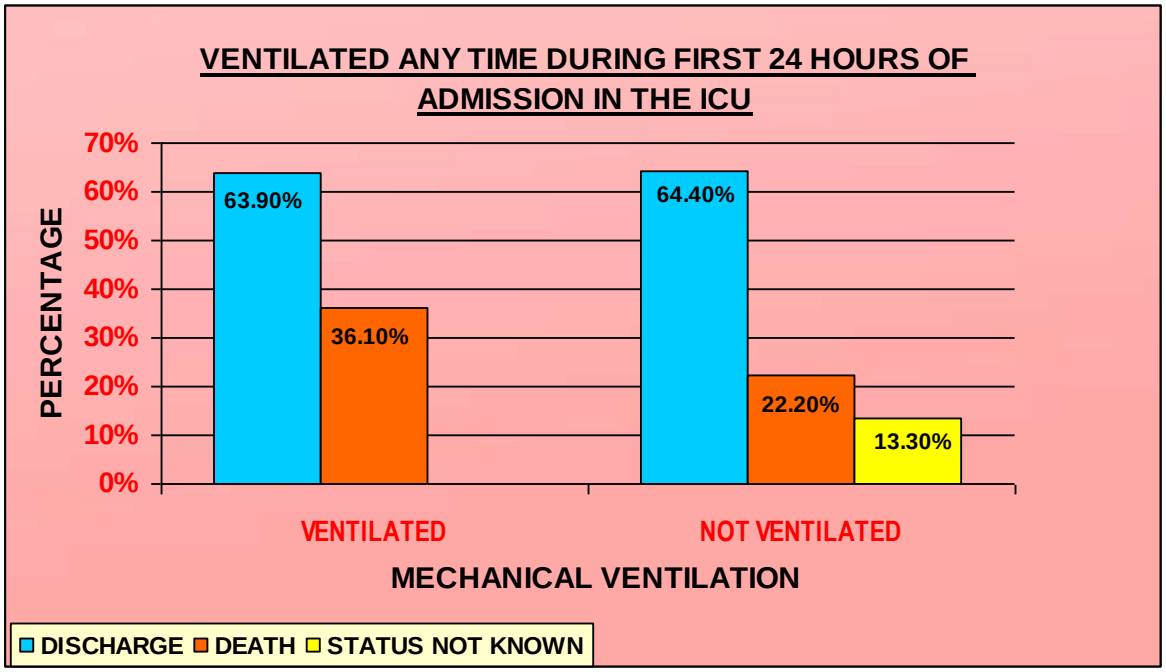
RESULTS

Age: total One hundred and sixty two patients were included in the study with an average age of 38.024 (0.9-90) years.

Gender: 46.91% of patients were males while 53.09% of patients were female.

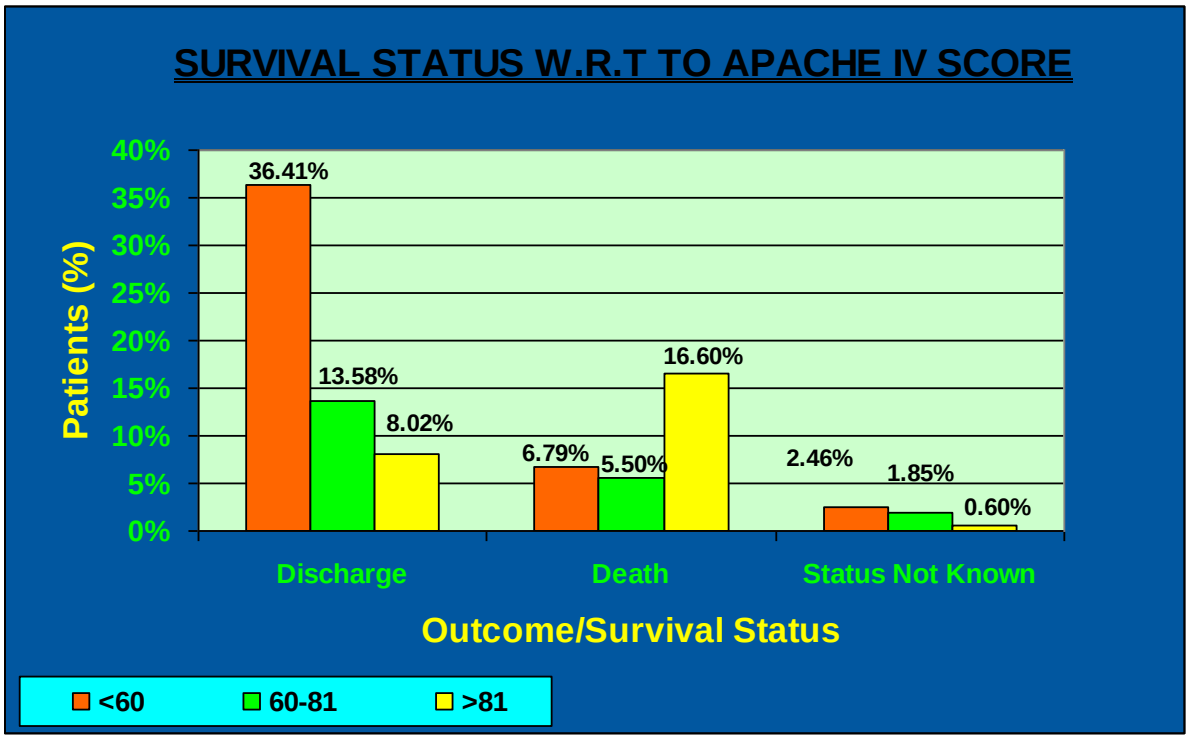
Patients with Complete/incomplete labs or data: Out of 162patients; 119 (74.07%) patients had complete data while forty three (26.38%) patients did not have complete data.

Mortality rate: Mean Predicted mortality of overall patient was found to be 21.0835 (25.7%) with standard deviation of 22.3 while mean observed mortality was 28.4% with SD of 0.439 and standardized mortality ratio (SMR) =1.09. 44.44% of patient ventilated during first 24 hours. Among them, 63.9% of patient was discharged and 36.1% died. Where as 55.55 % of patient do not go on mechanical ventilation. Among these 64.4% of patient were discharge and 22.2% were died.



Survival status

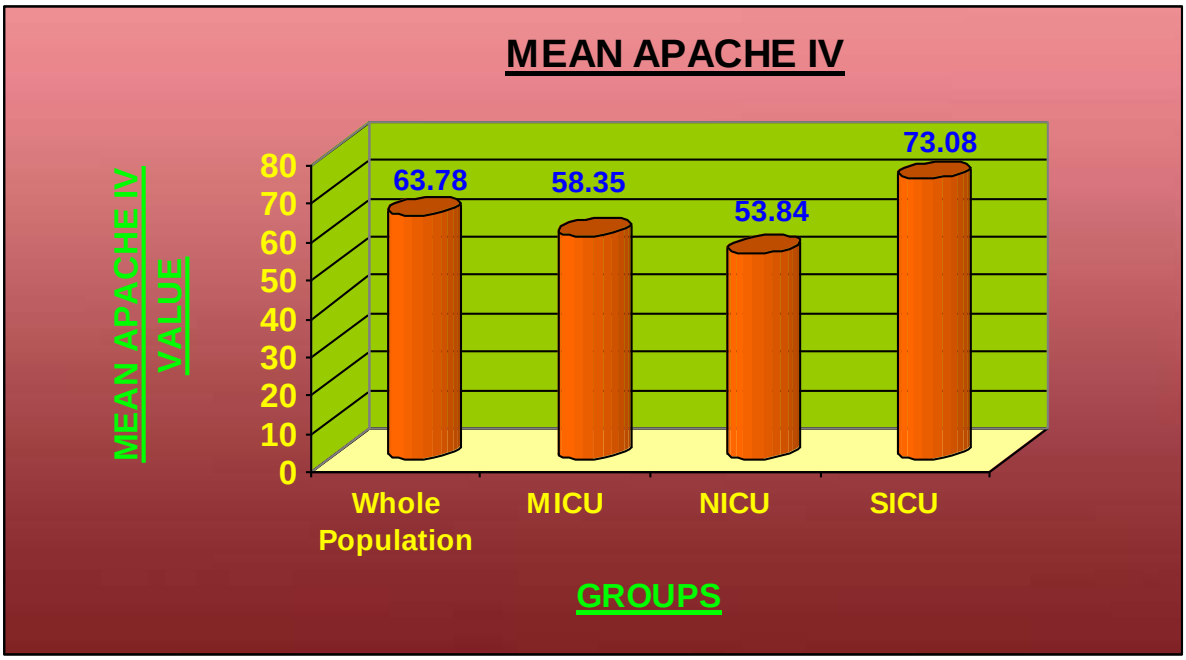
The no. of patients who survive was 104 (64.2 %) while the out come of remaining 12 (7.4 %) patient could not record whether they survived or not. Among SICU patients 70.3% survived. Whereas survival status of MICU was 62.8% and survival status of NICU was 56.3%



APACHE IV score

Mean APACHE IV score of over all patients was found to be 63.78 with standard deviation of 29.821. Mean APACHE IV score of survivors was found to be 54.55 with standard deviation of 25.32. Mean APACHE IV score of non-survivor was 85.07 with Standard Deviation of 30.398 which is significantly higher.

Mean APACHE IV score of SICU was 73.08 with standard deviation of 30.788.Mean APACHE IV score of MICU was 58.35 with standard deviation of 25.4.Mean APACHE IV score of NICU was 53.84 with standard deviation of 29.86



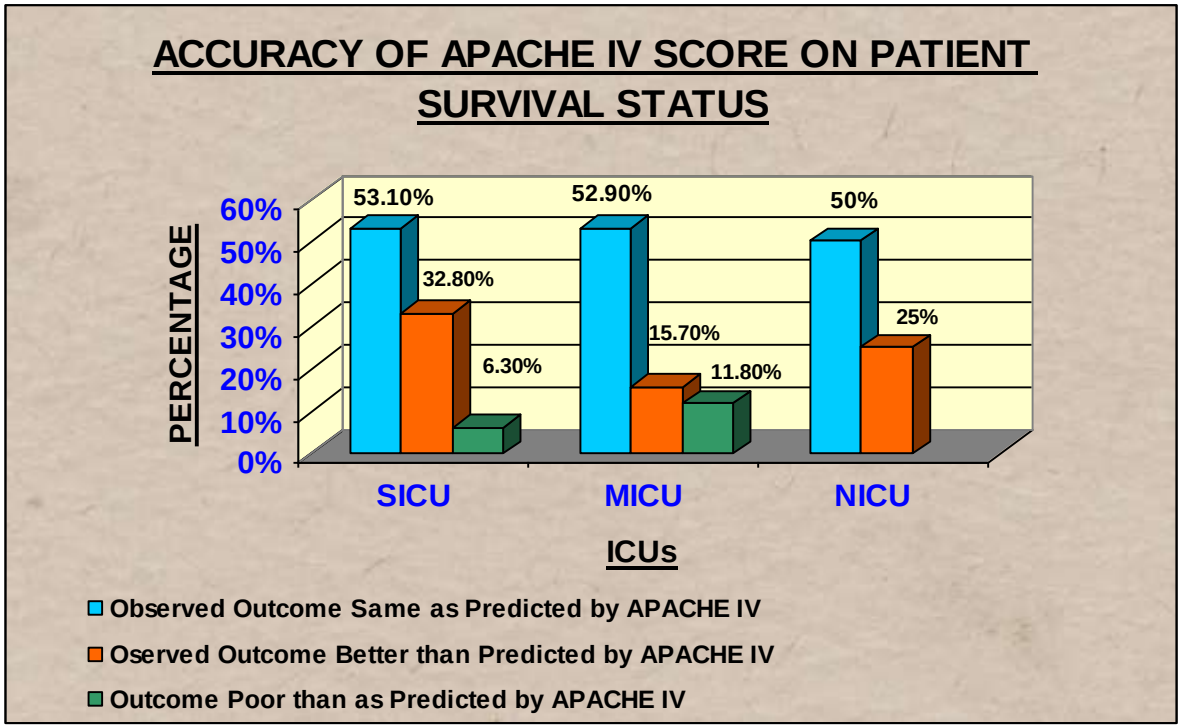
Observed outcome of Patients from ICU as predicted by APACHE IV Score

63.9% patients have APACHE IV score <60, out of these 79.7% were discharged from ICU and 14.8% don't survive. 27.8% patients have APACHE IV score >81. Out of these 31.7% were discharged from ICU and 65.8% do not survive ($p<0.001$). The 62.1% of overall population show the same outcome as predicted by APACHE IV ($p=0.61$).

Among SICU Patients 38.9 % of patients have APACHE IV Score <60 out of these 45.45% were discharge from ICU and only 6.3% of patient died. Where as 39.68% of SICU Patients have APACHE IV Score more than 81. Out of these patients 40 %discharged and 60%died ($p=0.000$)

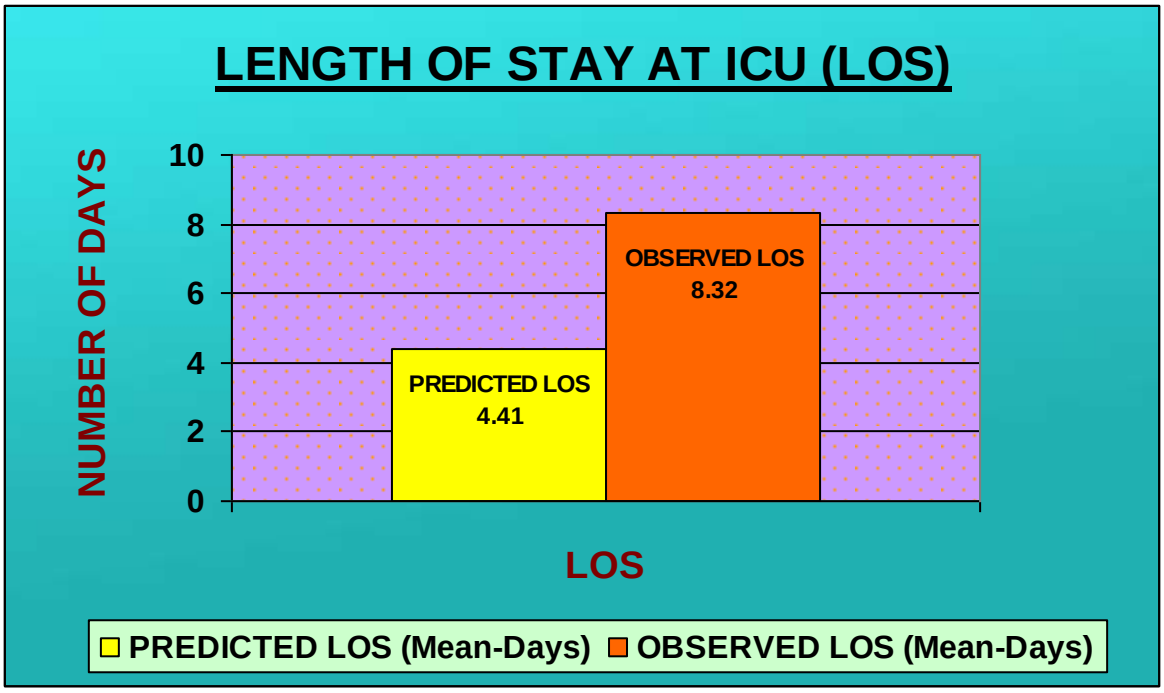
Among MICU Patients 56.86 % of patients have APACHE IV Score <60 out of these 82.7% were discharge from ICU and only 3.4% of patient died. Where as 17.64% of MICU Patients have APACHE IV Score more than 81. Out of these patients 22.2 %discharged and 66.7% died ($p<0.05$).

Among NICU Patients 65.62 % of patients have APACHE IV Score <60 out of these 71.4% were discharge from ICU and 28.6% of patient died. Where as 21.87% of NICU Patients have APACHE IV Score more than 81. Out of these patients 14.3 %discharged and 85.7% died ($p=0.30$).



Length of Stay (LOS)

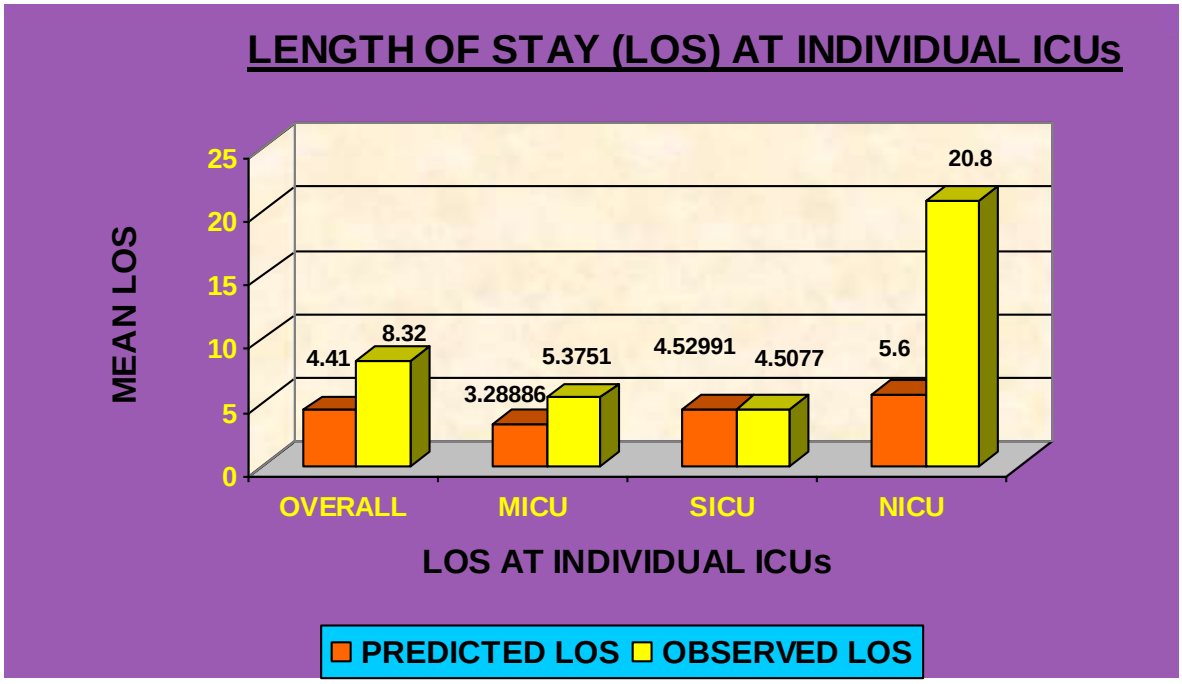
Mean predicted ICU LOS of whole study population was 4.41 with standard deviation of 2.431802, while mean observed LOS was 8.3 with standard deviation of 11.47.

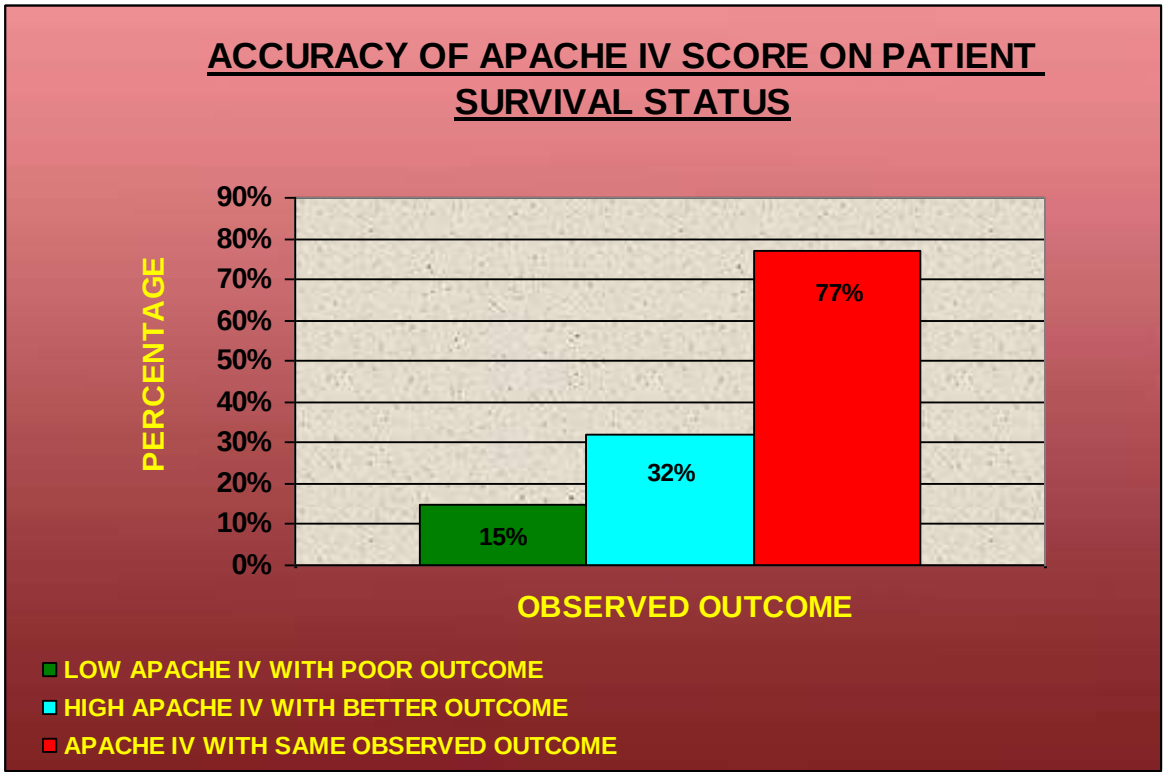


In SICU mean and observed LOS was same. Mean predicted LOS SICU patients was 4.5 with standard deviation of 2.32 and observed LOS was 4.5 with standard deviation of 5.49.

Mean predicted LOS MICU patients was 3.28 with standard deviation of 4.39 and observed LOS was 5.37 days with standard deviation of 1.47.

Mean predicted LOS NICU patients was 5.59 with standard deviation of 2.88 and observed LOS was 20.8 days with standard deviation of 17.88.





DISCUSSIONS

With the development of emergency medicine and quality care of health care in our set up, a need arose for evaluation scales that would provide a rapid triage and assessment to provide good and quality care in emergencies and critically ill patients to reduce mortality and morbidity. On other hand, a pre intensive care unit evolution would be optimal; it had a prognostic component, and would therefore be applicable to hospital-based observation of the patient.

In our study we predicted and observed length of stay, mortality rate through APACHE-IV evaluation forms for each patient for first 24 hours parameters, we calculated values through APACHE-IV calculator in 3 intensive care units Surgical intensive care, Medical intensive care and Neurocoma Intensive Care Unit of a tertiary care hospital Karachi.

We compared our study with others for the APACHE-IV scoring system which is done in different countries.

A US study at APACHE IV shows that for 90% of 116 ICU admission diagnoses, the ratio of observed to predicted mortality was not significantly different from1.0 [23]. The standardized mortality ratio is 1.06 (P = 0.79, 95% CI = 0.7 to 1.5). In contrary with other study a total of 54 patients with mean age of 53.8 years were included. Fifty-six percent were males; 62% of patients were medical, 38% were surgical. The predicted ICU length of stay of 6.3 days (SD = 2, range of 2.1 to 10.2) was insignificantly lower than the observed ICU length of stay of 8.0 days (SD = 8.5, range of 1 to 45) (P < 0.12). The observed mortality of 44.4% was not statistically different from predicted mortality of 42.1 (P = 0.8). The observed mortality of sepsis patients at King Faisal Specialist Hospital was 33.1%. with predicted mortality of 32.2% and SMR of 0.99 (95% CI = 0.78 to 1.32, P = 0.82) The hospital mortality calibration curve for APACHE IV shows good calibration, with the line of perfect fit agreement lying within the 95% CI[24].

Among SICU Patients 38.9 % 0f patients have APACHE IV Score <60 out of these 45.45% were discharge from ICU and only 6.3% of patient died. Where as 39.68% of SICU Patients have APACHE IV Score more than 81. Out of these patients 40 %discharged and 60%died (p=0.000). Similarly a study conducted at Washington University, Washington proves that as the Acute Physiology Score rose there is a linear increase in ICU stay until the score exceeded 80, at which point ICU stay decreased[22].

Among MICU Patients 56.86 % 0f patients have APACHE IV Score <60 out of these 82.7% were discharge from ICU and only 3.4% of patient died. Where as 17.64% of MICU Patients have APACHE IV Score more than 81. Out of these patients 22.2% discharged and 66.7% died (p<0.05).

Among NICU Patients 65.62 % 0f patients have APACHE IV Score <60 out of these 71.4% were discharge from ICU and 28.6% of patient died. Where as 21.87% of NICU Patients have APACHE IV Score more than 81. Out of these patients 14.3 %discharged and 85.7% died (p=0.30). In the contrary with a study, coma patients were grouped on the basis of etiology, according to the method of Sacco et al[Error! Reference source not found.]. No statistically significant differences in accuracy of prognosis prediction were identified for the three scales assessed. For prehospital work, this finding is important

because it shows that GCS does not deviate significantly either from the MEES scale (which has more parameters) or from the APACHE II scale (which is measured in hospital). GCS has important advantages over other scales, because it enables rapid evaluation of status and may direct necessary interventions. Furthermore, it is possible to observe continuously the state of consciousness, and to identify eventual improvement (indicating efficacy of therapy) or deterioration. GCS is widespread and clinicians are familiar with it. This scale therefore facilitates good 'clinical communication' between prehospital work and further hospital procedures and treatments. So in patients of Neurocoma Intensive Care Unit length of stay and mortality was higher because of lower GCS score. It means GCS affects on prognosis and out come.

Mean predicted Length of stay in Neurocoma Intensive Care Unit patients was 5.59 with standard deviation of 2.88 and observed Length of stay was 20.8 days with standard deviation of 17.88 which is so high than other units. Similarly In one of the study at Tertiary Saudi Hospital It was demonstrated that ICU prediction equation of the APACHE IV system performs poorly at Saudi for expected range of < 1 day[25].

On the other hand in the year 2007-2008 a study on Performance of the APACHE IV system in patients with acute renal failure the predicted ICU length of stay of 6.3 days (SD = 2, range of 2.1 to 10.2) was insignificantly lower than the observed ICU length of stay of 8.0 days (SD = 8.5, range of 1 to 45)[26].

In our study we found that the Length of stay increases as the APACHE IV score increases. At APACHE IV scores more than 81 Length of stay decreases and the mortality rate increases. The same effect of high APACHE IV score was noticed in one of the study at Thailand ICU[22]

Among SICU patients 70.3% survived, where as survival rate of MICU was 62.8% and

NICU survival rate was 56.3%, which is lower than other units.

Mean APACHE IV score of over all patients was found to be 63.78 with standard deviation of 29.821. Mean APACHE IV score of survivors was found to be 54.55 with standard deviation of 25.32. And mean APACHE IV score of non-survivor was 85.07 with Standard Deviation of 30.398 which is significantly higher.

APACHE IV is not reliable tool to predict mortality and length of stay in sepsis patients with sepsis and acute pancreatitis[27]. In a study at India on APACHE IV in pancreatitis patients the predicted and observed LOS and mortality were different[28].

CONCLUSION

The present study demonstrates that the mortality prediction and LOS predicted by APACHE IV system performs acceptably in some of our ICUs and can be utilized as a performance assessment tool in our ICUs. But there is need for more research on APACHE IV with different ICU and different diseases.

RECOMMENDATIONS

APACHE IV can be use as it shows good prediction of mortality among all ICU patients. APACHE IV shows good prediction for length of stay and mortality at ICU in the Surgical ICU patients.
Since the GCS is low in the patients of NICU and most of the patients have respiratory muscle weakness APACHE IV can be used to predict the length of stay at ICU. But looking at overall statistics APACHE IV is a good tool to predict mortality and LOS at ICU. Still more research is needed to evaluate the predictive efficacy of APACHE IV in different diseases and at other ICUs.

Abbreviations

APACHE: Acute Physiolical And Chronic Health Evaluation
ICU: intensive care unit
NICU: neurocoma ICU
MICU: Medical ICU
SICU: surgical ICU
CHK: Civil Hospital Karachi
SMR: standardize mortality ratios
SD: standard deviation
LOS: Length of stay
TRISS: Trauma and Injury Severity Score
ASCOT: A Severity Characterization of Trauma
GCS: Glasgow Coma Scale
APS: Acute Physiology Score
ICNARC: Intensive Care National Audit Research Centre
SAP: severe acute pancreatitis
CABG: coronary artery by pass grafting
CI: confidence interval

Key words

APACHE IV, ICU Scoring System, Severity Assessment tools

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