A Prospective Observational Study on Use of Acute Physiology and Chronic Health Evaluation-II and Sequential Organ Failure Assessment Score to Predict Outcome

Niraj Kumar Keyal,[1] Sudhakar Jha,[2] Shahnaj Parween,[3] Ishfa Banu Haque, [4]Tauqueer Ansari,[1] Istiyaque Ansari[1]

[1]Department of General Practice and Emergency Medicine-Critical Care Medicine Unit, National Medical College, Birgunj, Nepal, [2]Department of Internal Medicine, National Medical College, Birgunj, Nepal, [3] Department of Anaesthesiology,, National Medical College, Birgunj, Nepal,[4] Department of Oral and Maxillofacial Surgery, National Academy of Medical Sciences, Bir Hospital.

ABSTRACT

Background: Acute physiology and chronic health evaluation –II (APACHE-II) and Sequential organ failure assessment (SOFA) is used to predict overall mortality and sepsis outcome in the intensive care unit (ICU) respectively. There are limited studies that have shown that both score can be used to predict mortality in surgical and medical patients admitted in the intensive care unit.

Methods: It was a prospective, observational study in a level three intensive care unit of National Medical College, Birgunj. This study was conducted in 542 patients admitted in the mixed intensive care unit of medical; college. Demographic data was gathered from each patient in the preformed sheet at the time of presentation to the intensive care unit. Outcome of patients was recorded in terms of mortality, discharge toward and leave against medical advice. The descriptive data are presented as the number and percentage for categorical data and mean $\pm$ standard deviation for continuous data according to their distribution

Results: Five hundred forty two patients were included in this study. 340(62.7%) were males and 202(37.3%) were females. 440(81%) patients survived and went home, 65(12%) expired, 26(5%) left the hospital against medical advice (LAMA) and 11(2%) gave do not resuscitate orders (DNR). The discrimination power was similar for APACHE II and SOFA scores (AUC=0.732 versus 0.771, respectively, p>0.05). APACHE II score>8.5 and SOFA >3.5 was cut off to predict mortality

Conclusions: SOFA and APACHE II has similar discriminating power to predict mortality in all group of patients in a mixed intensive care unit.

Keywords: APACHE II; intensive care units; SOFA.

INTRODUCTION

Acute physiology and chronic health evaluation –II (APACHE-II) [1] and Sequential organ failure assessment (SOFA)[2] is used to predict overall mortality and sepsis outcome in the intensive care unit (ICU) respectively. SOFA is used to quantify the severity of patient's illness, based on six organ dysfunction. APACHE-II is used within the first 24 hours of patient admission the worst value for each physiological variable is calculated

APACHE-II and SOFA are common in use with moderate discrimination. But both scoring system requires further validation depending upon the type, model of ICU and different patient characteristics. There are limited studies[3,4] that have shown that both score can be used to predict mortality in surgical and medical patients admitted in the intensive care unit.

This study was conducted to know use of Acute physiology and chronic health evaluation-II and Sequential organ failure assessment score to predict mortality in a mixed semi-closed intensive care unit

Correspondence: Dr Niraj Kumar Keyal, Department of General Practice and Emergency Medicine-Critical Care Medicine Unit, National Medical College, Birgunj, Nepal. Email: nirajkumarkeyal@gmail.com, Phone +9779855027141.

METHODS

It was a prospective, descriptive observational study in a level three intensive care unit of National Medical College, Birgunj, Nepal between Feburary1, 2024 to January 31, 2025. Ethical approval from the Institutional Review Committee was obtained before enrolment in this study. Ethical Approval number was F-NMC/639/079-080.Written informed consents were obtained from the patients or surrogate decision-makers.

All patients >18 years admitted to the mixed intensive care unit of a tertiary care hospital were included in this study. Patients younger than 18 years, whose surrogate decision-maker, or patient did not give written informed consent were excluded from this study.

The following data was gathered from each patient in the preformed sheet at the time of presentation to the intensive care unit.

Age, Sex, Occupation, Ethnicity, Acute Physiology And Chronic Health Evaluation (APACHE) II, initial Sequential Organ Failure Assessment (SOFA) Score, Injury severity score, Diagnosis, Intubated or Non-intubated, Specialty, Sub-specialty, Co-morbidity, Time lag between injury or symptom and presentation to the ICU, mode of admission in ICU, Outcome of patients was recorded in the intensive care unit. The out-come of the patient was defined as leave against medical advice, do not resuscitate, death, and discharge to ward.

The following data was gathered before the patient was shifted to the ward from the intensive care unit: days on mechanical ventilation, length of stay in the intensive care unit.

Data collection was done in a preformed sheet. The preformed sheet included all physiologic variables and demographic variables. All data was transferred to the excel sheet and transferred to SPSS-16. The descriptive data are presented as the number and percentage for categorical data and mean ± standard deviation for continuous data according to their distribution. A convenience sampling was done to maintain the validity and reliability of the study. Bias was reduced by collecting data from all groups of patients.

Values are presented as mean (± standard deviation SD) or frequency. Mann Whiteney U test was used to compare the numeric variables across different categories. MEDCALC 19.2.0 is used to compare ROC

curves. De Long et.al method is used to compare area under ROC. For determination p-value <0.05(2-tailed) was considered as statistically significant.
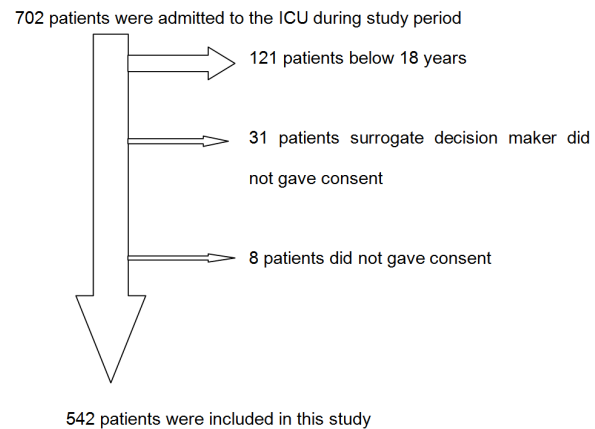
RESULTS

702 patients were admitted to the ICU during study period

121 patients below 18 years

31 patients surrogate decision maker did not gave consent

8 patients did not gave consent

542 patients were included in this study

Figure1. Flow diagram of patients included in this study.

Table 1. Demographic characteristics of the study population.

Parameters	n (%)
Age (Years)	
18-35	168(30)
36-60	194(35.8)
>60	180(33.2)
Sex	
Male	340(62.7)
Female	202(37.3)
Ethnicity	
Hindu	485(89.5)
Kirat	39(7.2)
Buddhist	13(2.4)
Muslim	4(0.7)
Christian	1(0.2)
Occupation	
Unemployed	182(33.6)
Farmer	126(23.2)
Housewife	98(18.1)
Student	51(9.4)
Labour	31(5.7)
Businessman	24(4.4)
Technical worker	22(4)
Army	8(1.4)

Table 1 shows the demographics characteristics of the study population. 340(62.7%) were males and 202(37.3%) were females. Most of the patients in this study were Hindus and unemployed.

Table 2. Clinical characteristics of the study population.	
Parameters	n (%)
Diagnosis	
Non-Trauma	351(64.8)
Trauma	191(35.2)
Injury severity score	
<15	121(63.3)
>15	70(36.6)
APACHE II Score at time of admission	
3-10	340(62.7)
11-20	131(24.1)
21-30	47(8.6)
31-40	24(4.42)
SOFA Score at time of admission	
0-6	422(77.8)
7-12	63(11.6)
13-18	36(6.6)
19-24	21(3.8)
Time of presentation to ICU (Hours)	
<6	74(13.7)
6-12	58(10.7)
12-24	113(20.8)
>24	297(54.9)
Mode of admission in ICU	
Direct	136(25)
Refer	388(71.5)
Ward	18(3.3)
Group of patient	
Intubated	144(26.6)
Non-Intubated	398(73.4)

APACHE: Acute physiology and chronic health evaluation; ICU: Intensive Care Unit; SOFA: Sequential Organ Failure Assessment

Table 2 shows the clinical characteristics of the study population. Non-trauma patient were more common than trauma patients. 63.3% of trauma patients had injury severity score less than 15. Majority of the patient at the time of admission had APACHE II of 3-10 and SOFA score of 0-6. Most of patients were admitted after 24

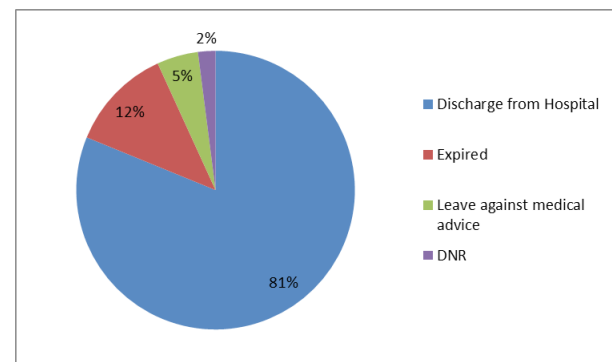hour of injury or illness, referred from other hospitals and non-intubated.

Figure 2. Outcome of patients from the hospital that were admitted to the intensive care unit.

Figure 2 shows the outcome of patients from the hospital that was admitted to the intensive care unit. Our study showed that 440(81%) patients survived and went home, 65(12%) expired, 26(5%) left the hospital against medical advice (LAMA) and 11(2%) gave do not resuscitate orders (DNR).

Mortality rate in this study was 65(12%). Forty-four (67.7%) expired after 48 hours of ICU admission and 21(32.3%) within 48 hour of ICU admission.

Out of 542 patients, 144(26.5%) were intubated and required mechanical ventilation. The minimum days on a mechanical ventilator were 1 day and the maximum was 16 days. Mean days on mechanical ventilator was 3±2.2 days. Mortality in intubated patient was 25%.

Out of 542 patients, 191(35.2%) were trauma patients and mortality was 9(4.71%).

The minimum length of stay (LOS) for all groups of patients in the ICU was 1 day and maximum was 51 days. Mean LOS in the ICU was 4.7±4.9 days.
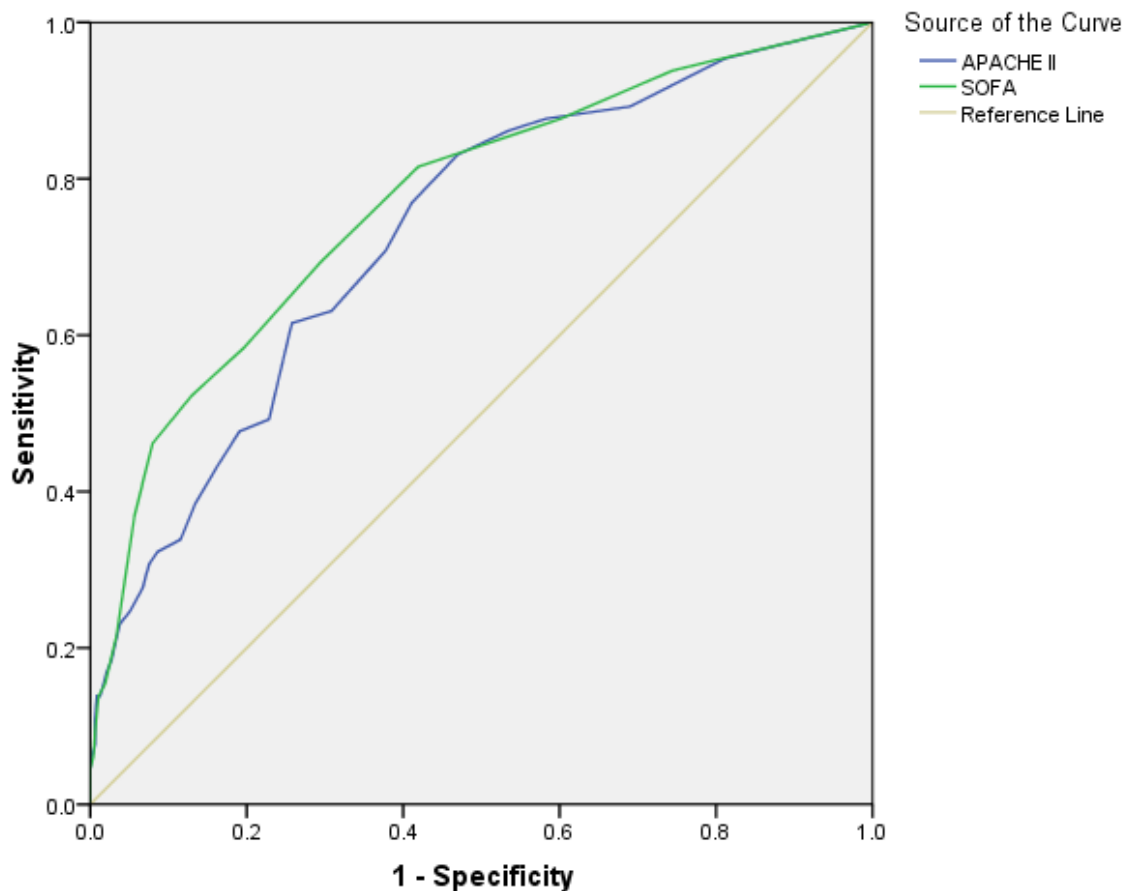
Figure3. Receiver operating curve for predicting mortality according to APACHE-II and SOFA scoring systems.

Table 3. compares the APACHE II and SOFA score to predict mortality in the Intensive care unit.

Test Result Variable(s)	Area	SE	p	95% Confidence Interval			Sensitivity	Specificity	PPV	NPV	Accuracy
				Lower Bound	Upper Bound	cutoff					
APACHE_II	.732	.033	<0.001	.667	.797	8.5	76.9	58.9	20.3	94.9	61.1
SOFA	.771	.033	<0.001	.706	.836	3.5	69.2	70.6	24.3	94.4	70.5

The discrimination power was similar for APACHE II and SOFA scores (AUC=0.732 vs 0.771, respectively, p>0.05). By cut-off score 8.5, APACHE II predicted mortality with a sensitivity of 76.9%, a specificity of 58.9%, negative predictive value (NPV) 94.9%, positive predictive value (PPV) 20.3% and accuracy of 61.1%, with an AUROC curve of 0.732±0.033 standard error (SE) (95%, 0.667-0.797, p<0.001).

SOFA predicted mortality with a sensitivity of 69.2%, a specificity of 70.6%, negative predictive value (NPV) 94.4%, positive predictive value (PPV) 24.3% and accuracy of 70.5%, with an AUROC curve of 0.771±0.033 standard error (SE) (95%, 0.706-0.836, p<0.001) with cut off score 3.5.

DISCUSSION

The prognosis of the patient is an important part of patient management for intensivist and family members for which different scoring system are used. Discrimination is defined as the power of a scoring system to differentiate deaths and survivors.[5,6]

APACHE II score has shown correlation with mortality, length of stay,[7] The AUROC for APACHE II was 0.732 in our study while in study by Basile-Filho A et al [3]and Falcao et al[8] it was 0.86 and 0.80 respectively. This difference may be due to different sub-group of patients and small

sample size.

The AUROC for SOFA was 0.732 in our study while in study by Basile-Filho A et al [3] and Falcao et al[8] it was 0.79 and 0.74 respectively. This difference may be due to different sub-group of patients and small sample size.

This study has shown that SOFA and APACHE II has similar discriminating power to predict mortality in the ICU which is similar to other studies [8,9] while study by Hosseini et al[10] has shown that APACHE II is better to predict mortality in the ICU. This difference may be because all groups of patients are included in this study while other studies have included only one specific group of patients.

Study by Lee et al [11] has shown that SOFA was more effective in predicting mortality than APACHE II. This difference may be because study was done in trauma patient while our study included all group of patients.

This study has shown that the cut off score to predict mortality for APACHE II and SOFA was 8.5 and 3.5 respectively while it was 13.5 and 5.5 in a study by Hosseini et al[10] This difference may be due small sample size, and this study was not designed or intended to establish a new cut off value for APACHE II and SOFA to predict mortality, although our current findings warrant further outcome studies to identify such cut off values.

Our study has limitations like it was a single-center, small sample size study. Serial measurement of SOFA score was not done.

CONCLUSIONS

SOFA and APACHE II has similar discriminating power to predict mortality in the ICU. The cut off score to predict mortality for APACHE II and SOFA was 8.5 and 3.5 respectively.

CONFLICT OF INTEREST

None

ACKNOWLEDGEMENTS

None

REFERENCES

1. Godinjak A, Iglica A, Rama A,Tancica I, Jusufovic S, Ajanovic A et al. Predictive value of SAPS II and APACHE II scoring systems for patient outcome in medical intensive care unit. Acta Med Acad 2016;45(2):97-103. doi: https://doi.org/10.5644/ama2006-124.165

2. Lukoko LN, Kussin PS, Adam RD, Orwa J, Waweru-Siika W. Investigating SOFA, delta-SOFA and MPM-III for mortality prediction among critically ill patients at a private tertiary hospital ICU in Kenya: A retrospective cohort study. PLoS One. 2020 Jul 16;15(7):e0235809. doi: https://doi.org/10.1371/journal.pone.0235809

3. Basile-Filho A, Lago AF, Menegueti MG, Nicolini EA, Rodrigues LAB, Nunes RS et al.The use of APACHE II, SOFA, SAPS 3, C-reactive protein/albumin ratio, and lactate to predict mortality of surgical critically ill patients: A retrospective cohort study. Medicine (Baltimore). 2019;98(26):e16204. doi: https://doi.org/10.1097/MD.0000000000016204

4. Saleh A, Ahmed M, Sultan I, Abdel-Lateif A. Comparison of the mortality prediction of different ICU scoring systems (APACHE II and III, SAPA II and SOFA) in a single-center ICU subpopulation with acute respiratory distress syndrome. Egypt J Chest Dis Tuberc 2015;64:843-8. doi: https://doi.org/10.1016/j.ejcdt.2015.05.012

5. Vincent JL, Moreno R. Clinical review: scoring systems in the critically ill. Crit care 2010;14:207. doi: https://doi.org/10.1186/cc8204

6. Strand K, Flaatten H. Severity scoring in ICU: a review. Acta Anaesthesiol Scand 2008;52:467-78. doi: https://doi.org/10.1111/j.1399-6576.2008.01586.x

7. Mumtaz H, Ejaz MK, Tayyab M, Vohra LI, Sapkota S, Hasan M et al.APACHE scoring as an indicator of mortality rate in ICU patients: a cohort study. Ann Med Surg (Lond). 2023 Mar 24;85(3):416-421. doi: https://doi.org/10.1097/MS9.0000000000000264

8. Falcao ALE, Barros AGA, Bezerra AAM, Ferreira NL, Logato CM, Silva FP et al. The prognostic accuracy evaluation of SAPS 3, SOFA and APACHEII scores for mortality prediction in the surgical ICU: an external validation study and decision- making analysis. Ann Intensive Care 2019;9:18. doi: https://doi.org/10.1186/s13613-019-0488-9

9. Chen YC, Tian YC, Liu NJ, Ho YP, Yang C, Chu

YY et al. Prospective cohort study comparing sequential organ failure assessment and acute physiology, age, chronic health evaluation III scoring systems for hospital mortality prediction in critically ill cirrhotic patients. Int J Clin Pract. 2006 ;60(2):160-6. doi: https://doi.org/10.1111/j.1742-1241.2005.00634.x

10. Hosseini M, Ramazani J. Evaluation of Acute Physiology and Chronic Health Evaluation and sequential organ failure assessment scoring systems for prognostication of outcomes among Intensive care unit's patients. Saudi J Aneasth 2016;10:168-73. doi: https://doi.org/10.4103/1658-354x.168817

11. Lee MA, Choi KK, Yu B, Park JJ, Park Y, Gwak J et al. Acute physiology and chronic health evaluation II score and sequential organ failure assessment score as predictors for severe trauma patients in the intensive care unit. Korean J Crit Care Med 2017;32(4):340-6. doi: https://doi.org/10.4266/kjccm.2017.00255