



## Comparison of Mortality Predictive Scoring Systems in PICU Patients

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### Abstract

*Rapidly developing the intensive care units [ICUs] created the need for quantitative and clinically relevant surrogates to evaluate the effectiveness of the management protocols. Predictive scoring systems have been developed to measure the severity of disease and prognosis of patients in the intensive care unit [ICU]. Such scoring systems are useful in clinical decision making, standardizing research and comparing the quality of patient care across ICUs. The outcome of the ICU patients in both adults and children depends on many factors present within the first 24 hours of admission. Many scoring systems have been developed for the ICU populations but very few are actually used in practice. In this study, 4 such scoring systems – namely APACHE II, SOFA, MODS and PRISM shall be studied and compared.*

### Introduction

Severity scoring systems allow generation of a score that reflects the severity of the condition resulting in ICU admission. The scores allow the factors that influence outcome and those that differ between patients to be considered and can be standardized to allow comparison between patients. Inferences can be made regarding patient response to therapies and interventions if sequential scoring systems (e.g. SOFA, MODS) are monitored for several days after ICU admission. Another important use for scoring systems in ICU is as an audit tool. They can help individual ICUs to assess their performance. In this study, 4 such scoring systems namely APACHE II, SOFA, MODS and PRISM shall be studied and compared. APACHE II, SOFA & MODS can be used in both, adults and children under intensive care while PRISM is specific for paediatric patients under intensive care. A

comparison of these scoring systems in predicting the mortality in PICU patients could help us choose one system which proves to be superior to the others in predicting the same and alter the course with timely changes if necessary in the management.

### Aims and Objectives

The aims and objectives of this study were to compare the accuracy of the mortality predictive scoring systems- 'APACHE II', 'SOFA', 'MODS' and 'PRISM' in predicting prognosis of patients admitted in the paediatric intensive care (PICU) unit in a tertiary care centre within 24 hours of admission. Also to ascertain whether the adult scoring systems like APACHE II, SOFA, MODS [with no modification for the paediatric age group] can to be applied to paediatric patients in critical care and their efficacy in doing so.

## Materials and Methods

This study of comparison between the mortality predictive scoring systems, namely, APACHE II, SOFA, MODS and PRISM was conducted at a Paediatric Intensive Care Unit of a tertiary care centre in a metropolitan city over a period of 18 months. The required data collection and investigations were done within 24 hours of admission to the PICU. Study area was Paediatric Intensive Care Unit (PICU) at a Tertiary care hospital in a metropolitan city. The sample size is 208 subjects fulfilling the inclusion and exclusion criteria [as mentioned below] were studied. The study was conducted over 18 months (February 2016 to September 2017). It is a comparative clinical study, where patients between 1 month-12 years of age admitted in the paediatric intensive care unit were considered. Four Mortality predictive scoring systems namely APACHE II, SOFA, MODS and PRISM were calculated for each patient within 24 hours of admission to the PICU. The efficiency of the scoring systems in predicting mortality was compared on the basis of AREA UNDER CURVE.

## Results and Discussion

A detailed analysis of the various parameters considered in the blood investigations was done for all children. This included parameters like the levels of sodium, potassium, glucose, total calcium, total bilirubin, creatinine, white blood cell counts [WBC], platelets, haematocrit and prothrombin and partial thromboplastin time [PT/APTT] with the mean scores of each of the parameters. The results obtained show that of the 208 patients included in the study, 46.6% children show normal levels of sodium whereas 53.4% children show reduced levels of sodium with a mean level of 134.3. Similarly on examination of the levels of potassium in the patients, 87.5% of the children exhibit normal levels of potassium while about 12.5% children show potassium deficiencies with a mean level of 3.9. On analysis of the glucose levels in each of the patients included in the study, 55.8% children show

normal levels of glucose, while 25.5% were found to be hypoglycemic and the remaining 18.8% were found to be hyperglycemic with the mean levels of sugar found to be 88.7 mg/dL.

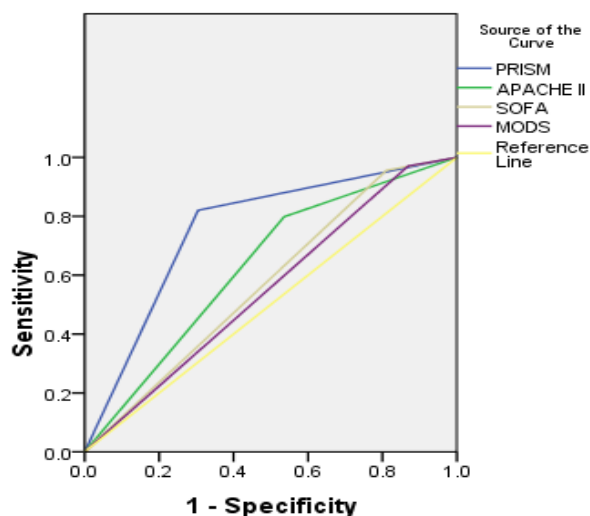
Total calcium levels were also a part of the blood investigations done in this study. Of all the children investigated, 112 children (53.8%) show normal levels of total calcium in the body. 92 children (44.2%) show hypocalcaemia, while 4 children (1.9%) were found to be hypercalcemic with an overall mean score of 8.4. The total bilirubin count in the total blood investigation showed that as high as 90.4 % of the children i.e. 188 children have normal levels of bilirubin. 16 children (7.7%) show higher than normal levels of bilirubin while 4 children (1.9%) show lower than normal levels of bilirubin with a mean value of 8.76.

The creatinine levels were found to be normal in 193 patients (92.8%) with the remaining 15 patients (7.2%) show raised creatinine levels in blood with a mean value of 0.8. The WBC count was also documented. The results show that (6.3 %) 13 patients suffered from leucopenia i.e. WBC count of less than 4000, while 55 patients (26.4%) had their WBC count in the normal range of 4000-11000. However, majority of the children i.e. 140 (67.3%) showed leukocytosis or a WBC count in excess of 11000. The mean WBC count overall was found to be 13451.4. The platelet count was also analyzed in the blood investigations. 61 children (29.3%) show their platelet count to be less than 150000 while only 5 children (2.4%) of all the children examined show a platelet count in excess of 450000. However as high as 68.3% children (142) had a platelet count in the normal range of 150000- 450000 with an overall mean platelet count of 193607.7. Majority of the PT/APTT findings were found to be normal. In all, 186 children i.e. 89.6%, PT/APTT findings were normal. Only 22 patients (10.6 %) show any abnormality in the PT/APTT findings. Lastly the hematocrit levels were evaluated and the overall mean score was found to be 34.8. The comparison done on the basis of "AREA UNDER CURVE"

comparison. While evaluating the mortality scoring systems, it was found that the APACHE II has the highest mean score of 15.6 followed by PRISM with a mean score of 8 as per table below. The SOFA and MODS show comparatively low mean scores of 5.8 and 5.5 respectively

Scoring Systems	Mean	SD	Min – Max
PRISM	8.0	6.4	0 – 32
APACHE II	15.6	6.3	4 – 32
SOFA	5.8	2.7	0 – 13
MODS	5.5	2.3	0 – 13

ROC Curve



On the basis of area under curve, PRISM was found to be superior to the other scoring systems as far as paediatric intensive care patients (PICU) are concerned.

### Conclusion

Thus to summarize, as per a detailed statistical analysis, that was performed, PRISM was found to be superior to the other scoring systems as far as paediatric intensive care patients (PICU) are concerned. APACHE II was next, followed by SOFA and MODS. As mentioned, a detailed analysis of the demographic and epidemiological data and other observations made during the course of the study has also been performed. This study was selected as there is indeed very little data as far as mortality prediction in paediatric ICU is concerned, especially in our country. Moreover, the adult scores that have been in use for decades now have not been adequately evaluated for their application the paediatric age

group. Thus, there are number of advantages of this observation like if a sensitive scoring system [PRISM > APACHE II] if applied to all PICU patients within 24 hours of admission, the prognosis can be predicted and amendment or alteration in the management if required, can be applied. It has been ascertained that the adult scoring systems [without any modification] can be applied in predicting mortality in the PICU patients and their sensitivity and specificity in doing so is fairly acceptable. Most of parameters included in the study are routinely a part of critical care, hence any additional intervention affecting the patients and influencing their co-operation was not done. Also the observations regarding the immunization and nutritional status that have been made can be utilized to spread greater awareness among the health workers to bridge the gap. However, there are also a few shortcomings observed like The parameters and scores of the adult scoring systems [APACHE II, SOFA and MODS] are based on the upper and lower physiological limits for the various parameters as observed in adults, which vary greatly from the paediatric population. Also the variations in the physiological parameters of the different sub-groups of the paediatric population itself, on the basis of age /gender etc. have not been included, the results of this study cannot be applied to neonates, the eventual outcome of the subjects discharged from PICU, in the long run, could not be ascertained. Also as follow up of the patients was not a part of this study, the morbidity correlation could not be assessed. Hence, an accurate, sensitive and reliable mortality prediction tool can significantly influence the management protocols and thus the outcome, amendments in the quality of care can be made and the overall mortality trends can be influenced for the better. Thus routine application of these scoring systems should be encouraged and the healthcare workers including the nurses should be made aware about the same.

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