

Mortality Risk Prediction by Application of Pediatric Risk of Mortality Scoring System in Pediatric Intensive Care Unit

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Abstract

Objective: The Pediatric Risk of Mortality (PRISM) score is one of the scores used by many pediatricians for prediction of the mortality risk in the pediatric intensive care unit (PICU). Herein, we intend to evaluate the efficacy of PRISM score in prediction of mortality rate in PICU.

Methods: In this cohort study, 221 children admitted during an 18-month period to PICU, were enrolled. PRISM score and mortality risk were calculated. Follow up was noted as death or discharge. Results were analyzed by Kaplan-Meier curve, ROC curve, Log Rank (Mantel-Cox), Logistic regression model using SPSS 15.

Findings: Totally, 57% of the patients were males. Forty seven patients died during the study period. The PRISM score was 0-10 in 71%, 11-20 in 20.4% and 21-30 in 8.6%. PRISM score showed an increase of mortality from 10.2% in 0-10 score patients to 73.8% in 21-30 score ones. The survival time significantly decreased as PRISM score increased ($P \leq 0.001$). A 7.2 fold mortality risk was present in patients with score 21-30 compared with score 0-10. ROC curve analysis for mortality according to PRISM score showed an under curve area of 80.3%.

Conclusion: PRISM score is a good predictor for evaluation of mortality risk in PICU.

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Key Words: PRISM Score; Mortality; Pediatric Intensive Care Unit; Children

Introduction

The Pediatric Risk of Mortality (PRISM) score is effective in predicting children's mortality. Information about the predictive value of PRISM score is very limited outside America and Europe, especially in developing countries^[1]. Especially in centers with limited pediatric intensive care unit (PICU) beds, by helping physicians predict the mortality risk, PRISM score may help the medical group decide which patient benefits more from admission to PICU^[2]. PRISM scoring system is a physiologic stability index that predicts mortality

through normal physiologic disturbances during the period of disease. It was first described by Pollack et al in 1988^[3]. World Health Organization (WHO) estimated that 10 million children die every year of which 99% occurs in the developing countries. Acute respiratory disease and malaria are the most common causes of death in under 5-year-old children in these countries. With good care in PICU, physicians may save lives of one million children in developing countries such as Pakistan^[4]. Maysat et al introduced PRISM and pediatric index of mortality (PIM) as two evaluating systems in PICU worldwide. PRISM

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score is used in PICU and needs observation during the first 24 hours of admission. But now PRISM III scoring system is used to evaluate the severity of the disease after 12 and 24 hours of admission in PICU^[5]. Lacroix et al pointed out that PRISM score may be used in neonates, infants, children and adolescents with severe disease, but may not be used in preterm neonates and adults^[6]. Tan et al aimed to evaluate risk factors that increase the mortality risk in PICU, especially with the use of PRISM scoring system as an outcome predictor^[7]. A prospective study in India showed that a simple clinically scoring system will be useful in predicting severity of illness and outcome at admission in emergency^[8]. The purpose of present study was to evaluate the PRISM scoring system in predicting mortality rate in PICU.

analysis including bicarbonate, $Paco_2$ and Pao_2 was carried out in each patient. The Glasgow Coma Score (GCS) was calculated by the pediatric resident at admission. The patients were followed up during hospital stay by the resident doctor, and he reported the outcome as death or survival at the end of the hospital stay. Finally, PRISM score was calculated for each patient. PRISM score evaluation was done as recommendation of Pollack et al. This score is calculated from the most abnormal values of 14 physiological variables in the first 24 h and the patient's age and operative status^[3]. A written informed parental consent was obtained. The study was approved by the ethics committee of Zahedan University of Medical Sciences. The results were analyzed by Kaplan-Meier curve, ROC curve, Log Rank (Mantel-Cox), Cox and Logistic regression model. SPSS 15 for Windows (SPSS Inc, Chicago, Illinois) was used for statistical analysis.

Subjects and Methods

This cohort study was performed on 1-month to 14-year-old patients admitted during an 18-month period in the PICU of Ali-ebne-Abitaleb hospital of Zahedan. Children with congenital anomalies and infants less than 1 month of age were excluded.

Each patient received a chart including vital signs, temperature, respiratory rate, heart rate and blood pressure. Systolic and diastolic blood pressure was measured by Doppler method. Oxygen saturation was monitored by pulse oximeter. White blood cell count, platelets, liver enzymes (SGOT, SGPT), bilirubin (total, direct), PT, PTT, glucose, blood urea, creatinine, sodium, potassium and calcium were measured by standard laboratory tests. Arterial blood gas

Findings

Of the 221 patients admitted to PICU during the study period, 126 were males. Forty-seven (21.3%) patients died, of whom 26 were males. Table 1 One-hundred ten patients were less than 1 year old, 37 patients were 1-2 years old and 74 patients were more than 2 years old, of whom 22.7%, 27% and 16.2% respectively died. Sixteen (10.2%) of 157 patients with PRISM score 0-10 died. PRISM score 11-20 and 21-30 were observed in 45 and 19 cases, of whom 17 (37.8%) and 14 (73.8%) patients expired, respectively (Table 1). The outcomes based on the causes of illness are shown in Table 2.

Table 1: Survival of hospitalized patients in the PICU according to age, gender and PRISM score

Variable		Number	Died (%)	Median (month)	Standard Error	Confidence Interval	P. value
Gender	Female	95	21 (22.1)	25	7.4	10.5-39.4	0.6
	Male	126	26 (20.6)	35	7.5	20.2-49.8	
Age (month)	0-12	110	25 (22.7)	35	13.5	8.6-61.4	0.6
	13-24	37	10 (27)	36	12.8	10.9-61	
	>24	74	12 (16.2)	45	0	-	
PRISM Score	0-10	157	16 (10.2)	36	0.8	34.5-37.5	≤0.001
	11-20	45	17 (37.8)	16	4.7	6.8-25.2	
	21-30	19	14 (73.8)	4	4.9	0- 13.6	

PICU: Pediatric intensive care unit; PRISM: Pediatric Risk of Mortality

Table 2: Outcome based on the type of disease

Underlying Disease	no	Mortality (%)	Median Survival (month)
Neurologic	66	10 (15.2)	35
Infectious	56	14 (25)	12
Hematologic and malignant disorders	33	7 (21.2)	-
Respiratory	33	6 (18.2)	13
Renal and metabolic	21	6 (28.6)	10
Gastrointestinal	12	4 (33.3)	25

According to time and rate of mortality, seven (87.5%) of the eight patients who were admitted at day 0-0.33 to PICU died. Five children (66.7%) died at day 0.34-0.5, six children (100%) died at day 0.51-1. Twenty-nine patients (14.6%) died one day after admission. There was no relationship between sex and age with death. However, probability of death significantly increased by higher PRISM scores (Table 3 and 4, Fig 1). The median age of survived girls and boys was 25 and 35 months respectively. The difference between these groups was not significant ($P=0.346$). The median age of survived children was 35 months in less than one year olds, 36 months in those between 1-2 years old and 45 months in more than 2 years old. The differences between these groups were not statistically significant ($P=0.599$). The median age of survived children was 36 months for patients with PRISM score 0-10, 16 months for patients with PRISM score 11-20 and 4 months for patients with PRISM score 21-30. According to PRISM score, survival probability showed significant differences between groups, so with increase of the PRISM score, survival probability decreased ($P\leq 0.001$) (Fig. 2). Compared to children with PRISM score of 1-10, hazard of death increased 3.2 times and 8.3 times in children with a PRISM score of 11-20 and 21-30, respectively (Table 1). According to disturbance of different systems, life probability did not show significant differences.

Table 3: Prediction of the probability of death according to PRISM score based on the logistic regression model

PRISM Score	Probability of Death (%)
5	11
10	23
15	40
20	61
25	78
30	89

PRISM: Pediatric Risk of Mortality

Discussion

Improvement of care for critically ill patients is a goal in all countries. Different care systems have been created to increase the quality of care for children who need special care. Efforts to decrease children's mortality led to PICU establishment. It is necessary to develop models which predict the mortality risk in PICU in order to monitor the effectiveness of the cares carried out. They enable us to compare different units and evaluate the associations between the severity of diseases, hospitalization duration and the costs. The predictor model must be independent from time and place. It is important to know the accuracy of these scoring systems to estimate the mortality risk in ICUs of different groups and countries.

PRISM is a physiologically based score that predicts the mortality risk according to the changes of normal values during disease period. This was a score designed by Pollack et al in 1988^[1-3].

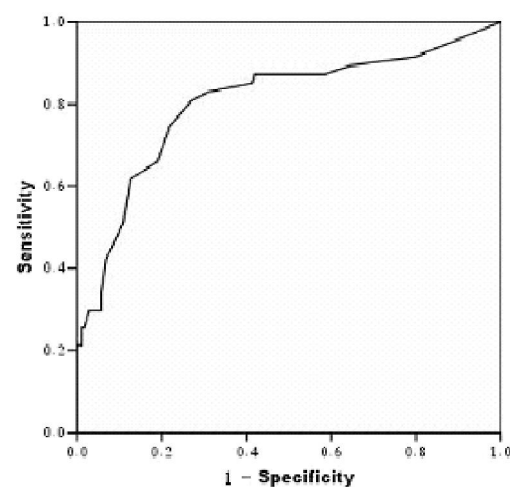
**Fig. 1:** Prediction of outcome by ROC analysis according to ROC curve analysis. Under the curve area is 80.3% showing good outcome

Table 4: Predictive model for the patient situation in hospitalized PICU patients

PRISM Score	Total No	Deaths		Alive	
		Observed (%)	Expected (%)	Observed	Expected
1-10	157	16 (10.2)	16.9 (10.8)	141	140.1
11-20	45	17 (37.8)	15.2 (33.8)	28	29.8
21-30	19	14 (73.7)	14.9 (78.4)	5	4.1

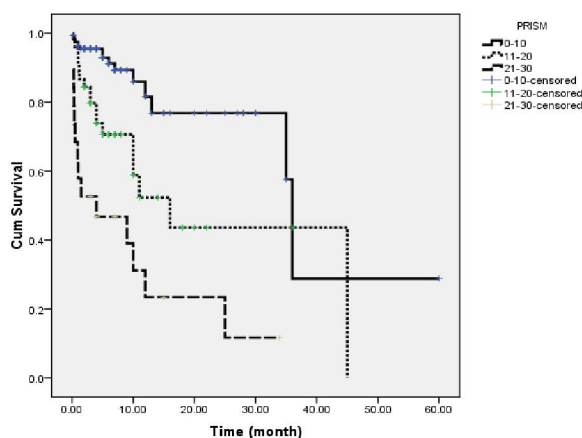
PICU: Pediatric intensive care unit; Hosmer-Lemeshow Chi-square=0.62; df=3; *P*. value=0.8

Qureshi et al^[9] indicate that by use of statistical analyses such as Hosmer, odds ratio, Spearman correlation test, ROC, Lemeshow Goodness-of-Fit, PRISM scoring system is a good predictor of mortality rate in PICU. They found that PRISM and PIM scoring systems had the same validity for estimating mortality. Their results are congruent with those of our study.

Another study^[7] demonstrated that PRISM scoring system can predict mortality in children admitted to PICU. These findings are similar to present study.

Martha VF et al^[10] observed that PRISM scoring system had good validity to predict mortality, but PIM scoring system was not acceptable for this purpose. Gemek et al^[11] stated that PRISM and PRISM III scores are good scales to estimate the mortality rate in PICU which is in harmony with our survey. A study by Anu T et al showed that under the ROC curve area in PIM, PIM₂ and PRISM are higher than 0.8, but these models predict mortality less than that observed in PICU. In our study, the area under the ROC curve was more than 0.8^[12]. In a study^[13], it was indicated that PIM₂ had the highest accuracy to differentiate risk groups; therefore, it was thought to be the best model to predict mortality in PICUs in Australia

and New Zealand. A prospective cohort study in Iran revealed that PIM₂ is a good index for prediction of mortality in PICU^[14]. In another study^[15], it has been mentioned that PIM₂ shows significant differences between life and mortality in patients who were admitted in PICU, but PIM did not show significant relationship with Hosmer Lemeshow test. Taylor et al showed that most patients admitted in PICU had acceptable functional outcome and quality of life after discharge. These findings are similar to ours^[16]. Shann et al^[17] stated that if the area under the curve of ROC is equal to one, the model is perfect. An area between 0.9 and 0.99% is very good, between 0.8 and 0.89% is good and finally, between 0.7 and 0.79% is acceptable. If the area is 0.5, the model is bad. In our study, the area under the curve was 80.3%, so it is good to predict mortality in PICU admitted patients. Choi et al^[18] concluded that PIM and PRISM III scoring systems are good predictors of mortality in PICU and the validity of these models are high such as in our study. Brady et al^[1] found that PIM₂ and PRISM III are good scales to estimate PICU mortality in the United Kingdom. They also showed fixed results to predict death in children. Parts of these findings are similar to present survey. Lacroix et al^[6] showed that PIM and PRISM scores are able to estimate the severity of disease that was consistent with our study. Another similar study^[19] showed that PRISM scoring system has high sensitivity to predict the outcome of children admitted in PICU. Sensitivity in score 15 was 89%.

**Fig. 2:** Probability of survival by time in terms of PRISM score

Conclusion

Our survey showed that PRISM scoring system is a good predicting value to evaluate death probability of children admitted to PICU of our center.

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Conflict of Interest: None

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