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Accuracy of pediatric risk of mortality (PRISM) III score in predicting mortality outcomes in a pediatric intensive care unit in Srinagar

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Abstract
Background: With the advancements in medicine and increasing access to modern technology, pediatric intensive care units (PICU) are becoming a vital part of any health care setting. PICUs play a key role in saving the life of young patients. Various scales have been designed by researchers to aid in predicting the mortality of a patient admitted in PICU. Study aimed at validating the Pediatric Risk of Mortality score (PRISM score) in predicting mortality in a tertiary care Pediatric Intensive Care Unit in Srinagar.
Study design: The study was conducted at Pediatric Intensive Care Unit of Postgraduate Department of Pediatrics in GB Pant Hospital, an associated hospital of Government Medical College Srinagar 315 patients included in our study. Out of these patients, 166 patients were males and 149 patients were females.
Results: In our study we found that PRISM III score of the patients who expired was significantly higher (31.4±8.75) as compared to patients who were discharged (14.3±3.60) ($p<0.0001$).
Conclusion: PRISM score is a significant predictor of PICU mortality.

Keywords: PRISM score, PICU

Introduction

The severity of illness assessments is a critical part of ICU management and administration in both adult and pediatric medicine [1]. Several scoring systems have been developed in anesthesiology to predict mortality in admitted patients. By assessing the patient's mortality risk in the critical care unit and by assigning a score we aim to predict and prevent deaths in the critical care unit. However, mortality does not depend only on ICU performance but also on many other characteristics like demographic and clinical characteristic of population and infrastructure [2].

Khajeh *et al*. discussed two analysis programs from PICUs, with the help of the pediatric index of mortality (PIM) and the PRISM score, which was significant to evaluate the pediatric patients at higher risk of mortality [3, 4]. Lacroix *et al*. mentioned that the PRISM can be used in infants, neonates, children, and adolescents with severe disease but cannot be used in premature infants and adults [5].

PRISM III 24 is a widely accepted score against which other scores are compared. There are certain limitations, however, with the use of PRISM score as a predictor of mortality. First, a lot of information is used to calculate the score. Secondly, it takes into account the worst reading within the initial 12 or 24 hours. So the score may be more of a diagnosing death rather than predicting it. Thirdly, patients in a good intensive care unit may recover more rapidly than those in a poor unit and scores of patients in a poor intensive care unit may be high. This discrepancy can lead to an interpretation that higher mortality is due to sicker patients [6].

Materials and Method

The study was conducted at Pediatric Intensive Care Unit of Postgraduate Department of Pediatrics in GB Pant Hospital, an associated hospital of Government Medical College Srinagar. The hospital has a catchment area of both rural and urban populations and is a referral tertiary care hospital.

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Study design
This study was a hospital based prospective observational study.

Inclusion criteria
All patients between age group of >1 month to 14 years admitted to the Pediatric Intensive Care Unit.

Exclusion criteria
1. Children with known errors of metabolism
2. Children with trauma
3. Children who died within 6 hours of admission to PICU

Results
We enrolled a total of 315 patients in our study. Out of these patients, 166 patients were males and 149 patients were females. More males were admitted compared to females. Male to female ratio was 1.1. Predominant age group to be admitted was the 12-24 months age group. Thereafter, as the age increased the proportion of patients in higher age groups decreased. However, patients admitted in 61-120 months age group were more than those admitted in 49-60 months age group. Least number of patients was admitted in 120-168 months age group.

Table 1: Percentage across diagnostic categories

Diagnostic category	Percentage
Respiratory emergencies	49.5%
Neurological emergencies	26.7%
Gastrointestinal emergencies	11.1%
Cardiovascular emergencies	0.6%
Miscellaneous emergencies	12.1%
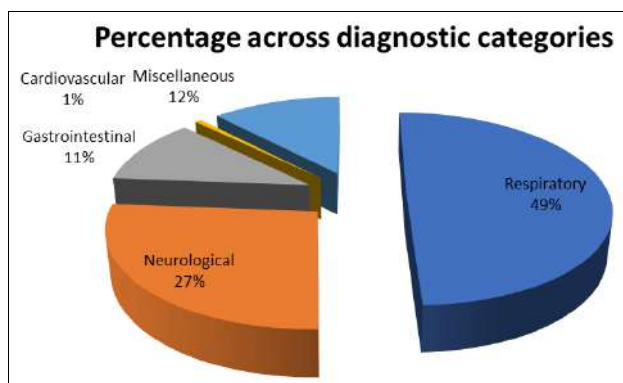
Fig 1: Percentage across diagnostic categories

Majority of patients in our study were shifted to respective wards as per hospital protocol before being discharged from their respective units. Sixty two (62) patients died during the course of hospital stay giving a mortality rate was 19.7%. Age group specific mortality showed that mortality was highest in the 120-168 months age group followed by that of 7-12 months age group.

**Table 2:** Outcome of study population

Outcome	Absolute number	Percent
Discharged	253	80.3%
Expired	62	19.7%
Total	315	100%

Table 3: Outcome across age groups

Age group	Total patients admitted in PICU	Expired	Discharged
1-6 months	55	16	39
7-12 months	40	16	34
13-24months	105	14	91
25-36 months	40	2	38
37-48 months	33	4	29
49-60 months	11	0	11
61-120 months	28	7	21
121-168 months	3	3	0
Total	315	62	263

Table 4: Age specific mortality

Age group	Total patients admitted in PICU	Expired	Mortality
1-6 months	55	16	29.1%
7-12 months	40	16	40%
13-24months	105	14	13.3%
25-36 months	40	2	5%
37-48 months	33	4	12.1%
49-60 months	11	-	0%
61-120 months	28	7	25%
121-168 months	3	3	100%
Total	315	62	19.7%
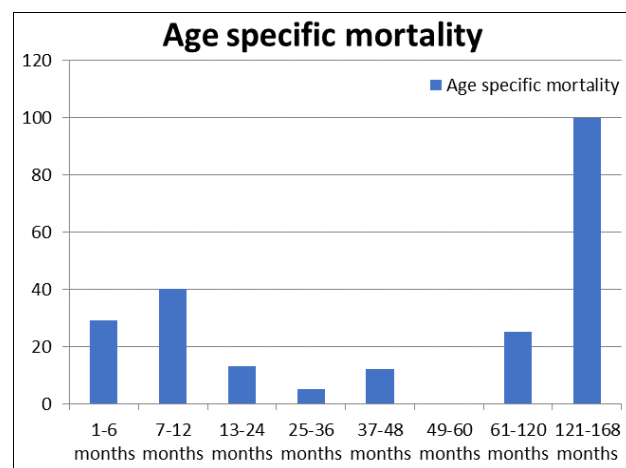
Fig 2: Age specific mortality

Table 5: Independent samples t-test PRISM III Score assuming unequal variance

Test statistic t(d)	15.098
Degree of Freedom(DF)	66.1
Two tailed probability	$P < 0.0001$

Table 5: In our study we found that patients who expired had a significantly higher PRISM III score (31.4±8.75) as compared to patients who were discharged (14.3±3.60) ($p<0.0001$). Thus, PRISM III score was also a significant predictor of mortality in our study.

ROC curve for PRISM III score
The ROC curve for PRISM III score (Figure 3) yielded an AUC of 0.977(95% CI,0.954-0.991).The optimal cut off point was PRISM III score >18 which predicted mortality with a sensitivity of 98.39%, specificity of 92.89%, PPV 77.2% and NPV 99.6% (Tables 6, 7, 8).
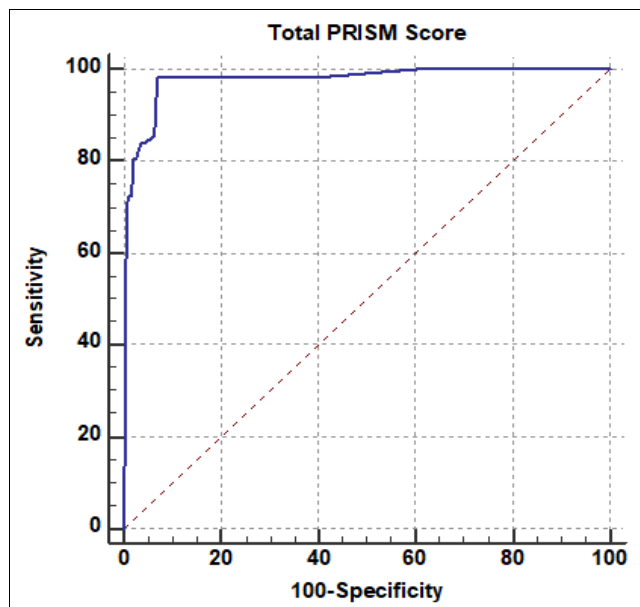
Fig 3: ROC curve for PRISM III score

Table 6: Area under the ROC curve (AUC) and associated criterion

Area under the ROC curve (AUC)	0.977
Standard error	0.00949
95% Confidence Interval	0.954 to 0.991
z statistic	50.298
Significance level P(Area=0.5)	<0.0001
Youden index J	0.9127
Associated criterion	>18
Sensitivity	98.39
Specificity	92.89

Table 7: Shows sensitivity and specificity of PRISM III score for predicting mortality at different cut off points

Criterion	Sensitivity	95% CI	Specificity	95% CI
>16	98.39	91.3-100.0	82.61	77.4-87.1
>17	98.39	91.3-100.0	88.93	84.4-92.5
>18	98.39	91.3-100.0	92.89	89.0-95.7
>19	85.48	74.2-93.1	93.68	89.9-96.3
>20	83.87	72.3-92.0	95.65	92.4-97.8
>21	83.87	72.3-92.0	96.44	93.4-98.4

Table 8: Shows predictive value at different cut-offs of PRISM III score

PRISM score cut-off	Positive predictive value PPV=True positive/Total Positive	Negative predictive value NPV=True negative/Total Negative
>16	61/105=58.1%	209/210=99.5%
>17	61/89=68.5%	225/226=99.6%
>18	61/79=77.2%	235/236=99.6%
>19	53/69=76.85	237/246=96.3%
>20	52/63=82.5%	242/252=96%
>21	52/61=85.2%	244/254=96.1%

Discussion

The Pediatric Risk of Mortality (PRISM) score was developed from the Physiologic Stability Index (PSI) to reduce the number of physiologic variables required for mortality risk assessment from 34 to 14 and to obtain an objective weighing of the remaining variables by Pollack *et al*. [1]. PRISM III, an updated third-generation physiology-based scoring system, was developed in 1996. Although these scoring systems are used to determine the risk of death and disease severity, there are many factors that affect mortality in critically ill patients and these factors are not well understood.

The mean age of our patients was 28.48±27.84 months and there were more males as compared to females with a male-female ratio of 1.1:1.This was comparable to sudy done by Roopsa B Mangshetty1, Aishwarya Patil *et al*. [12]. However the mean age was higher in study done by A M Munde, N Kumar *et al*. [13] (mean age 40.15, range 1-144 months). Predominant age group to be admitted was the 12-24months age group. Least number of patients were admitted in 120-168 months age group.

In our study most of the patients were admitted for pediatric respiratory emergencies (49.5%) followed next in frequency by neurological emergencies (26.7%), gastroenterological emergencies (11.1%), cardiovascular emergencies (0.6%) which correlate well with study conducted by Khilnani P Sharma *et al*. [8].

In our study we found that out of 315 patients admitted to PICU, 62 patients died giving a mortality rate of 19.7% which was comparable to mortality rate observed in study of D Singhal *et al*. [14].

In our study we found that PRISM III score of the patients who expired was significantly higher (31.4±8.75) as compared to patients who were discharged (14.3±3.60) (*p*<0.0001). Thus, PRISM III score was also a significant predictor of mortality in our study. ROC curve of PRISM III score (Fig.3) yielded an AUC of 0.977 [(95% CI, 0.95-0.99) (*p*<0.0001)]. The optimal cut off point was PRISM III score >18 which predicted mortality with a sensitivity of 98.39% Specificity of 92.89%, PPV of 77.2% and NPV of 96.3%.Thus in our study we found that PRISM III score of >18 has the maximum sum of sensitivity (98.39%) and specificity (92.89%) for predicting mortality. The study conducted by Roopa Bellard, Surendra Rao *et al*. [9] revealed that a cut off score of 15 was associated with 89.23% accuracy while as the study conducted by Ahmed El-Nawawy [10] revealed a cut off score of 26 with an accuracy of 91.6%. The PRISMIII score at the cutoff point of 13 had the best sensitivity (0.71) and specificity (0.64) was found in the study conducted by de Leon AL, Romero-Guiterez G [11]. The severity of illness may cause the difference in the cutoff point of PRISM score obtained in each study.

Conclusion

The pediatric mortality rate is higher in underdeveloped countries compared to other developed countries of the world. Pediatric critical care and emergency medicine are at a promising stage in INDIA similar to the status in other developing countries. Certainly, there is a great need for trained pediatricians in this stage in PICU to reduce the rates of deaths. The initiation has been done yet still; there is a long way to go. This field is full of challenges and opportunities simultaneously; however, its dynamism is also there. Dedication and motivation towards providing quality

care to such critically and severely ill children is the most imperative part of pediatric critical care medicine.

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