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ORIGINAL RESEARCH

Clinical Patterns of PICU Admissions in a Large Government Teaching Hospital and the Utility of PRISM III Score in Predicting Outcomes

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ABSTRACT

Background: PRISMIII score was shown to be effective in predicting the risk of mortality and as well as the factors contributing to poor outcome. Therefore, we have evaluated our PICU using modified PRISMIII results.

Martial and Methods: A Prospective observational study was conducted on 120 seriously ill infants and children meeting the inclusion and exclusion criteria admitted to PICU were taken up for the study at the Department of Paediatrics, Mahatma Gandhi Memorial Hospital, KMC Warangal, Telangana, South India.

Results: Mean age among survivors was 57.16±49.35 months and among deceased were 34.8±43.4 months. Male to female ratio was 1.06:1.00. Our PICU is catered to the medical critical illness only. The overall mortality rate is 57.5%. The major causes of illness in the order of decadence were, infections, Respiratory, CNS, CVS and GIT disorders Altered sensorium, multiorgan dysfunction and need for mechanical ventilation were significant risk factors of mortality. The duration of hospital stay among non-survivors was less than the survivors.

Conclusion: The mean PRISMIII score among non-survivors was higher than survivors. PRISMIII score at 24hrs, PRISMIII difference, length of hospital stay, showed a statistically significant correlation with the mortality (p=0.000). The probability of deaths increased significantly with increase in PRISM score. Area under ROC is 99.9%, with cut-off point at score 15.

Keywords: Paediatric Intensive Care Unit, Paediatric Risk of Mortality Score, Outcome.

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INTRODUCTION

The science of caring for critically ill patient has evolved rapidly over the past decade, as molecular mediators of illness have become better defined and new therapies have been devised based on those advances. As a result, critical care is a multidisciplinary field

requiring a team-oriented approach, including critical care physicians, nursing staff, pharmacists, referring physicians, consulting specialists and social services specialists.[1]

In a country like India where provision of basic health care to the masses in itself is a challenge, access to tertiary level paediatric intensive care for general population is almost non-existent. Here most of care of seriously ill children is provided by nurses, paramedical staff and non-specialist doctors in rural or remote hospitals or overburdened staff in overcrowded urban government hospitals. In most such hospitals resources are inadequate, access to information and technology is poor and ongoing professional development & staff training is minimal. These basic deficiencies affect lives of millions of children each year & form background to any consideration of appropriate role of intensive care.[2]

Various scoring systems are currently used in the PICU like Glasgow coma scale, Paediatric trauma score or Injury severity score, Paediatric index of mortality score, the physiologic stability index or the Paediatric risk of mortality (PRISM). Out of all these scoring systems, PRISMIII score was shown to be effective in predicting the risk of mortality and as well as the factors contributing to poor outcome. Therefore, we have evaluated our PICU using modified PRISMIII results.

PRISM SCORE:[3] PRISM is the Paediatric risk of mortality score which has been devised by Pollock et al to predict the mortality in hospitalized children. PRISM score is a revised form of physiologic stability index of mortality score. This score uses 14 physiologic variables (34 ranges) based on abnormalities observed at the bedside examination and laboratory assessment. The patients past medical history are also taken into account, particularly chronic illness and previous hospital admissions. The PRISM score has a consistently strong relationship between number of malfunctioning organ system at 12 and 24 hours and the mortality risk in a given PICU. Attempts to use PRISM for decision making in a single patient are not valid, owing to less than "adequate certainty". The PRISM is most useful in assessing case mix adjustments between units and the overall outcomes for a population of patients in a PICU. A PICU that performs a periodic self-assessment using PRISM can determine if its performance is on a par with the reference population. If performance is below standard, a chart review may reveal the reasons, such as high secondary infection rates, co-morbidity issues and decision to withdraw or limit therapy. Therefore, PRISM serves as an objective and efficient method for the physicians to predict the outcome and risk of mortality, as well as helps them to provide the medical services with valuable epidemiological criteria. An updated version of this model, PRISM III has recently been developed.

PRISM III,[3] This was based upon a sample of 11,165 consecutive admissions to 32 paediatric ICUs (10% of PICUs of USA) representing a wide diversity of organizational and structural characteristics. 16 The variables that were most predictive of mortality as indicated by the highest PRISM scores were minimum systolic BP, abnormal pupillary reflexes and stupor/coma were tained from PRISM score. Variables in the original PRISM that were not included in PRISM III are diastolic BP, respiratory rate, PaCO2/F1O2, serum bilirubin and calcium concentration. PRISM III has 17 physiologic variables subdivided into 26 ranges and is population independent.

Predictive equations:

Predictive equations for prognosis are available for the 12 hour and 24 hour scores. PRISM III is a widely accepted and is a standard against which other scores are compared.

However there some problems with the use of PRISM III:

A lot of information is needed to calculate it and many units do not calculate it routinely. Worst reading of 12/24 hours is used and a lot of deaths occur (in one study over 40%) with in first 24 hours, so the score may be diagnosing death rather predicting it. There may be

blurring of differences of 2 units as patient in a good unit may recover rapidly and score may be lower and the same patient in a bad unit might have had higher score due to poor management and high mortality of bad unit may be interpreted as due to sicker patients. The time spent in the hospital before coming to ICU could improve the PRISM score and predict lower than actual mortality (lead time bias).[4]

Uses of models of mortality prediction including PRISM III:

PRISM III are most applicable to groups of patients (e.g. to assess institutional performance). These models help us to investigate best ways of organizing PICU by comparing different units. They also help us to monitor effect of change in practice by observing trends within the unit over a time.[4] They can also be used for controlling severity of illness for various clinical trials.[5] They can be applied for resource utilization (rationing intensive care).

PRISM III takes 24 hours to complete and can't be used in regulating admission to PICU.[3] They have been used to assess relation between severity of illness and length of stay or cost.

A critically ill child is exposed to sophisticated equipment and undergoes aggressive treatment in a well-established PICU. Evaluation of the outcome of such therapy serves as a guide for prognosis, cost analysis, staffing, inter-institutional comparision. Therefore, it is essential to evaluate every PICU, so that any changes in the management protocols can be known and measures to reduce the factors which contribute to the poor outcome are taken. An attempt has been made through this study, to study the clinical pattern, disease severity, assess PRISM III score & outcome of critically ill children being admitted to PICU, MGM Hospital with its available resources.

AIMS & OBJECTIVES

- To assess the clinical spectrum and severity of illness of infants and children at admission.
- To assess the risk factors contributing to mortality in PICU.
- To analyze the mortality pattern.

MATERIALS & METHODS

A Prospective observational study was conducted on a convenience sample of 120 seriously ill infants and children meeting the inclusion and exclusion criteria admitted to PICU were taken up for the study at the Department of Paediatrics, Mahatma Gandhi Memorial Hospital, KMC Warangal.

Inclusion Criteria:

- A convenience sample of 1 month to 12 years aged critically ill Infants and children admitted to PICU
- Parents who gave consent.

Exclusion Criteria:

- Neonates and children above 12yrs of age.
- Infants and children who died within 24hrs of admission
- Infants and children who absconded, left against medical advice, transported to higher centres.
- Parents who did not give consent

Following admission, a detailed history was taken, followed by thorough general and systemic examination which was done by the duty junior resident in a predesigned standard case record form. Then PRISMIII score is calculated at 12hrs and 24hrs by me in all these children using 17 variables and the final hospital outcome recorded as died or survived.

Study Variables includes

- Age
- Sex
- Length of Hospital stay
- Primary affected system
- Multi Organ Dysfunction System (MODS)
- Mechanical ventilation
- PRISM variables

Statistical Analysis

The association between the study variables i.e., demographic profile, system involvement and PRISMIII were analyzed using windostat version 9.2 from indostat services and Epi-info17 version. The association between the study variables and the PICU mortality was tested using the student t-test and one way ANOVA. Results were considered statistically significant if there was $p \leq 0.05$. The capacity of discrimination of PRISMIII between survived and expired patients was calculated b Receiver Operating Characteristic (ROC) curve analysis. Whenever its under surface area is close to 1, the capacity of discrimination is considered to be high.[6]

RESULTS

The mode of presentation, clinical profile, disease severity status, PRISM III at 12 hours and 24 hours of admission, hospital stay, and need of mechanical ventilation, management details and outcome are as follows:

Table 1: Age and Sex distribution

Age in years	Male	Female	Total
0-3yrs*	37 (51.3%)	35(49.7%)	72 (60%)
4-6yrs	6 (5%)	8 (6%)	14 (11.6%)
7-9yrs	9 (7%)	4 (3.3%)	13 (10.8%)
9-12yrs	10 (8.3%)	11 (9.1%)	21 (17.5%)
TOTAL	62 (51.6%)	58 (48.3%)	N=120

*neonates are excluded.

72 (60%) critically ill infants and children were from age 1 month to 3yrs. Out of these, 37(51.3%) were males & 35(49.7%) were females. Boys and girls are equally admitted (1.06:1.00). 14(11.6%),13(10.8%) & 21(17.5%) ill children were aged between 4 to 6yrs,7-9yrs and 10-12yrs respectively. Out of these 6(5%), 9(7%) &10(8.3%) aged between 4-6yrs, 7-9yrs & 10-12yrs were males. 8(6%), 4(3.3%) &11(9.1%) aged between 4-6yrs, 7-9yrs & 10-12yrs were females respectively.

Clinical Pattern and primary system involvement

The clinical presentation of these 120 infants and children is recorded as follows Parents reported fever in 105 (87.5%) children. Remaining 15(12.5%) were cold and clammy. Rash was associated finding in 18(15%) of these children. Rash was confluent, generalized and

erythematous. Varying degrees of edema was also observed in these children with fever and rash. These cases were provisionally diagnosed as viral hemorrhagic fevers with shock.

Table 2: Fever & Rash

Fever and Rash	**Total**
Temperature	105(87.5%)
100-102° F	16(15.2%)
102- 104° F	35(33.3%)
Above 104° F	54(51.4%)
Rash	18(15%)

Out of 105 (87.5%) infants and children with fever, 89(84.7%) had high grade fever and 16(15.2%) had low grade fever.

Table 3: Predominant system involved at the time of admission

System	**Total**
Infections	30(25%)
Respiratory	26(21.6%)
CNS	26(21.6%)
CVS	15(12.5%)
GIT	8(6.6%)
Poisoning	6(5%)
Blood	4(3.3%)
Musculoskeletal	3(2.5%)
Renal	1(0.8%)
Endocrinology	1(0.8%)

Shock were observed in 30(%) critically ill infants and children after an average of 1 week of fever; Respiratory distress /respiratory failure (tachypnoea, tachycardia, chest retractions of various degrees of severity, stridor, cyanosis) in 26(%); altered sensorium with seizures 28 (23.3%) and without seizures12(10%); history of congenital heart disease (extreme tachycardia, gallop rhythm, hepatomegaly) in 15(12.5%); severe dehydration signs 8(6.6%); severe pallor, bleeding gums in 4(3.3%); see-saw breathing (spinal muscular atrophy) in 3(2.5%); anuria in 1(0.8%); kussumal breathing with altered sensorium 1(0.8%) were other features.

Table 4: mean temperature, mean Heart rate and mean SBP

Mean temperature(°F)		**12hrs**			**24hrs**	
	survivors	deaths	Total	survivors	Deaths	total
	102±2.2	101.9±2.3	102±2.3	101.9±2.3	102.8±2.0	102.4±2.2
Mean heart rate(bpm)		12hrs			24hrs	
	survivors	Deaths	Total	survivors	Deaths	total
	144.8±26.7	139±34.7	141.9±31.5	128.7±17.6	134.7±21.5	132.1±20.1
Mean SBP (mmHg)		12hrs			24hrs	

	survivors	Deaths	Total	survivors	Deaths	total
	78.7±17.1	88.7±17.1	84.4±17.7	85.7±14.6	77.0±15.6	80.7±15.7

The mean Systolic blood pressure at 12hrs after admission was 84.4±17.7mmHg and at 24hrs was 80.7±15.7mmhg. 40 patients were in hypotensive shock (SBP< 5th centile) at presentation. Another 50 children were in compensatory shock, showing various clinical features of shock like tachycardia, tachypnoea, cold clammy extremities etc.19 children with hypotensive shock died.

Mechanical ventilation

22(18.3%) males, 17(14.1%) females; total 39(32.5%) required mechanical ventilation. 26(66.6%) were below 3yrs of age. 4(10.2%), 5(12.5%) & 4(10.2%) required ventilation in the age group of 4-6yrs,7-9yrs & 10-12yrs respectively. only 6(15.3%) of these children discharged.

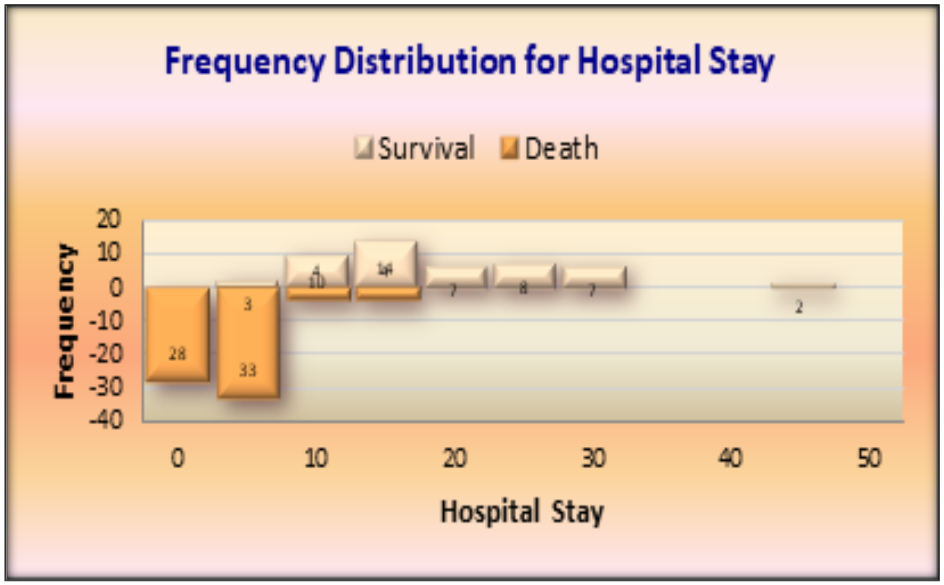

Figure 1: Hospital stay

46(38.3%) ill infants and children received care in the hospital for 3days.There was a lone survivor in these 46.18(15%) received treatment up to 7days in the hospital. 16(88.8%) of them expired. Survival was better in infants and children who survived the first week and received treatment in second week 18(15%); only 5(27.7%) of these children died. 30(25%) infant and children who survived first 2weeks till 4weeks did better. Only 2(8%) died. there were 8(6.6%) children who survived for more than 4weeks, all got discharged.

Mortality details:

- 69(57.5%) infants and children died in this study. 50(72.4%) children who died were below 3yrs of age; males 26(37.6%), females 24(34.7%).4(5.7%) between 4-6yrs; 7(10.1%) among 7-9yrs of age and 8(11.5%) between 10-12yrs of age died.
- Mortality was high among children below 3yrs of age than in children from 4-12yrs (p value-0.001**).
- 32(26.6%) females and 37(30.8%) males died in the present study.
- 11(68.7%) patients with CHD died in the present study. Among these 10(8.3%), 6(37.5%) had acyanotic CHD and 5(31.2%) had complex cyanotic CHD.

- 33 (84.6%) patients of 39(32.5%) ventilated infants and children died. Ventilation proved statistically to be a significant risk factor of mortality (p=0.000***).

Table 5: PRISMIII at 12hrs & at 24hrs

PRISM SCORE at 12hrs	**Male**	**Female**	**Total**	**Deaths**
0-9	32(26.6%)	27(22.5%)	59(49.1%)	38(31.6%)
10-19	26(20.8%)	35(30%)	61(50.8%)	31(25.8%)
20-29	0	0	0	0
>30	0	0	0	0
Total				69(57.5%)
PRISM SCORE at 24hrs	**Male**	**Female**	**Total**	**Deaths**
0-9	24(20%)	23(19.2%)	47(39.1%)	0
10-19	13(10.8%)	6 (5%)	19(15.8%)	15(12.5%)
20-29	15(12.5%)	13(10.8%)	28(23.3%)	28(23.3%)
>30	12(10%)	14(11.6%)	26(21.6%)	26(21.6%)
Total				69(57.5%)

38(31.6%) and 31(25.8%) critically ill infants and children with PRISMIII 0-9 & 10-19 at 12hrs expired respectively. Infants and children with score above 20 at 12hrs were not observed in the present study. No patient with PRISMIII between 0-9 at 24hrs died.15 (12.5%), 28(23.3%) and 26(21.6%) patients with scores between 10-19, 20-29 & above 30 expired respectively. Unlike PRISMIII at 12hrs, PRISMIII at 24hrs had patients with scores above 20. The mean PRISMIII at 12hrs among survivors is 10.8±4.5 and among deceased is 9.1±4.8. The mean PRISMIII at 24hr is 4.6±3.1 among survivors and among deceased is 25.7±6.8. PRISMIII at 24hrs predicted mortality strongly. The worsening of PRISMIII from 12hrs to 24hrs among survivors and deceased is statistically significant. (p=0.000) It is 6.2±3.4 in survivors to -16.7±7.9 in deceased infants and children. Respiratory infections contributed to 13% of deaths. All these 9(13%) diagnosed having bronchopneumonia.4 (5%) patients with poisoning died in the present study. All 3(4.3%) patients with spinal muscular atrophy died. one child (1.4%) each with ARF, ALL and severe anemia died.

DISCUSSION

120 critically ill infants and children were admitted. Clinical details, PRISMIII at 12hrs and 24hrs recorded, results analyzed as follows.

Table 6: Age distribution of paediatric intensive care unit patients

Age group					
<1 month	**(2003, N=439)**		**(2009, N=794)**		
1-6 month	**N**	**%**	**Age group**	**N**	**%**
7-12 month	14	3.2	< 1month	10	1.25
1-4 years	107	24.3	1-12 month	236	29.7
5-8 years	44	10.0	1-3 years	123	15
9-12 years	125	28.47	3-5 years	106	13.3
>12 years	65	14.8	5-10 years	149	18.7

	47	10.7	10-15 years	137	17

Age distribution of PICU patients in Gangaram hospital New Delhi, in the year 2003 & 2009 are depicted above,[7] about 45% admissions in 2009 and 65.4% admissions treated in PICU were below 4yrs of age, present study shows similar age distribution (62%) [Table 1]. In Voiakli E study,[8] the mean age of PICU population was 54.26±49.9 months. In our study mean age among survivors was 57.16±49.35 months and among deceased were 34.8±43.4 months. There was male sex preponderance in the Voaikli E study (64.6%) which was not observed in our study. Male to female ratio was 1.06:1.00 in our study. Various PICU'S cater to the needs of 16-60% of trauma patients. Our PICU is catered to the medical critical illness only.

Table 7: The distribution of patients by primary system of involvement in various institutions in India[9]

Pediatric intensive care unit patients – distribution by primary system of involvement					
System	**Vellore (%)**	**AIIMS (%)**	**SGRH (%)**	**PGIMER (2007-2010) (%)**	**Present study (%)**
Respiratory	26.2	13.5	17.31	25	21.6
CNS	23.4	36.0	23.69	30.5	21.6
CVS	9.5	7.8	5.92	9	12.5
GIT	7.3	13.8	11.39	2.9	6.6
Renal	2.2	7.0	4.1	2.9	0.8
Hematology	4.5	6.3	4.1	2.9	3.3
Infections	9.5	14.8	10.25	13	25
Poisoning	9.3	10.2	0.91	5.3	5
Miscellaneous	5.1	-	5.47	5.3	3.3

Primary respiratory involvement was observed in 13.5% in AIIMS, 26.2% in Vellore and 25% in PGIMER. The study from our PICU also showed similar distribution 26 (21.6%). The CNS involvement in various PICU'S ranged between 23% to 30%; our PICU 21.6% Primary CVS involvement in various PICU'S ranged between 6-12%; 5.9% in Lucknow, 9% & 9.5% in PGIMER and Vellore. Primary GIT involvement is 6.6% in our PICU, 13.8% in AIIMS and 11.8% in Lucknow which is almost 2 times our patients. This may be due to advanced tertiary care facilities including research facilities offered by these two institutes in gastrointestinal diseases. Infections with generalized symptoms ranged between 9%-15% in these institutes. Infections with generalized symptoms are 25% in our PICU which is highest. Compared to PICU'S in Delhi, Chandigarh, and Vellore which cater to the needs of referral patients, our PICU is open to direct admissions and caters to the needs of predominantly rural population. Mechanical ventilation rate in Voailki E et al study,[8] is 67.3%, 58% at admission. In our PICU mechanical ventilation is 32.5%. Mechanical ventilation started in our unit since 2004. It is a significant risk factor of mortality in G H Tan et al study.[10] Similarly in our PICU, the ventilation mortality is very high 87.5%, this could be because this PICU has a access to direct admissions and also has need for improvement of trained personnel and gadgets. In the presence of MODS, the mortality is 56.3% in G H Tan et al study,[10] and 66.7% in Voaikli E,[8] study. It is 85.7% in our centre. Hospital stay for survivors and deceased has a distinct pattern in various PICU's. In N. Bilan et al study,[11] the Mean hospital stay in survivors was 10.6±7.2 days. In our study it is 18.4 ± 9.2 days, this

duration of stay included stay in step down ward after clinical status improved in PICU. The mean hospital stay in N.Bilan et al study,[11] in the deceased was 7.0 ± 8.3 days. The difference in hospital stay in the study was 3 days which was statistically not significant (p=0.037). The mortality in the study was 9%. However, in the present study the mean hospital stay among the dead patients was 4±3.1 days compared to 18.4±9.2 days among survivors which is statistically significant. This difference in hospital stay among survivors and deceased is may be due to high mortality rate in our children that too within three days of admission. Taori et al study,[12] Prashanth and Baswaraj study from Karnataka,[13] Bellad R et al,[14] study, singhal et al study,[15] from Delhi, Bhatia et al from Ludhiana,[16] have predicted the mortality for PRISMIII 0-9,10-19,20-29 and more than 30. The sample size ranged from 100 to 230 in these studies.

Table 8: PRISMIII & mortality in various studies

SI.NO.	Study	Sample Size	Score	Mortality	Predictability
1	Singhal D et al St Stephen's Hospital Delhi 2000,[15]	100	1-9 10-19 20-29 >30	8.2% 24.4% 33.3% 66.3%	Area under ROC curve 0.72 validates the PRISM-III score in predicting mortality
2	Bhatia RC et al DMC&H, Ludhiana,[16] India 2003	109	1-9 10-19 20-29 >30	20.75% 30.8% 42.8% 71.4%	the area under the ROC curve was 0.70, which validates the PRISM-III score in predicting mortality
3	Bellad R et al JNMC Belgaum 2008,[14]	203	1-9 20-29	5.3% ~100%	89.2% accuracy at cut-off score of 15
4	Taori et al KEMH Mumbai 2010,[12]	230	0-1 1-5 5-15 15-30 >30	0% 6.6% 23.6% 63.3% 77.27%	the area under ROC was 0.85, which validates the PRISM-III score in predicting mortality
5	Dr. Prashanth et al study June 2012,[13]	207	0-9 10-19 20-29 >30	4.4% 27.6% 48.1% 71.4%	Area under ROC was 0.87 which validates the PRISM-III score in predicting mortality
6	Present study	120	0-9 10-19 20-29 >30	0% 12.5% 23.8% 21.6%	the area under the ROC curve was 0.70, which validates the PRISM-III score in predicting mortality

Mortality till PRISMIII 9 was 0 in the present study and 5.3 %, 8.2 % and 20.7% in Bellad et al,[14] Singhal et al,[15] and Bhatia et al,[16] studies respectively. At PRISM more than 30 mortality was 66.3%, 71.4% nearly 100%, 77.2% and 21.6% in Singhal et al,[15] Bhatia et al,[16] Bellad et al,[14] Taori et al,[12] and the present studies respectively. The area under the Curve in ROC curve analysis was 0.89, 0.85, 0.72 and 0.99 in Singhal et al,[15] Bhatia et al,[16] Bellad et al,[14] Taori et al,[12] and the present studies respectively. The proportion of deaths gradually increased with increasing PRISM scores with a cut-off PRISM score of 15 in our

study. Hence a higher PRISMIII score showed a highly significant correlation with the outcome (p=0.00000***).

The mortality was underscored by PRISM 24hrs at more than 30 in our study, which may be due to all surgical and Trauma cases didn't form our study group, large number of direct admissions and possible improvement in the critical care to be provided to these children on the first day and subsequently. As the care improves in PICU's the mortality starts declining. To further decrease the mortality a decrease in ventilation and central venous cannulation in low risk patients with improvement in infection control practices is required as suggested by Karambeldkar et al study.[17]

CONCLUSION

The overall mortality rate is 57.5%. The major causes of illness in the order of decadence were, infections, Respiratory, CNS, CVS and GIT disorders Altered sensorium, multiorgan dysfunction and need for mechanical ventilation were significant risk factors of mortality. Acidosis worsened (PH 7.30 to 7.25) from 12hrs to 24hrs in deceased infants and children. The duration of hospital stay among non-survivors was less than the Survivors. CNS infection and septic shock contributed to half of mortality (49.1%).

The mean PRISMIII score among non-survivors was higher than survivors. PRISMIII score at 24hrs, PRISMIII difference, length of hospital stay showed a statistically significant correlation with the mortality (p=0.000). The probability of deaths increased significantly with increase in PRISM score. Area under ROC is 99.9%, with cut-off point at score15.

The present study is an attempt in such endeavour. The high mortality in the present study is not acceptable and there is urgent need of defining ill infants and children and early referral by community based programmes like F-IMNCI (facility based integrated management of neonatal and childhood illnesses) and ongoing care in this PICU with proper training of Post graduates, faculty and nursing staff in intensive care training on regular basis. Initial resuscitation of a critically ill infant or child should be followed by good facilities for transport of such children. In PICU's like this institute cardiac monitors, central venous catheterization, renal replacement therapy should be initiated in required patients.

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