

Demographic Profile and Outcome Analysis of a Tertiary Level Pediatric Intensive Care Unit

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Abstract. Objective : To study the profile and outcome of children admitted to a tertiary level pediatric intensive care unit (PICU) in India. **Methods :** Prospective study of patient demographics, PRISM III scores, diagnoses, treatment, morbidity and mortality of all PICU admissions. **Results :** 948 children were admitted to the PICU. Mean age was 41.48 months. Male to female ratio was 2.95:1. Mean PRISM III score on admission was 18.50. Diagnoses included respiratory (19.7%), cardiac (9.7%), neurological (17.9%), infectious (12.5%), trauma (11.7%), other surgical (8.8%). 196 children (20.68%) required mechanical ventilation. Average duration of ventilation was 6.39 days. 27 children (30.7 children /1000 admissions) had acute respiratory distress syndrome. Gross mortality was 6.7% (59 patients). PRISMIII adjusted mortality was directly proportional to PRISMIII scores. 49.5% of nonsurvivors had multiorgan failure. Average length of PICU stay was 4.52 +/- 2.6 days. Complications commonly encountered were atelectasis (6.37%), accidental extubation (2%), and pneumothorax (0.9%). Incidence of nosocomial infections was 16.86%. **Conclusion :** Our data appears to be similar with regards to PRISMIII scores and adjusted mortality, length of the PICU stay, and duration of ventilation, to previously published western data. Multiorgan failure remains a major cause of death. As expected, Dengue and malaria were common. Incidence of nosocomial infections was somewhat high. Interestingly, more boys got admitted to the PICU as compared to girls. Clearly more studies are required to assess the overall outcomes of critically ill children in India. [*Indian J Pediatr* 2004; 71 (7) : 587-591]

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There are many studies documenting outcomes of Pediatric intensive care units (PICU) from western countries¹⁻⁶ but very few such studies are available from the developing countries.⁹⁻¹² Parikh *et al* outlined significant issues in quality, cost and outcomes from an adult Intensive care unit (ICU) in India.¹⁰ Current status of information regarding a variety of clinical conditions, and outcomes from Indian PICUs is unknown with the exception of a few studies retrospectively looking at specific issues such as incidence and outcome of acute respiratory distress syndrome (ARDS) in children.¹¹ A retrospective study reviewing the admission records from 1986-93 documented the profile and outcomes of patients admitted to a six bedded pediatric intensive care unit.⁹ The present prospective observational study attempts to characterize the profile of children admitted to a tertiary PICU in India over a period of three years with various disease entities, their management in the PICU, adjusted mortality according to PRISMIII scores, iatrogenic and other complications, morbidity and overall outcomes.

Study PICU Profile

Study PICU is a 10 bedded Pediatric Intensive care unit of a private tertiary care hospital located in New Delhi, India

established in 1996. This PICU is located in a 541 bedded tertiary care hospital with total of 120 intensive care unit (ICU) beds including a ten bed dedicated PICU, separate from neonatal ICU. Total number of beds for Pediatric patients is 52. The multidisciplinary PICU receives patients from Pediatric ward, direct transfers from other hospitals, patients brought from other hospitals by the pediatric critical care transport team, as well as post operative patients requiring PICU care. The hospital, in most part, caters to self paying middle class and higher socioeconomic groups of patients from India and neighbouring Asian and Middle eastern countries. The hospital has an active pediatric congenital heart surgery program as well as active pediatric liver and kidney transplant programs.

The study unit is staffed by two full time pediatric intensivists (one with formal fellowship training and American board certification in pediatric critical care medicine, and other with British training in pediatric intensive care), supported by referring pediatricians and various pediatric subspecialists. Six pediatric registrars (MD, Pediatrics, 3 years residency trained qualified pediatricians) are responsible for covering the pediatric ward and the PICU, with one registrar physically present in the PICU 24 hours a day on a rotational basis. There is an active pediatric residency training (DNB) program

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with pediatric residents involved with supervised patient care.

For ventilated patients, nurse to patients ratio is 2 : 1 or 1:1 as needed and for other patients it is 1 : 2. Ventilators are handled by pediatric registrars and pediatric intensivists with back up support of biomedical engineers for correction of any technical faults. Suction and nebulizer therapy is routinely handled by PICU nurses. Physiotherapists and nurses provide chest physiotherapy as instructed by the attending pediatric intensivist.

The hospital does not have a separate laboratory for the PICU but a central emergency laboratory is operative 24 hours with one hour turn around time for laboratory results. Results of arterial blood gas analysis, electrolytes, and ionized calcium are available on immediate basis round the clock. Pediatric critical care transport team consists of a pediatric registrar, a nurse and a paramedic available 24 hours with 30 min response time (time elapsed from the time of receiving a transport request to the time that transport team leaves to get the patient). Ambulance is equipped with emergency drugs, ventilators, monitors, suction equipment and adequate oxygen supply. Pediatric intensivist accompanies the transport team for a few selected patients upon request of the transport team or upon the discretion of the pediatric intensivist if the patient is very critical requiring multiple interventions.

At the time of the study, admission age in our PICU was 12 years and under due to the then existing hospital rules. This has been recently changed in year 2002. Patients of ages 16 years and under can be admitted to PICU if they need PICU admission. Standard admission criteria were used for admission to the PICU as per PICU protocol established in 1998 and published recently as consensus guidelines for Pediatric intensive care units in India.¹³

MATERIALS AND METHODS

After obtaining approval from the hospital review board (Ethics committee), all patients admitted to the PICU between Jan'1998 to Dec'2000 (Age 12 years and under) were prospectively studied till discharge, transfer or death. Data collected on patients included : age, gender, admission and discharge diagnosis classified by system and etiology of the disease, elective or emergency status, admission source (same hospital, referral hospital, home), transportation to the hospital by an organized transport system and critical care management during the PICU stay, average length of the PICU stay, and duration of mechanical ventilation, as applicable. All patients underwent PRISM-III scoring (most abnormal value within 24 hours of admission was used) . Each PICU admission and discharge was considered as one observation unit. Overall outcomes including all iatrogenic and other complications including nosocomial

infections, morbidity and mortality rates adjusted according to PRISMIII scores were recorded.

RESULTS

During the 36 months study period, 948 children were admitted to the 10 bedded PICU (270, 310, and 368 each year in 3 years). 650 admissions were via emergency room and 298 were either planned post operative admissions or transferred from ward. 480 patients had received treatment in a smaller community hospital for at least 24 hours before admission to our hospital. 175 children were transported from the referring hospital by our pediatric critical care transport team. Out of 948 children 134 (14.14%) had congenital disorders and rest had acquired disorders. Various disease categories encountered are shown in Table 1. Patient age was 42.48 ±18.25 months (Mean ± Standard Deviation). 708 boys and 240 girls were treated (Ratio 2.95:1). The mean PRISM III score was 18.50 (Fig. 1). 70 patients did not complete the treatment and got discharged against medical advice due to personal circumstances, were therefore, excluded from the study. Average duration of PICU stay was 4.52 days±2.6 days 27 children (30.75 children /1000 admission) had acute respiratory distress syndrome (ARDS) as defined by standard criteria.¹⁴ 196 children (20.68%) required mechanical ventilation. Duration of mechanical ventilation was 6.39 ±1.2 days (Fig. 2). During PICU stay common complications

TABLE 1. Disease Categories Requiring PICU Admission

Disease Categories	Number of Patients
Respiratory	187 (19.73)
Cardiac (Including Surgical)	92 (9.70)
Neurological	170 (17.93)
Gastrointestinal + Hepatobiliary	79 (8.33)
Viral Hemorrhagic Fever	54 (5.69)
Endocrine	16 (1.69)
Renal	30 (3.16)
Hemoncology	41 (4.32)
Other Infectious	65 (6.85)
Trauma	111 (11.70)
Other Surgical	81 (8.84)
Others	22 (2.32)

n=948, Figures in brackets per cent

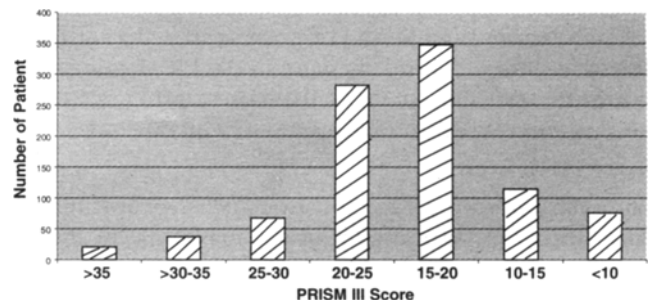


Fig 1. Distribution of PRISM III scores in the PICU

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encountered as a sequel of primary diseases (or iatrogenic) were respiratory (92 children:10.48%) such as atelectasis (56 children-6.37%), pneumothorax(13 children-0.9%), accidental extubation(23 children-2%), and neurological sequelae such as ongoing seizures (88 children-10.02%). The incidence of nosocomial infections was 16.86% (148 children) as defined by Center for disease control (CDC) guidelines, Atlanta (Georgia, USA).¹⁵ Ventilator associated pneumonias and bacteremia from indwelling intravascular catheters were the main sites of infections in patients with nosocomial infections. Overall mortality was 6.72% (59 out of 878 patients). Mortality rate adjusted by PRISM III scores is shown in Fig. 3. Children with PRISM III scores in the range of 25 to 30 were associated with a mortality of 25 percent. Those children with PRISM III greater than 35 had mortality greater than 40 percent. Among nonsurvivors the major cause of death was multisystem organ failure (29 children : 49.5%).

Tables 2 and 3 outline profiles and various diagnoses of non survivors.

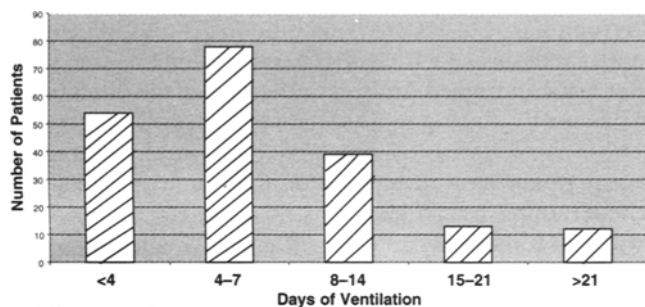


Fig 2. Distribution of days of ventilation in the PICU

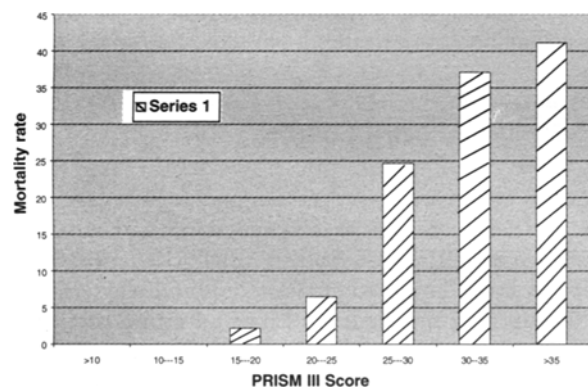


Fig 3. PRISM III adjusted mortality

TABLE 2. Profile of Non survivors

Data of non survivors	
Mean PRISM-III Score of non survivors	30.75
Mortality	59 patients (6.72%)
Major cause of death	Multi system organ failure – 29 cases (49.5% of non survivors)
Death within 24 hours of admission	9 patients (1 % of total admissions)

TABLE 3. Disease Categories of Nonsurvivors

Disease categories	Patients died	Percentage of non survivors
Multiple trauma	10	16.95
Viral hemorrhagic fever (dengue and dengue like illness)	10	16.95
Cardiac (myocarditis, cyanotic heart diseases, post operative cardiac cases)	8	13.55
Respiratory (bronchopneumonia, foreign body aspiration, congenital lobar emphysema)	7	11.86
Other infectious diseases (cerebral malaria, tubercular meningitis, human immune deficiency virus infection, septic shock)	6	10.16
Fulminant hepatic failure	6	10.16
Acute renal failure	2	3.39
Poisoning	2	3.39
Malignancy (acute myeloid leukemia, Non Hodgkin's lymphoma)	2	3.39
Others	6	10.16

DISCUSSION

The concept of pediatric critical care is relatively new in India. Due to rapid growth in population and, general lack of education and health awareness, inability to adequately control infectious diseases is a major public health issue. A gradual rise in incidence of modern epidemiological diseases (such as multiple trauma), improving socioeconomic status and increasing awareness of health related issues among urban population have led to increasing demand for pediatric critical care in India. During the three years of study period the number of admissions to our PICU also gradually increased from 270 in first year to 368 in third year. Currently the PICU admissions average 450 to 500 per annum. Information regarding status of PICUs in various states is largely unpublished. Only a few major centers run by state medical colleges have tertiary level PICUs, in addition to even fewer privately run tertiary level institutions. Various previously published studies have reported significant variability between PICUs in age, percentage of surgical or trauma patients, morbidity, and mortality.¹⁶⁻¹⁹ Although many scoring systems exist for different illnesses for assessing severity,^{7,8,19-23} a fool-proof qualitative and unbiased assessment of severity of illness is difficult, and controversy continues regarding the accuracy of prediction of mortality due to significantly different mortality rates reported in different studies.^{2,8,22} ICUs with higher mortality rates may be caring for patients with more severe illnesses and vice versa. In addition, lower mortality rates do not necessarily translate into better long term patient outcomes. PRISM III may be inaccurate in predicting mortality in multiple trauma patients.

In the present study we encountered a wide spectrum of cases including respiratory, cardiac, neurological, trauma patients, as well as patients with septic shock, dengue, malaria, ARDS and multiorgan failure requiring mechanical ventilation, inotropes, and various critical care treatment modalities such as renal replacement therapy and hepatic support. We found a general trend towards direct proportionality of PRISMIII scores with respect to increasing mortality in our patient population. Despite some discrepancies PRISMIII remains the most practical predictor of mortality in critically ill children.

Due to scanty published data of PICU profile within India, an adequate comparison of relative incidences and outcomes is not possible within the country. A retrospective study performed at the All India Institute of Medical Sciences (AIIMS study) reviewed PICU (from a 6 bedded PICU established in 1986) patient data over a period of six years (1986-93), published in 1993.⁹ In this study 69.2% of patients were males. We found a similar male preponderance in our PICU population for almost every 3 boys admitted, there was only 1 girl, possibly reflecting the social bias still prevailing against the girl child in India. In the 1993 AIIMS study,⁹ septicemia was found to be the most common cause of admission (14.8%), compared to respiratory failure (19.73%) being the most common cause in the present study. Septicemia as an isolated entity was not looked at in the present study, but could have been coexistent in patients with respiratory distress due to respiratory tract infections, ARDS, other infections and multiorgan failure.

Overall mortality was 23.5%, with age related mortality being highest (32.1%) in 1-5 years in AIIMS study.⁹ Mortality due to fulminant hepatic failure was 10.16% in our study compared to the AIIMS study (51.3%). Severity of illness scores were not documented in the AIIMS study probably due to non availability of established scoring systems such as PRISM until late 80s, therefore an adequate comparison of mortality based on severity of illness to AIIMS study is not possible. Overall mortality in the present study was lower (6.72%) compared to the AIIMS study. This could possibly be due to significant improvement in pediatric critical care in the last decade, earlier referral to the PICU, as well as a difference in the case mix.

Based on our observations, it appears that Pediatric Intensive Care in our center is somewhat similar to the western world in terms of severity of illness and prediction of mortality, PRISMIII adjusted mortality, average days of ventilation required and length of PICU stay. Most of our data falls within the range of data of Pediatric critical care study group.² Our overall mortality rate appears to be less than that of other developing countries.²⁵ Observed PRISMIII adjusted mortality rate seems directly proportional to PRISMIII scores as expected.

In the present study 119 children (12.55%) were admitted for infectious diseases and significant number of

which were due to dengue hemorrhagic fever (54 cases :5.5% of total admission). Other important tropical infectious diseases that required admission included cerebral malaria, pulmonary tuberculosis and tubercular meningitis. Some of the infectious diseases that required admission included vaccine preventable diseases (Hemophilus influenzae meningitis, fulminant measles and fulminant Hepatitis due to Hepatitis A and Hepatitis B Viruses). Above findings regarding different infectious diseases, although not common in the West, are common in this part of the world.

The incidence of ARDS was somewhat higher than reported in other studies.^{26,27} This finding may be explained by the fact that a significant number of our ARDS cases were secondary to dengue shock syndrome which is not very common in other countries. The incidence of nosocomial infections was 16.86%. This is somewhat higher than that reported in literature from developed countries, expected to be 5 to 15 %, ²⁸ but similar to that of other developing countries.^{29,30} A relatively high rate of nosocomial infections could be related to factors such as personal hygiene, noncompliance of PICU visitation policies and infection control measures such as strict hand washing before and after patient contact. Authors acknowledge the limitation of this study as being representative for only a subgroup of hospitals catering to a relatively higher socioeconomic group, rather than rural areas of India or even medical school (university) affiliated city hospitals run by various state governments. With more PICUs coming up in India in state governments run institutions catering to the poor population, perhaps a multicenter outcome analysis from PICUs would establish the profiles and outcomes more firmly and present a more realistic picture of the status of pediatric intensive care in the developing countries like India.

CONCLUSION

Pediatric intensive care in our center appears to be largely similar to the western world in terms of severity of illness and prediction of mortality, PRISMIII adjusted mortality, average days of ventilation required and length of PICU stay. The profile of children admitted mainly differs from western countries in terms of some of the demographic profile, spectrum of diseases and incidence of nosocomial infections: as expected, diseases such as tuberculosis, cerebral malaria, dengue hemorrhagic fever are more common. Male children are more likely to be admitted in PICU compared to female children (2.95 :1) probably related to gender bias still prevailing in India. There is somewhat high incidence of nosocomial infections (16.86%) compared to available western data, necessitating a need for better compliance with infection control policies. More data is needed from various other private as well as state medical college affiliated pediatric intensive care units to get the overall picture of the status

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of pediatric critical care in India.

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