

**ORIGINAL ARTICLE**

**Title:** Morbidity profile and outcome in a paediatric intensive care unit of a tertiary care hospital over a one-year period: a single institution study from rural India.

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No of words: 2400(excluding abstract, tables and references)

No of tables: 4

**ABSTRACT**

**Background:** The study is done to have a better understanding of the morbidity profile and outcome in a Paediatric Intensive Care Unit (PICU) of a rural-based tertiary care centre which can enable the caretakers to plan and plant possible interventions to enhance patient care. The study was carried out in a retrospective manner.

**Methods:** This retrospective study was carried out in the department of paediatrics in children aged 1 month to 12 years, who were admitted to the PICU during the period of 1st September 2021 to 31st August 2022. A total of 925 children were admitted and data were collected from PICU records using predesigned proforma and analysed accordingly.

**Results** A total of 925 children were admitted during the study period. The 61.62% of children were male and the rest 38.38% were female. The male to female ratio was 1.6:1. The infants excluding neonates constituted 59.89% of total admission. The mean age of presentation was  $2.63 \pm 3.41$  years. 67.46% of children were admitted with infections of different organ systems and the rest 32.54% with diseases of non-infectious aetiology. So far outcome is concerned, 13.62%, 56.10%, 3.24%, 3.78%, and 23.24% of children were discharged, transferred to the paediatric ward, referred out to elsewhere, left against medical advice (LAMA) and death respectively. Infants excluding neonates constituted 69.30% of total death and the most common aetiology of death being documented was infections (84.19%).

**Conclusion:** In our study, most of the admitted children were found to have died of infective causes and most of them were infants. This puts a much necessary focus on the control of

infections among infants by various means and should be addressed promptly and meticulously.

**Keywords:** Children, PICU, morbidity, outcome

### **Introduction**

Management of critically ill patients has always been challenging in the field of Paediatrics. Paediatric critical and emergency medicine is evolving every day as a sub-speciality[1, 2]. Advances in knowledge and technology leading to early recognition of the critically ill child and subsequent early interventions and quality care have come up with the sole purpose of improving the prognosis at all levels[3]. PICU admissions in the eastern parts of the country mainly include respiratory, neurological, and infectious diseases on the higher side when compared to western studies. All previous studies have shown an improving trend in the outcome of children receiving intensive care[4]. The study of morbidity and mortality of critically ill children admitted in PICU, is a lesser treaded path in the Eastern regions of rural India, more so, considering studies from tertiary care centres of similar origin, as compared to Western studies[5-10].

This study was aimed to identify the outcome and then analyse the results of the outcome from one such centre. The more we understand the pattern and outcome of the PICU admissions, the more will be our understanding of the aspects that require changes or possible interventions to reduce the burden of morbidity and mortality and enhance the quality of care rendered to the public.

### **Materials and Methods**

This retrospective study was conducted in a PICU of the Department of Paediatrics, BSMCH, Bankura, a rural-based tertiary teaching hospital in the rural parts of West Bengal, India after obtaining ethical approval from the respective committee of the institution. The institution has a well-equipped seven bedded PICU and is supported by an eleven bedded high dependency unit(HDU) used for step-down care. In the PICU, we admit the children aged 1 month to 12 years of age requiring constant monitoring, cardiopulmonary and hemodynamic support. Residents are present round the clock to attend to the patients and are supervised by senior faculty. During the study period (1st September 2021 to 31st August 2022), a total of 925 children were admitted to PICU. The data about 925 children's age; gender; final diagnosis at the time of discharge, transfer to the paediatric ward, referred out to elsewhere for a specific reason, leaving against medical advice(LAMA), and death along with length of hospital stay were collected from PICU records. All the patients were treated as per standard protocol. Relevant investigations such as complete blood count(CBC), blood culture and sensitivity tests, serum electrolytes measurements, liver and renal function tests, capillary blood glucose measurements, arterial blood gas analysis, urine analysis and culture sensitivity tests were done in all cases. Cerebrospinal fluid(CSF) analysis and tests for typhoid, malaria, dengue, scrub typhus and Japanese Encephalitis were done whenever indicated. Gastric fluid for acid-fast bacilli and cartilage based nucleic acid amplification test(CBNAAT), Mantoux test and chest x-rays were also done to rule out tuberculosis. Different imagine studies such as X-rays, ultrasonography, CT, and MRI of different parts of the body were done wherever indicated. The outcome was categorised into five groups (i) Discharged home and (ii) Transfer to paediatric ward after satisfactory improvement, (iii) Transfer to elsewhere for specific reason, (iv) LAMA and (v) Death. Collected data were put into Microsoft Excel

speed sheet and analysed by Epi Info (version 3.5.1) Software. Continuous variables were measured by mean and standard deviation and categorical one by ratio, proportion, and percentages.

## Results

A total of 925 children aged 1 month to 12 years were admitted to PICU during the study period. Of 925 children, 61.62% (n=570) children were male and rest 38.38% (n=355) were female. The male to female ratio was 1.6:1. The age of 59.89 % (n=554), 20.54% (n=190) and 19.57% (n=181) of children were less than one year, between 1 – 5 years and > 5 years of age respectively. The mean age of the study population was  $2.63 \pm 3.41$  years (Table 1).

Of 925 children, 67.46% (n=624) had infections involving the different organ systems and the rest 32.54% (n=301) children had suffered from non-infectious diseases (Table 2).

Among infections, pneumonia (n=353, 38.16%) ranked first followed by infection of central nervous system (n=99, 10.70%), septicaemia (n=84, 9.08%), infection of gastrointestinal system (n=26, 2.81%), pyrexia of unknown origin (n=37, 4.00%) and miscellaneous infections (n=23, 2.49%). Miscellaneous infections constituted the orthopaedics and surgical ailments. Among non-infectious morbidity, disorders of central nervous system (CNS) were the most common and constituted about 7.46% (n=73) of cases which was immediately followed by cardiovascular system (CVS) which contributed 6.59% (n=61). Others non-infectious origin of morbidity were snake envenomation (n=40, 4.32%), poisoning other than animal bites (n=21, 2.27%), disorders of renal (n=23, 2.49%) and haematopoietic system (n=21, 2.27%) and metabolic disorders including diabetic ketoacidosis (n=17, 1.84%). Severe acute malnutrition (SAM) and near drowning constituted 1.04% (n=13) and 0.86% (n=8) of cases respectively (Table 3).

Outcome was categorised into five groups –

- (i) Discharged home (n=126, 13.62%)
- (ii) Transfer to general paediatrics ward after satisfactory improvements (n=519, 56.10%)
- (iii) Transfer to elsewhere for specific reasons (n=30, 3.24%)
- (iv) LAMA (n=35, 3.78%)
- (v) Death (n=215, 23.24%).

The death or mortality rate was found to have 23.24% (n=215) in our present study. Infections (n=181, 84.19%) were the most common cause of death and non-infectious aetiology contributed only 15.81% (n=34). Amongst infections, pneumonia and septicaemia constituted 36.74% (n=79) and 32.56% (n=70) of cases respectively. Neurological disorders were the leading causes of death in terms of non-infectious aetiology is concerned. So, far case fatality is considered, Scorpion sting was found to have a 100% case fatality followed by septicaemia which had 83.33 %. The least case fatality rate was seen in the case of snake envenomation (2.50%) (Table 4). Out of 215 deaths, the male children were 60% (n= 129) and the rest 40% (n=86) were female. The male to female ratio was 1.5:1. 38.14% (n=82) of children succumbed to death within 24 hours of admission. The 31.62 % (n=68) and 30.23% (n=65) deaths had occurred between 1 -5 days and after 5 days respectively (Table 5).

## Discussion

The management of critically ill children poses intricate and diverse challenges to a paediatrician particularly in a resource-limited setting of a developing country[11]. A sound knowledge of the pathophysiology of a particular ailment along with skills to utilise the available resources at hand are required for the care of a child in critical condition to bring about the best possible outcome in spite of several constraints such as scarcity of necessary equipment coupled with lack of manpower and infrastructure. There are huge variations in the morbidity profile and outcome in a PICU from one study to another across different parts of the world and across different parts of our country too.

In our present retrospective study, we found the mean admission per month to be of 77.08. Of the 925-study population, 61.62% of children were male and the rest 38.38% (n=355) were female. The male to female child ratio was 1.6:1 which is comparable to a study conducted by Joshi et al. which showed male to female ratio of 1.55:1[3]. The male to female ratio in some other similar studies were 2.95 and 1.49:1 reported by Khilnani et al, and Blessing I et al. respectively[12, 13]. These variations can be due to different gender ratios in the community and gender preference health-seeking behaviour among parents. In our present study, the age of 59.89% (n=554) children were less than one year which is comparable to a study conducted by different authors who showed 54.16% child belonged to less than one year of age[1]. Our study showed that 20.54% of children were between 1 to 5 years which is comparable to a study conducted by Joshi et al[3]. The under-five age group constituted 80.43% and it is comparable to different studies conducted by Jothi AK et al. El Halal HG et al. which showed 78.3% and 83.33% of children in the under-five age category, respectively[1, 14]. Much lower i.e., 62.5% was reported by Haque A et al[15]. In our study, 19.57% of children were above 5 years and it is comparable to a study conducted by Roy SM et al. which showed 24.53% of children were above 5 years[16]. This variation could be due to geographical variations of children at risk. In our study, it was found that the mean age of the study population at the time of admission was  $2.63 \pm 3.41$  years.

Our study showed that infections involving the different organ systems constituted 67.46% (n=624) of total admission. Of this infection, pneumonia was the most common morbidity requiring PICU admission which contributed 38.16% (n=353) and it is comparable to a study conducted by Earan SK et al. which showed that 40.2% of children who suffered from the disease of the respiratory system, required PICU admission. In contrast to our study, Bagchi NR et al. had reported that 21.6% of their children had pneumonia requiring PICU admission[4]. The contribution of pneumonia to total PICU morbidity varied from one study to another which ranged from 5.7% to 33.1% as reported by different authors[3,12,17-19]. These variations could be due to geographical variations in the prevalence of different diseases.

Our present study showed that 9.08% (n=84) of children had suffered from septicaemia and is corroborating to a study conducted by Roy SM et al. which showed 8.11% of children had septicaemia requiring PICU admission[16]. Hoque M et al. and Bofarraj MAM et al. had reported that 7% and 10.1% of their study population had septicaemia respectively[11,20].

In our present study, infection of the central nervous system (meningitis and meningoencephalitis) constituted 10.70% (n=99) of total morbidity. On literature search, it was found that 6.1% to 21.9% of central nervous system infections constituted PICU

admission as reported by different authors[3,4]. It is well known to us that, central nervous infection particularly acute encephalitis syndrome, has definite geographical and seasonal variations[21].

Among non-infectious origin of morbidity, disorder of CNS, CVS, haemopoietic system, renal system, snake envenomation and poison constituted 7.46% (n=73), 6.59% (n=61), 2.27% (n=21), 2.49%(n=23), 4.32% (n=40) and 2.27% (n=21) respectively. Our present study showed that 6.59% (n=61) of children had cardiovascular disease, of which congenital heart diseases (CHD) constituted 5.19% (n=48). Our observation was like that of a study conducted by Shah GS et al. which showed 6.5% of children having CHD[18]. In our study, haematological disorders constituted 2.27% (n=21) of morbidity and it is comparable to a study conducted by Roy SM et al. which showed 2.91%[16]. Also, our study showed that 2.27% of total morbidity had been contributed by poison other than Snake envenomation. It varies from 1.16% to 4.8% as reported by other authors[1,3,18].

Snake envenomation, which is the unique observation of our study, contributed 4.32% (n=40) of morbidity of non-infectious origin and this observation not only reflects the location of our institution but also denotes the magnitude of the same in the rural area. Most of these were neurotoxic envenomation and required respiratory support in the form of artificial ventilation to survive. Out of 40 Snake envenomation, only one succumbed to death.

In terms of outcome, our study showed that 13.62% (n=126), 68.86% (n=637), 3.24% (n=30), 3.78% (n=35) and 23.24% (n=215) of children were discharged home, transferred to paediatric ward, referred out to elsewhere for specific reasons, LAMA, and death respectively. Overall survival rate was 76.76% (n=710). Several studies showed good outcome in PICU ranging from 52.5 % to 98%[1, 11, 13, 16, 18, 22]. The outcome for 7.03% of children could not be accounted for as they were transferred to other health care facilities due to lack of super speciality services like neurosurgery and paediatric surgery in our set-up. Our present study showed a mortality rate of 23.24% (n=215) which was like a study conducted by Roy SM et al. which showed 24.31% mortality in PICU[16].It has also been observed that the mortality rate varied from one study to another and ranged from 2.1% to 35.44% reported by different authors[13, 14, 23-26]. The lowest was being reported by Abhulimhen –Iyoha BL et al. and the highest by Jeena PM et al[13, 26].

In our study, it was found that 84.19% (n=181) of children succumbed to infections and the rest 15.81% (n=34) deaths due to non-infectious aetiology. Of infections, pneumonia and septicaemia were the most common causes of death in our study population which contributed 36.74% (n=79) and 32.56% (n=70) of total death respectively. The studies conducted by Hoque M et al. and Morris et al. showed that 52% and 60% of death respectively caused by infections[11, 27]. These variations could be due to variations in the geographical distribution of diseases, different traditional beliefs, and practices among parents in terms of child-rearing and knowledge on infection control among caregivers.

In our present study, Scorpion sting (100%) had the highest case fatality rate (CFR) followed by septicaemia (83.3%). Acute lymphoblastic leukaemia(ALL) and pneumonia had a CFR of 37.5% and 22.37%. Joshi P et al. reported a CFR of 38.5% for ALL which is the same as in our study but considering the CFR for septicaemia, it was much less (23.6%) than our study (83.3%)[10]. The disparity might be due to geographical variations in the incidence of infections, lack of awareness regarding danger signs of infection among parents as well as

primary caregivers, delayed health-seeking behaviour, delayed arrival to a health care facility and lastly delayed administration of the state-of-the-art care. The least CFR was observed in snake bite envenomation which was only 2.5% reflecting a high level of knowledge and expertise among our faculties in the management of the same.

Being retrospective in nature, our study has some limitations such as recall bias and incomplete information leading to possible errors in data analysis. We also had a substantial proportion of patients being referred out to other health care facilities for specific reasons like lack of neurosurgical as well as paediatric surgical facilities in our institution and LAMA caused an error in outcome measurement.

### **Conclusion**

Most of the death of the critically ill children in PICU were attributed to infective causes and most of them were found to be infants. Apart from scorpion sting, septicaemia had a CFR of 83.3% and this necessitates in-depth investigations. Henceforth, control of infections by increasing awareness regarding common infectious diseases such as pneumonia, septicaemia and CNS infection among primary care physicians and /or paediatricians; timely referral with prior stabilisation; strengthening peripheral health care facility; increasing vaccination coverage against preventable diseases; judicious uses of logistics; monitoring of ongoing integrated management of neonate and childhood illness; and strict hand washing practices among caregivers have to be addressed meticulously.

**Funding:** There has been no funding for this research study.

### **Acknowledgements:**

We would like to express our profound gratefulness to all the residents, nursing staff and medical technologists who are working tirelessly round the clock for ensuring patient care in the PICU and their valuable contribution to our work.

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