Disease pattern and outcome of patients in the pediatric intensive care unit of St Paul's Hospital Millennium Medical College: a retrospective cross-sectional study

Tsedenia Kebede[1*], Gesit Metaferia[2]

Affiliations:

[1]Department of pediatrics and child health, St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia

[2]Division of Neonatology, Department of pediatrics and child health, St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia

Correspondence *:

Tsedenia Kebede

tsedenia@sphmmc.edu.et

St. Paul's Hospital Millennium Medical College

Abstract

Background: A Pediatric intensive care unit is a specialized facility that supports children with failing vital functions due to neurological deterioration, respiratory issues, cardiovascular compromise, severe infections, and accidental poisoning. However, critical care data in low-resource settings is scarce.

Objectives: This study aimed to assess the disease pattern and outcome of patients admitted in pediatric intensive care unit of St. Paul's Hospital Millennium Medical College (SPHMMC).

Methods: A retrospective hospital-based cross-sectional study was conducted in the Pediatrics and Child Health department among consecutively admitted patients from December 2019 to June 2021. The data was analyzed using the Statistical Package for Social Sciences version 25. A chi-square test was used to test for the significance of the association; a p-value of less than 0.05 was considered significant. Logistic regression was applied as necessary.

Results: A total of 211 children were included in the study. Of these, children under 1 year (45.5%) accounted for the largest number; males outnumbered females at 53.6%. Respiratory illnesses, neurological disorders, and infectious diseases were the most common reasons for admission. Patients who stayed in the intensive care unit for 2–7 days accounted for 52.6%. Ventilator support was required by 45.5% of patients, while 35.1% of patients needed circulatory support. Upon discharge, 29.4% of patients had died, 59.2% were transferred to the ward, and 10.4% left against medical advice. Significant associations were found between mortality and patients under 2 years, admission for less than 2 days, and the need for mechanical ventilation and inotrope support.

Conclusion: Respiratory and neurological diseases were the most common reasons for admission. The overall mortality in our pediatric intensive care unit was high and most deaths occurred within the first 2 days of admission. This emphasizes the importance of early detection and the timely transfer of critically ill patients.

Keywords: Children, Outcome, Pattern, Pediatric intensive care unit

Background

The pediatric intensive care unit (PICU) is an important component of any tertiary care center. It is a distinct organizational and geographic entity designed for monitoring and supporting failing vital functions. It ideally has to be established in an area where an integral medical, surgical, anesthesiologic, and radiologic intervention is possible. [1]

Pediatric critical care in low- and middle-income countries remains in its infancy in most hospitals. The majority of hospitals lack designated intensive care units, healthcare staff trained to care for critically ill children, adequate numbers of staff, and rapid access to necessary medications, supplies, and equipment. PICU can improve the quality of pediatric care in general and, if properly organized, can effectively treat the severe complications of high-burden diseases, such as diarrhea, severe malaria, and respiratory distress, using low-cost interventions. [2]

According to World Health Organization (WHO), the major causes of death in under-five children in developing countries are preventable and curable diseases, if the care is optimized. [17] Admission into the intensive care unit may be required if the patient experiences hemodynamic instability requiring frequent monitoring of vital signs and rapid titration of intravenous medication with concurrent monitoring. [4] Critically ill patients are admitted to the intensive care unit (ICU) to reduce morbidity and mortality associated with acute illness, trauma, or surgical procedures.[3]

Children with acute neurological deterioration, respiratory distress, cardiovascular compromise, severe infections, and accidental poisonings constitute the major admissions to the PICU. [5] In critical care medicine, intensive care unit results can be assessed on the basis of outcomes such as mortality rate or survival. [6]

Disease Patterns in the PICU, particularly in an early age group, are a sensitive indicator of the community's availability, utilization, and effectiveness of mother and child services. [6]

Although mortality in patients depends on many factors, such as demographic and clinical characteristics of the population, infrastructure and non-medical factors, case mix, and admission practice, it is also affected by ICU performance. [7] Care of critically ill patients is resource-intensive, and 15-20% of hospital budgets are spent in the ICUs. [8]

In sub-Saharan Africa, ICUs have varying qualities and quantities of infrastructure necessary for the provision of proper critical care services. The reported disease characteristics and mortality rates of patients admitted to ICUs in sub-Saharan Africa vary widely from one population to another. [4]

In Ethiopia, though data on critical care is limited, in a study conducted on the admission pattern and outcome of patients admitted to the PICU at Gondar University Hospital, mortality was 30.9%. [9]

In critical care medicine, intensive care unit performance can be evaluated based on mortality or survival outcomes. With the proper evaluation of PICU performance, we can identify and standardize appropriate interventions that are not only effective but can also guide efforts to manage resources needed to deliver care in intensive units. [10] This study assessed the disease pattern and clinical outcome of patients admitted to the pediatric intensive care unit of St. Paul's Hospital Millennium Medical College (SPHMMC).

Methods and materials

Study setting, design, period, and population

This study was conducted in the pediatric ICU of SPHMMC. The Department of Pediatrics is one of the major departments in the college, which has outpatient, inpatient, pediatric, and neonatal ICUs. The pediatric intensive care unit was established in 2007. It has a capacity of six beds and is equipped with a central oxygen supply, patient care monitors, infusion pumps, and mechanical ventilators. The unit is staffed by two consultants (an intensivist and pulmonology and critical care physicians), two residents, and 10 nurses during working hours. A retrospective hospital-based cross-sectional study was conducted over 18 months (December 1, 2019–June 30, 2021). All pediatric patients between the ages of 8 days to 18 years who were consecutively admitted to the PICU were included in the study. Those patients with incomplete information or missing charts and who died within 2 hours of arrival were excluded from the study.

Data collection and procedures

The data was collected using a structured questionnaire, which included demographic information, admission sources, treatment characteristics, and outcomes of patients. The questionnaire was prepared in English. Data was obtained from the pediatric intensive care unit registry, patient charts, and death certificates. Trained general practitioners took part in the data collection, and the investigator provided supervision to ensure

data quality and completeness.

Study variables and operational definitions

The outcome of patients admitted to the pediatric intensive care unit was the dependent variable. In contrast, the patient's age, sex, place of residence, admission diagnosis, admission source, disease character, nutritional status, length of PICU stay, vasopressor use, renal replacement, use of a mechanical ventilator, and Glasgow Coma Scale (GCS) at admission were the independent variables.

Operational definition

Pediatric age group: refers to 8 days to 18 years of age.

Length of stay (LOS): refers to the duration of stay in a number of days from the date of admission to the date of discharge from the PICU.

Short term outcome: the outcome the patient until she/he leaves the intensive care unit.

Death on arrival: those patients who died within 2 hours of admission to the pediatric intensive care unit.

Discharged: discharged alive from the ICU.

Left the hospital against medical advice (LAMA): patients who leave regardless of the health professional's advice about the need of treatment.

Data Processing and Analysis

After the data collection, each set was checked for inconsistencies and completeness based on the code assigned for each set during the data collection process. The collected data was entered using SPSS version 25 for windows. Descriptive statistical method was used to produce percentages, mean, and median. For categorical variables, binary logistic regression was first used to identify possible factors for further analysis. Factors with a p value of <0.25 were entered into multiple regression to identify significant associations between variables with a p value of <0.05.

Results

From December 1, 2019, to June 30, 2021, 252 patients were admitted to SPHMMC's pediatric intensive care unit; 211 of these patients met the inclusion criteria and were included in the study and analyzed.

Socio-demographic characteristics of patients admitted to the PICU

Of the total admitted patients, 113 (53.6%) were male, and the majority, 119 (56.4%), came from the Oromia region. Nearly half (46.5%) of patients were aged between 1 month and 1 year, and three-quarters (75.8%) of them were under five children (Table 1).

Table1: Socio-demographic characteristics of patients admitted to SPHMMC's PICU from December 1, 2019–June 30 ,2021 (n=211)

Characteristics		Frequency	Percentage
Age	Less than 1 year	96	45.5%
	1-2	25	11.8%
	3-5	39	18.5%
	6-11	22	10.4%
	12-18	29	13.7%
Sex	Female	98	46.4%
	Male	113	53.6%
Address	Addis Ababa	67	31.8%
	Oromia	119	56.4%
	Amhara	14	6.6%
	SNNP	10	4.7%
	Others	1	0.5%

Admission characteristics of patients admitted to the pediatric intensive care unit

The majority of patients admitted to the ICU were due to medical problems (169, or 80.1%). Direct admission from the emergency pediatric outpatient department (OPD) constituted 136 (64.5%) of the patients, and 52 (24.6%) were transferred from the wards. The two major primary indications for admission were the need for respiratory support (59, 28%) and intensive or post-operative monitoring (60, 28.4%). The majority of the children, 161 (76.3%), stayed in the ICU for less than seven days, regardless of the outcome. Among the admitted patients, 43 (20.4%) were malnourished, and of these, 32 (74.4%) had severe acute malnutrition. Ninety-six (45.5%) patients needed invasive mechanical ventilation for respiratory support; of those, 91 (94.8%) were placed on ventilators, with half 46 (50.5%) remaining on them for 2–7 days. Seventy-four (35.1%) needed continuous infusions of inotropes and vasoactive agents for hemodynamic support, and 10 (4.7%) required renal replacement therapy. The majority of the patients (125, or 59.2%) admitted to the PICU had an admission GCS of 13–15 (Table 2).

Table 2: Admission characteristics of patients admitted to SPHMMC's PICU from December 1, 2019–June 30, 2021 (n=211)

Admission characteristics		Frequency	Percentage
Patient category	Medical	169	80.1%
	Surgical	27	12.8%
	Both	15	7.1%
Admission source	EPOPD	136	64.5%
	Ward	52	24.6%
	OR/Recovery	21	10%
	From other hospital	2	0.9%
Primary indication for admission	Respiratory support	59	28%
	Shock	42	19.9%
	Low GCS/ raised ICP	33	15.6%
	Intensive monitoring/post op	60	28.4%
	Post cardiac arrest	4	1.9%
	Others	6	2.8%
Nutritional status	Well nourished	168	79.6%
	Malnourished	43	20.4%
Length of stay	<2days	50	23.7%
	2-7 days	111	52.6%
	8-14 days	32	15.2%
	15-28 days	16	7.6%
	>28days	2	0.9%
Need for mechanical ventilation	Yes	96	45.5%
	No	115	54.5%
Need for inotropes	Yes	74	35.1%
	No	137	64.9%
Need for renal replacement therapy	Yes	10	4.7%
	No	201	95.3%
Admission GCS	<=8	22	10.4%
	9-12	51	24.2%
	13-15	125	59.2%
	Sedated	13	6.2%

Disease pattern and outcome of patients admitted to the pediatric intensive care unit

The three most common disease categories admitted were respiratory diseases (42.9%), followed by central nervous system diseases (17.5%), and infectious diseases/sepsis (15.6%). The most common diseases among admitted patients were sepsis, complicated meningitis, pneumonia, congestive heart failure, acute kidney injury, and severe diabetic ketoacidosis. (Table 3)

Table 3: Disease pattern of patients admitted to SPHMMC's PICU from December 1, 2019–June 30, 2021 (n=211)

		Frequency	Percentage
Admission diagnosis	Respiratory	42	19.9%
	Infectious/sepsis	33	15.6%
	Neurological	37	17.5%
	Cardiac	18	8.5%
	Renal	16	7.6%
	ENT	14	6.6%
	Post-major surgery	18	8.5%
	Gastrointestinal	6	2.8%
	Poisoning	4	1.9%
	Hemato-oncologic	5	2.4%
	Endocrine	12	5.7%
	Trauma/ burn	6	2.8%

Outcome of patients admitted in pediatric ICU

Of the 211 patients admitted to the PICU, 149 (70.6%) survived. Among the survivors, 125 (83.9%) were transferred from the ICU to the ward, 2 (1.3%) were discharged home, and 22 (14.8%) left against medical advice. Meanwhile, 62 (29.4%) of the total admissions died. The study revealed that 32.2% of deaths were male and 28.8% female, with most occurring in patients under one year old, medical cases, emergency OPD admissions, PICU stay of less than 2 days, and admission GCS of 13–15. Of the 62 deaths, 75.8% were mechanically ventilated, and 4.8% required renal replacement therapy. (Table 4)

Table 4: Association of socio-demographic, admission characteristics and outcome of admission SPHMMC's PICU from December 1, 2019 – June 30, 2021 (n=211)

Variables	Outcome N (%)		Chi-square p-value
	Survived n(%)	Died n(%)	
Sex			
Male	78(52.3%)	35(56.5%)	0.58
Female	69(47.7%)	27(43.5%)	
Age in years			
<=1	19(12.8%)	31(50%)	0.12
1-2	85(57%)	26(41.9%)	
3-5	28(18.8%)	4(6.5%)	
6-11	15(10.1%)	1(1.6%)	
12-18	2(1.3%)	0(0.0%)	
Admission source			
EPOPD	96(64.4%)	40(64.5%)	0.015
Ward	34(22.8%)	18(29%)	
OR/ recovery	19(12.8%)	2(3.2%)	
From other hospital	0(0.0%)	2(3.2%)	
Admission category			
Medical	116(77.9%)	53(85.5%)	0.2
Surgical	23(15.4%)	4(6.5%)	
Both	10(6.7%)	5(8.1%)	
Length of stay in days			
<2	19(12.8%)	31(50%)	<0.01
2-7	85(57%)	26(41.9%)	
8-14	28(18.8%)	4(6.5%)	
15-28	15(10.1%)	1(1.6%)	
>28	2(1.3%)	0(0.0%)	
GCS			
<=8	11(7.4%)	11(17.7%)	0.06
9-12	33(22.1%)	18(29%)	
13-15	95(63.8%)	30(48.4%)	
sedated	10(6.7%)	3(4.8%)	
Mechanical ventilation			
Yes	49(32.9%)	47(75.8%)	<0.01
No	100(67.1%)	15(24.2%)	
Renal replacement			
Yes	7(4.7%)	3(4.8%)	0.6
No	142(95.3%)	59(95.2%)	
Inotropes/vasopressors			
Yes	34(22.8%)	40(64.5%)	<0.01
No	115(77.2%)	22(40.3%)	

Among the analyzed co-variates, age less than 2 years of age, duration of stay less than 2 days, the need for a mechanical ventilator, and the need for inotropes or vasopressors were found to be significantly

associated with the mortality of patients admitted to the pediatric intensive care unit. (Table 5)

Discussion

This study assessed the disease pattern and treatment outcome of children admitted to the PICU at SPHMMC. In this analysis, 96 (45.5%) of patients were infants, and most of the population is male; 113 (53.6%) were male, giving a male-to-female ratio of 1.2:1. This finding is similar to a study done in Nepal, where there was a male preponderance (a male-to-female ratio of 1.7:1) and the maximum number of patients belonged to the age group of less than 1 year. [11] These findings were also similar to a study done in Jimma, Ethiopia, where the greater share was taken by males (54.7%). [12] Contrary to our study, a similar study was done in Gondar, Ethiopia, where more than half of the admitted patients were over 5 years of age. [9] This could be explained by the difference in the disease pattern, like the predominance of pneumonia and sepsis in our setting. The majority of admitted patients were medical (80.1%), and most were direct admissions from EPOPD (64.5%). This finding is consistent with a study conducted at Tikur Anbessa Hospital in Ethiopia, where the majority of admissions were for medical emergencies (39.1%).[13] However, this finding differs from studies done in similar settings in Ethiopia and Tanzania, where most admissions are for trauma cases.[12,14]The observed difference is explained by the presence of a separate trauma center in our setting.

The majority of the children (76.3%) stayed in the ICU for less than seven days, regardless of the outcome. Similarly, in studies conducted in Pakistan (54.9%) and Iraq (71.1%), children stayed in the ICU for less than seven days. [15,16] In our study, 45.5% of admitted patients required mechanical ventilation; this showed an almost similar finding in another study done in Ethiopia. [12] However, it showed a higher rate compared to studies conducted in Nepal and Eastern India, where the range was between 8-18%.[10] This difference may be attributed to delayed healthcare presentation, which is a common issue in developing countries. The most common medical systemic illnesses involved the respiratory system (19.9%), followed by the central nervous system

(17.5%). In a study done in Egypt, respiratory illnesses (47%), central nervous system diseases (14.7%), and gastrointestinal diseases (10.8%) were the most common diseases requiring ICU admissions.[15] In a similar manner, a study conducted at Ayder Referral Hospital in Ethiopia revealed that the respiratory system (22.5%) and central nervous system (20.7%) were the most commonly affected systems.[17]

In our study, sixty-two patients died, giving a mortality rate of 29.4%. Comparable findings were seen in retrospective descriptive studies done in Bangladesh and North India, with 21% and 23.5% mortality rates, respectively.[18,19] In contrast, a prospective cross-sectional study conducted in Pakistan reported an overall mortality rate of 19.07%. Other PICU studies from India, Malaysia, and Nepal indicated mortality rates ranging from 12% to 18%. [16] The disparity in the availability of diagnostic and treatment methods may account for the observed difference. In a retrospective cross-sectional study conducted in Mekelle, Ethiopia, the mortality rate was 8.5%, which was significantly lower than what was observed in our study. [17] The high mortality rate in our study may be attributed to the larger number of patients who required mechanical ventilation and inotrope/vasopressor support from admission. The proportion of mortality in our PICU is lower than findings seen in retrospective cross-sectional studies done in Jimma, Ethiopia, and Tanzania, which ranged between 40% and 42%. [12,14] The difference might be due to the higher proportion of trauma patients admitted to their PICU compared to ours. Another possible reason could be the higher proportion of LAMAs in our study, potentially leading to an underestimation of the mortality rate. A study in Iran revealed that children under the age of two had the highest proportion of deaths (74.3%), which was statistically significant. [5] Similar findings were observed in studies in India and Ethiopia, where the need for mechanical ventilators and inotropes was an important predictor of mortality. [17,19]

Limitations of the study

The study had limitations due to its retrospective design and the limited availability of data in the registers. The lack of proper chart storage and retrieval also led to missing patient records.

Table 5: Bi-variate and multivariate analysis of factors associated with the outcome of patients admitted to SPHMMC PICU from December 2019 to June 2021

Category	Survived n(%)	Died n(%)	COR(95%CI)	P-value	AOR(95%CI)	P-value
Age						
<=1 year	19(12.8%)	31(50%)	0.22(0.062-0.782)	0.019	0.147(0.032-0.685)	0.015
1-2 years	85(57%)	26(41.9%)	0.205(0.048-0.872)	0.032	0.162(0.027-0.940)	0.049
Length of stay						
<=2days	19(12.8%)	31(50%)	0.036(0.004-0.293	0.002	0.009(0.001-0.102)	0.000
Need of Ventilator						
Yes	49(32.9%)	47(75.8%)	0.156(0.080-0.307)	0.000	0.062(0.021-0.182)	0.000
Need of inotropes						
Yes	34(22.8%)	40(64.5%)	0.163(0.085-0.31)	0.000	0.211(0.086-0.518)	0.001

Conclusion

In conclusion, the highest number of admissions into the PICU were due to respiratory disorders, followed by nervous system disorders and infectious diseases. The overall mortality rate of our PICU was 29.4%; the highest number of deaths occurred within 2 days of admission. This highlights the importance of early detection and the transfer of critical patients to the ICU to improve their outcomes. Additionally, a continuing effort should be made to improve the quality of care through support focusing on hemodynamic support and mechanical ventilator use.

Abbreviations

ICU –Intensive care unit

IRB- institutional review board

LAMA-Left the hospital against medical advice

LOS – length of stay

PICU- Pediatric intensive care unit

SPHMMC – St Paul's hospital millennium medical college

SPSS- Statistical package for social sciences

Declarations

Consent for publication

Not applicable

Ethical declaration

The study was commenced after clearance was obtained from the SPHMMC's institutional review board (IRB). Confidentiality was observed and personal identifiers were not quoted. All patient files were considered private and confidential as per the hospital's ethical regulations. The information retrieved was used only for study purpose.

Authors' contributions

TK conceptualized research problem, collected and analyzed data, drafted the manuscript and responsible for submission .GM was involved in conceptualization of problem, research proposal development and revising final manuscript.

Competing interest

All authors read and approved the final manuscript. The authors declare that they have no competing interests.

Availability of Data and Materials

The data set used and data collection tool will be made available from the corresponding author upon a reasonable request.

References

1. Murthy S, Leligdowicz A, Adhikari NKJ. Intensive care unit capacity in low-income countries: A systematic review. PLoS One. 2015;10(1):1–12.

2. Slusher TM, Kiragu AW, Day LT, Bjorklund AR, Shirk A, Johannsen C, et al. Pediatric critical care in resource-limited settings-overview and lessons learned. Front Pediatr. 2018;6(March):1–6.

3. Braber A, van Zanten AR. Unravelling post-ICU mortality: predictors and causes of death. Eur J Anaesthesiol. 2010

May;27(5):486-90. doi: 10.1097/EJA.0b013e3283333aac.

4.   Mohammed SO, Abdi OA, Getish BG. Clinical outcomes of patients admitted in intensive care units of Nigist Eleni Mohammed Memorial Hospital of Hosanna, Southern Ethiopia. Int J Med Med Sci.2017;9(6):79-85.

5.   Valavi E, Aminzadeh M, Shirvani E, Jaafari L, Madhooshi S. The main causes of mortality in pediatric intensive care unit in south west of Iran. Zahedan Journal of Research in Medical Sciences.2018;20(4).doi:10.5812/zjrms.63006.

6.   Hs N. Mortality Pattern at Pediatric Intensive Care Unit of Hue Central Hospital, Vietnam. Biomedical Journal of Scientific & Technical Research [Internet]. 2018 Dec 6;11(5). Available from: https://doi.org/10.26717/bjstr.2018.11.002155

7.   Abhulimhen-Iyoha BI,Pooboni SK, Vuppali NKK. Morbidity Pattern and Outcome of Patients Admitted into a Pediatric Intensive Care Unit in India. Indian J Clin Med. 2014 Jan;5:IJCM.S13902.

8.   Rady H. Profile of patients admitted to pediatric intensive care unit, Cairo University Hospital: 1-year study. Ain-Shams J Anaesthesiol. 2014;7(4):500.

9.   Tazebew A, Chakilu Tilahun B, Bacha Heye T.Admission pattern and outcome in a pediatric intensive care unit of Gondar university hospital. Ethiop Med J.2019; 57(2). Avialable from https://www.researchgate.net/publication/333660065

10. Shrestha AK, Bhattarai S, Paudel P, Basel PL. Morbidity and mortality pattern of patients admitted into paediatric intensive care unit of tertiary level hospital of Nepal. J Nepal Paediatr Soc. 2020;40(1):28–33.

11. Shah GS, Shah BK, Thapa A, Shah L, Mishra OP. Admission Patterns and Outcome in a Pediatric Intensive Care Unit in Nepal. Vol. 4, Original Research Article British Journal of Medicine & Medical Research. 2014. Available from: www.sciencedomain.org

12. Abebe T, Girmay M, G/Michael G, Tesfaye M. The epidemiological profile of pediatric patients admitted to the general intensive care unit in an Ethiopian university hospital. Int J Gen Med. 2015 Jan 29;8:63–7.

13. Abebe A, Adal O, Noah Y. Disease pattern, outcome, and associated factor of patient admitted in Pediatric Intensive Care Unit at Tikur Anbessa Specialized Hospital, 2022: Retrospective Study. 2022; doi:10.21203/rs.3.rs-2261826/v1.

14. Sawe HR, Mfinanga JA, Lidenge SJ, Mpondo BCT, Msangi S, Lugazia E, et al. Disease patterns and clinical outcomes of patients admitted in intensive care units of tertiary referral hospitals of Tanzania. BMC Int Health Hum Rights. 2014 Sep 23;14(1).

15. Abdelatif RG, Mohammed MM, Mahmoud RA, Bakheet MA, Gima M, Nakagawa S. Characterization and outcome of two pediatric intensive care units with different resources. Critical Care Research and Practice. 2020;2020:1–6. doi:10.1155/2020/5171790

16. Bano A. 605-608 Haque A, Bano S. Improving Outcome in Pediatric Intensive Care Unit in Academic Hospital in Pakistan [Internet]. Vol. 25, Pakistan Journal of Medical Sciences. 2009. Available from:http://ecommons.aku.edu/pakistan_fhs_mc_emerg_medwww. pjms.com.pk605

17. Haftu H, Hailu T, Medhaniye A, Gtsadik T. Assessment of pattern and treatment outcome of patients admitted to pediatric intensive care unit, Ayder Referral Hospital, Tigray, Ethiopia, 2015. BMC Res Notes. 2018 May 24;11(1).

18. Kapil D, Bagga A. The Profile and Outcome of Patients Admitted to a Pediatric Intensive Care Unit.Indian J pediatr. 1993;60:5-10

19. Sahoo B, Patnaik S, Mishra R, Jain MK. Morbidity pattern and outcome of children admitted to a paediatric intensive care unit of Eastern India. Int J Contemp Pediatr. 2017 Feb 22;4(2):486.