Original Article

Access this article online
Website: www.afrjpaedsurg.org
DOI: 10.4103/0189-6725.78670
Quick Response Code:

Paediatric admissions and outcome in a general intensive care unit

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ABSTRACT

Background: It is believed that intensive care greatly improves the prognosis for critically ill children and that critically ill children admitted to a dedicated Paediatric Intensive Care Unit (PICU) do better than those admitted to a general intensive care unit (ICU). **Methods:** A retrospective study of all paediatric (< 16 years) admissions to our general ICU from January 1994 to December 2007. **Results:** Out of a total of 1364 admissions, 302 (22.1%) were in the paediatric age group. Their age ranged from a few hours old to 15 years with a mean of 4.9 ± 2.5 years. The male: female ratio was 1.5:1. Postoperative admissions made up 51.7% of the admissions while trauma and burn made up 31.6% of admissions. Medical cases on the other hand constituted 11.6% of admissions. Of the 302 children admitted to the ICU, 193 were transferred from the ICU to other wards or in some cases other hospitals while 109 patients died giving a mortality rate of 36.1%. Mortality was significantly high in post-surgical paediatric patients and in patients with burn and tetanus. The length of stay (LOS) in the ICU ranged from less than one day to 56 days with a mean of 5.5 days. **Conclusion:** We found an increasing rate of paediatric admissions to our general ICU over the years. We also found a high mortality rate among paediatric patients admitted to our ICU. The poor outcome in paediatric patients managed in our ICU appears to be a reflection of the inadequacy of facilities. Better equipping our ICUs and improved man-power development would improve the outcome for our critically ill children. Hospitals in our region should also begin to look into the feasibility of establishing PICUs in order to further improve the standard of critical care for our children.

Keywords: General intensive care unit, outcome, paediatric admissions

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INTRODUCTION

Advances in the field of intensive care medicine have greatly improved the prognosis in critically ill children. The concept of dedicating an intensive care unit (ICU) to critically ill infants, children and the teenage groups started in Sweden in the 1950s and in the United States in the 1960s and later spread to other parts of the world.[1] Before then, the practice had been to group paediatric patients along with adults. Though a report by the British Paediatric Association in 1993 did not show any difference in the outcome between children managed in a dedicated paediatric intensive care unit (PICU) and those managed in a general ICU,[2] subsequent studies by other authors have indicated an improved outcome in critically ill children managed in the PICU.[3-6]

Though general and neonatal ICUs are now commonly found in our country, it is not so with PICUs and so most critically ill children are managed in the general ICUs along with adults. The ICU in our hospital is a general (multidisciplinary) ICU established 27 years ago to cater for critically ill patients of all age groups. It has expanded from its initial size of two beds to its present status of six beds. Earlier studies have looked generally at admissions involving all ages in our ICU and also at some specific groups like burn patients[7,8] but none had particularly paid attention to the paediatric age group. We carried out a retrospective study to see how the paediatric patients fared in our intensive care unit over a 14-year period. We set out to determine the common reasons for admission to our ICU among paediatric patients and the groups with the highest mortalities and some factors associated with mortality in these patients.

MATERIALS AND METHODS

All paediatric patients (<16 years) admitted to the ICU of our tertiary hospital from January 1994 to December 2007 constituted the study population of

this retrospective study. The patients were managed by the attending anaesthetists, admitting surgeons, paediatricians, and in some cases obstetricians.

The ICU in our hospital has a six-bed capacity and is equipped with an adult and a paediatric ventilator, electrocardiograph monitors connected to a central monitor, a defibrillator and pulse oximeters. It has a mobile X-ray unit while most laboratory investigations are carried out at the hospital main laboratory.

The information obtained from the patients' case notes and admission/discharge records included the age, gender, working diagnosis, length of stay (LOS) in the ICU, the management and outcome. Data were described in rates and proportions. Statistical analysis was performed using Epiinfo version 3.5. $P< 0.05$ was considered statistically significant.

RESULTS

A total of 1364 patients were admitted to the ICU during the study period out of which 302 (22.1%) were children. There were 179 males and 123 females giving a male: female ratio of 1.5:1. The age range was from a few hours old to 15 years old with a mean of 4.9 ± 2.5 years. Table 1 shows the age distribution of the patients. The peaks in admissions occurred in patients < 1 month and in the age groups 3-8 years and 9-15 years.

Postoperative admissions made up 51.7% of the admissions [Table 2]. Of these the paediatric surgical unit had 108 (35.8%), neurosurgical unit 19 (6.3%), cardiothoracic unit 5 (1.7%), and obstetrics 3 (1%) admissions. Among the paediatric surgical cases 88 (81.5%) had gastrointestinal pathologies (congenital or acquired). Of these 68 (77.3%) were congenital and most of these patients were in their neonatal period. Also 15 (13.9%) were cases of trachea-oesophageal fistula (TOF). The remaining 4.6% were children who had some other surgeries and experienced perioperative complications like cardiac arrest or aspiration of gastric content. Two of the obstetric cases were 15 years old with post-partum eclampsia while the third was a 14-year-old who was admitted with burst abdomen and sepsis after undergoing emergency caesarean section for obstructed labour. Trauma cases made up 31.6% of admissions of which 59 (19.5%) were burn and 14 (4.6%) were polytrauma cases (i.e. patients with significant injuries to more than one system). Cases of respiratory failure were mostly due to pneumonia and the Guillian Barre syndrome while airway obstructions were mostly due to foreign body aspiration. The total number of ICU admissions rose steadily from 52 per year in 1994 to 157 per year in 2007 while paediatric admissions rose from 13 in 1994 to a peak of 34 in 2003 as shown in Figure 1.

Of the 302 children admitted to the ICU during the period, 193 were transferred from the ICU to other wards or in some cases other hospitals while 109 patients died, giving a mortality rate of 36.1%. The pattern of mortality can be seen in Table 3. Burn alone accounted for 29.4% of the total deaths and 82.1% of deaths from trauma. Mortality was highest in the age group 9 to 15 years with 32.7%, 3 to 8 years and < 1 month had 20.2% mortality each, 1 month to 6 months had 12.5% and the least mortality was in the age group 7 months to 1 year with 6.7%. There was no statistical correlation between age and mortality. The total mortality rate in the ICU within the same period was 35.7% (487 patients died out of 1364 admissions). Causes of death in the postoperative cases included

Table 1: Age distribution of patients

Age	No. of admissions	Percentage
≤ 1 month	66	21.9
1 month – 6 months	32	10.6
7 months – 1 year	28	9.3
1 year – 2 years	24	7.9
3 years – 8 years	73	24.2
9 years – 15 years	79	26.1
Total	302	100

Table 2: Indications for admission

Admissions	
A. Postoperative Cases	n (%)
Paediatric surgical	108
Neurosurgical	19
Cardiothoracic	5
Obstetric	3
Others	21
Sub-total	156(51.6%)
B. Trauma	n (%)
Burn	59
Polytrauma	14
Head injury	21
Spinal cord injury	1
Sub-total	95 (31.6%)
C. Airway obstruction	n (%)
16	(5.2%)
D. Medical CASES	n (%)
Cong. Heart disease	6
Respiratory failure	7
Tetanus	6
Cardiac arrhythmias	3
Others	13
Sub-total	35 (11.6%)
Total	302 (100%)

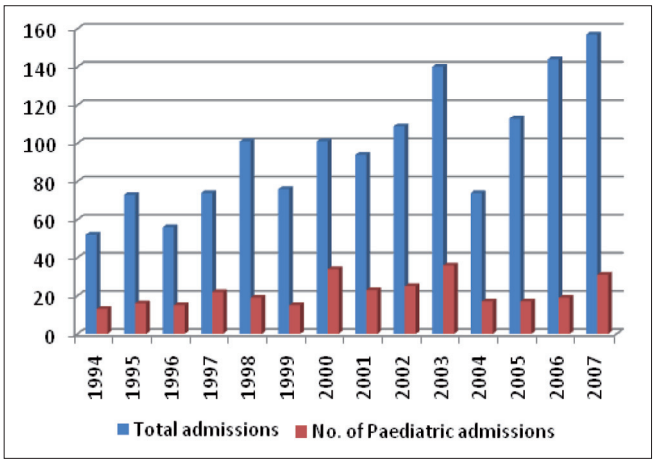


Figure 1: Admissions over the years

shock, sepsis and respiratory failure while in the burns patients it was due to shock, sepsis, and multiple organ dysfunction. Of the paediatric surgical cases, 15 deaths (i.e. 44.2%) were from respiratory failure, mostly post tracheo-oesophageal fistula repair, six (17.6%) were due to hypovolaemic shock, seven (20.6%) from sepsis and six (17.6%) from multiple organ dysfunction (MODS). Among the burn patients eight (25%) deaths were due to sepsis, 14 (43.8%) due to hypovolaemic shock, six (18.7%) due to MODS, and four (12.5%) from airway compromise as a result of inhalational burns.

The LOS in the ICU ranged from < 1 day to 56 days with a mean of 5.5 days as shown in Table 4. Only one patient stayed longer than 28 days while most of the patients spent between 24 h and seven days in the ICU. Eighty-six deaths i.e. 78.9% of the mortalities occurred in patients with LOS of seven days and below, while LOS < 24 h and three to seven days was statistically related with mortalities.

Table 3: Pattern of mortalities in the ICU

Mortalities	
A. Postoperative Cases	n (%)
Paediatric surgical	34*
Neurosurgical	2
Cardiothoracic	2
Obstetric	1
Others	12
Sub-total	51(46.8%)
B. Trauma	
Burn	32*
Polytrauma	2
Head injury	5
Spinal cord injury	
Sub-total	39 (35.8%)
C. Airway obstruction	
	2 (1.8%)
D. Medical cases	
Cong. Heart disease	3
Respiratory failure	3
Tetanus	5*
Cardiac arrhythmias	
Others	6
SUB-TOTAL	17 (15.6%)
Total *P<0.05	109 (100%)

DISCUSSION

In our study 22.1% of patients admitted to our ICU were of the paediatric age group. Kushimo *et al.*, found a paediatric ICU admission rate of over 28% in an earlier study in Lagos, Nigeria[9] while McHugh *et al.*, in their study in New Zealand had an admission rate of 7.4% for the paediatric age group in their general ICU.[10] The low paediatric admission rate in the New Zealand study may be a result of regionalization of ICUs with the establishment and development of PICUs where the more severe cases were referred. This is however not the practice in our country.

Postsurgical patients and trauma patients constituted the bulk of paediatric admissions to our ICU accounting for over 80% (postsurgical 51.7%; post-trauma 31.6%) of the admissions. This was also the general trend found by Isamade *et al.*, some years ago in a study involving children and adults in the same ICU.[7] In the study by Kushimo *et al.*, in Lagos they discovered a postoperative admission rate of 57% while in the study from Sagamu, Nigeria, trauma constituted 73.4% of their ICU admissions with postoperative admissions making up only 3.6%.[11] This suggests that trauma is a significant cause of morbidity in both the adult and paediatric age groups in our region, a situation that is true for some other regions of the world.[12] Our country had in the past few years experienced an increase in the number of burn cases reporting to hospitals. Often implicated was careless handling of flammable explosive agents like adulterated petroleum products.[13] An earlier study had also implicated explosions from adulterated petroleum products as a major aetiological factor in patients presenting with burn in our hospital.[8] The reason why a high number

Table 4: Length of stay of patients in the ICU

Length of stay (los)	No. of patients	Percentage
< 24 Hours	27	8.9
24 – 48 Hours	106	35.2
3 – 7 Days	100	33.1
8 – 14 Days	46	15.2
15 – 28 Days	23	7.6
Total	302	100

of such cases were admitted to the ICU is probably because of the absence of a burns unit in our hospital. While admissions due to trauma and burn affecting children were quite high (31.6%) in our hospital, Nq *et al*., recorded only 7% admissions as a result of trauma and burn in a study from Hong Kong,[14] suggesting a much lower incidence of trauma in their region. Their study also showed that the more severe cases of trauma admitted to their PICU were as a result of non-accidental injuries, a situation not so common in our experience. The high rate of postoperative admissions in our study was probably due to high referrals directly from the theatre, usually for monitoring or respiratory support since there was no high dependency unit in our hospital. A study involving six hospitals in the United Kingdom also had a high rate (66.4%) of postsurgical admissions.[15] This is unlike the study from Jordan where most of their ICU admissions were non-surgical.[12] Over the years the number of admissions to our ICU had been on the rise. The increase in the number of paediatric admissions, especially from the year 2000 could be attributed to the expansion of the ICU in the late 1990s and the establishment of a paediatric surgical unit in the hospital in the early 2000s.

One of the age groups with the highest number of admissions was the neonatal age group. Though our hospital had a neonatal ICU a significant number of postsurgical neonates were admitted to the general ICU in order to stabilize them before being transferred to the neonatal ICU since the neonatal ICU did not have facilities for advanced respiratory support and adequate monitoring. We also had significantly high admissions in the age group of 3 to 15 years. This was probably because of the vulnerability of this age group to trauma as we found significantly more admissions due to trauma in this age group.

The mortality rate in our ICU for paediatric patients during the study period was 36.1%. This rate is similar to that reported by McCrosan *et al*., by El-Nawawy in a study in Egypt, and also in some Nigerian studies.[11,15-17] McHugh and Hicks,[10] on the other hand, in their study from New Zealand recorded a mortality rate of 3.6% among the paediatric patients who were admitted to their general ICU. The paediatric admission rate to their ICU was only 7.4% and these patients were described as low to moderate risk. The high-risk patients were managed in dedicated PICUs. In our case our patients covered the whole spectrum from low to high risk. However, in our study which was retrospective we could not objectively determine the severity of our patients' illness using tools like the Paediatric Risk of Mortality (PRISM) and the Paediatric Index of Mortality (PIM) since they were not applied from the onset. Though several studies have suggested better outcome in critically ill children managed in the PICU as compared with those managed in the general ICU,[3-6,18] we are yet to develop PICUs in our country and it will be interesting to find out the experiences of other general ICUs in our region with regards to the management of paediatric patients. Authors have reported mortality rates between 2–16% from PICUs in other parts of the world.[17,19] The high mortality rate in our study may also be a reflection of the inadequacy of the facilities in our ICU. The ICU has only one paediatric ventilator which sometimes is non-funtional for long periods. Postoperative patients with tracheo-oesophageal fistula (TOF) and omphalocoele repair often require postoperative ventilatory support which frequently could not be provided for these reasons. There were also no facilities for invasive monitoring.

The LOS in a paediatric ICU has been considered to be a reflection of the severity of the patient's illness and health status, as well as PICU quality and performance. While many studies agree that there is a correlation between LOS and the outcome of paediatric patients,[16,19] there are conflicting findings as to how LOS affects outcome. El-Nawawy in his study found greater mortality in paediatric patients with shorter LOS in the ICU,[16] while Marcin *et al*., in their study found greater mortality in patients with longer LOS.[19] This may be a reflection of the types of patients they had in these categories. While in the first study the short-stay patients were mainly cases of sepsis and neurological disease syndrome, in the second study the long-stay patients were cases of acquired cardiac disease, pneumonia and other respiratory disorders. In our own experience patients with burn had the highest mortality rates and they tend to have short LOS in the ICU. There was also significant correlation between short LOS and mortality. The high mortality among the burn patients was probably because most of the burn patients admitted to the ICU were severe cases in terms of body surface area involved or the existence of airway involvement or inhalational burn which usually carry poor prognosis. The most common causes of death in the burn patients were shock and sepsis. The patients who died from shock were most likely to die within the first 24 h while those who died from sepsis usually died within the three to seven days LOS. The LOS 24-48 h had the highest number of admissions. These were mostly postoperative paediatric surgical patients who were admitted usually for organ support.

Our study found an increasing rate of paediatric admissions to our general ICU over the years. We also found a high mortality rate among paediatric patients admitted to our ICU. Current evidence tends to suggest that critically ill children do benefit immensely from critical care and those managed in a PICU appear to do better than those managed in a general ICU. The development of PICUs in many countries was tied to the development of super-specialties in paediatric surgery and in our country the development of super-specialties in paediatric surgery is still rudimentary. However, the poor outcome in paediatric patients managed in our ICU appears to be more a reflection of the inadequacy of facilities rather than the lack of development of PICUs. If stakeholders become more committed to better equipping our ICUs and to manpower development we would indeed experience improved outcome in our critically ill children. Hospitals in our region should also begin to look into the feasibility of establishing PICUs where equipment are more adapted for use in this age group in order to further improve the standard of critical care in the paediatric age group.

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Cite this article as: Embu HY, Yiltok SJ, Isamade ES, Nuhu SI, Oyeniran OO, Uba FA. Paediatric admissions and outcome in a general intensive care unit. Afr J Paediatr Surg 2011;8:57-61.

Source of Support: Nil, **Conflict of Interest:** None declared.