Review Article

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Pediatric High Dependency Unit (HDU): Pattern of Admission, Length of Stay (LoS) and Outcome

Mohammed El. A. Zayed MD[1*], Omer Saeed Magzoub MD[2] and Tagwa. Y. E. Ahmed MBBS[3]

[1]*Assistant professor of Pediatric and Child Health, Faculty of Medicine and Health Science, Kordofan University, Kordofan, Sudan.*

[2]*Specialist General Pediatrician at Ain Al-Khaleej Hospital, Al-Ain, Abu Dhabi, UAE.*

[3]*House officer, Elobied Pediatric Teaching Hospital.*

[*]Correspondence:
Dr. Mohammed El. A. Zayed, Assistant Professor of Pediatrics and Child Health, Faculty of Medicine and Health Science, Kordofan University, Al-Obaid, Sudan, Mobile No: 00249128750205.

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ABSTRACT

Patients admitted to the HDU usually need medical care more than the capacity of general pediatric ward and less than Pediatric Intensive Care Unit (PICU) and they are usually children with acute medical problems necessitate close observation, monitoring and management.

Objectives: *To determine the pattern of admissions, length of stay (LoS) and outcome of patients admitted to pediatric high dependency (PHDU) in Elobied Pediatrics Teaching Hospital.*

Methods: *It is a retrospective cross-sectional hospital-based study where data including age, sex, origin, length of stay (LoS), diagnosis and outcome were retrieved from pediatric HDU and hospital records for a 2-year period. All cases were individually reviewed by two pediatricians to identify the cause of admission along with LoS and outcome.*

Results: *During the study period; 519 children were admitted with age ranging from 1 day to 17 years with the median age of 7 months. Males were 295 (56.8%) and females were 224 (43.1%). It was found that most patient 323 (62.2%) were from rural area and 196 (37.7%) were from urban area.*

Pattern of admission was as follows: *neonatal Sepsis 123 (23.7%), severe malaria 52 (10%), cardiovascular diseases 51 (9.8%) of which heart failure in 29 (5.5%) due to anemia or congenital heart disease, diabetic ketoacidosis (DKA) 49 (9.4%), respiratory diseases 49 (9.4%) of which pneumonia 33 (6.3%) meningoencephalitis 49 (9.4%), renal diseases 33 (6.3%), neurological diseases 18 (3.4%), gastrointestinal diseases 13 (2.5%), septic shock 11 (2.1%), surgical cases 18 (3.4%) of which intestinal obstruction was 9 (1.7%) and others 53 (10.2%).*

The length of stay (LoS) was ranging from 1 day to 40 days with the median of 4 days. Regarding the outcome; 192 (37%) were discharged from HDU in good condition, 215 (41.4%) died out of them; 121 (23.3% died within 48 hours after admission to hospital and 101(19.8%) died after 48 hours after admission), 81 (15.6%) referred to higher centres and 31 (6%) left against medical advice (LAMA).

Conclusion: *It was obvious that communicable and preventable diseases are the most prevalent causes for morbidity and mortality among children admitted to HDU with high mortality rate.*

Keywords
Pattern of admission, Outcome, Pediatric HDU.

Introduction
Elobied Pediatrics Teaching Hospital is a busy hospital located in Elobied City, capital of North Kordofan state and provides secondary health care level of service. The hospital has 130 beds in general pediatric wards, 12 beds in High Dependency Unit (HDU) and PICU of 5 beds with artificial ventilation facilities. Around 500 patients seen per day in emergency room and admission rate of around 5 -10% of daily seen patients. Patients admitted to the HDU usually constituted about 3% - 5% of all admitted pediatric patients and usually need medical care more than the capacity of general pediatric ward and less than Pediatric Intensive Care Unit (PICU) and they are usually children with acute medical problems and at a high risk of developing severe morbidity and necessitate close observation, monitoring and management.

Royal College of Paediatrics and Child Health (UK) proposed that two levels of Critical Care (Level 1 and Level 2) be used to describe activities which would have previously been described as HDC. Level 1 Critical Care will be used to describe activities which should be delivered in any hospital which admits acutely ill children and will focus on the commoner acute presentations and clinical scenarios that require an enhanced level of observation, monitoring and intervention than can be safely delivered on a normal ward. Level 2 Critical Care will be used to describe more complex activities and interventions which are undertaken less frequently, to children with a higher level of critical illness, and demand the supervision by competent medical and nursing staff who have undergone additional training. Level 3 Critical Care will be used to describe activities that should only be undertaken within pediatric intensive care units (PICUs) [1].

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. The majority (99%) of childhood deaths occurring in developing countries, especially under-five mortality, is highest in sub-Saharan Africa (> tenfold). Intensive care could reduce mortality rates by 15–60%, when it is a well-equipped, and staffed with intensivists [2].

The HDU outcomes were determined by clinical condition at admission, patient age, comorbidity, level of pre-hospital and emergency care, and factors reported during HDU admission, such as level of consciousness, duration of HDU stay, as well as complications during HDU stay such as circulatory and respiratory complications. The effectiveness of therapy will be determined by evaluating the outcomes of medical treatments. The mortality determinants have varied across the globe [3].

Krithika et al. in India have a simple scoring system TOPRS which stands for: T-Temperature, O-Oxygen saturation, P-Pulse rate, R -Respiratory rate and S-Seizure. The score using simple clinical variables and does not require expertise to perform. The study has shown a definite correlation between the TOPRS score and the poor outcome. It has also revealed that, higher the score, longer the ICU stays. Among the variables, the temperature and the heart rate abnormality were associated with poorer outcomes in comparison to the other variables [4].

Methodology and Results
Methods
It is a retrospective cross-sectional hospital-based study conducted in Elobied Pediatrics Teaching Hospital which is located in Elobied city, capital of North Kordofan state. It's a busy pediatric hospital and provides secondary health care level of service. The hospital has 130 beds in general pediatric wards, 12 beds in High Dependency Unit (HDU) and PICU of 5 beds with artificial ventilation facilities. Around 500 patients seen per day in emergency room with admission rate of around 5 - 10% of daily seen patients. Patients admitted to the HDU usually constituted about 3 - 5% of all admitted patients. The data including age, sex, origin, length of stay (LoS), diagnosis and outcome were retrieved from pediatric HDU and hospital records from 01/01/2020 to 31/12/2021 (2-year period). All cases were individually reviewed by two pediatricians to identify the cause of admission along with their length of stay (LoS) and outcome.

Objectives
To determine the pattern of admissions, length of stay (LoS) and outcome of patients admitted to pediatric high dependency (PHDU) in Elobied Pediatrics Teaching Hospital.

Sample and consent
All pediatric patients admitted to HDU aged 0 – 17 years same study period were included in the study. Consent was obtained from head of HDU department and hospital administration.

Study technique
Data obtained from admission and discharge hospital records of all patients admitted to PHDU from 01/01/2020 to 31/12/2021 (2-years period) as well as patients files. Data contained age, sex, diagnosis, LoS and outcome was analysed and reviewed.

Results
519 children were admitted during this period with age ranging from 1 day to 17 years; 197 (37.7%) 0 – 2 months, 118 (22.7%) 2 months – 2 years, 52 (10%) 2 years – 5 years, 87 (16.7%) 5 years – 12 years and 65 (12.5%) more than 12 years figure [1]. Males were 295 (56.8%) and females were 224 (43.1%). The median age was 7 months. Male to female ratio was 1.27:1 figure [2]. It was found that most patient 323 (62.2%) were from rural area and 196 (37.7%) were from urban area figure [3]. The length of stay (LoS) was ranging from 1 day to 40 days with the median of 4 days.

Pattern of admission
It was found that neonatal Sepsis accounted for 123 (23.7%) of HDU admissions, severe malaria 52 (10%), cardiovascular diseases 51 (9.8%) of which heart failure in 29 (5.5%) due to anemia or congenital heart disease, DKA 49 (9.4%), respiratory diseases 49

Figure 1: Distribution according to age.

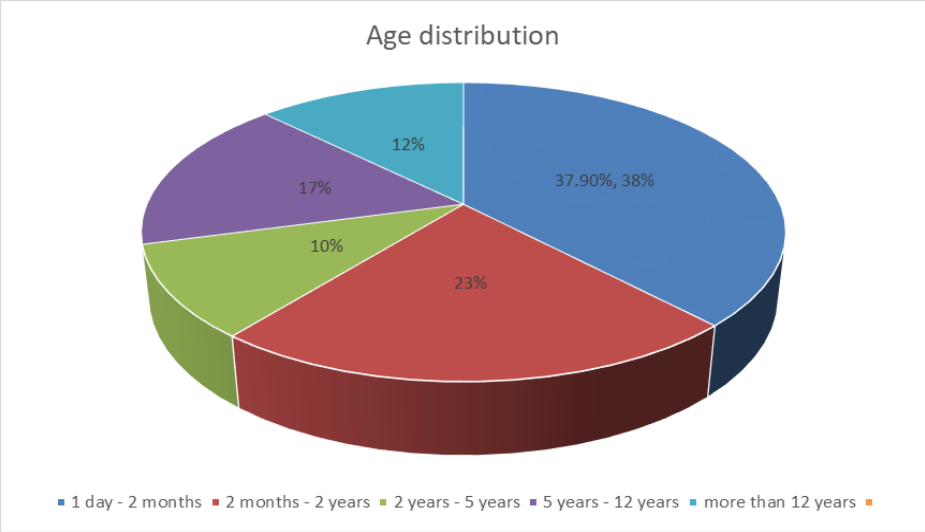


Figure 2: Sex distribution of patients admitted to HDU.

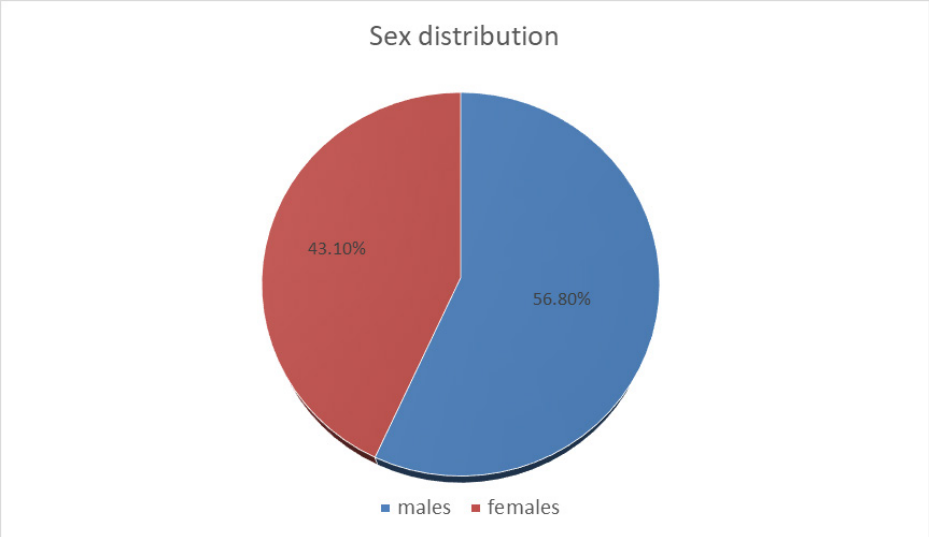
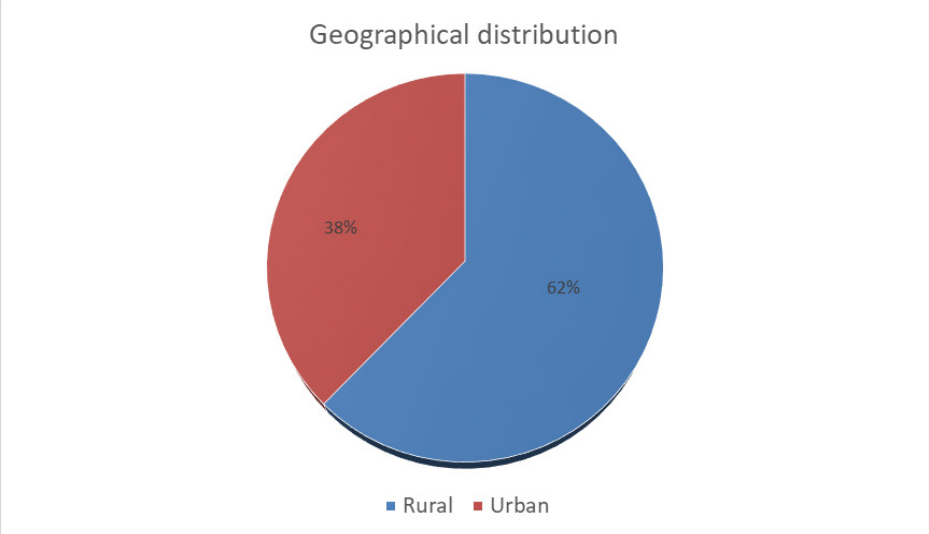


Figure 3: Geographical distribution of patient admitted to HDU.



(9.4%) of which pneumonia 33 (6.3%) meningoencephalitis 49 (9.4%), renal diseases 33 (6.3%), neurological diseases 18 (3.4%), gastrointestinal diseases 13 (2.5%), septic shock 11 (2.1%), surgical cases 18 (3.4%) of which intestinal obstruction was 9 (1.7%) and others 53 (10.2%) (Table 1).

Table 1: Pattern of admission to pediatric HDU.

No	Disease	No	%
1	Neonatal sepsis	123	23.7%
2	Severe malaria	52	10%
3	Cardiovascular diseases	51	9.8%
4	Respiratory diseases	49	9.4%
5	Meningoencephalitis	49	9.4%
6	Diabetic keto-acidosis DKA	49	9.4%
7	Renal diseases	33	6.3%
8	Neurological diseases	18	3.4%
9	Gastro-intestinal diseases	13	2.5%
10	Septic shock	11	2.1%
11	Surgical conditions	18	3.4%
12	Others	53	10.2%
	Total	**519**	**100%**

The length of stay (LoS) was ranging from 1 day to 40 days with the median of 4 days.

Regarding the outcome; 193 (37.1%) were discharged in good condition, 215 (41.4%) died in HDU out of them; 121 (23.3% died within 48 hours after admission to hospital and 101(19.8%) died after 48 hours after admission), 78 (15%) referred to higher centres and 33 (6.4%) left against medical advice (Table 2). The 3 most common causes of admission were neonatal sepsis, severe malaria and cardiovascular diseases constituted 226 (43%) of total admissions to the HDU and had the following outcome; 123 neonates admitted to HDU constituted (23.6%) of total admissions out of them 37 (30%) discharged in good condition, 59 (47.9%) died of them 37 (30%) died in the first 48 hours after admission and 22 (17.8%) died after 48 hours after admission, 15 (12.1%) referred and 9 (7.3%) left against medical advice (Table 3). Regarding outcome of severe malaria; 52 children admitted to HDU constitute (10%) of total admissions out of them 19 (36.5%) discharged in good condition, 16 (30.7%) died of whom 9 (17.3%) died within 48 hours of admission and 7 (13.4%) died after 48 hours, 15 (28.8%) referred and 9 (17.3%) left against medical advice (Table 4). Regarding outcome of cardiovascular diseases; 51 children admitted to HDU constituted (9.8%) of total admissions out of them 15 (29.4%) discharged in good condition, 24 (47%) died of whom 14 (27.4%) died within 48 hours of admission and 10 (19.6%) died after 48 hours, 15 (29.4%) referred and 9 (17.6%) left against medical advice (Table 5).

Table 2: Outcome of patients in relation to length of stay LoS (N = 519).

Length of stay (LoS)	Discharged		Died		Referred		LAMA		Total	
	No	%	No	%	No	%	No	%	No	%
< 2 days	21	4%	125	23.9%	17	3.2%	10	2%	173	33.3%
2 - 7 days	92	17.7%	53	10.2%	34	6.5%	14	2.7%	193	37.1%
7 – 14 days	65	12.5%	30	5.9%	22	4.2%	6	1.1%	123	23.7%
14 – 28 days	14	2.6%	7	1.3%	5	1%	2	0.4%	28	5.4%
> 28 days	1	0.2%	0	0	0	0	1	0.2%	2	0.4%
Total	193	37.1%	215	41.4%	78	15%	33	6.4%	519	100%

*LAMA = left against medical advice.

Table 3: Outcome of neonatal sepsis (N = 123).

Discharged		Died				Referred		LAMA		Total
No	%	No	%	No	%	No	%	No	%	
37	30%	37	30%	22	17.8%	15	12.1%	9	7.3%	**123**
		59 = 47.9%								

*LAMA = left against medical advice.

Table 4: Outcome of severe malaria (N = 52).

Discharged		Died				Referred		LAMA		Total
No	%	↓ 48 hours	↑ 48 hours	No	%	No	%	No	%	
19	36.5%	9	17.3%	7	13.4%	10	19.2%	7	13.4%	**52**
		19 = 36.5%								

*LAMA = left against medical advice.

Table 5: Outcome of cardiovascular diseases (N = 51).

Discharged		Died				Referred		LAMA		Total
No	**%**	**↓ 48 hours**	**↑ 48 hours**	**No**	**%**	**No**	**%**	**No**	**%**	
15	29.4%	14	27.4%	10	19.6%	11	21.5%	1	1.9%	**51**
		24 = 47%								

*LAMA = left against medical advice.

Discussion

Caring for the critically ill children is a challenge in developing countries, where health needs often outstrip available resources. Necessary equipment is scarce and often malfunctions and trained manpower is limited. Management of critically ill patients requires significant human, infrastructural, and financial resources. These resources are typically limited in low-income countries [5]. Sudan, similar to other developing countries where communicable diseases are the most prevalent causes for morbidity and mortality among children, has a high pediatric mortality rate [6].

For the best of our knowledge, this the first report from pediatric HDU in Sudan where total number of patients admitted to pediatric HDU was 519 during period of 2 years from 01/01/2020 to 31/12/2021 which represented 3 – 5% of total pediatric admissions compared to report by Nafela Alkowari et al from Bahrain (5 – 15%) [7]. The age was ranging from 1 day to 17 years out of them 367 (70.7%) under 5 years, 65 (12.5%) 5- 12 years and 87 (16.7%) more than 12 years with median age of 7 months. This is less than the report by Mobarak MR et al from Bangladesh where he found that patients under 5 years were 80% [8]. We found that males were 56.8% and females were 43.2% with ratio 1.3:1 which is similar to report by Mobarak MR et al from Bangladesh [8]. Unlike Md Badruddozar et al who is also from Bangladesh reported male: female ratio: 0.54 [9].

Regarding pattern of admission: we found that neonatal Sepsis accounted for 123 (23.7%) of HDU admissions, severe malaria 52 (10%), cardiovascular diseases 51 (9.8%) of which heart failure in 29 (5.5%) due to anemia or congenital heart disease, DKA 49 (9.4%), respiratory diseases 49 (9.4%) of which pneumonia 33 (6.3%) meningoencephalitis 49 (9.4%), renal diseases 33 (6.3%), neurological diseases 18 (3.4%), gastrointestinal diseases 13 (2.5%), septic shock 11 (2.1%), surgical cases 18 (3.4%) of which intestinal obstruction was 9 (1.7%) and others 53 (10.2%). This is completely different from pattern reported Mobarak MR et al where they reported 45% with meningitis and encephalitis, other indications were seizure disorders (febrile & afebrile) 12.8% and bronchopneumonia including bronchiolitis 10.7%, neonatal sepsis and jaundice 9.28% and surgical conditions 5% compared to 3.4% in our study [8]. Md Badruddozar et al found a different pattern of admission where pneumonia was the leading cause of admission and mortality where it was responsible for 23.25 % of admission. Other leading causes of admission were acute bronchiolitis 15.23%, meningitis 15.48% and septicemia 13.5% [9].

Regarding outcome in our study: 193 (37.1%) were discharged in good condition, 215 (41.4%) died in HDU out of them; 121 (23.3% died within 48 hours after admission to hospital and 101(19.8%) died after 48 hours after admission), 78 (15%) referred to higher centres and 33 (6.4%) left against medical advice. The 3 most common causes of admission were neonatal sepsis, severe malaria and cardiovascular diseases constituted 226 (43%) of total admissions to the HDU and had the following outcome; 123 neonates admitted to HDU constituted (23.6%) of total admissions out of them 37 (30%) discharged in good condition, 59 (47.9%) died of them 37 (30%) died in the first 48 hours after admission and 22 (17.8%) died after 48 hours after admission, 15 (12.1%) referred and 9 (7.3%) left against medical advice table. Regarding outcome of severe malaria; 52 children admitted to HDU constitute (10%) of total admissions out of them 19 (36.5%) discharged in good condition, 16 (30.7%) died of whom 9 (17.3%) died within 48 hours of admission and 7 (13.4%) died after 48 hours, 15 (28.8%) referred and 9 (17.3%) left against medical advice table. Regarding outcome of cardiovascular diseases; 51 children admitted to HDU constituted (9.8%) of total admissions out of them 15 (29.4%) discharged in good condition, 24 (47%) died of whom 14 (27.4%) died within 48 hours of admission and 10 (19.6%) died after 48 hours, 15 (29.4%) referred and 9 (17.6%) left against medical advice. Mobarak et al (represents the private sector in Bangladesh) reported meningitis and encephalitis as leading causes of death whereas Md Badruddozar et al (who represents public sector in Bangladesh) reported severe pneumonia, acute bronchiolitis, septicemia and meningitis as main causes of death in pediatric HDU [8,9].

We have very limited numbers of pediatric HDU nationwide with limited resources and lacking skills and knowledge regarding critical care. Knowing the pattern of admission and outcomes of critically ill pediatric patients admitted to HDU is essential to set priorities in limited resources country like Sudan. The authors would like to acknowledge the limitation of this study due to the paucity of information available from pediatric HDUs around the country and the unfavourable conditions and environment of the pediatric HDU.

Conclusion

It was obvious that communicable and preventable diseases (neonatal sepsis, severe malaria, meningoencephalitis and pneumonia) are the most prevalent causes for morbidity and mortality among children admitted to HDU with very high mortality rate.

Recommendations

- Encourage aseptic hospital delivery and proper perinatal care.
- Effective immunization program against the main bacterial

organisms (Haemophilus Influenzae, Neisseria Meningitis, and Streptococcus Pneumonia) leads to dramatic falls in life threatening infections.

- Reinforce malaria prevention/ control program.
- Introduction of simple screening and observation system in emergency department like TOPRS scoring system for early detection and management of sick children.
- Establish proper community awareness and appropriate referral system.
- Adequate skilled manpower, necessary equipment and pediatric Intensive care units (PICU) facilities in the regional hospitals.

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