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A Two-year Retrospective Review of Paediatric Mortality in a Tertiary Facility in North-western Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author MOU designed the study, performed literature search, managed data collection, performed statistical analysis and wrote the first draft of the manuscript. Author BIG performed literature search, and critically reviewed the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Introduction: Mortality pattern is reflective of both the severity of illness and the quality of treatment given.
Objective: To identify the age, time and cause of death in the paediatric wards of Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto.
Methods: This was a retrospective review of mortalities in children 5weeks to 15 years at the paediatric wards of UDUTH from 1st January 2016 to 31st December 2017. The bio-data, duration of illness, diagnoses, complications and duration of hospital stay were extracted from the mortality case files and analysed.
Results: There were 121 mortalities, representing 2.3% of 5,355 total admissions during the study period. Sixty-seven (55.4%) were males (M: F ratio 1.2:1). Seventy-five (62.0%) were under-fives and mean age ± standard deviation was 54 months ± 46.3. Most deaths 76 (62.0%) occurred between July and December and majority 96 (79.3%) occurred ≥ 24 hours after admission. Severe acute malnutrition [SAM] 31 (41.3%), severe malaria 12(16.0%), and septicaemia 9 (12.0%), were the leading causes of death in the under-fives, whereas severe malaria 8 (17.4%), meningitis

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7(15.2%) and malignancy 5 (10.9%) predominate in those > 5 years [*P*<0.001]. There was delayed presentation ≥ 7 days in 87 (71.9%) children and 90 (74.4%) had at least one or more complications.

Conclusion: Severe acute malnutrition and severe malaria were the leading causes of mortalities in our facility. It is needful to scale up preventive and curative services targeted at curbing these diseases in Sokoto and environs.

Keywords: Paediatric mortality; cause of death; under-five; tertiary facility; Nigeria.

1. INTRODUCTION

Child mortality is a sensitive indicator of a country's development and a telling evidence of her priorities and values [1]. Mortality from a disease is a reflection of the disease severity, promptness, of treatment and quality of care given. Mortality review data of hospitalized patients gives a reasonable idea of what is obtainable in the community at large.

The world has made substantial progress in reducing child mortality in the past several decades. The total number of under-five deaths world-wide dropped from 12.6 million in 1990 (35,000 deaths every day) to 5.6 million (15,000 deaths every day) in 2016 [2] and 5.2 million (14,000 deaths every day) in 2019 [3]. Globally, the under-five mortality rate dropped from 93 deaths per 1,000 live births in 1990 to 41 deaths per 1,000 live births in 2016 and 38per 1,000 live births in 2019- a 59 per cent decline [2]. This is equivalent to 1 in 11 children dying before reaching age 5 in 1990 compared to 1 in 27 in 2019 [3]. More than 80 per cent of under-five deaths occur in two regions; sub-Saharan Africa, which includes Nigeria and Southern Asia [2,3].

In sub-Saharan Africa, approximately 1 child in 13 dies before their fifth birthday, while in the world's high-income countries the ratio is 1 in 189 [2,3]. Mortality in Children above five years has been reported to be much less; one million children aged 5–14 years died in 2016, which is equivalent to 3,000 children aged 5–14 years dying every day [2]. Most under-five deaths are caused by diseases such as pneumonia, diarrhoea and malaria that are readily preventable or treatable with proven, cost effective interventions including immunization, adequate nutrition, safe water/food and quality care by trained health provider when needed [2,4]. Studies have shown that about half to two-thirds of these preventable diseases have malnutrition as a major underlying risk factor [2,5]. Malnourished children, particularly those with SAM, have a higher risk of death from common childhood illnesses such as diarrhoea, pneumonia, and malaria [3]. Infectious diseases and neonatal complications such as preterm birth, birth asphyxia, and congenital anomalies are responsible for the vast majority of under-five deaths globally [2,3].

Nigeria's under five mortality rates is currently at 132/1000 live birth, meaning one in five Nigerian children dies before their fifth birthday [6]. This figure is still unacceptably high despite the various interventions and progress made thus far. Some of the major contributing factors to this high mortality rate are poverty, ignorance, female illiteracy, poor water and environmental sanitation, poor access to health care, poor recognition and responses to signs of infection, poor nutrition including micronutrient deficiencies, harmful socio-cultural practices, place of residence, regional variation and ethnicity [7,8].

Mortality review data is usually beneficial in re-evaluating existing services, improving facilities and quality of patient care [9]. It is hoped that data obtained from this review will assist policy makers and stake holders in child health to make informed and focused decisions on the strategies to further reduce the deaths in our locality and in the nation as a whole.

Ibitoye et al [10], in a previous study done in our centre in 2011, reviewed childhood mortality pattern within 24 hours of admission. However, they did not include mortality after 24 hours of admission. This study therefore aimed at determining the cause, the age and time of death of hospitalized children at the paediatric wards of Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto, Sokoto State, Nigeria.

2. MATERIALS AND METHODS

This was a descriptive, cross-sectional and retrospective review of all the deaths, among children who were within the age bracket of >1 month to 15 years, admitted to the paediatric

department through the emergency paediatric unit (EPU), paediatrics out-patient/specialty clinic and Paediatric Medical wards of Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto, from 1st January 2016 to 31st December 2017.

The hospital is a tertiary facility that serves as a referral centre for other health facilities in the neighbouring states such as Zamfara, Kebbi, Niger and Katsina states, as well as neighbouring countries like Niger Republic.

Sokoto city is the capital of Sokoto state, located in the extreme north west of Nigeria. The state has a population of 5.8 million as at 2019 based on the 2006 national population census and an annual growth rate of 3% [11]. Sokoto is a semi-arid region lying in the Sahel zone of North-western Nigeria [12]. Daytime temperature ranges from 31°C- 41°C and night time temperatures ranges from 15.5- 25°C. The warmest months are February to April and the cold months spans from December to January [13]. The raining season is from June to October [12], whilst the dry season is from November to mid-May [13] Most of the ethnic groups are represented but majority are the indigenous Hausa's and Fulani. The state is basically agrarian.

The total number of admissions and mortality over the two-year period was obtained from the medical records department. Neonatal deaths, mortality before arrival and deaths from surgical cases that were not admitted via EPU (i.e. exclusively managed by surgeons) were all excluded. Case files of all in-patient deaths during the period under review were retrieved and relevant information were extracted into a pre-designed pro forma. Information extracted included the age, gender, duration of illness before presentation, principal diagnosis, duration of hospitalization, presence or absence of complications, and cause of death. The principal diagnoses were based on the final assessment of the managing unit, and was made on the basis of the clinical features (history and physical examination findings) with or without the results of laboratory tests.

The cause of death was defined as the underlying diagnoses leading to the sequence of events resulting in death, whilst complication was defined as secondary disease or conditions aggravating an already existing one. For instance, in the case of diagnosis of bronchopneumonia with heart failure, Bronchopneumonia was diagnosed clinically with or without supportive chest x-ray (CXR) findings, it was also documented as the cause of death, while heart failure; a complication. In the same vein, in a case of SAM with conditions like sepsis, hypothermia, hypoglycaemia or electrolyte derangement, SAM, was diagnosed using the World Health Organization (WHO) criteria of weight for length/height < -3Z score of the WHO growth standard and/or presence of bilateral oedema [14]. The former was documented as the cause of death while the latter conditions were documented as complications. Similarly, diagnosis of severe malaria was supported by the presence of *Plasmodium falciparum* asexual parasitaemia and one or more WHO severity criteria with no other confirmed cause for their symptoms and signs [15]. Each of the severity criteria (such as impaired consciousness, severe anaemia, hypoglycaemia, hyperpyrexia, hyper parasitaemia and others) [15] were individually taken as complications.

Data obtained were entered directly into the statistical package for social sciences (SPSS) version 20, SPSS incorporated, Chicago, Illinois, USA. Statistical analysis involved basic descriptive statistics and chi square test which was used to determine the relationship between categorical variables such as age group and cause of death. A p-value of ≤ 0.05 was taken as statistical significance.

3. RESULTS

3.1 Death Rates in Year 2016 and 2017

One hundred and twenty-one children died out of 5,355 children admitted over the two-year period of review giving a death rate of 2.3%. In 2016, 61 (50.4%) died out of 2,725 hospitalized children (1635 males, M: F= 1.5: 1) and in 2017, 60 (49.6%) died out of 2,135 hospitalized children (1584 males, M: F= 1.5: 1). Of the mortalities, 90 (74.4%) cases had one or more complications identified, whilst 31 (25.6%) had none.

3.2 Age and Gender Distribution of 121 Mortalities over a Two-Year Period

Table 1 shows the age and gender distribution of 121 mortalities within the two-year review period. The peak mortality was within the age group of > 1 to < 5years. The deaths were slightly more in males than females. (Male: Female ratio= 1.2:1).

3.3 Distribution of Mortality by Year, Month and Leading Cause of Death

The peak mortality occurred in January in 2016 and October in 2017. Cumulatively (2016 and 2017 combined) highest mortality was in October- 22 (18.2%) with spikes in July 16 (13.2%) and April 13 (10.7%) as depicted in Fig. 1.

The leading cause of death during these afore mentioned months were severe malaria (8/22), SAM (9/16) and Meningitis (3/13), respectively.

3.4 Cumulative Quarterly Mortality over 2-year Period of Review (2016- 2017)

Table 2 shows 40 (33%) deaths occurred in the last quarter (October to December) followed closely by the third quarter (July- September); 36(29.8%). There were more mortalities between July and December 76(62.8%) compared to January to June 45(37.2%).

3.5 Causes of Death in Under-five Children and its Association with Age Group Category

Seventy-five (62%) of the mortalities occurred in under-five children. The leading cause of death in under-five children was severe acute malnutrition- 31 (41.3%). This is followed, with a wide margin, by severe malaria- 12(16%), septicaemia-9 (12%), measles-5 (6.7%) and malignancies- 5 (6.7%). Other causes of death were acute diarrhoea disease, pneumonia, and meningitis. As depicted in Table 3. There was a statistically significant association between the cause of death (diagnoses) and age group category in under-five children (*P*= 0.01).

Table 1. Age and gender distribution of 121 mortalities over two-year period

No (%) Age group	Male	Female	Total
5 weeks - 1 year	7 (10.4)	4(7.4)	11(9.1)
>1 year - < 5 years	33(49.3)	31(57.4)	64(52.9)
5 - < 10 years	21(31.3)	13(24.1)	34(28.1)
10 – 15 years	6(9.0)	6(11.1)	12(9.9)
Total	67(100)	54(100)	121(100)

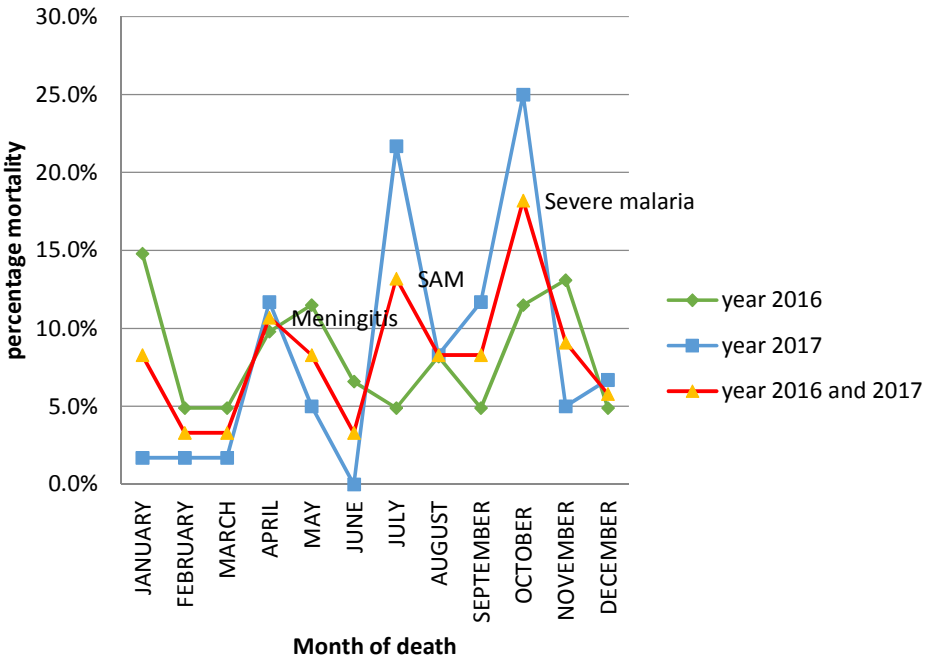

Fig. 1. Distribution of Mortality by year, month and leading cause of death

Table 2. Cumulative quarterly mortality over 2-year period (2016-2017)

Quarterly months	Number of deaths	percentage
January-march	18	14.9
April-June	27	22.3
July-September	36	29.8
October-December	40	33.0
Total	121	100

Table 3. Causes of death in under-five children and the association with age group category

Causes of death:	Age group: no (% within diagnosis)		
Diagnosis	5 weeks- 1 year>	1 year- 4 years	Total (% total)
SAM	4(12.9)	27(87.1)	31(41.3)
Severe Malaria	0(0)	12(100)	12(16)
Septicaemia	2(22.2)	7(77.8)	9(12.0)
Measles	0(0)	5(100)	5(6.7)
Malignancies	1(20.0)	4(80.0)	5(6.7)
Acute diarrhoea	1(33.3)	2(66.7)	3(4.0)
Pneumonias	3(100)	0(0)	3(4.0)
Meningitis	0(0)	2(100)	2(2.7)
Tetanus	0(0)	1(100)	1(1.3)
Typhoid fever	0(0)	1(100)	1(1.3)
*Others	0(0)	3(100)	3(4.0)
Total	11(14.7)	64(85.3)	^75(100)

Mean age: 23 months ± 11.5. SAM: severe acute malnutrition. ^ 75 (62% of Overall mortality)
** pharyngo-tonsillitis, snake bite, Tuberculosis. χ^2 = 23.02, P = 0.01*

Table 4. Causes of death in children aged five years and above and the association with age group category

Causes of death:	Age group: no (% within diagnosis)		
Diagnosis	5 weeks- 10 year>	10 year- 15 years	Total (% total)
Severe Malaria	8(100)	0(0)	8(17.4)
Meningitis	5(71.4)	2(28.6)	7(15.2)
Malignancies	5(100)	0(0)	5(10.9)
AGN/Nephrotic Syndrome	2(50)	2(50)	4 (8.7)
Typhoidfever ± perforation	3(75)	1(25)	4(8.7)
Acute Leukaemias	1(50)	1(50)	2(4.3)
Guillain Barre Syndrome	2(100)	0(0)	2(4.3)
Liver Disease	1(50)	1(50)	2(4.3)
Tetanus	2(100)	0(0)	2(4.3)
Septicaemia	1(100)	0(0)	1(2.2)
Pneumonia	0(0)	1(100)	1(2.2)
*Others	4(50)	4(50)	8(17.4)
Total	34(100)	12(100)	^ 46(100)

** persistent vegetative state, seizure disorder, viral encephalitis, acquired heart diseases, near drowning.*
^46 (38% of overall mortality)
χ^2 = 13.96, P= 0.24

Table 5. Distribution of mortalities by time of death and leading causes

Time of Death	Number of deaths (% total)	Leading causes-no (%within time)
< 24 hours	25 (20.7)	Severe malaria- 8(32) SAM-6(24) Meningitis-4(16)
24-48 hours	41(33.8)	SAM-11 (26.8) Severe malaria-8(19.5) Septicaemia-8(19.5)
>48 hours	55(45.5)	SAM-14(25.5) *Malignancy-10(18.2) Severe malaria measles-4(7.3) each
Total	121(100)	

** Nephroblastoma-1, Burkitt Lymphoma-2, Rhabdomyosarcoma-2, Neuroblastoma- 3, Retinoblastoma- 2.*

Table 6. Duration of Illness before hospital presentation

Duration of illness	No. of patients (%)
≤ 24hours	9(7.4)
>24hours - 6 days	25(20.7)
7-13 days	20(16.5)
≥ 14 days	67(55.4)
Total	121(11)

3.6 Causes of Death in Children Aged Five Years and Above, and Its Association with age Group Category

As shown in Table 4, the top three causes of death in children **≥** 5 years were severe malaria 8(17.4%), meningitis 7(15.2%) and malignancies 5 (10.9%). The least common cause of death was septicaemia and pneumonia constituting 2.2% each. There was no statistically significant association between cause of death and age group category in children above 5 years. (*P*= 0.24).

3.7 Distribution of Mortalities by Time of Death from Admission and Leading Causes

As depicted in table 5, majority- 96 (79.3%) mortalities occurred after 24 hours; of which 41 (33.8%) occurred between 24-48 hours and 55(45.5%) greater than 48 hours. Only 25(20.7%) mortalities occurred less than 24 hours of admission. The leading cause of death <24 hours of admission was severe malaria and >24 hours was SAM. Mortalities from meningitis occurred < 24 hours while those due to malignancies occurred > 48 hours.

3.8 Duration of Illness Before Hospital Presentation

As shown in Table 6. majority-67 (55.4%) of the deaths occurred in children who had been ill for greater or equal to 14 days prior to presentation in hospital, while the least mortality occurred in those who presented within 24 hours of illness.

4. DISCUSSION

The overall mortality of 2.3% found in our study was comparable to the 2.8% reported in Port Harcourt, Nigeria by George et al [16], and the 2.5% reported in South India [17]. However, it is lower than the reported 10.6% by Ibitoye et al [10] in a prior study done in our centre in 2011, and in Azare, Bauchi, north east, Nigeria in 2012 [18].It is also lower than the reported 4.9% in Abuja [19], 8.4% in Ilorin [20], 11.2% in Gusau [21] and 15.1% in Zaria [22], all within the north central and north west geopolitical zones of Nigeria. Likewise, it is lower than the documented mortality rates in Irrua [23] and Lagos [24], southern Nigeria, and the mortality rates documented in other African countries such as Liberia [25] and Kenya [26].

The differences in the mortality rates reported in different studies could be due to the different

methodology adopted by these studies. Some of which include differences in study population; some studies excluded neonates while others utilized both neonates and post neonatal children. The upper age limit of the paediatric study population utilized, also varied from 12-17 years. The mortality review was restricted to the first 24 hours of admission in some studies. Even though most studies were retrospective reviews, a few were prospective. The review period varied, the shortest, being six months, and longest over a ten-year period. Some studies were exclusively mortality studies, while others combined both morbidity and mortality. Of note, is the observation that the study in Port Harcourt [16] in which similar methodology as ours was utilized, reported a comparable mortality rate of 2.8%. A notable strength of this study was that the review was not limited to mortalities occurring in the EPU only, nor mortalities occurring within the first 24 hours of admissions, rather it included all post-neonatal mortalities in both EPU and PMW irrespective of time of death from point of admission.

The finding of a lower mortality rate in current study compared to the previous study done in our centre [10], may be a reflection of the gradual growth of the department in terms of staff strength, resulting in improved services and better patient outcomes in the department over the years. More so that, the total number of admissions within the study periods of the two studies were comparable, suggesting a fairly constant patient load.

Other likely reasons for the generally low mortality in our study could be that fewer critically ill children presented to our facility during the study period. This may have been due to poor referral practice of peripheral hospitals in the study area and suburbs. It is possible that the majority of the critically ill children were not timely referred to our facility, hence, they succumbed to the illness at the peripheral hospitals or somewhat before arrival in our facility. Another fraction of severely ill children may have died at home due to poor illness perception, and poor health seeking behaviour of the indigenous parents and families [27]. Some may have received inappropriate care from drug vendors or traditional healers, contributing to their deterioration, others may have died at home due to the inability to afford cost of hospital care as a result of poverty [28].

Our finding of higher mortalities in male children across all age group is consistent with other previous studies within [10,16-21,23-24] and outside Nigeria [29,30]. This may be because of the sex differences in biologic and genetic make-up, which makes the male child biologically weaker, and more susceptible to diseases and premature death [31]. It is an established fact that sex has a major impact on outcome from a range of infectious diseases starting from the beginning of life [31]. Overall, morbidity and mortality rates are higher in males than in females throughout life [32]. A few studies however have documented equal mortality pattern in both genders [17,22].

This study has shown a higher mortality in the under-five children, a finding consistent with previous studies, [10,16-24] and reflects the vulnerability of this age group to various illnesses. This may be explained by the fact that at this period of life the passively acquired maternal immunity is already waning and the child is still developing his/her own natural immunity [33]. As a result, the child is susceptible to various infections such as malaria, measles and diarrhoea disease. The under five child ends up dying from these diseases as a consequence of several factors which include lack of education of the parents and guardians, lack of health awareness and inability to recognise danger signs of common childhood diseases, thus causing delay in seeking medical care, harmful socio-cultural beliefs and practices, poor socio-economic status, non-proximity to health care facility and poor roads. All these factors contribute to delay in treatment, progression of the disease with development of complications and ultimately, death of the under-five children.

Peak mortality over the 2-year period was in the month of October, with spikes in July and April. October marks the tail end of the raining season in Sokoto, and heavy downpours are commonly experienced. July, marks the beginning of the raining, and thus, planting season. Sokoto, being a predominantly agrarian community, where majority of the population get their livelihood from peasant farming, there tend to be food scarcity around this time (July) because the food stores from previous harvest would have been exhausted. April is the period of intense heat and the tail end of the dry season. It is not surprising therefore, that the peak mortality in October was mostly due to severe malaria, and the spikes in July and April were due to SAM and Meningitis respectively. Reason being that breeding sites

for mosquitoes, food scarcity, dry and hot weather, which are identified risk factors for these disease conditions are typically commoner during these months.

The commonest cause of mortality amongst the under-fives in current study was SAM, similar to the finding in Ilorin by Adeboye et al [20], whilst it is the second leading cause of paediatric death in Azare [18]. This is not surprising, given the high poverty rate in the study area, [28] the socio-cultural practice of early female marriage, lack of female empowerment, polygamy and resultant large family size in the face of poverty [34], all of which impacts negatively on the nutrition, growth and development of the child [27]. The other likely reasons that may explain the higher mortality from SAM include high female illiteracy, poor knowledge of optimal nutrition, and poor health seeking behaviour of mothers as earlier elucidated [27,34]. These aforementioned reasons may have contributed to the high rate of complications, and late presentations observed in this study. Since current study did not set out to determine the social and behavioural factors leading to mortality in severe acute malnourished children, we are unable to conclude on the reasons for the higher mortality in SAM patients, hence, it would be worthwhile for future studies to investigate the socio-behavioural and clinical factors associated with mortality in children with SAM.

Whereas severe malaria, was the second leading cause of mortality in the under-fives in our study, it was reported as the commonest cause of mortality among under-five children in Azare [18], Gusau, [21] Irrua [23], Uyo [35], and Liberia [25], while HIV/AIDS was reported in Port Harcourt [16], Nigeria. It is not surprising that severe malaria was the commonest cause of death in Irrua [23] and Uyo [35]. These cities are located in the Southern part of Nigeria, typified by a longer raining season (7months) spanning march to July, and September to October [12].Rain typically falls throughout the year in Uyo [36], giving rise to more breeding sites for mosquitoes, higher burden of malaria infection, and severe malaria deaths.

It is documented in literature that under-five children, particularly, infants, constitute high risk groups for malaria infection and have a high risk of dying from severe malaria [14]. However we found severe malaria as the leading cause of death in children> 5years to 15 years, which may be due to high levels of parasite resistance to affordable drugs and late presentation to hospital.

Majority (79.3%) of the deaths occurred after 24 hours, similar to the reports of Garba et al [21] in Gusau. Our finding that mortalities occurring more than 24 hours of admission were predominantly due to SAM while those occurring < 24 hours were mostly due to severe malaria is not surprising, because severe malaria is an acute life-threatening disease which if not treated promptly, may progress rapidly to death. Inadequate facilities for resuscitation (such as oxygen, suction machines, and emergency drugs) or delay in treatment, due to financial constraints or lack of prescribed drugs in the department/hospital pharmacy, as often occurs, may have contributed to the deaths occurring less than 24 hours [22]. Mortalities due to SAM in our study were from acute complications such as severe dehydration from diarrhoeal disease, shock, electrolyte derangement, hypothermia, and infections.

More than half of the mortalities in current study were in children who had been sick for 14 days or more prior to hospitalization while the children who had been sick for 24 hours or less had the least mortality. This agrees favourably with the report by Adeboye et al. [20] in Ilorin, and emphasizes the role of early hospital presentation and prompt treatment of childhood diseases in the prevention of mortality.

5. CONCLUSIONS

In conclusion, the leading causes of paediatric mortality in our facility were SAM with (various complications) and severe malaria, both of which are preventable. Most of the deaths occurred in under-five children. Delayed presentation to the hospital and presence of one or more complications were contributory. There is need to scale up preventive and curative services targeted at curbing the menace of SAM and severe malaria in Sokoto. Intensified health education on preventive strategies such as exclusive breastfeeding, optimal nutrition/weaning practices, immunization, personal and environmental sanitation, prevention of malaria using insecticide-treated bed nets, knowledge of danger signs and early hospital presentation during illnesses, should be disseminated regularly by the media and by health care providers at every opportunity within the health facility, and in the community at large. Stakeholders in child health, should make the

provision of essential and emergency drugs, a priority, in our tertiary hospitals.

6. STUDY LIMITATIONS

The study limitations include missing case files and possibly inaccurate mortality record, which may have contributed to the low mortality rate reported. Some diagnoses were based on clinical judgement alone, particularly in those patients that died before supportive/confirmatory laboratory results were retrieved.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Approval for the study was obtained from the Research Ethics Committee of the Usmanu Danfodiyo University Teaching Hospital, Sokoto.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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