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What factors are associated with paediatric admissions and their outcomes in a rural hospital in northern Sierra Leone? Insights from a pilot observational study

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ABSTRACT

Introduction Data on the pattern of admissions and causes of child death are crucial in informing priorities for improving child survival. In many health facilities in sub-Saharan Africa, understanding the pattern of paediatric admissions and their outcomes is constrained by poor documentation of these important features.

Methods We developed and piloted a simple paper-based tool for documentation of basic, standardised patient-level information on causes of admissions, diagnoses, treatments and outcomes in children admitted to a rural hospital in Sierra Leone. The tool contained sections covering basic sociodemographic information about a patient, chief medical complaints, findings from clinical examinations and tests conducted at admission, results from subsequent clinical and laboratory investigations, working/definitive diagnoses, management and treatment outcomes.

Results From 1 August 2019 to 31 July 2021, we used this tool to document the admissions, treatments and clinical outcomes of 1663 children admitted to Kambia district hospital in northern Sierra Leone. The majority of the children (1015, 62%) were aged 12–59 months, were boys (942, 57%), were wasted (516, 31%), stunted (238, 14%) or underweight (537, 32%). Above a half of the children lived more than 1 km distance from the hospital (876/1410, 62%). The highest number of admissions occurred in November 2019 and the lowest in April 2020. Severe malaria was the leading cause of admission. More than 80% of the children were successfully treated and discharged home (1356/1663, 81.5%) while 122/1663 (7.3%) died. Children aged under 5 years who were underweight, and those who presented with danger signs (eg, signs of breathing difficulty, dehydration, head injury or severe infections) had a higher risk of death than children without these features (p<0.01; p=0.03; p=0.011 and p=0.009, respectively).

Conclusion Lack of systematic documentation of medical histories and poor record keeping of hospital admissions and outcomes can be overcome by using a simple tool. Continuous use of the tool with regular audits could improve delivery of paediatric care in resource-limited settings.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Data on the pattern of hospital admissions and causes of child death are crucial in informing priorities for improving child survival. In resource-constrained health facility settings in sub-Saharan Africa, challenges frequently exist to accurately document paediatric hospital admissions and treatment outcomes.

WHAT THIS STUDY ADDS

⇒ A simple customised tool for documentation of basic, standardised patient-level information on causes of hospital admissions, diagnoses, treatments and outcomes can overcome the challenges of poor documentation of paediatric hospital admissions and outcomes in health facilities operating in low-income countries.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Developing a simple tool for documentation of basic, standardised patient-level information and demonstrating its usefulness in a rural hospital in Sierra Leone could help other hospitals with limited resources in finding a way to collect more reliable data on paediatric hospital admissions and their outcomes.

INTRODUCTION

Sierra Leone has some of the world's poorest health indicators. In 2020, the infant mortality rate was 80 deaths per 1000 live births, and the overall under-5 mortality rate was 108 deaths per 1000 live births,[1] placing Sierra Leone the fourth lowest country in Africa in the ranking of these child health indicators.[2] In the same year, an estimated 27336 under-5 deaths occurred in the country, largely due to preventable causes.[3] Despite the progress recorded following the multifaceted approaches to rebuild the country's fragile health system which was weakened by 11 years of civil war and the 2014–2016 Ebola outbreak,[4] improving child survival remains a major public health challenge in the country.[5]

Data on the pattern of hospital admissions and causes of child death are crucial in informing priorities for improving child survival.[6] Accurate and complete documentation of admissions and treatment outcomes is essential in any health facility.[7] However, given the infrastructural challenges frequently encountered in health facilities in sub-Saharan Africa, assessing the pattern of paediatric hospital admissions and their outcomes is often constrained by poor documentation of these features.[8] Implementation of a multipronged intervention including improved documentation of admissions and outcomes in health facilities can support impact evaluation, exploration of links between health system inputs and outcomes and provide critical information on geographical variations in the outcomes of care.[9 10] In addition, accurate and reliable hospital data can provide valuable insights on the disease burden in a population. The data provided by these records can serve as an entry point to the investigation of system weaknesses and failures, assessment of the quality of health systems and can be used as a prism through which determinants of health system performance can be investigated.[11]

The scarcity of reliable data on births, deaths and causes of death in many low-income and middle-income countries has led to heavy reliance on extrapolating data obtained from a few populations that are under demographic surveillance and from verbal autopsies.[11] More effective use of high-quality hospital data has been advocated by global health organisations as a way to understand disease burden in a specific community, enabling prioritisation of resource allocations and facilitating achievement of universal health coverage.[9]

Towards addressing this need, we have developed and piloted a simple tool for documentation of basic, standardised, patient-level information on causes of admissions, diagnoses, treatments and outcomes in a paediatric ward of a district hospital in a rural community in Sierra Leone. In this paper, we describe the findings of the pilot implementation of the tool in providing valuable information on the pattern of admissions and clinical outcomes of the children admitted to the paediatric ward of the Kambia Government Hospital (KGH), Sierra Leone, using this tool continuously over a 2-year period. During this study, the COVID-19 outbreak spread across Sierra Leone and lockdowns and travel restrictions were imposed by the government as public health measures. Therefore, we also assessed the impact of the COVID-19 outbreak on paediatric admissions and outcomes in the hospital.

MATERIALS AND METHODS

Study population

Kambia is located in the north-west region of Sierra Leone, about 200 km from Freetown, the capital city. Kambia is one of the communities that was heavily affected by the country's civil war (1991–2002) and the West African Ebola outbreak in 2014–2016.[12] Kambia district has one of the highest childhood morbidities and mortalities among the 14 administrative districts of Sierra Leone.[13] Top among the causes of death and illness in children in this area are malaria, pneumonia and diarrheal diseases. Government primary healthcare services consist of peripheral health units, which are run by nurses and community health officers. Remote and rural settlements are served informally by unregulated mobile drug vendors and traditional practitioners.[14]

Study setting and context

KGH is the only public health centre providing primary and secondary healthcare for a population of more than 60000 under-5 children.[15] The hospital has four wards (adult male, adult female, paediatric and maternity), one surgical theatre and two outpatient clinic rooms. The paediatric ward is run primarily by nurses and community health officers. The hospital also has a laboratory where basic diagnostic services of common childhood diseases are provided. A histidine-rich protein-2 antigen-based rapid diagnostic test (RDT) was usually the first-line diagnostic test for malaria. This was complemented by malaria microscopy when the RDT gave inconclusive results. Packed cell volume or haemoglobin concentration was determined by using haematocrit centrifuge method. HIV testing was conducted by using Determine HIV-1/2 test kit. In the event of a positive result with Determine kit in a child aged below 18 months, the blood sample would be sent for a confirmatory test at a reference laboratory in Freetown.

In KGH and other government hospitals in Sierra Leone, under-5 children receive free treatment, while parents/caregivers of children aged 5 years and above, pay for treatments received by their children. Also, some medications are not covered by the free treatment policy for under-5 children, therefore, parents/caregivers of children placed on these medications had to buy them. Similarly, some essential drugs, such as artesunate injections for the treatment of severe malaria, are usually in short supply and during stock-out, parents/caregivers of children who need these drugs are requested to buy them.

When a sick child has been assessed by the managing team at the paediatric ward and the child needs to be referred for specialist care at the only paediatric tertiary hospital in Freetown, about 200 km from KGH, an ambulance is provided as part of the national ambulance services to facilitate the referral of the child to the tertiary hospital.

At the time of this study, a paediatrician and a paediatric nurse were employed to provide specialist care for the paediatric ward by the EBOVAC-Salone project which was evaluating a prophylactic Ebola vaccine regimen (ClinicalTrials.gov NCT02509494) in Kambia district.[16 17] As part of the preparation for the implementation of the vaccine trial, the EBOVAC-Salone project supported the paediatric ward with life-saving equipment such as oxygen concentrators and HaemoCues. The EBOVAC-Salone project also trained the paediatric ward nurses on the Emergency Triage, Assessment and Treatment plus (ETAT+) protocol—a WHO recommended training package developed to support the poorest and most vulnerable children in rural and periurban areas.[18] In addition, the paediatric ward nurses received parallel training and mentorship on ETAT+guidelines and processes from the Sierra Leone Ministry of Health and Sanitation (MoHS) national ETAT+programme during a 6-month period from 2017 to 2019.[19] Using the ETAT guidelines, the nurses made primary diagnosis for a sick child and commenced appropriate treatment. The EBOVAC paediatrician and paediatric nurse supported the nurses by reviewing the patients and made multiple diagnoses, when required.

Prior to the deployment of the tool described in this paper, few records were kept for patients accessing care at the hospital. Clinical histories and care plans were usually documented in ad hoc notebooks procured by parents/caregivers on arrival at the hospital ward with their sick child. Consequently, paediatric admissions and outcomes were often incompletely documented in the hospital register.

Development and pilot implementation of study tool

To improve collection of individual patient-level data on hospital admissions, we developed a simplified, user-friendly, paper-based tool. The audit tool was developed through an iterative process. The first step involved identification and setting up a team of clinicians who prepared and scrutinised the audit tool for accuracy and relevance to a resource-constrained hospital setting like Kambia. At the inaugural meeting of the audit team, the first author (MOA) was assigned the role of working with the project paediatrician (HHA) and the paediatric nurse (BK) to develop and pilot the audit tool. The team considered similar tools used in hospital settings across West Africa for documenting patient-level information about the care of a sick child. These tools essentially contained the following items: chief medical complaints, findings from clinical examinations, tests conducted at admission, results from subsequent clinical and laboratory investigations, working/definitive diagnoses, management and treatment outcomes.[20] We scrutinised the existing tools to shape and develop the first draft of the audit tool, which was subsequently modified and adapted to the Kambia hospital context. The modification focused on making it easy for the paediatric ward staff to use the tool to document clinical history, results of the investigations carried out during the in-patient management of sick children, the treatments instituted and the clinical outcomes. The team subsequently shared the draft tool with experts in tropical paediatrics and development of clinical questionnaires.

The feedback obtained from the experts included improving the structure of the tool to ensure the systematic flow of information and adding missing information that was important in the clinical management of paediatric patients in a rural hospital setting where resources for life-saving equipment were limited. We incorporated this feedback in the tool and pretested it for content validity among health workers who were not involved in the paediatric care at the hospital. The audit team discussed the feedback obtained from the pretest and revised the wording of some ambiguous items to make them clearer and easier to use by the paediatric ward staff. After the revision, we retested the tool among a randomly selected subset of the health workers involved in the pretest. Next, we trained all paediatric ward staff, including nurses and community health workers, on how to use the tool to document patient-level information. We used role-plays to demonstrate different scenarios that commonly occurred in the emergency unit of the paediatric ward and in daily clinical management of sick children in the ward. A feedback mechanism was put in place to address the concerns and observations of the ward staff when piloting the tool. The feedback that warranted urgent resolution was discussed during the regular meetings of the audit team and pragmatic solutions were proffered to address these concerns. Following this, the ward staff provided positive feedback about the ease of use of the tool.

Furthermore, to address the challenges involved in moving from patient-held records (notebooks) to hospital-held records (the audit tool), we trained the hospital staff on basic medical record keeping. To support longitudinal patient care involved in using the tool, we also set up an analogue medical record unit in the paediatric ward that allowed safe-keeping and easy retrieval of the medical records for subsequent readmission and care of children. Oversight support was provided by the attending physicians (MOA and HHA) to ensure that the tool was used to collect complete and legible data in a timely fashion.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

Statistical analysis

Hospital data collected during the implementation period were double entered in an OpenClinica database at the Kambia COMAHS/LSHTM research centre, cleaned and then analysed using descriptive and inferential statistics. All statistical analyses were conducted using Stata V.16 Statistical Software (StataCorp). Information on the clinical indices (presentations, investigations, interventions, complications and outcomes) and service indices (such as the duration of admission) were represented through graphical charts. We used χ^2 tests to evaluate the associations between individual characteristics of the hospitalised children during the study and categorised the clinical outcomes into five levels—discharged alive, referred, absconded, discharged against medical advice by parents and death during hospitalisation. Unadjusted logistic regression was performed to examine risk factors for death among paediatric admissions by assessing the association between death and each risk factor in turn. Using WHO classification, we defined underweight as a weight-for-age z (WAZ) score of <− 2SD, wasting as a weight-for-height z (WHZ) score of <− 2SD and stunting as height-for-age z score of <− 2SD.[21] Missing data were uncommon except for three variables—weight for height, height for age and the distance between home and hospital—which were complete for 83%, 63% and 85% of participants, respectively. At least 93% of observations were complete for each of the remaining variables in the analysis. We did not attempt to impute missing data for the anthropometric measurements because most of the missing values for these anthropometric indices resulted from height measurements that were outside the range of the WHO 2007 reference growth charts,[22] which were used to calculate the indices. Statistical analysis was based on complete cases.

We conducted multivariable regression analysis for death adjusted for time of the day during which admission occurred, presence of danger signs (such as signs of breathing difficulty, dehydration, head injury and severe infections) during admission and WAZ and WHZ scores which had shown significant associations with mortality in the unadjusted logistic regression, based on two-tailed p value cut-off <0.05.

RESULTS

We administered the tool from 1 August 2019 to 31 July 2021 to a total of 1663 children out of 2068 children admitted into the ward during the same period, representing an 80% response rate. The main reason for failure to administer the tool to all admitted children during this period was an early discharge from the hospital before consent could be obtained from the parents/caregivers.

Characteristics of hospitalised children

Table 1 summarises the sociodemographic characteristics of the 1663 children enrolled into the study. Overall, 1015 (62%) were aged 12–59 months and 942 (57%) were boys. One hundred and twelve children (9%) were severely malnourished based on the mid-upper arm circumference measurements of <11.5 cm, while 516 (31%) were wasted, 238 (14%) were stunted and 537 (32%) were underweight. Over half of the children lived more than 1 km from the hospital (876/1410, 62%), and most were admitted before 16:00 hours (1171/1626; 72%) and during weekdays (1231/1662; 74%).

Table 1 Sociodemographic characteristics of study participants, KGH, 2019–2021

	N=1663
	n (%)
Age groups	
0 to 27 days (neonates)	141 (9)
1 to <12 months (infants)	312 (19)
12 to 59 months	1015 (62)
5 to 14 years	181 (11)
Sex	
Male	942 (57)
Female	720 (43)
MUAC	
Below 11.5 cm	112 (9)
Above 11.5 cm	1148 (91)
WFA	
<−2 SD	516 (31)
>−2 SD	1006 (60)
Missing	141 (8)
HFA	
<−2 SD	238 (14)
>−2 SD	1144 (69)
Missing	281 (17)
WFH	
<−2 SD	537 (32)
>−2 SD	510 (31)
Missing	616 (37)
Proximity of residence to KGH*	
Within 1 km	534 (38)
More than 1 km	876 (62)
Time of admission†	
Before 16:00 hours	1171 (72)
After 16:00 hours	455 (28)
Admission day	
During weekdays	1231 (74)
During weekends	431 (26)
Sources of referral	
Within KGH	114 (7)
Self/parent referred	1069 (64)
Other facility	478 (29)

*Number of children whose home addresses were correctly provided by parents/caregivers=1410.
†Number of children whose times of admission were documented=1626.
HFA, height-for-age; KGH, Kambia Government Hospital; MUAC, mid-upper arm circumference; WFA, weight-for-age; WFH, weight-for-height.

Seasonality of admission

Over the study period, the highest number of admissions was recorded in November 2019 and the lowest number

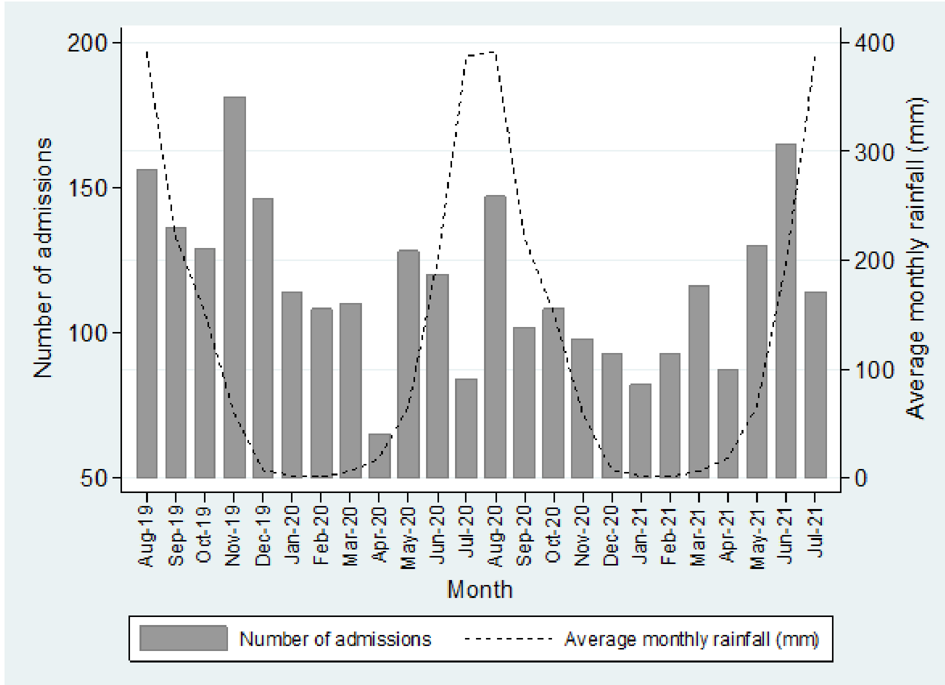

Figure 1 Seasonal pattern of admissions to the KGH paediatric ward, August 2019–July 2021. This figure shows that paediatric admissions were highest in November 2019 and lowest in April 2020, and these did not reflect the fluctuations in the rainfall pattern. KGH, Kambia Government Hospital.

occurred in April 2020 (figure 1). This pattern of admissions did not mirror the changes in the weather conditions in the study area where the dry season typically runs from November to March and the rainy season from April to October with a peak of rainfall in August. However, the seasonal pattern of admissions may have been modified during the audit in 2020 by the COVID-19 pandemic, with the first imported case of COVID-19 reported on 30 March 2020.

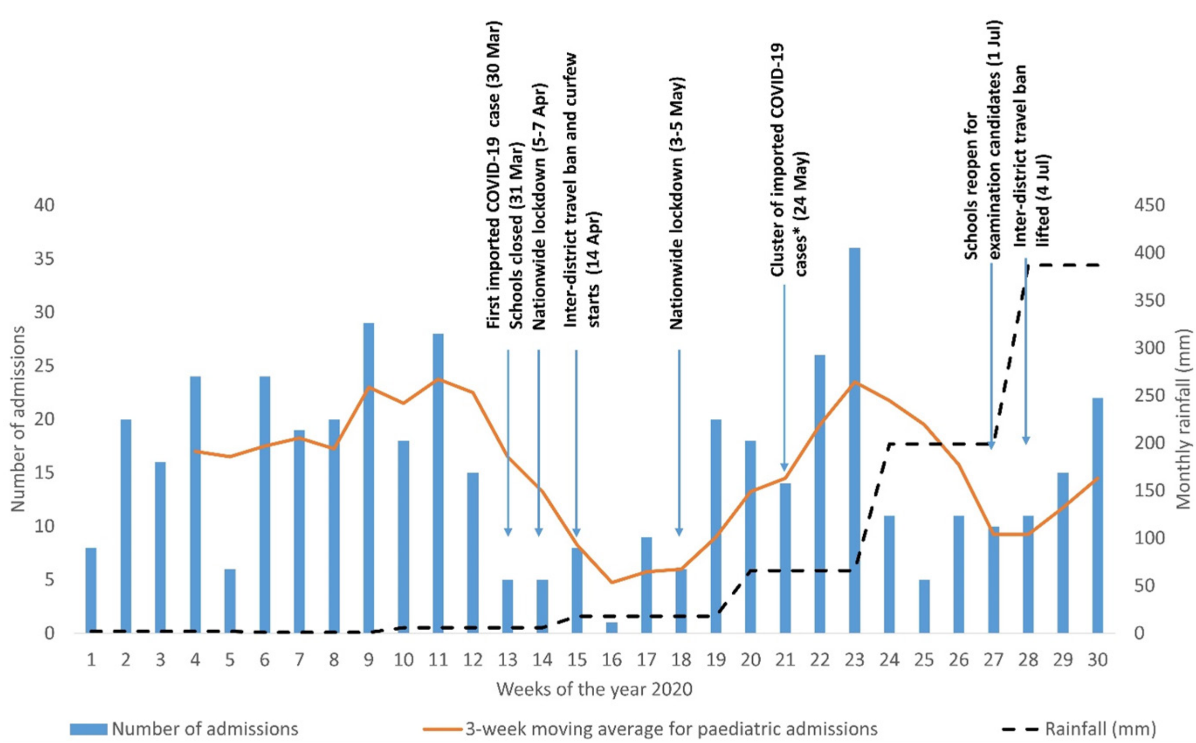

Figure 2 Effect of COVID-19 pandemic on admissions among study participants, KGH, 2019–2021. This figure shows that lowest paediatric admissions were recorded in weeks 13, 14 and 16 of year 2020, which fell around the period when lockdown and travel restrictions were imposed as preventive measures for COVID-19 pandemic. KGH, Kambia Government Hospital.

Table 2 Primary diagnoses among children admitted to KGH, 2019–2021

	Age in years				
	<1 year	1–4 years	5–14 years	No age documented	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
Primary admission diagnosis (N=1663)					
Severe malarial anaemia	71 (16)	373 (37)	52 (29)	2 (14)	498 (30)
Severe malaria	58 (13)	267 (26)	54 (30)	4 (29)	383 (23)
Cerebral malaria	12 (3)	73 (7)	21 (12)	–	106 (6)
Severe malaria with respiratory distress	–	9 (1)	1 (1)	–	10 (1)
Non-severe malaria	20 (4)	63 (6)	8 (4)	1 (7)	92 (6)
Asphyxia	83 (18)	1 (0)	–	2 (14)	86 (5)
Malnutrition	15 (3)	40 (4)	–	–	55 (3)
Sepsis	33 (7)	14 (1)	3 (2)	1 (7)	51 (3)
Surgical conditions/ burns/ trauma/accidents	6 (1)	25 (2)	19 (10)	1 (7)	51 (3)
Severe pneumonia	29 (6)	12 (1)	–	1 (7)	42 (3)
Anaemia	11 (2)	27 (3)	3 (2)	–	41 (2)
Acute gastroenteritis	16 (4)	22 (2)	1 (1)	–	39 (2)
Febrile convulsion	4 (1)	18 (2)	2 (1)	–	24 (1)
Neonatal sepsis	19 (4)	–	–	1 (7)	20 (1)
Prematurity	12 (3)	–	–	–	12 (1)
Non-severe pneumonia	9 (2)	2 (0)	–	–	11 (1)
HIV	1 (0)	6 (1)	–	–	7 (0)
Other infectious diagnoses	18 (4)	11 (1)	8 (4)	–	37 (2)
Other non-infectious diagnoses	13 (3)	18 (2)	4 (2)	–	35 (2)
>1 diagnosis but primary diagnosis not determined	14 (3)	11 (1)	3 (2)	1 (7)	29 (2)
Diagnosis not documented	9 (2)	23 (2)	2 (1)	–	34 (2)
Total	453 (100)	1015 (100)	181 (100)	14 (100)	1663 (100)

KGH, Kambia Government Hospital.

Changes in admission pattern during COVID-19 lockdown

The national lockdowns and restrictions of movements imposed in Sierra Leone in the wake of COVID-19 outbreak affected paediatric admissions. There were two 3-day national lockdowns between 5 April 2020–7 April 2020 and 3 May 2020–5 May 2020. From 14 April to 4 July, there were movement restrictions within districts across the country. From 22 March 2020 to 22 July 2020, international commercial air travel was suspended.[23] During these periods, schools were closed and considerable reductions in paediatric admissions were observed during and around these periods, with the nadir recorded 2 weeks after the first national lockdown (figure 2).

Admission diagnosis

One thousand and fifty-three of the 1663 paediatric admissions (63.3%) had a single admission diagnosis; 474 (28.5%) had two diagnoses and 102 (6.1%) had three or more diagnoses. There was no documentation of a diagnosis in the admission records of 34 (2%) participants. After assigning a primary diagnosis for each of the 576 participants with comorbid illnesses, the most common diagnoses among all participants were malaria 1089 (65%), asphyxia 86 (5%), malnutrition 55 (3%), sepsis 51 (3%) and surgical conditions 51 (3%). The leading clinical phenotypes for malaria were severe malarial anaemia 498 (30% of all admission), severe malaria not meeting other criteria 383 (23%) and cerebral malaria 106 (6%) (table 2).

Malaria diagnosis relied on an RDT; microscopy was performed in 72.3% (1193/1649) of children admitted to the ward in whom a positive test was obtained. When disaggregated by age group, children aged 1–4 years had the highest malaria positivity by using a combination of RDT and microscopy (853/1015, 84%). This was followed by children aged 5–14 years who had a malaria positivity of 81.2% (147/181). Nine hundred and fifty-two (79.8%) of the 1193 children diagnosed with malaria by RDT and microscopy had severe malaria. Five hundred and fifty-three of the 952 children with severe malaria (58.1%) had severe anaemia; prostration was observed in

Table 3 Malaria diagnosis and severe malaria clinical syndromes according to the age of paediatric admissions at KGH, 2019–2021

	Age			
	<1 year	1–4 years	5–14 years	Total
	n (%)	n (%)	n (%)	n (%)
No of hospital admissions	**N=453**	**N=1015**	**N=181**	**N=1649***
RDT/microscopy confirmed malaria				
Positive	193 (42.6)	853 (84)	147 (81.2)	1193 (72.3)
Negative	87 (19.2)	109 (10.7)	13 (7.2)	209 (12.7)
Malaria test not done	173 (38.2)	53 (5.2)	21 (11.6)	247 (15.0)
Malaria severity	**N=193**	**N=853**	**N=147**	**N=1193***
Uncomplicated malaria	55 (28.5)	162 (19.0)	24 (16.3)	241 (20.0)
Severe malaria†	138 (71.5)	691 (81.0)	123 (83.7)	952 (79.8)
Clinical features of severe malaria	**N=138**	**N=691**	**N=123**	**N=952***
Severe anaemia‡	77 (55.8)	415 (60.0)	61 (49.6)	553 (58.1)
Prostration	76 (55.1)	390 (56.4)	73 (59.3)	539 (56.6)
Impaired consciousness	45 (32.6)	302 (43.7)	55 (44.7)	402 (42.2)
Multiple convulsions	16 (11.6)	69 (10.0)	15 (12.2)	100 (10.5)
Cerebral malaria	16 (11.6)	104 (15.0)	27 (22.0)	147 (15.4)
Respiratory distress	1 (0.7)	12 (1.72)	2 (1.7)	15 (1.6)

*Fourteen children who did not have documentation of age were not included in analysis for age distribution of malaria diagnosis and for clinical features by age.
†Severe malaria defined as acute malaria with signs of organ dysfunction and/or high level of parasitaemia characterised by impaired consciousness, hypoglycaemia, shock, pulmonary oedema, etc.
‡Severe anaemia is defined by a haemoglobin concentration of <50 g/L or a haematocrit of <15%.
KGH, Kambia Government Hospital; RDT, rapid diagnostic test.

539/952 (56.6%), cerebral malaria in 147/952 (15.4%) and respiratory distress in 1.6% (15/952) (table 3). When disaggregated by age group, prostration, impaired consciousness, multiple convulsions and cerebral malaria were observed more frequently among 1–4 years old children than among other age groups (p<0.001). Although the incidence of respiratory distress was disproportionately higher among 1–4 years old children than among other age groups, this did not reach statistical significance (p=0.192) (table 4).

Clinical outcomes

One thousand, three hundred and fifty-six of the 1663 study children were treated successfully and discharged home (1356/1663, 81.5%) while 122 (7.3%) died, 93 (5.6%) absconded and 68 (4.1%) were discharged against medical advice. Reasons for discharge against medical advice included an inability to pay the hospital bills; some children were discharged against medical advice when their parents or guardians perceived that their child was not making satisfactory clinical improvement despite the medical management instituted. Twenty children (1.2%) were referred for further management at the paediatric specialist hospital in Freetown. Referral to the specialist hospital was mainly for the management of surgical conditions such as hernia, severe burns and head injuries following a road traffic accident. Factors associated with the clinical outcomes among the children admitted to the Kambia hospital included age group (p=0.021), WAZ (p=0.034), proximity of residence to the hospital (p=0.052), time of presentation or admission to the hospital (p=0.002) and the duration of hospital stay (p=0.017) (table 4).

Risk of death

Children aged under-5 years (p<0.01), those underweight (p=0.03) or who presented with danger signs (p=0.009) had a higher risk of death than children without these features (table 5). The risk of death was greatest within 48 hours of admission and gradually tapered off after this time point (figure 3).

DISCUSSION

We developed and implemented a simple tool to improve the documentation of paediatric admissions and clinical outcomes in a resource-constrained, rural hospital in northern Sierra Leone. Under-5 male children constituted the majority of children admitted to the hospital during the period in which the toll was implemented. These demographic features are consistent with findings obtained from studies conducted in similar settings.[24 25] Higher admission rates of boys to the hospitals in these studies were attributed to an increased vulnerability of

Table 4 Clinical outcomes of children admitted to the paediatric ward, KGH, 2019–2021

Clinical outcomes (n/N—%)	Death	Discharged alive	Referred	Discharged against medical advice+absconded	χ^2	P value
Age groups						
0 to 27 days (neonates)	16 (11.3)	108 (76.6)	2 (1.4)	15 (10.6)	19.5	**0.021**
1 to <12 months (infants)	14 (4.5)	266 (85.3)	5 (1.6)	27 (8.7)		
12 to 59 months	82 (8.1)	823 (81.1)	7 (0.7)	99 (9.8)		
5 to 14 years	9 (5.0)	147 (81.2)	6 (3.3)	19 (10.5)		
Sex						
Male	65 (6.9)	760 (80.7)	15 (1.6)	99 (10.5)	5	0.171
Female	57 (7.9)	595 (82.6)	5 (0.7)	62 (8.6)		
MUAC						
Below 11.5 cm	12 (10.7)	87 (77.7)	0 (0.0)	12 (10.7)	3.7	0.294
Above 11.5 cm	78 (6.8)	950 (82.8)	10 (0.9)	107 (9.3)		
WFA						
<–2 SD	48 (9.3)	405 (78.5)	7 (1.4)	54 (10.5)	8.7	**0.034**
>–2 SD	58 (5.8)	845 (84.0)	9 (0.9)	92 (9.1)		
HFA						
<–2 SD	17 (7.1)	191 (80.3)	2 (0.8)	27 (11.3)	0.9	0.828
>–2 SD	77 (6.7)	937 (81.9)	15 (1.3)	113 (9.9)		
WFH						
<–2 SD	43 (8.0)	437 (81.4)	3 (0.6)	54 (10.1)	7.3	0.064
>–2 SD	23 (4.5)	438 (85.9)	5 (1.0)	42 (8.2)		
Proximity of residence to KGH						
Within 1 km	32 (6.0)	460 (86.1)	3 (0.6)	39 (7.3)	7.7	**0.052**
More than 1 km	69 (7.9)	702 (80.1)	10 (1.1)	91 (10.4)		
Time of presentation/admission						
Before 16:00 hours	94 (8.0)	963 (82.2)	8 (0.7)	105 (9.0)	15.1	**0.002**
After 16:00 hours	21 (4.6)	367 (80.7)	10 (2.2)	54 (11.9)		
Day of admission						
Within weekdays	90 (7.3)	1003 (81.5)	17 (1.4)	119 (9.7)	1.3	0.74
Outside weekdays	32 (7.4)	352 (81.7)	3 (0.7)	42 (9.7)		
Hospital stay						
Within 7 days	107 (7.5)	1169 (82.4)	18 (1.3)	124 (8.7)	10.3	**0.017**
More than 7 days	14 (5.9)	185 (78.1)	2 (0.8)	36 (15.2)		

P-value of 0.05 or lower is considered statistically significant (shown in bold).
HFA, height-for-age; KGH, Kambia Government Hospital; MUAC, mid-upper arm circumference; WFA, weight-for-age; WFH, weight-for-height; χ^2, Chi squared.

male children to some illnesses and the prevalent African custom of placing a higher premium on care of a male child compared with a female child, because of the relatively higher social importance attached to a male child.[26] Nevertheless, the gender disparity in the admission rate was not identified as a risk factor for death in our study population. This finding differs from previous studies conducted in similar settings where mortality in some studies was higher in females[24 27 28] and higher in males in other studies.[25 29]

Although, severe acute malnutrition (SAM) was not a major primary cause of admission among the hospitalised children in our study, about one-third of the children were wasting and were underweight. This nutritional status is typical of the features commonly seen in similar African settings where low rates of exclusive breastfeeding and incorrect complementary feeding practices are prevalent.[30 31] SAM might also be due to individual or combined effects of malaria and intestinal parasitic infections which were prevalent in the study areas.[32]

Table 5 Risk factors for deaths among paediatric inpatients in KGH, 2019–2021

	n/N (%) Deaths	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Age groups					
0 to 27 days (neonates)	16/141 (11.3%)	1.00 (ref)	0.025	1.00 (ref)	**<0.001**
1 to <12 months (infants)	14/312 (4.5%)	0.37 (0.17 to 0.77)		0.22 (0.09 to 0.52)	
12 to 59 months	82/1015 (8.1%)	0.69 (0.39 to 1.21)		0.62 (0.31 to 1.23)	
5 to 14 years	9/181 (5.0%)	0.41 (0.17 to 0.96)		0.35 (0.14 to 0.86)	
Sex					
Male	65/942 (6.9%)	1.00 (ref)			
Female	57/720 (7.9%)	1.16 (0.80 to 1.68)	0.431	–	–
Nutritional status					
MUAC					
Below 11.5 cm	12/112 (10.7%)	1.00 (ref)			
Above 11.5 cm	78/1148 (6.8%)	0.61 (0.32 to 1.15)	0.128	–	–
WFA					
<–2 SD	48/516 (9.3%)	1.00 (ref)	0.007	1.00 (ref)	0.249
>–2 SD	58/1006 (5.8%)	0.60 (0.40 to 0.89)		0.74 (0.48 to 1.15)	
Missing	16/141 (11.3%)	1.25 (0.69 to 2.27)		1.24 (0.60 to 2.56)	
HFA					
<–2 SD	17/238 (7.1%)	1.00 (ref)	0.175		
>–2 SD	77/1144 (6.7%)	0.94 (0.54 to 1.62)		–	–
Missing	28/281 (10.0%)	1.44 (0.77 to 2.70)			
WFH					
<–2 SD	43/537 (8.0%)	1.00 (ref)	0.01	1.00 (ref)	**0.029**
>–2 SD	23/510 (4.5%)	0.54 (0.32 to 0.91)		0.54 (0.31 to 0.95)	
Missing	56/616 (9.1%)	1.15 (0.76 to 1.74)		1.18 (0.71 to 1.97)	
Proximity of residence to KGH					
Within 1 km	32/534 (6.0%)	1.00 (ref)			
More than 1 km	69/876 (7.9%)	1.34 (0.87 to 2.07)	0.185	–	–
Time of presentation/admission					
Before 16:00 hours	94/1171 (8.0%)	1.00 (ref)		1.00 (ref)	
After 16:00 hours	21/455 (4.6%)	0.55 (0.34 to 0.90)	0.017	0.52 (0.32 to 0.86)	**0.011**
Day of admission					
Within weekdays	90/1231 (7.3%)	1.00 (ref)			
Outside weekdays	32/431 (7.4%)	1.02 (0.67 to 1.55)	0.938	–	–
Hospital stay					
Within 7 days	107/1419 (7.5%)	1.00 (ref)			
More than 7 days	14/237 (5.9%)	0.77 (0.43 to 1.37)	0.372	–	–
Presence of at least one danger sign*					
No danger sign	14/449 (3.1%)	1.00 (ref)		1.00 (ref)	
At least one danger sign	108/1214 (8.9%)	3.03 (1.72 to 5.35)	<0.001	3.10 (1.70 to 5.63)	**0.009**

P-value of 0.05 or lower is considered statistically significant (shown in bold).
*Examples of danger signs include signs of breathing difficulty, dehydration, head injury or severe infections.
HFA, height-for-age; KGH, Kambia Government Hospital; MUAC, mid-upper arm circumference; n/N, proportion of death; WFA, weight-for-age; WFH, weight-for-height.

A majority of the children in our study lived more than 1 km from the hospital, although this did not translate to late presentation to the hospital. This might be because commercial motorcycles taxis, the most common means of transport in the study community, were readily available across the community and could be used to take a sick child to the hospital. More than 70% of the children presented at the hospital before 16:00 hours and during

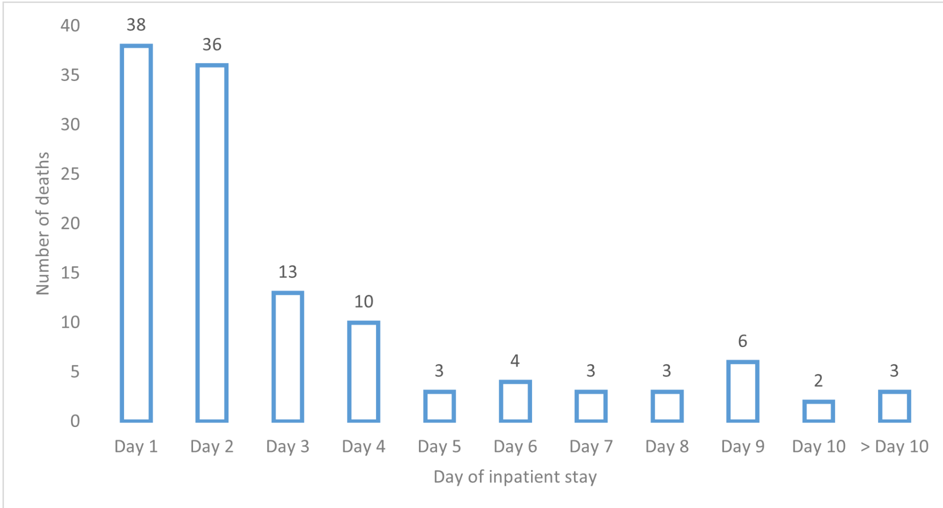

Figure 3 Time-to-death for admissions during the first 10 days of inpatient stay, KGH, 2019–2021. This figure shows that the children had a higher risk of death in the first 48 hours of admission than in subsequent days of hospitalisation. KGH, Kambia Government Hospital.

weekdays, nevertheless, improved clinical outcomes were significantly associated with patient admission after 16:00 hours. This finding is contrary to the findings of similar studies[8 33 34] where poor quality care was associated with patient admission outside daytime work hour. Our study findings might be explained by the care provided by the hospital staff following their training on the ETAT guidelines, hands-on support and post-training mentorship provided by the Sierra Leone MoHS national ETAT+programme staff and the EBOVAC paediatric staff during and outside the work hours.

Outside COVID-19 pandemic, admissions into the paediatric ward followed the seasonal pattern that has been widely reported in many African settings.[35–40] This is mainly because malaria still remains the leading cause of hospitalisations in these endemic countries, and given that malaria transmission is driven by environment factors such as rainfall, it is not surprising that a rise in admissions was observed during the rainy seasons.[41]

Owing to the rural location of the study hospital, which is not connected to the national electricity grid and depends largely on electricity supply from generators to power essential life-saving equipment, a point-of-care test was the major laboratory investigation deployed to confirm clinical suspicions of malaria. Similarly, because of the limited diagnostic facilities, the diagnosis of common childhood diseases such as pneumonia and meningitis depended on clinical symptoms and signs. This practice is consistent with the WHO guidelines recommendations in the integrated management of childhood illnesses that do not focus on a single diagnosis, but on selected signs and symptoms to guide rational treatment.[42] These guidelines might have improved the case-management skills of health workers in settings such as Kambia.[43]

As expected, malaria was the leading cause of paediatric admissions during the course of the tool implementation. Manifestations of severe malaria and its complications which included cerebral malaria, prostration, severe malaria anaemia and complex febrile convulsions were consistent with findings of similar studies conducted in malaria endemic countries in sub-Saharan Africa,[24 29 36–38] and lend credence to a WHO report that many African countries still carry a high burden of malaria, despite the considerable achievements recorded in the last two decades.[44]

We found an overall mortality of 7% among the children enrolled in this study. This finding is similar to that reported in a study which implemented ETAT+guidelines to strengthen paediatric care in similar settings.[19] The ETAT+training programme offered by the staff of the Sierra Leone MoHS was complemented by the paediatric personnel employed to work in the hospital by the EBOVAC-Salone project to ensure appropriate clinical care for children enrolled in the Ebola vaccine trial and other sick children admitted to the ward. The high prevalence of anaemia recorded in the study was managed by an efficient blood transfusion service, which was supported by regular blood donation campaigns organised by community volunteers and a solar-powered fridge for optimal storage of the donated blood. Improved clinical care has been a major benefit of hosting clinical trials in African communities but sustainability of the quality of care beyond the lifespan of the projects is usually a challenge.[45 46]

The leading cause of death in our study was severe malaria. Being an under-5 child, wasted (ie, WFH <–2SD), and having at least one danger sign were risk factors for death in hospital. These factors resonate with findings of similar studies conducted in Africa[24 28 29] and underscore the need for improved hospital care, improved nutritional support for children and better health-seeking behaviours of parents and caregivers of under-5 children.

Contrary to the findings of a nationwide survey on the impact of COVID-19 pandemic, which reported a slight reduction in the hospital utilisations but no significant changes in paediatric admissions across Sierra Leone,[23] we observed a substantial reduction in paediatric admissions during the COVID-19 pandemic, especially during the period shortly after the first national lockdown in Sierra Leone. The reason for this disparity is not known, but it might be connected with the design of the national survey which focused on a specific time point during the early phase of the pandemic. Although, children have been reported to carry a low risk of morbidity and mortality from COVID-19, reduction in the hospital admissions during COVID-19 pandemic led to planned health service reconfigurations, with prioritisation of COVID-19 infection, and reduction of non-essential services, unplanned service disruption and changes in health-seeking behaviour.[23]

Our study had a few limitations. First, the clinical diagnoses were based almost entirely on clinical judgement with very limited laboratory support. Second, although it was documented that malaria was by far the most important cause of admission to the paediatric ward of Kambia hospital, clinical staff had not had enough experience, or had sufficient laboratory support, to allocate all hospital admissions with severe malaria to one of WHO recommended subgroups of this condition. Third, there were some missing data for anthropometric indices of the children. It is possible that these anthropometric measurements were taken by the ward staff, but were not recorded. Also, the proximity of the hospital to the homes of some children could not be estimated because their parents/caregivers did not provide a specific home address, making it difficult to estimate the distance between their homes and the hospital. Although the study was not designed to measure the impact of deployment of the tool on outcomes, it is possible that some of these factors, such as duration of hospital stay and mortality in hospital, were affected by the activities undertaken to introduce the tool into routine care.

Nevertheless, the overall response rate of about 80% of children admitted to the ward during this study enabled us to demonstrate that the challenges of lack of systematic documentation of medical histories and poor record keeping of hospital admissions and outcomes can be overcome with a simple tool. Following successful implementation, the tool was adopted by the management of the hospital as the standard method of record keeping for the paediatric ward and has been adapted for other wards in the hospital. Overall, despite the usefulness of hospital data in providing a rich source of information that can be used to inform quality health systems, its limitations should not be overlooked. Chronic conditions that rarely present in hospital are usually not captured in hospital data, thereby limiting the usefulness of hospital data as an indicator of disease burden in a community. More importantly, accuracy of hospital data is shaped by data quality checks, which depends on the primary purpose of the data.[11]

CONCLUSION

We developed and implemented a simple tool for documentation of paediatric admissions and outcomes at a rural hospital in a resource-limited setting. We found that severe malaria remains the leading cause of admission and mortality among the hospitalised children and advised the hospital management on the continuous use of the tool to improve paediatric care services delivery.

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Contributors MOA conceptualised the study and developed the tool. MOA, HHA and BK coordinated the data collection. YN, DK, ABJ, ES and LO handled the data management. PA performed the statistical analysis. MOA wrote the first draft of the manuscript. BG supervised the study implementation, revised the tool and reviewed the early drafts of the manuscript. All authors reviewed the manuscript for substantial intellectual input and approved the final version of the manuscript for submission. MOA is responsible for the overall content as the guarantor of this paper. The guarantor accepts full responsibility for the work and the conduct of the study, had access to the data, and controlled the decision to publish.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Ethical approvals for the study were obtained from the Research Ethics Committee of the London School of Hygiene and Tropical Medicine (reference number 16175) and from the Sierra Leone Ethics and Scientific Review Committee. Written permission for the study was obtained from the Management of the Kambia Government Hospital, an arm of the Sierra Leone Ministry of Health and Sanitation. Written informed consent was obtained from the parents/caregivers before the tool was used to collect their child's health information. In addition, assent was obtained from children aged 7 years and above. Personal data collected about the hospitalised children were anonymised, kept confidential and held in compliance with international data privacy protection laws and regulations.

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