Texila International Journal of Public Health
ISSN: 2520-3134
DOI: 10.21522/TIJPH.2013.10.01.Art022

Assessing Health Workers' Adherence to the National Guidelines for Diagnosis and Treatment of Severe Malaria in Children (0-5 Years) - A Cross-Sectional Study of Hospitals in Kebbi State, Nigeria

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Abstract

Adherence to treatment guidelines for severe malaria (SM) is a vital component of malaria control strategies. Non-compliance with treatment guidelines has implications on effective SM case management, particularly in children. The study aimed to assess Health workers' adherence to the National Treatment Guideline for Diagnosis and Treatment of SM in children. A retrospective audit of patients' records treated for SM from 1st January 2018 to 30th December 2019 was carried out through data abstraction in 5 General hospitals in Kebbi state. Also, questionnaires were distributed to health workers to assess their knowledge of the treatment guideline. Data from the hospitals were analyzed using SPSS version 23.0 and evaluated for HW's adherence to treatment guidelines in the management of SM cases. A total of 377 cases of severe malaria (SM) were identified. All the cases (100%) were tested for malaria, with RDT being the commonest (60.2%) technique used, while 71 (18.83%) cases received intra-artesunate, 24 (6.36%) received intravenous quinine, and 41 (19.80%) received a follow-up dose of ACT. From the 50 health workers sampled, 38 (76%) of the responders established laboratory confirmation for SM, and all (100%) the responders had received one or more pieces of training on malaria treatment, with 28 (56%) respondents confirming the availability of National Treatment Guidelines for Diagnosis and Treatment of malaria. Findings suggest good compliance with the National Guidelines for Diagnosis and Treatment of severe malaria. However, there is a need to ensure the availability of a copy of the Guidelines in hospitals to sustain the present adherence observed.

Keywords: *Adherence, Anti-malarial, Compliance, Guideline, Kebbi State, Malaria, Nigeria, Providers Supportive treatment.*

Introduction

Although death from malaria results from progression from uncomplicated malaria to severe diseases [1], the risk of malaria mortality is highest within the first 24 hours following the onset of severe symptoms [2], suggesting the pivotal role of quick initiation of treatment in preventing severe morbidity and mortality. While the burden of malaria morbidity and mortality has been on the decrease substantially in different parts of sub-Saharan Africa, attributable to extensive scale-up of control intervention programs and enhanced case management [3, 4], malaria still constitutes a leading global health issue [5]. According to the recent World Malaria Report, in 2020, the global malaria cases stood at 241 million, with an estimated number of deaths pegged at 627 000 – an increase of 69 000 deaths over the previous year. Also, about two-thirds (47,000) of these deaths were attributed to disruptions to the health systems caused by the COVID-19

Received: 17.01.2022 ***Accepted: 28.02.2022*** ***Published on: 30.03.2022***
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pandemic, the remaining one-third (22,000) of deaths shows a recent alteration in World Health Organization (WHO) methodology for estimating malaria mortality. However, the WHO African Region bears a high share of the global malaria burden, accounting for about 95% and 96% of global malaria cases and deaths, respectively. Shockingly, Children under 5 were disproportionately affected, bearing about 80% of malaria deaths in the Region. Surprisingly, Nigeria alone accounted for about 31.9% of all malaria deaths globally [6, 7]. Effective case management plays a key role in the control and elimination of malaria [8].

Given the role effective case management plays in malaria control, the WHO has developed the "test, treat and track" (TTT) policy which advocated for improved diagnosis of malaria infection, prompt treatment with effective antimalarial drugs, and regular monitoring through routine information systems to ensure effective implementation [9, 10]. This policy has, however been adopted by many malaria-endemic countries in Africa, including Nigeria, signifying the importance of subjecting all patients suspected of having malaria to accurate clinical assessment through appropriate diagnosis by either microscopy or malaria rapid diagnosis test (RDT) before treatment with the recommended drug therapy [9]. However, the bottleneck to policy guidelines implementation is the fact that a change in policy recommendations does not usually have an immediate effect at the health care provider levels, thereby leading to inadequate quality case management at the health care delivery point [11]. Consequently, many studies have reported inappropriate practices among healthcare providers in malaria treatment from hospitals in many malaria-endemic settings [12-14]. And this constitutes non-adherence to treatment guidelines, hence, undermining the goals of malaria treatment policy [15].

While studies on adherence to treatment guidelines are limited in Low and Middle-Income Countries [16], a study on adherence to artemisinin-based combination therapies (ACTs) in Tanzania reported that health workers relied on self-report in the treatment of malaria [17]. Additionally, evidence suggests a varying level of adherence to malaria diagnostic test and treatment guidelines, as well as a lack of awareness on the availability of malaria diagnosis and treatment guidelines [18-20]. A study in Kenya depicted how lack of adherence to treatment guidelines impacted inappropriate prescription practices through the use of sub-therapeutics doses, thus, contributing to the risk of developing parasite resistance [21]. Moreover, according to a 2009 survey of health facilities for severe malaria case management practices in Uganda, it was found that, out of all patients assessed, only 27 % were correctly diagnosed with severe malaria, and 30 % did not receive the correct initial parenteral antimalarial at the appropriate dose and frequency. While about 54 % of the health facilities reported no stock-outs of the recommended parenteral quinine in the 3 months before the survey, shockingly, no facilities had consistent availability of all supplies required for the management of severe malaria [22]. Although policy change was introduced in Nigeria in 2005 [23], several inappropriate practices have also been reported by many studies [24, 25]. In Nigeria, it has become more pertinent to follow the laydown protocols in the management of severe malaria in children considering the huge impact this has on the country's children population health outcome. More so, studies have shown that the risk of developing severe malaria among children in resource-poor settings varies considerably due to the environmental, socioeconomic, and available interventional factors [26, 27]. And poses a serious threat to the control of severe malaria in children from Nigeria [28]. Thus, considering all of these, Health workers (HWs) need to adhere to the recommended management strategies and to strictly comply with the treatment guidelines. Besides, findings show slow relay of relevant information to the health facilities constitutes a

major challenge to the implementation of adherence to malaria diagnosis and treatment guidelines, thereby highlighting the lack of awareness on the availability of diagnosis and treatment guidelines [29].

Several factors such as the inadequate supply of recommended drugs, polypharmacy, continuous availability of monotherapy, staff shortages, and high workload as well as conflicting training messages that confuse workers have been identified to contribute to the non-adherence of health workers to recommended guidelines [30]. Most importantly, the various challenges and the burden of severe malaria in children in Nigeria further underscore the need to assess severe malaria case management practices regarding the National treatment guidelines. Moreover, understanding some of the underlying factors responsible for low/non-adherence to National treatment guidelines is key for generating evidence-based information for implementing strategies to improve effective malaria treatment. Therefore, the study aimed to assess the diagnostics and treatment patterns for severe malaria in children under five managed at public inpatient health facilities in Nigeria. And to determine the current conformity to recommended policy guidelines.

Material and Method

Study Location

Kebbi is a state in north-western Nigeria with its capital at Birnin Kebbi. The state was created out of a part of Sokoto State in 1991. Kebbi State is bordered by Sokoto State, Niger State, Zamfara State, Dosso Region in the Republic of Niger, and the nation of Benin. It has a total area of 36,800 km^2 [22]. The state has Sudan and Sahel-savannah. The southern part is generally rocky, with the Niger River traversing the state from Benin to Ngaski LGA. The northern part of the state is sandy, with the Rima River passing through Argungu to Bagudo LGA where it empties into the Niger. Agriculture is the main occupation of the people, especially in rural areas, Crops produced are mainly grains; animal rearing and fishing are also common. Christianity and Islam are the dominant religions of the people. There are 225 political wards, 3000 settlements, and 1036 hard-to-reach settlements in the 21 Local Government Areas in the State [31].

Study Design

A cross-sectional survey of inpatient malaria case management was conducted in 5 general hospitals using multistage sampling techniques. Hospitals were selected with an equal probability from a list of all general hospitals in kebbi state that admit children's patients with severe malaria.

Study Population

The reference population was children admitted with severe malaria in the kebbi state. The target populations were children aged 0-5 years hospitalized in a paediatric emergency unit (EPU).

Selection of Study Participants

The case folder of the child was randomly selected from all the general hospitals that had a positive thick blood smear and/or a positive RDT from 1st January 2018 to 30th December 2019. Patient records were abstracted by medically trained personnel on a standardized form. The abstracted forms were electronically entered independently by five data entry clerks, and all discrepancies were resolved by consulting the data abstraction forms.

Sample Size Determination

Sample size was calculated using the Bamgboye formula

$$n = \frac{Z^2 Pq}{d^2}$$ [32]

Where:

n = Minimum sample size desired.

z = Standard normal deviate at 95% confidence interval = 1.96.

p = Prevalence of malaria 0-5 year use = (66.3%) = 0.663(33).

q = complementary probability of p (q = 1- p) = 1-0.38= 0.205.

d = Level of precision = 5% = 0.05.

$$n = 1.96^2 \times 0.663 \times \frac{0.337}{(0.05)^2}$$

$$n = 343.$$

Adjusting the rate of 10%

$$n_1 = n\,(1 + f)$$

where 'n' is the minimum sample size and 'f 'is the non-response rate.

Therefore,

$$n_1 = 343^{*}(1 + 0.1) = 343^{*}1.1 = 377.$$

Sampling Methods

A multistage sampling method was adopted in sample selection. In stage I, two out of 3 senatorial districts in the State were selected through simple random sampling employing simple balloting. In stage 2, lists of general hospitals per district were obtained from the Ministry of Health, and the general hospitals were selected through simple random sampling employing simple balloting. In stage three, four general hospitals and one specialist hospital were also randomly selected from a list of general hospitals in two senatorial districts namely. General Hospital Zuru, General Hospital Koko, General Hospital Arugungu, General Hospital Yawuri and Sir Yahaya specialist Hospital. Equal proportions of severe malaria from each hospital were collected. The total number of severe malaria cases = 75.

The Instrument for Data Collection and Study Variables

Data abstraction form was used to extract the relevant parameters for severe malaria from each eligible pediatric patient's record. A structured questionnaire was employed by trained research assistants who interviewed health workers involved in the management of severe malaria. Reliability of the instrument was ensured by pre-testing (pilot testing) of the questionnaires among 10 healthcare workers involved in the management of severe malaria in children in Sir Yahaya Specialist Hospital; this was used in modifying the questionnaire for better clarity. Validity was carried out by ensuring that the content of the questionnaire was full and comparable to guidelines for the management of severe malaria in children. Study variables include information on demographic characteristics of the respondents, knowledge on the management of severe malaria among children, and training participation.

Ethical consideration and Approval

Ethical approval to conduct this study was obtained from the Research Ethics Committee of Kebbi State Ministry of Health (KSHREC Registration Number: 105:29/2020). Permissions were also taken from the Medical Director of the general hospitals. Written informed consent was obtained from each respondent who took part in this study.

Data Analysis and Management

Data validation was done in Microsoft Excel version 13 and exported to SPSS version 23.0 (Chicago IL) for windows for statistical analysis. All variables were coded as binary dummy variables. For sex (male = 1, female = 2). Data presented as charts and frequency distribution generated for all categorical variables while mean and standard deviation for numerical variables. Descriptive statistics were applied between the demographic and clinical presentation of severe malaria variables. Bivariate spearman ranking correlation analysis was used to determine patient characteristics predicting severe malaria among the study population. To determine the strengths of association in a Bivariate analysis, P-value < 0.05 was considered statistically significant.

Result

There were a total of 377 cases of severe malaria identified from five general hospitals in kebbi state, with an equal proportion from each cluster. From Figure 1, there were more male

children, 215(57%) with severe malaria, compared to counterpart females 162(43%), with a male to female ratio of 1.3:1. While according to Figure 2, the mean age of the children was 24.2 ± 14 months. The overall average length of hospital stay during the period was 4.2 ± 4, with a range of (0 - 32) days. The mean temperature and overall weight of children with severe malaria were [13.7 ± 6.5 Kg and 33.1±3.8^0 Celsius]. Table 1 showed the age distribution of children; the peak incidence occurred within the range of 12-23 months accounted for 110(29.18%), followed by 24 -35 months 100(26.53), 36-47 months 66(17.51%), 61(16.18%) 0-11 months and 40(10.61%) 48-60 months. The most commonly documented severe malaria symptoms according to Table 2 among the study participant fever was documented in 163 (43.2 %) of all patient records, including fever, followed by convulsion –seizure 99(26.3%), pallor 39(10.3%) loss consciousness 12(3.2%), jaundice accounted for 5(1.3%).

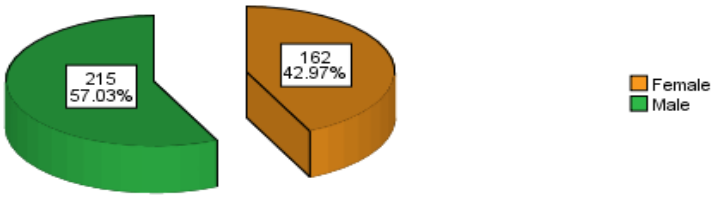

Figure 1. A Pie chart showing the Gender Distribution of the Study Participants

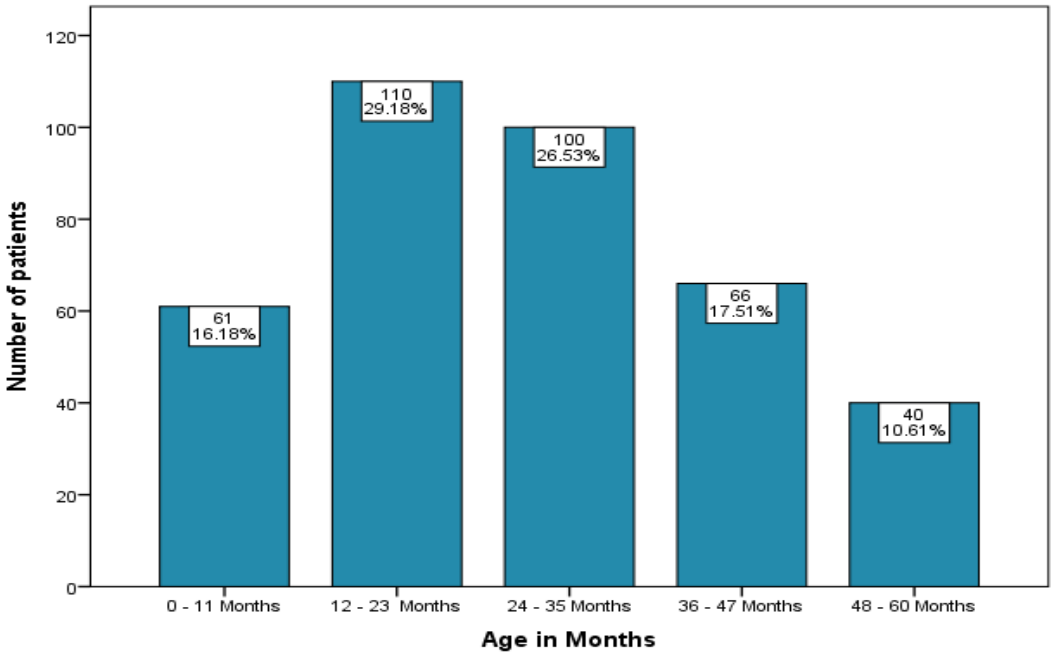

Figure 2. A Histogram that Depicts the Age Disaggregation of the Study Participants

Table 1. Uni-Variate Analysis of Age and Gender among 377 Children Patient Admitted with Severe Malaria

Ages in Months	**Total**		**Gender**		**P-values**
			Male	**Female**	
Age= 0 - 11 Months	61	Count	26	35	0.016
		Percent	42.6%	57.4%	
Age=12 - 23 Months	110	Count	61	49	0.735
		Percent	55.5%	44.5%	
Age=24 - 35 Months	100	Count	63	37	0.195
		Percent	63.0%	37.0%	
Age=36 - 47 Months	66	Count	43	23	0.171
		Percent	65.2%	34.8%	
Age=48 - 60 Months	40	Count	22	18	0.866
		Percent	55.0%	45.0%	

Table 2. Clinical Characteristics of Severe Malaria

Clinical Feature of Severe Malaria	**Frequency**	**Percent**
Fever	163	43.2
Convulsions-Seizure	99	26.3
Pallor	39	10.3
Multiple convulsions	17	4.5
Loss-of-consciousness	12	3.2
Jaundice	5	1.3
Severe-malarial-anaemia	4	1.1
Impaired consciousness	3	0.8
Pulmonary oedema	3	0.8
Prostration	1	0.3
Significant bleeding	1	0.3
Others	30	8
Co-morbidities		
Sickle-Cell-Anaemia	78	20.7
Sepsis	23	6.1
Severe malnutrition	11	2.9
Pneumonia	7	1.9
Acute gastroenteritis	6	1.6
Meningitis	3	0.8
UTI	2	0.5
None	247	65.5
Total	377	100

One hundred and thirty patients (34.5%) presented with co-morbidities, of which 78(20.7%) were sickle cell anemia, sepsis 23(6.1%), severe malnutrition 11(2.9%), pneumonia 7(1.9%) acute gastroenteritis 6(1.6%), meningitis 3(0.8%) and Urinary tract infection 2(0.5%). Figure 3 depicts the age versus gender among children with severe

malaria, where 0 -11 months significantly differ between the age categories (P<0.05), there were more female children accounted for 35(57.40%) while males had 26(42.6%). Within the age group of 12 – 23 months, 61(55.5%) were males while 49(44.5%) were females. There was no significant difference in the distribution of severe malaria within the age range of 12 - 23 months between the males and females (P>0.05). Based on Table 3, RDT was the commonest 227/377(60.2%) method used for malaria parasite test (MP) among all the general hospitals, while those used both RDT and Microscopic accounted for 91/377(24.1%) and 59/377(15.64%) tested for parasitemia using microscopy. And based on the result in Table 4, laboratory investigation for malaria parasite test showed that 228/377(60.5%) Malaria RDT was administered, of which 189/228(82.9%) were positive and 39/228(17.1%) were negative, the distribution of severe malaria test using RDT has significantly differed across all the starter (P<0.05).

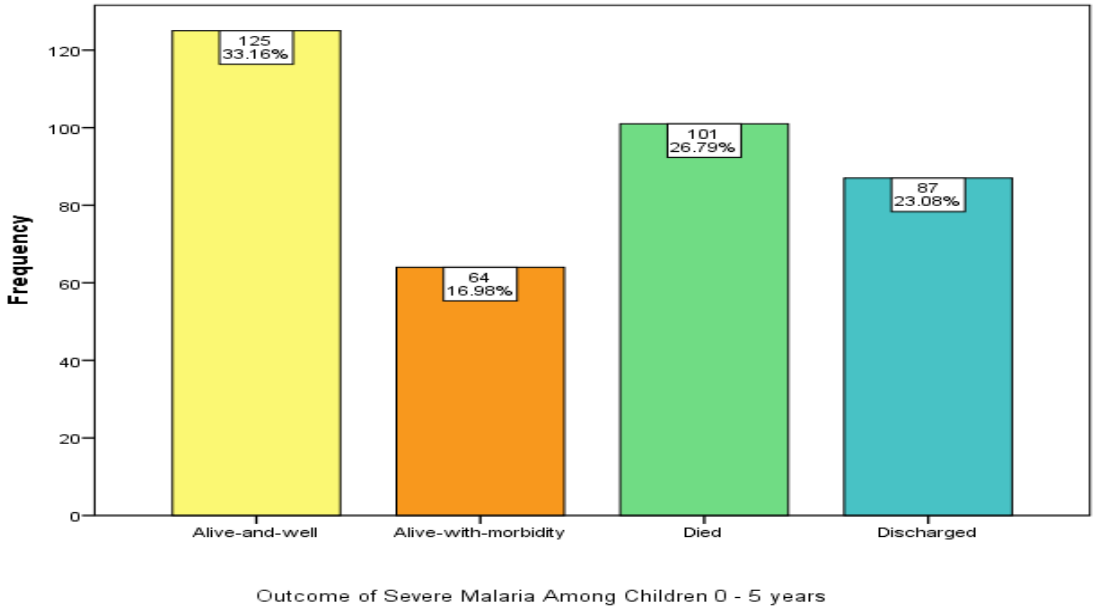

Figure 3. Age Versus Gender among Children with Severe Malaria

Table 3. Various Forms of Laboratory Test for Severe Malaria by Study Location

Form of Lab Test		**Total**	**Location of Study**					
			GH Argungu	**Sir Yahaya SH**	**GH Yawuri**	**GH Zuru**	**GH Koko**	**P-value**
RDT	Count	227	13	61	20	66	67	0.01
	Percent		5.7%	26.9%	8.8%	29.1%	29.5%	
Microscopic	Count	91	62	14	1	6	8	0.01
	Percent		68.1%	15.4%	1.1%	6.6%	8.8%	
Both RDT and Microscopic	Count	59	0	0	56	3	0	0.01
	Percent		0.0%	0.0%	94.9%	5.1%	0.0%	
Result status								
One Plus (1+)	Count	10	2	2	3	3	0	0.55
	Percent		20.0%	20.0%	30.0%	30.0%	0.0%	
Two Plus (2+)	Count	88	43	4	35	6	0	0.01
	Percent		48.9%	4.5%	39.8%	6.8%	0.0%	

Two Plus (3+)	Count	51	17	8	18	0	8	0.01
	Percent		33.3%	15.7%	35.3%	0.0%	15.7%	
RDT (Positive)	Count	189	10	39	21	64	55	0.01
	Percent		5.3%	20.6%	11.1%	33.9%	29.1%	
RDT (Negative)	Count	39	3	22	0	2	12	0.01
	Percent		7.7%	56.4%	0.00%	5.1%	30.8%	

Table. Other Laboratory Investigation for Severe Malaria

Hematological Parameters	**Response**		**Total**	**Study Location**				
				GH Argungu	**Sir Yahaya SH**	**GH Yawuri**	**GH Zuru**	**GH Koko**
PCV	Yes	Count	190	21	40	26	69	34
		Percent		11.10%	21.10%	13.70%	36.30%	17.90%
	No	Count	187	54	35	51	6	41
		Percent		28.90%	18.70%	27.30%	3.20%	21.90%
Full Blood Count	Yes	Count	76	37	33	2	4	0
		Percent		48.70%	43.40%	2.60%	5.30%	0.00%
	No	Count	301	38	42	75	71	75
		Percent		12.60%	14.00%	24.90%	23.60%	24.90%
EUCR	Yes	Count	50	41	9	0	0	0
		Percent		82.00%	18.00%	0.00%	0.00%	0.00%
	No	Count	327	34	66	77	75	75
		Percent		10.40%	20.20%	23.50%	22.90%	22.90%
Blood sugar	Yes	Count	24	20	3	0	0	1
		Percent		83.30%	12.50%	0.00%	0.00%	4.20%
	No	Count	353	55	72	77	75	74
		Percent		15.60%	20.40%	21.80%	21.20%	21.00%
Urinalysis	No	Count	352	53	74	77	73	75
		Percent		15.10%	21.00%	21.90%	20.70%	21.30%
	Yes	Count	25	22	1	0	2	0
		Percent		88.00%	4.00%	0.00%	8.00%	0.00%
CSFMCS	Yes	Count	27	25	2	0	0	0
		Percent		92.60%	7.40%	0.00%	0.00%	0.00%
	No	Count	350	50	73	77	75	75
		Percent		14.30%	20.90%	22.00%	21.40%	21.40%
CSF Chemistry	Yes	Count	37	37	0	0	0	0
		Percent		100.00%	0.00%	0.00%	0.00%	0.00%
	No	Count	340	38	75	77	75	75
		Percent		11.20%	22.10%	22.60%	22.10%	22.10%
Liver Function Test	Yes	Count	30	25	3	0	2	0
		Percent		83.30%	10.00%	0.00%	6.70%	0.00%
	No	Count	347	50	72	77	73	75
		Percent		14.40%	20.70%	22.20%	21.00%	21.60%
Blood culture MCS	Yes	Count	27	25	1	0	1	0
		Percent		92.60%	3.70%	0.00%	3.70%	0.00%

	No	Count	350	50	74	77	74	75
		Percent		14.30%	21.10%	22.00%	21.10%	21.40%

From Table 5, regarding the documented treatment of severe malaria, one hundred and one of the patients were received intravenous antibiotics, of which 60(59.4%) were male while 41(40.6%) were female, 83 children patients received blood transfusion; males accounted for 41(49.4%, female had 42(50.6%), the proportion of child patients received intra-artesunate were 71 individuals 29(40.8%) were male while 42(59.2%) were females. Out of 377 patients admitted with severe malaria, 125(33.16%) recovered, with a morbidity of 64(16.98%). While the rate of mortality cases during the period of admission was raised to 101(26.79%) and 87(23.08%) patients were discharged home, as evident in Figure 3.

Table 5. Treatment of Severe Malaria among Children 377 patients admitted

Form of Treatment		**Gender**		**Total**
		Male	**Female**	
Anticonvulsant	Count	26	9	35
	Percent	74.3%	25.7%	
Antipyretics	Count	5	1	6
	Percent	83.3%	16.7%	
Blood transfusion	Count	41	42	83
	Percent	49.4%	50.6%	
Follow-up-dose-with-ACT	Count	31	10	41
	Percent	75.6%	24.4%	
Intra-Artesunate	Count	29	42	71
	Percent	40.8%	59.2%	
Intra-glucose	Count	10	6	16
	Percent	62.5%	37.5%	
Intra-Quinine	Count	13	11	24
	Percent	54.2%	45.8%	
Intravenous-antibiotics	Count	60	41	101
	Percent	59.4%	40.6%	
Total	Count	215	162	377
	Percent	57.0%	43.0%	

According to Table 6 summarizing the characteristics of health workers, 10 responders of equal gender formed a cluster. Of which 30(60%) were males, and 20(40%) were females participated in the study. The majority of the responders were Nurses 23(46%), followed by doctors 13(26%), CHEW 7(14%), CHO 4(8%), and 3(6%) were students on practical. And based on Table 7, 21(42%) of the participants have received malaria case management on-the-job training, 11(22%) received training either in services or on the job. While the majority of health care providers received two three 29(58%) pieces of training on malaria cases management. Besides, most of the responders, 38(76%), established laboratory confirmation for severe malaria using both techniques [RDT and Microscopic]. Moreover, the majority, 30(60%) of the respondents, participated in in-house training on the management of severe malaria in the last 2 years, while 20(40%) of responders did not participate.

Table 6. Summary Characteristics of Health Workers providing Treatment on Severe Malaria

Study Location	***Frequency***	***Percent***
GH Yawuri	10	20
GH Argungu	10	20
GH Zuru	10	20
GH Koko	10	20
Sir Yahaya Specialist	10	20
Gender		
Male	30	60
Female	20	40
Qualifications		
CHEW	7	14
CHO	4	8
Nurse	23	46
Doctors	13	26
Students on practical	3	6
Total	50	100

Table 7: Training received by Participants for Management of Severe Malaria

Knowledge on Diagnosis and Treatment of Severe Malaria	**Frequency**	**Percent**
Malaria case management in-service training	9	18
Malaria case management on-the-job training	21	42
Either in-service or on-the-job malaria case management training	11	22
Integrated management of childhood illness (IMCI) training within the last 5 years	6	12
Other Training	3	6
Number of Training Received		
One	12	24
Two	16	32
Three	13	26
Four	5	10
Five	4	8

For the treatment of choice for severe malaria according to WHO/national guideline according to Table 8, 24(48%) of the study participants administered intravenous artesunate to the children with severe malaria. Whereas 27(54%) of the responders were incorrectly describing the dosing formula for Intravenous artesunate in under 5 in mg/kg body weight. And nearly more than half, 27(54%) of participants were incorrectly describing the parenteral dosing frequency of Intravenous artesunate within the first 24 hours. Twenty-eight (56%) of healthcare providers reported that there was the availability of SOP/National Treatment Guidelines for case management of patients with severe malaria, while 22(44%) reported that there was no availability of SOP/National Treatment Guidelines for case management of patients with severe malaria.

Table 8. Treatment and National Guideline for the Treatment of Severe Malaria

Availability of SOP/National Treatment Guidelines for case management of patients with severe malaria	**Frequency**	**Percent**
Yes	28	56
No	22	44
Total	50	100

Discussion

This study depicts the practical realities in the management of severe malaria in public health facilities in Nigeria, which has a direct impact on the implementation of malaria treatment guidelines. Results of the study reflect practices as they relate to test and treat policy used in malaria control. For this study, adherence to the National Treatment Guidelines for Diagnosis and Treatment of malaria was measured in terms of parasitological diagnosis of severe malaria and treatment with the correct drug, coupled with appropriate treatment follow-up. Based on the National Treatment Guidelines, malaria case-management services include both diagnostics and treatment and were widely utilized in the inpatient hospitals in Kebbi State, Nigeria, representing tremendous progress over the years.

From the retrospective Patient records evaluation for severe malaria case management in this survey, it was observed that the majority of the admitted patients (87.53%) demonstrated clear symptoms of severe malaria that include fever, convulsion-seizure, pallor, Multiple convulsion, and loss of consciousness. This could be an improvement in the documentation practice in the HFs through the introduction of structured admission record forms for patients to facilitate data collection and performance monitoring, as reported by some studies (33, 34).

From the study, there was more male gender than their female counterpart in the patient's record assessed. This is contrary to the findings from many studies, where females outnumbered males in health facilities [35, 36]. While this observation disagrees with the suggestion that females make more use of public health facilities than males, [37] it, however, conforms to the 2006 population census figure that shows that Kebbi state has more males than female gender [38]. Besides, it also implies that the population of males remains higher than females in the study location. Thus, more males suffer from severe malaria than females in the study location.

While poor adherence to standard diagnostic and treatment guidelines is a major cause of therapeutic failure and drives the emergence and spread of drug resistance, in severe malaria management, it heightens the mortality rate [8]. In this study, health workers (HWs) were adherent to the National Treatment Guidelines for Diagnosis and Treatment of malaria when testing for malaria. This is evident by the 100% testing for severe malaria in the sampled patients admitted to the pediatric wards. This is in similitude with the finding reported in Kenya [39], but higher than that reported in many other malaria-endemic settings since the release of the WHO recommendation for universal access to malaria diagnostics testing [40-42]. Moreover, WHO stipulates parasitological confirmation of malaria either by RDT or microscopy before treatment. In this study, testing with RDTs (60.2%) was observed to be the most common laboratory testing mode employed by the health facilities (HFs). This could be attributed to the wide availability and supply of RDT to government HFs in the country through the support from the National Malaria Elimination Programme (NMEP), thereby showing a significant improvement from the report of a study conducted in Uganda, where low RDT use was attributed to its limited availability in the studied health facilities [43]. This result also

aligns with but is higher than the finding from a study conducted in Ogun State, Nigeria which showed 54.6% of health workers adhered to diagnosis guidelines by utilizing the RDT technique [44]. It is also consistent with the 51.1% laboratory testing rate reported in a study in Enugu State, Nigeria, suggesting a significant improvement since 2010 [45].

Also, the study shows that in the treatment of severe malaria, artesunate (18.8%) was used more than quinine (6.37%), with other supportive care to reduce mortality. Interestingly, after seven years of change of treatment policy from quinine to artesunate, it could be said that the policy is taking effect in the sampled facilities as there is a substantial shift to the use of artesunate, probably due to increased training awareness among the health workers. Although similar to a study in Uganda [46], this study also shows low levels of ACT follow-on treatment (19.3%) among those that were alive and/or discharged who could tolerate oral ACT. However, this result is worrisome and requires further investigations to unravel the reasons for such practice, which invariably could contribute to the discharge rate of 23.08% observed in this study. Therefore, factors such as ACT availability, provision of SOP, and the nature of training highlighting the importance of ACT follow-up treatment will go a long way in improving patient's health outcomes in the health facilities.

Additionally, the study revealed that all the health workers sampled (100%) had received one or more forms of pieces of training on malaria case management as stipulated in the National Treatment Guidelines for Diagnosis and Treatment of malaria, which is consistent with other studies in Angola, and Ghana [47, 48]. While the study revealed that health workers had received training in malaria case management, the study however did not probe whether the health workers were knowledgeable about the National Guidelines for Diagnosis and Treatment of Malaria. However, evidence suggests that pieces of training have resulted in an improvement in the knowledge, competencies, and skill set of the participants in malaria case management [50], it can therefore be argued that in this study, the health workers could be said to possess the requisite knowledge about the recommended treatment for malaria case management.

Moreover, several studies already conducted in Africa have indicated that the awareness of the existence of national malaria treatment guidelines is high among healthcare workers [51, 44]. However, despite the high level of awareness, a study conducted to evaluate the extent to which the medical doctors in Ebonyi state, Nigeria, knew, viewed, and practiced the 2015 National Guidelines for Diagnosis and Treatment of Malaria, revealed low knowledge of salient recommendations of the 2015 Guidelines, attributable to low availability of a copy of the 2015 Guidelines in the surveyed hospitals [51]. Shockingly, this study showed that slightly above half (56%) of the health workers in the sampled health facilities have a copy of the National Guidelines for Diagnosis and Treatment of Malaria. Although health workers have several sources for learning about the optimal management of severe malaria patients, including clinical meetings or seminars, it is expected that having a copy of the National Guidelines (and regularly using it as reference material) would enhance comprehensive and in-depth knowledge of such Guidelines [51].

Limitation

This study has several limitations. As it was limited to the pediatric patients aged 0-5 years admitted with severe malaria in a paediatric emergency unit. Besides, Survey Teams did not directly observe patient-Health workers' (HW) interactions and relied on patient reports, which is subject to recall bias. Also, the fact that the study collected self-reported data about the practices could result in the tendency for respondents to overestimate desirable practices and underestimate undesirable practices. However, the bias was minimized by ensuring

all the patients had their clinical encounters recorded in the health booklet which was examined by the survey teams.

The presence of the survey teams at Health facilities (HFs) likely influenced HW practices even though they did not directly observe their work. This may have overestimated appropriate treatment since HWs may have been more likely to follow guidelines under assumed supervision. and the questionnaire was made anonymous to ensure respondents have a high degree of confidentiality.

In addition, the accuracy and validity of the testing materials/equipment were not evaluated to make sure that HWs followed manufacturer instructions and that the kits were in good condition. And given the retrospective nature of reviewing patient records, it was not possible to verify information from the caregiver or patients in real-time to ascertain or obtain information regarding the onset of the signs of severe malaria in the patients.

Furthermore, the multivariable analysis for appropriate treatment was limited to 377 presumed severe malaria patients seen at five HFs, a small sample size that may have underpowered the analysis.

Conclusion

Although a majority of the health workers in Kebbi State public hospitals exhibit good compliance practices for the management of severe malaria, only above half of the health workers have a copy of the National Guidelines for Diagnosis and Treatment of malaria in their respective health facilities. Thereby suggesting the need to ensure the provision and availability of copies of the National Guidelines for Diagnosis and Treatment of malaria in hospitals to complement the training on malaria case management and sustain the present adherence observed.

Acknowledgments

The authors would like to acknowledge the health workers that participated in the study and survey teams that engaged in data collection. We would also like to extend our gratitude to the hospitals used as the study sites, Kebbi State Ministry of Health, and Ministry of Health staff who assisted in training and data collection.

Conflict of Interest

The authors declare that they have no competing interests.

Availability of Data and Materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

Written informed consent was obtained from all enrolled health workers before conducting interviews. Ethical approval (KSHREC Registration Number: 105:29/2020) was provided by the Research Ethics Committee of Kebbi State Ministry of Health. And Permissions were also taken from the medical director of the general hospitals used as the study sites.

Funding

This study did not receive any funding support.

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