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Pre-referral injectable artesunate and outcomes of childhood severe malaria at a secondary health facility in North-central Nigeria: a cross-sectional study

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Abstract

Background The use of pre-referral injectable artesunate is among the strategies adopted to improve the outcome of childhood severe malaria in Nigeria. However, the extent of its implementation and impact on outcomes remain unknown. This study assessed the pre-referral treatment with injectable artesunate for severe malaria, associated factors, and hospitalisation outcomes (discharge or death) among a cohort of children managed at a secondary health facility in Nigeria.

Methods This cross-sectional study included children diagnosed with severe malaria admitted to a secondary health facility in Nigeria. Data on pre-referral treatment with injectable artesunate and other medications, demographics, clinical features, and outcomes among children were prospectively gathered and analysed them using SPSS.

Results Of the 137 children recruited, 7(6.3%) received pre-referral injectable artesunate; other medications received included antipyretics (53;47.3%), antibiotics (16;14.3%), artemisinin-based combination therapy (14;12.5%), and supplements (11;9.8%). Pre-referral injectable artesunate treatment was not associated with age, sex, and socioeconomic status ($p > 0.05$), and most of the clinical features except impaired consciousness with an adjusted odds ratio of 17.876 (95% CI 2.050 to 155.883). Of the 137 children, two deaths occurred, with a crude mortality rate of 1.5% (95% CI 0.04–5.2%). Pre-referral injectable artesunate treatment was not associated with hospitalisation durations and outcomes (death or discharge).

Conclusion This study showed a very low uptake of pre-referral injectable artesunate among children with severe malaria, and the presence of impaired consciousness increased the odds of a child receiving injectable artesunate. In addition, most children with severe malaria had received pre-hospitalisation medications that were mostly inappropriate.

Keywords Pre-referral injectable artesunate, Severe malaria, Children, Outcomes

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Background

Malaria remains a significant cause of morbidity and mortality in tropical and subtropical regions, with an estimated 263 million malaria cases and 597,000 deaths reported in 2023 [1]. The huge global burden of malaria affects mainly the African sub-region where 94% (246 million) and 95% (569,000) of cases and deaths occurred, respectively (2023) [1]. Nigeria is the single largest contributor to the burden in Africa and globally [2]. In 2022, the country recorded an estimated 68.1 million cases and 189,300 deaths from malaria, which accounted for 44.0% of deaths from the twelve 'high-burden, high-impact' (HBHI) countries [3].

Despite global efforts and progress in malaria control, children, especially under-fives, continue to experience high mortality rates where as much as 80% of deaths occur mainly due to severe forms of the disease, particularly in rural communities, where there is little or no access to quality healthcare services [4]. To mitigate the rapid progression of severe malaria, its associated complications, and adverse outcomes, the World Health Organization (WHO) recommends the administration of pre-referral anti-malarial treatments in order of preference as follows: intramuscular artesunate, rectal artesunate (in children less than six), intramuscular artemether, or intramuscular quinine, particularly in settings where access to complete treatments is delayed or unavailable [5]. This follows the outcomes of the WHO technical consultation review of the Community Access to Rectal Artesunate for Malaria (CARAMAL) study, which was constituted to reappraise preliminary findings that suggested there was no reduction in mortality following a multi-country study on the use of rectal artesunate (RAS) [5–7]. After careful review of CARAMAL data including its limitations, the WHO technical expert consultation recommended that countries adopting RAS should ensure a continuum of care for children with severe malaria with the goal of completing post-referral treatment [7]. In addition, the countries should strengthen their healthcare systems and ensure healthcare workers follow guidelines, including for full treatment with parenteral artesunate and a full course of artemisinin-based combination therapy for all cases of severe malaria, including those referred after pre-referral treatment [7].

In Nigeria, the primary healthcare levels are expected to identify and administer pre-referral treatment with artesunate for severe malaria only when there is an anticipated delay in presentation to a secondary or tertiary health facility for complete treatment with parenteral artesunate [8, 9]. The national guidelines recommended the following pre-referral treatments in order of preference: a single dose of intramuscular artesunate or pre-referral rectal artesunate, intramuscular artemether, or intramuscular quinine for children under the age of six. For those six years and above, including adults, the recommended pre-referral treatment included intramuscular artesunate, intramuscular artemether, or intramuscular quinine [8, 9]. All pre-referral treatments are to be followed-up and health workers must ensure that the patient get to an appropriate health facility for proper treatment of severe malaria.

Pre-referral treatment with artesunate is a key aspect of the Nigerian malaria treatment guidelines and is expected to be deployed across various lower level health facilities for implementation [10, 11]. A recent stakeholder meeting for malaria in Nigeria acknowledged challenges with implementation and suggested the need to scale up its uptake among other interventions [11]. However, several critical questions must be addressed to optimise pre-referral treatment strategies in Nigeria. Some of the issues raised include: where do children with severe malaria typically receive treatment before they present at secondary health facilities? How many of these children received appropriate pre-referral treatment including injectable artesunate before presenting at a higher-level health facility? In addition, is pre-referral injectable artesunate treatment related to clinical outcomes in the community settings? Thus, this study was conceived to answer these research questions.

Thus, data were collected among children who presented with severe malaria at a secondary health facility in north-central Nigeria, a departure from tertiary health centre-dominated data for hospitalised cases of severe malaria in Nigeria. In addition, secondary health facilities are closer to the community than are tertiary health centres and they are more likely to reflect the actual malaria burden at the community level in malaria and real-life scenarios. In addition, this study contributes to the ongoing discourse on optimising pre-referral treatment strategies in areas with limited healthcare access, potentially informing future WHO guidelines and malaria control policies. Therefore, this study determined the pre-referral treatment (injectable artesunate) for severe malaria, and associated factors (sociodemographic factors, types of treatment and where it is received, and clinical features), and hospitalisation outcomes (discharge or death) among a cohort of children managed at a secondary health facility in north-central Nigeria.

Methods

Study designs and settings

This cross-sectional study involved children admitted for severe malaria from July 1, 2023, to August 31, 2024, at the Children Specialist Hospital, Ilorin, Kwara State, North-central Nigeria. The Children Specialist Hospital, a healthcare facility with 35 beds, is strategically

positioned in the central district of Ilorin. This ancient city serves as the capital of Kwara State, one of the six states that constitute Nigeria's north–central region. It is the only government-owned dedicated paediatric hospital within the state with an estimated population size of 3,551,000 (2022). The facility receives referrals from primary healthcare facilities, cottage hospitals, private hospitals within the city, and neighbouring rural communities in the state and has an average annual admission of 1300 paediatric cases. The hospital is supported by free malaria diagnostics and treatments from the Kwara State Ministry of Health and its partners.

Study participants

Children aged less than or equal to 15 years with confirmed diagnosis of malaria by rapid diagnostic test and or malaria microscopy with features of severe malaria according to WHO 2015 guidelines for the management of severe malaria were included in this study [10]. The features included an impaired level of consciousness defined as a Glasgow coma score of less than 11 or Blantyre score of less than 3 in younger children); prostration (generalized weakness with inability to sit or stand without support); acidosis (plasma bicarbonate less than 15); multiple convulsions (more than two episodes of convulsions in 24 h); hypoglycaemia (random blood sugar less than 2.2 mmol/L); anaemia (haemoglobin of 5 g/dL or less); renal impairment (serum creatinine greater than 3 mg/dL); pulmonary oedema (evidence of respiratory distress with hypoxaemia-oxygen saturation less than 92%); and shock (capillary refill more than 3 s and/or systolic blood pressure less than 70 mm Hg) [10]. Children admitted with other forms of diagnosis during the study period and those with chronic diseases, such as sickle cell anaemia were excluded from this study.

Sample size estimation

The minimum sample estimate was calculated using an online sample size calculator (http://www.raosoft.com/samplesize.html) at 95% confidence and a 5% margin of error. Using prevalence of severe malaria (18.6%) from a previous study, a relatively high prevalence because the data were from hospitalized children reported within the same city and 190 total malaria cases (hospital records) in the previous year, a minimum sample size of 105 was obtained [12]. However, the final data analysis included all 137 children with severe malaria who were admitted during the study period.

Patient recruitment and management

Consecutive children who met the inclusion criteria were recruited from July 1, 2023, to August 31, 2024. In line with the national guidelines for severe malaria, all children with severe malaria were diagnosed with rapid diagnostic tests or malaria microscopy with the presence of features of severe malaria and received appropriate management [8]. The treatment protocol included intravenous artesunate (for a minimum of 24 h once initiated), and subsequently transitioned to oral artemether-lumefantrine upon the patient's ability to tolerate oral administration. Children with severe anaemia received blood transfusion. Additional supportive care was administered based on clinical presentation, including intravenous fluid therapy, supplemental oxygen, antipyretic medication, and anticonvulsant agents, among other interventions, as appropriate. Patients were discharged from the hospital following clinical improvement for subsequent follow-up care.

Definition terms

Pre-referral medications

This is defined as any medication administered to a child with severe malaria before presentation to a health facility [13].

Pre-referral injectable artesunate treatment

This is defined as children who received injectable artesunate among those with suspected or confirmed severe malaria before presentation at a health facility in line with the national policy on the management of children with severe malaria [5].

Data collection

A pre-tested, semi-structured questionnaire was used to obtain socio-demographics, clinical and laboratory features, type of medications received before presentation, durations of hospitalisation, and clinical outcomes (death or discharge). Information on pre-referral treatment for severe malaria was specifically sorted out by careful review of referral notes where available and caregiver interviews. Also, additional calls were made to the referring facility to confirm the administration of medications prior to referrals where indicated. The study protocol was administered by a trained research assistant and supervised by the consultant paediatrician (a member of the research team).

Data analysis

The obtained data were entered into an Excel spreadsheet and updated regularly. After data cleaning, the data were transferred and analysed using IBM-SPSS version 29. The age distribution of the children was not normally distributed and was summarised using the median and interquartile range. The sociodemographic characteristics (sex and socioeconomic status) and clinical features were summarized in terms of frequency and percentage

and further compared using Fischer's exact test. The pre-referral medications, which included pre-referral injectable artesunate, and source of medications were summarised with frequency and percent. Associations between socio-demographics, clinical features, hospitalisation outcomes, and pre-referral injectable artesunate treatment were assessed with G-test (likelihood) for Chi-square test. To adjust for confounders, age, sex, and only the variable (impaired levels of consciousness) that were significantly associated with pre-referral injectable artesunate treatment on bivariate analysis were entered into binary logistic regression and reported as adjusted odds ratio with a 95% confidence interval. The level of statistical significance was set at $p < 0.05$.

Ethical consideration and approval

This study was approved by the Kwara State Ministry of Health Ethics Review Committee. This study was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from the parents and guardians of all participating children. Data were maintained with strict confidentiality, secured in a password-protected computer, and de-identified during the analysis process.

Results

General characteristic of the study children

This study recruited 137 children with a median (interquartile range) age of 4 (2.0–7.0) years with a minimum of 3 months and a maximum of 15 years. Most of the children were under five (90;65.7%), male (82;59.9%), and from the lower and middle socioeconomic classes (112; 81.7%) (Table 1).

Pre-referral medications

Of the 137 children recruited in this study, 112 (81.8%) received medications before presentation to the hospital (Fig. 1). Based on the distribution, 53 (38.7%) patients received antipyretics, followed by antibiotics (16;11.7%), artemisinin-based combination therapy (14;10.2%), supplements (11;8.0%), while 7 (5.1%) received injectable artesunate. None of the children received rectal artesunate, artemether, or quinine (Table 2). Of the 16 children that received antibiotics, 14 received oral antibiotics [Amoxycillin- 10, Amoxycillin-clavulanic acid-3, Ampicillin-1] and two received parenteral antibiotics [third-generation cephalosporins-ceftriaxone]. None of the children received injectable artesunate along with antibiotics. Out of the seven that received injectable artesunate, two received it at a private hospital, one at

Table 1 General characteristics of the study children

Variables	Total	Male n = 82 (%)	Female n = 55 (%)	P value
Age years Median [IQR]	4.0 (2.0–7.0)	4.0 (2.0–7.0)	3.0 (1.5–7.0)	0.034U
Age groups [Months]				
≤ 12	18 (13.1)	9 (11.0)	9 (16.4)	0.466*
13–59	72 (52.6)	42 (51.2)	30 (54.5)	
≥ 60	47 (34.3)	31 (37.8)	16 (29.1)	
Father education				
No formal	5 (3.6)	3 (3.7)	2 (3.6)	0.507*
Primary	40 (29.2)	27 (32.9)	13 (23.6)	
Secondary	50 (36.5)	26 (31.7)	24 (43.6)	
Tertiary	42 (30.7)	26 (31.7)	16 (29.1)	
Mother education				
No formal	18 (13.1)	10 (12.2)	8 (14.5)	0.967*
Primary	31 (22.6)	18 (22.0)	13 (23.6)	
Secondary	57 (41.6)	35 (42.7)	22 (40.0)	
Tertiary	31 (22.6)	19 (23.2)	12 (21.8)	
Socio-economic class				
Upper	25 (18.2)	16 (19.5)	9 (16.4)	0.896*
Middle	78 (56.9)	46 (56.1)	32 (58.2)	
Lower	34 (24.8)	20 (24.4)	14 (25.5)	

IQR, Interquartile range; U, Mann–Whitney U test

*G test for Chi-square

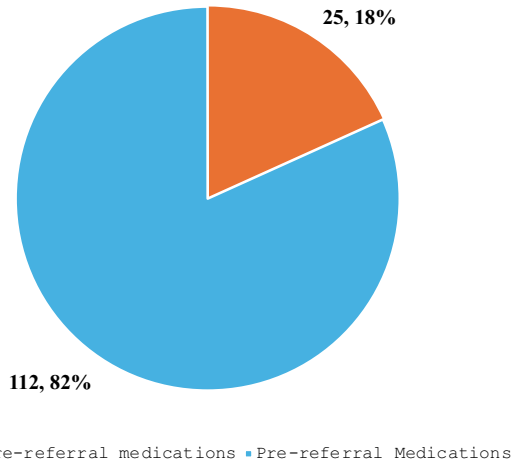

Fig. 1 Pre-referral medications among the study participants

Table 2 Pre-referral medications and source of medications among children with severe malaria

Variables	Frequency, $n=137$	%
Medications		
Antipyretics	53	38.7
Antibiotics[b]	16	11.7
Artemisinin-based combination therapy	14	10.2
Supplements	11	8.0
Injectable artesunate	7	5.1
Local herbs	3	2.2
Intravenous fluids	3	2.2
Unknown	3	2.2
Cough syrup	1	0.7
Chloroquine	1	0.7
No medications	25	18.3
Source of medications, $n=112$[a]		
Patent medicine store	54	48.2
Pharmacy	26	23.2
Private health facility	17	15.2
Primary health care centre	12	10.7
Home	3	2.7

[a] Only those that received medication before presentation at the hospital

[b] 14 [oral] and 2 [ceftriaxone]

a pharmacy shop, one at primary healthcare centre and three at patent medicine stores (Supplementary Table 1).

Sources of referrals

Of the 137 patients, 44 (32.1%) were referred from health facilities and the remaining were self-referrals. Based on the place where the pre-referral medications were received, most of the children received their medications from patent medicine stores (48.2%), followed by pharmacy shops (23.3%), and while 12 (10.7%) received their medication from primary healthcare centres (Table 2).

Relationship between sociodemographic characteristics, clinical features, and the use of pre-referral injectable artesunate

The age group of children who received pre-referral injectable artesunate treatment was comparable to that of those who did not (Table 3). Similarly, there was no association between parental educational level, socioeconomic status, and pre-referral artesunate treatment.

Among the clinical features, only impaired consciousness was associated with pre-referral artesunate treatment (Table 3). No statistically significant difference ($p>0.05$) was observed in the duration of symptoms and hospitalisation between paediatric patients who received pre-referral artesunate treatment and those who did not.

After adjusting for confounders, children with an impaired level of consciousness had increased odds of having received pre-referral artesunate with an adjusted odds ratio of 17.876 (95% CI 2.050 to 155.883) (Table 4).

Pre-referral injectable artesunate and outcomes of childhood severe malaria

Of the 137 children included in this study, two fatalities occurred, resulting in a mortality rate of 1.5% (95% CI 0.04% to 5.2%). Pre-referral injectable artesunate treatment was not associated with hospitalisation outcomes (Table 4). The two deaths occurred in children who did not receive pre-referral artesunate treatment (Table 5), and one had cerebral malaria, while the second case had cerebral malaria with disseminated intravascular coagulopathy (Supplementary Table S1).

Discussion

In Nigeria, severe malaria remains a major cause of hospital admissions and mortality among paediatric patients, with pre-referral injectable artesunate being among the key strategies adopted to improve their outcomes [9]. This study shows that 8 out of 10 children received some form of pre-referral medications which were mostly inappropriate. This observation is similar to that of a study in Uganda, where pre-hospitalisation medications (72%) were common among children with malaria and were mostly inappropriate [14]. These findings illustrate that although parents of children with severe malaria often recognise that their children are sick and seek treatment early, they are mostly inappropriate, which may further contribute to delay appropriate intervention, progression of their illnesses, and worsened outcomes in children with severe malaria. This study also found that antipyretics, followed by antibiotics were the most administered

Table 3 Relationship between socio-demographics, clinical features, and pre-referral injectable artesunate among children with severe malaria

Variables	Total $n=137$	Pre-referral Injectable artesunate, $n=7$ (%)	No pre-referral injectable artesunate $n=130$	*P* value
Age groups [months]				
≤ 12	18	1 (5.6)	17 (94.4)	0.166*
13–59	72	2 (2.8)	70 (97.2)	
≥ 60	47	4 (8.5)	43 (91.5)	
Father education				
No formal	5	0 (0.0)	5 (50.0)	0.067*
Primary	40	5 (12.5)	35 (87.5)	
Secondary	50	2 (4.0)	48 (96.0)	
Tertiary	42	0 (0.0)	42 (100.0)	
Mother education				
No formal	18	3 (16.7)	15 (83.3)	0.077*
Primary	31	1 (3.2)	30 (96.8)	
Secondary	57	3 (5.3)	54 (94.7)	
Tertiary	31	0 (0.0)	31 (100.0)	
Socio-economic class				
Upper	25	0 (0.0)	25 (100.0)	0.095*
Middle	78	3 (3.8)	75 (96.2)	
Lower	34	4 (11.8)	30 (88.2)	
Clinical features				
Fever	132	7 (5.3)	125 (94.7)	1.000
Vomiting	54	3 (5.6)	51 (94.4)	1.000
Loose stool	20	1 (100.0)	20 (0)	0.593
Convulsions	43	4 (9.3)	39 (90.7)	0.205
Severe anemia	79	2 (2.5)	77 (97.5)	0.113
Dark urine	43	1 (0.7)	42 (97.7)	0.433
Prostration	88	3 (3.4)	85 (96.6)	0.248
Jaundice	2	0 (0.0)	2 (100.0)	1.000
Reduce urine output	5	0 (0.0)	5 (100.0)	1.000
Impair levels of consciousness	7	2 (28.2))	5 (71.4)	0.042
Symptoms duration [hours]				
≤ 24	43 (31.4)	2 (4.7)	41 (95.3)	0.775*
25–72	62 (45.3)	4 (6.5)	58 (93.5)	
> 72	32 (23.4)	1 (3.1)	32 (96.9)	
Hospitalisation durations [days]				
≤ 1	6	0 (0.0)	6 (100.0)	0.727*
2–3	81	5 (6.2)	76 (93.8)	
> 3	50	2 (4.0)	48 (96.0)	

* G-test (likelihood) for Chi-square test

drugs before presentation to the hospital in children with severe malaria. While the observation of antipyretics is similar to a Nigerian study among febrile children, 11.7% of children receiving antibiotics are slightly higher than the 8% reported in Uganda [14, 15].

Appropriately administered antibiotics have been advocated for as part of treatment to be co-administered along with artesunate for childhood severe malaria due to the increased likelihood of concomitant bacteraemia, which may be indistinguishable from severe malaria, especially in low-resource settings with limited laboratory support [16]. In addition, some of the children may have been over diagnosed as a case severe malaria while missing ongoing sepsis, which may be the primary

Table 4 Outcomes of severe malaria and pre-referral injectable artesunate

Variables	Total *n* = 137	Pre-referral injectable artesunate *n* = 7	No pre-referral injectable artesunate *n* = 130	*P* value
Hospitalisation durations [days]				
≤ 1	6 (4.4)	0 (0.0)	6 (100.0)	0.714*
2–3	81 (59.1)	5 (6.2)	76 (93.8)	
> 3	50 (36.5)	2 (4.0)	48 (96.0)	
Hospitalisation outcomes				
Discharged	135 (98.5)	7	128	1.000*
Death	2 (1.5)	0	2	

IQR-Interquartile range

*G-test (likelihood) for Chi-square test

illness [17]. The antibiotics administered to some of the children in this study may be seen as a plus; however, a bit of concern was that the seven children that received injectable artesunate did not receive antibiotics as part of their pre-referral treatment, while others received antibiotics without injectable artesunate. This observation on the use of antibiotics in this study may likely reflect gaps in knowledge or possible another diagnosis at the point of first contact, as some symptoms of severe malaria may be confused with bacterial infections, thereby prioritising sepsis ahead of malaria in the treatment [17]. It is also worth noting that while parenteral antibiotics may be indicated in cases of severe malaria due to a high risk of concomitant bacteria, most of the children in this study received oral antibiotics, which did not have a bearing on the concomitant bacteraemia [12]. Furthermore, prescribing only antibiotics to some children may further delay the administration of appropriate anti-malarials, potentially worsening their outcomes. The implication of the observations on antibiotics suggests the need to refine the guidelines for antibiotic use in suspected cases of severe malaria especially at lower health care levels.

This study also shows that most pre-hospitalisation medications were received from patent medicine stores and pharmacy shops, with only about 10% visiting PHC, which is the recommended first point of call for a sick child with severe malaria. This finding further raised the issues of the need to understand while sick children are not presenting at PHC, including the possibility of secondary health facilities being closer than some PHC or the preference for seeking care at secondary health facilities. It is also worth noting that informal sectors where most of the children in this study received treatment were acknowledged in the recent stakeholder meeting in Nigeria and may need to be considered in the delivery of malaria essential services, especially if the country's desire to reduce malaria deaths to less than 50 per 100,000 population is to be achieved [9, 11]. Caregivers often seek treatment from informal sectors, including patent medicine stores, due to their closeness to the community, convenience, lack of access to formal healthcare, and relative affordability compared with the formal sector [18].

This observation also calls for a critical appraisal of current strategies of deploying pre-referral artesunate to PHC facilities within the country, where about 10% of sick children with severe malaria seek care at the onset of their illnesses, as observed in this study. A study on malaria delivery services among patent medicine vendors in Nigeria showed that they could be leveraged for the delivery of malaria-related services if trained and supervised, especially before the severe form of the disease [18]. Therefore, there is a need for the expansion of a pre-referral artesunate policy to include informal sectors with robust training in the diagnosis and delivery of antimalarial services, including rectal artesunate.

The findings from this study show that only 5% of the children in this study received injectable artesunate and were associated with impaired levels of consciousness. This observation may be related to the fact that only a fraction (approximately 10%) of the study children visited the PHCs where this medication was supposed to be administered. In addition, these observations may reflect broader challenges in malaria treatment across sub-Saharan Africa [19]. Some of these challenges include limited access to formal healthcare, health system inefficiencies, supply chain issues, and caregiver behaviours [19].

Table 5 Factors associated with pre-referral injectable artesunate

Variable	Pre-referral treatment, *n* = 7	Adjusted odds ratio	95% Confidence interval	*P*
Age groups [months]				
≤ 12	1			
13–59	2	0.253	0.017, 3.867	0.253
≥ 60	4	1.458	0.141, 12.260	0.748
Male	3	0.354	0.065, 1.928	0.230
Impair levels of consciousness*	2	17.876	2.050, 155.883	0.009

*A Blantyre comma score < 3 or Glasgow Coma score of < 11

Injectable artesunate being associated with unconsciousness may be related to the fact that this is a well-known danger sign among the parents and healthcare workers among the clinical features of severe malaria and hence likely to have received a parenteral anti-malarial [20]. The low proportion of patients who received appropriate pre-referral artesunate treatment in this study also indicates significant gaps in healthcare delivery, which may hamper the country's desire for timely and adequate treatment of severe malaria.

This study did not observe any association between sociodemographic factors and pre-referral artesunate injection. Although this finding could not be compared to any similar study, socio-demographic factors have been documented to influence malaria treatment-seeking behaviour in hospitalised children with severe malaria [21]. Also, no plausible explanation could be proposed for the lack of an association between the socio-demographics and injection rates; this will require further exploration with a larger sample size.

This study revealed a low crude mortality rate of 1.5%, which is consistent with the country wide decrease in paediatric malaria fatalities [2] and far lower than the data from tertiary hospitals in Nigeria [22]. The low mortality observed in this study may be due to the proximity of the health facility to the community, and government-subsidised cost of treatment, including free treatment for the diagnosis and treatment of malaria. In addition, the hospital protocol for administration of the first dose of parenteral artesunate within one hour of presentation, in line with the national guidelines for the management of severe malaria, may also contribute to the improved outcomes [23]. This observation further supports the need for more data on the role of pre-referral injectable artesunate in real-life scenarios at the community level.

Study strengths and limitations

This is the first study at the secondary level in Nigeria to examine the role of pre-referral artesunate since the country's adoption of the WHO recommendation for severe malaria, with prospective data gathered from July 2023 and August 2024. However, this study had some limitations. First is its cross-sectional design, which means that this study cannot establish a causal relationship. Second, this is a single secondary health facility data and may not be a true reflection of the entire state or region. Third, inquire about the details of the tests performed before pre-referral medication was administered to the children with severe malaria were not evaluated. Fourth, the sample size was relatively small (137) and may have impacted a few of the associations during the statistical analysis.

Conclusion

This study showed a very low uptake of pre-referral injectable artesunate among children admitted with severe malaria at a secondary health facility, and the presence of impaired levels of consciousness increased the odds of a child receiving injectable artesunate. This study also showed that a high number of children with severe malaria received pre-hospitalisation medications and were mostly inappropriate with some receiving only antibiotics. Considering the contribution of the informal section to malaria in Nigeria, there is a need to consider their incorporation into the delivery of key interventions for malaria elimination in the country.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12936-025-05317-6.

Additional file 1.

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Author contributions
ORI was involved in the conceptualization, literature review, data curation and analysis, draft, and critical appraisal of the manuscript. AA was involved in the conceptualization, literature review, data curation and analysis, and draft of the manuscript. LAF was involved in the conceptualization, literature review, data curation and visualization, and draft of the manuscript. MRF was involved in the conceptualization, literature review, data curation, data visualization, and draft of the manuscript. MA was involved in the conceptualization, literature review, data curation and visualization, and draft of the manuscript. MBA was involved in the conceptualization, data visualization and analysis, draft, and critical appraisal of the manuscript. OAM was involved in the conceptualization, data visualization and analysis, draft, and critical appraisal of the manuscript. All authors read and approved the final version of the manuscript.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study was approved by the Kwara State Ministry of Health Ethics Review Committee. This study was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from the parents and guardians of all participating children. Data were maintained with strict confidentiality, secured in a password-protected computer, and de-identified during the analysis process.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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