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Adherence to severe malaria treatment guidelines in Northern Uganda: a mixed-methods study

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Abstract

Background Adherence to severe malaria treatment guidelines is crucial for effective case management and reducing malaria-related morbidity and mortality. However, non-compliance among healthcare workers remains a challenge, particularly in resource-limited settings. This study assessed the level of adherence to severe malaria treatment guidelines among healthcare workers in public hospitals in the Acholi sub-region of Northern Uganda and explored factors influencing this adherence.

Methods A convergent parallel mixed-methods design was employed, incorporating both quantitative and qualitative approaches. Quantitatively, 384 patient records from Anaka General Hospital, Kitgum General Hospital, and Gulu Regional Referral Hospital were reviewed using a checklist. Qualitative data were collected via key informant interviews (KIIs) among nine purposely selected Healthcare Workers. Descriptive statistics were used to summarize adherence levels, and a modified Poisson regression analysis was conducted to identify associated factors. Statistical significance was set at $p < 0.05$. Thematic analysis using NVivo software was done for the qualitative part.

Results The level of adherence to severe malaria treatment guidelines was 33.07%. Non-adherence was observed for recommended treatment with intravenous (IV) drugs followed by oral medications for severe malaria (38.3%) and treatment of only malaria confirmed (25%). Medical doctors were more likely to adhere to malaria treatment guidelines [aIRR 1.7, $p = 0.035$] than other professionals. The qualitative findings categorized the facilitators of adherence into four themes including healthcare workers' knowledge and training support, institutional and policy support, guidelines accessibility and ease use, healthcare workers positive attitudes and motivation. Barriers to adherence included knowledge and awareness gaps, resource availability constraints, as well as socio-cultural and patient factors.

Conclusion Adherence to severe malaria treatment guidelines in Uganda is suboptimal, with significant gaps in prescribing practices. Institutionalization of routine refresher training, mentorship and support supervision for healthcare workers are critical to achieving Uganda's 2025 malaria reduction targets.

Keywords Severe malaria, Malaria treatment guidelines, Adherence, Uganda

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Background

Globally, Malaria still remains a public health concern, with the estimated burden rising to 263 million cases in 2023, an increase of 11 million from 2022 [1]. The African region alone is estimated to have 233 million cases, accounting for 94% of the global burden [1] and 95% of global malaria deaths, of which 80% were children below 5 years) [2]. In Sub-Saharan Africa (SSA) alone, more than half of the global cases were registered despite the implementation of various strategies to reduce malaria cases and deaths [3] like distribution of insecticide treated nets for beds (ITN), conducting Indoor Residual Spraying (IRS), and using Artemisinin-based Combined Therapy (ACT) for malaria treatment [4].

The malaria prevalence rate is 19% in Uganda, contributing 5% to the global burden [5, 6]. The prevalence of severe malaria is estimated at 29.8%, with febrile convulsions, hyperparasitaemia, and circulatory shock as leading presentations, and 14% mortality rate [7].

Reports from the Uganda 2023 Malaria Profile indicate that 95% of the entire population is at risk of acquiring malaria, with high transmission areas found in the Lango, Acholi, Northern Karamoja, West Nile, as well as Busoga regions. These Northern Uganda areas currently report an average of 37600 cases per day, resulting in increased hospitalization and mortality rates [8]. According to data from the District Health Information System 2 (DHIS2), 11.1 million malaria cases were reported in Uganda between July 2023 and June 2024 in which 1.3 million cases were from Acholi region [9, 10]. Factors such as unique post-conflict health system challenges, low literacy rates, disparities in drug supply and health worker supervision are unique drivers of malaria transmission in Northern Uganda [11].

In 2010, the World Health Organization (WHO) recommended a mandatory "test and treat policy", which Uganda adopted in 2011[12]. The latest WHO guideline for severe malaria recommends using parenteral artesunate as the first line treatment, with intramuscular artemether and parenteral quinine as the first and second alternatives, respectively [13]. This should be followed by oral artemisinin-based combined therapy (ACT) for the subsequent three days [13].

The malaria treatment guidelines for severe malaria in Uganda align with the WHO guidelines as outlined in the Uganda Clinical Guidelines (UCG) 2023 [14]. Furthermore, the Ugandan government, through the Malaria Control Programme (MCP) at the Ministry of Health (MOH), has developed strategic policy documents such as the Uganda Malaria Reduction and Elimination Strategy Policy 2021–2025 (UMRESP) [5]. This strategy aims to halve malaria infections and reduce malaria-related deaths by 75% by 2025 compared to 2019 levels, by focusing on improving diagnosis, ensuring 90% appropriate management of malaria cases in health facilities, and maintaining effective treatment practices [15]. Achieving this target, however, is contingent upon the adherence of healthcare workers to the guidelines.

In Africa, many studies [16–18] have shown that the adherence to malaria treatment guidelines is generally poor with knowledge gaps among healthcare workers (HCWs) as the main barrier. Commonly reported clinical shortcomings include delays in diagnosis [19], incomplete documentation [20], incorrect dosing or omission of the recommended injectable artesunate [21], failure to switch to the full oral artemisinin-based combination therapy after initial parenteral treatment [21], and inadequate monitoring of vital signs and complications [22]. A 2023 study conducted in Kampala, Uganda, revealed the adherence to be at a sub-optimal level of 63.1% [4]. In Ethiopia's private sector, while 80.6% of suspected cases were tested, only one-fifth of confirmed patients received treatment according to national guidelines [23]. Similarly, studies conducted in Mozambique and Nigeria found adherence levels of 72% and 60.8% respectively [16, 17], while in Tanzania, 54.6% of healthcare workers adhered strictly to diagnostic and treatment guidelines for malaria [24]. Key factors associated with better adherence included recent training on guidelines [25], continuing medical education sessions, and functional laboratory services [18].

Despite comprehensive policies and guidelines from the Ministry of Health [12, 26], there remains a significant gap in monitoring adherence to these guidelines, particularly in high-burden areas like the Acholi subregion. The observed reduction in policy implementation at this stage raises concerns about the sustainability of gains made in malaria control and poses a major barrier to achieving the national malaria reduction targets [5]. This study was conducted to assess the level of adherence to the severe malaria treatment guidelines by HCWs in the Acholi subregion, and to identify factors influencing adherence to the severe malaria treatment guidelines among HCWs in Public hospitals in the Acholi subregion.

Methods

Study area

The study was conducted in three public hospitals in the Acholi Region, located in the northern part of Uganda. The hospitals included: Anaka General Hospital, Kitgum General Hospital and Gulu Regional Referral Hospital. They were purposively selected because they are high volume health facilities and referral sites for the lower-level health facilities in the region, thus receive large volumes of malaria cases.

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Study design

This study used a facility-based convergent parallel mixed method design that integrated both quantitative and qualitative approaches. The quantitative component was used to determine the HCW level of adherence to the severe malaria treatment guidelines by retrospectively reviewing inpatient files and also helped to determine the factors influencing adherence to severe malaria treatment guidelines.

The qualitative component, on the other hand, was used to explore additional facilitators and barriers to adherence to the guidelines and understand the explanations behind the factors in quantitative part [27]. To integrate the quantitative and qualitative arms, the results from the quantitative phase were compared with emerging qualitative themes during the analysis. This triangulation allowed the qualitative data to explain, contextualize, or contrast the quantitative results, thereby enhancing the depth and validity of the study conclusions.

Study population

Medical records of adults and pediatric inpatients admitted with severe malaria from 1st January 2024 to 31th March 2024, defined according to the Uganda National Malaria Treatment Guidelines (2022) as laboratory-confirmed *Plasmodium falciparum* infection with at least one clinical or laboratory indicator of severity (e.g., impaired consciousness, convulsions, severe anaemia [Hb < 5 g/dl], respiratory distress, jaundice, haemoglobinuria, or hyperparasitaemia). In total, 2139 files were recorded from 1st January 2024 to 31th March 2024 in the three selected hospitals.

For qualitative data, study population comprised of healthcare workers involved in managing severe malaria on medical and pediatric wards, including medical officers/clinical officers, nurses, pharmacy staff, and laboratory personnel) who purposively selected for key informant interviews.

Sampling and sample size calculation

For the quantitative part of the study, a sample size of 384 was calculated using Cochran's formula [20] while considering an adherence level of 50% as a conservative estimate in the absence of consistent, reliable data for the Acholi sub-region and a sampling error of 5% and a 95% confidence interval.

Here is the formula**: $\mathbf{n = Z^2pq/e^2}$,** where, n is the sample size, z is the selected critical value of desired confidence level, p is the estimated proportion of an attribute that is present in the population,

q = 1−p and e is the desired level of precision

Substituting with values:

$$n = (1.96)^2 * 0.5 * (1 - 0.5)/(0.05)^2$$

$$n = 384$$

Participants were recruited proportionately based on the facility's malaria inpatient case load during the study period as shown in Table 1.

For each hospital purposively selected, medical records of patients admitted with severe malaria were sampled using a stratified sampling approach. This ensured that the selected files represented different patient categories such as age, gender, and severity of malaria (inpatient cases) and health care facilities. Then, a systematic random sampling method was used to draw a sample from each category. The sampling interval ($k = 6$) was determined by dividing the total number of malaria outpatient records during the study period (N = **2139**) by the required sample size (n = **384**). For each facility, a random starting point within the first 6 records was chosen using a random number generator. Subsequently, every 6th record was selected until the desired sample size was reached.

For the qualitative component, purposive sampling was employed to select healthcare workers and facility managers with relevant experience in malaria case management. Initially, 18 key informants were selected: two clinicians, two nurses, one pharmacy staff, and one laboratory personnel from each hospital, however, data collection was stopped after 9 interviews, which gave us thematic saturation was researched. This was determined during concurrent data collection and analysis, when no new themes or significant insights emerged and subsequent interviews confirmed existing themes, indicating

Table 1 Sample size

Health facilities	Severe malaria cases in 3 months recorded in DHIS2 (Jan–March 2024)	% Proportionality	Sample proportionality
Gulu referral hospital	776	36	138
Anaka hospital	526	25	96
Kitgum hospital	837	39	150
Total	2139	100	384 files

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that saturation had been achieved. The participants were approached in person at the health facilities by the research team, provided with information about the study objectives and procedures, and invited to participate voluntarily. The interviews were conducted within the hospital premises, in private spaces such as offices or designated meeting rooms, and no third parties were present during the interviews apart from the interviewer and the participant.

Inclusion criteria

For the quantitative data, the study included medical records of all patients admitted with severe malaria on medical and paediatric wards between 1st January 2024 to 31st March 2024.

For the qualitative data, HCWs managing severe malaria on medical and paediatric wards of the selected facilities were included.

Exclusion criteria

For quantitative data, pregnant mothers admitted for severe malaria on wards were excluded.

For the qualitative data, HCWs who did not consent to participate in the study were excluded.

Data collection tools

The quantitative data on health facilities and HCW indicators in severe malaria treatment on adherence to guidelines were collected using a patient's medical records assessment tool. The tool was adapted from related studies [28] and further aligned with the 2023 Uganda National Malaria Treatment Guidelines to ensure context relevance [26, 29]. The qualitative data was collected using a key informant interview (KIIs) guide designed by the researcher based on similar published studies [23, 30, 31]. The key informant interview guide consisted of open-ended questions supplemented with prompts to facilitate detailed exploration of issues related to malaria treatment adherence.

Study variables

Dependent variable was adherence to severe malaria treatment guidelines, considered for full compliance with all recommended steps: (1) assessment with both medical and physical examinations (patient weight, body temperature, fever, signs of severe illness such as neurological status, pallor, hydration status) (2) confirmation of malaria with a diagnostic test (RDT or microscopy), (3) treatment of positive cases with IV drugs and oral antimalarial on discharge with appropriate antimalarial drug, dosage, and treatment duration as per national guidelines or not prescribing antimalarial drugs to participants who test negative. Partial compliance, such as correct initiation of intravenous therapy without the recommended oral follow-up, or correct drug choice but incorrect dosage, was classified as non-adherence.

Independent variables included socio-demographic characteristics of healthcare workers, facility-related factors and knowledge-related factors. Additionally, contextual variables such as geographic location of the facility, staffing levels, and patient volumes were explored qualitatively.

Data collection techniques and procedures

A well-coordinated research team comprising the principal investigator and four research assistants collected the data. Hospitals were approached sequentially, and authorization was obtained. The patient's medical records were reviewed using a patient's medical records assessment tool designed and adapted from similar studies [4, 18, 25] to assess the actual practices related to severe malaria treatment and care within each health facility. Data quality was ensured through training of research assistants, pretesting tools, field editing, double-checking entries, and supervision.

For qualitative data at each health facility, the study content and objectives were clearly explained to all study participants, and the key informant guiding questions were administered to only those who provided written consent. Each interview took 45–60 min and [23] and was audio recorded. The interviews were conducted in English because all interviewees were fluent in the language. Each participant was interviewed once, and no repeat interviews were carried out. Additionally, transcripts were not returned to participants for review and correction.

Data analysis

Data cleaning was performed in Microsoft Excel 2022, and analysis was conducted using STATA 16.0. For quantitative data, descriptive statistics were used to summarize demographic data (frequencies, percentages for categorical variables; mean, median, standard deviation for continuous variables). Adherence to severe malaria treatment guidelines was assessed descriptively. Factors associated with adherence were analysed using modified Poisson regression (both bivariate and multivariate) with robust standard errors. Variables with $p < 0.2$ or biological plausibility in bivariate were included in the final model via stepwise elimination. Results were reported using Incident Rate Ratios (IRRs) with 95% confidence intervals. Statistical significance was set at $p < 0.05$.

For qualitative data, both inductive and deductive thematic analysis was used using NVivo. Data from interviews was transcribed and coded by two independent coders. Both coders reviewed the transcripts separately,

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applied initial codes, and then met to compare coding. Any discrepancies were discussed and resolved through consensus. A final coding framework was then developed based on both deductive codes (derived from the research objectives) and inductive codes (emerging from the data). Thematic analysis was used to identify recurring themes or patterns related to facilitators and barriers hindering adherence to severe malaria treatment guidelines. The process involved familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final list of codes and themes. The findings from qualitative analysis were triangulated with quantitative findings to provide a comprehensive understanding of the factors influencing adherence.

Data quality control

For the quantitative data, data quality was ensured through pretesting of data abstraction forms on 20 patient files at Soroti Regional Referral Hospital to ensure clarity, relevance, and appropriateness before full data collection and double data entry was done minimize data entry errors.

For qualitative data, reliability and credibility were maintained through standardized interview guides, training of interviewers, and pilot testing of the tools. To enhance trustworthiness, transcripts were double-checked against recordings, and a subset was independently coded by two researchers. Emerging themes were validated through team discussions and triangulated with quantitative findings to ensure robustness. Field notes were taken during and immediately after the key informant interviews to capture contextual details such as non-verbal cues and initial impressions. These notes were incorporated into the analysis to complement the interview transcripts and enhance interpretation. The KII guide was pilot tested with two healthcare workers at Soroti Regional Referral hospital, and revisions were made to improve clarity, flow, and relevance prior to data collection.

Results

Sociodemographic characteristics of the study participants

A total of 384 patients' medical records were assessed. Nearly half of the malaria cases were aged 6–18 years 187/384 (48.7%), followed by those aged ≤ 5 years 93/384 (24.22%). The sex distribution was nearly equal, with females accounting for 51.56% (n = 198/384). Table 2 provides the details.

For the key informants' interviews, the age range was 29 to 50 years, and years of experience ranged from 4 to 20 years. Academic qualifications varied from diplomas to a bachelor's degree. More details are reported in Table 3.

Table 2 Sociodemographic characteristics of participants

Variable	Options (n = 384)	n (%)
Age[1] (years)	≤ 5	93 (24.22)
	6–19	187 (48.7)
	20–30	53 (13.8)
	> 30	51 (13.28)
Sex	Female	198 (51.56)
	Male	186 (48.44)
Facility	Kitgum GH	150 (39.06)
	Gulu RRH	138 (35.94)
	Anaka GH	96 (25)

GH: General Hospital; RRH: Regional Referral Hospital

[1] Classed based on clinical relevance and malaria epidemiology in Uganda

Level of HCWs' adherence to severe malaria treatment guidelines

The overall level of adherence to severe malaria treatment guidelines was 33.07% (n = 127/384). Among the 384 patients that participated in the study, less than half, 180/384 (46.88%) had had a detailed history taking and medical examination performed, and 330/384 (85.94%) were tested for malaria. Majority 298/330 (90.3%) tested positive, of whom 237/298 (79.53%) were given a right treatment of IV drugs followed by oral medicines on stabilization. A total 24/32 (75%) patients tested negative and were not given antimalarial drugs while others were treated despite a negative test. Table 4 provides more details.

Factors influencing adherence to the severe malaria treatment guidelines among HCWs in public hospitals in Acholi sub region

On bivariate and multivariable analysis, medical officers were more likely to adhere to severe malaria treatment guidelines [aIRR = 1.7 (95% CI 1.03–2.794), P = 0.035] as compared to clinical officers (reference category) and nurses [aIRR 0.2 (95% CI 0.0332–1.851), P = 0.174].

Table 5 indicated that adherence to the severe malaria treatment guidelines was more likely among HCWs from general hospitals [aIRR = 2.9 (95% CI 1.782–4.817), P = 0.001] for Anaka general hospital and [aIRR 1.4 (95% CI 0.780–2.442), P = 0.268] for Kitgum general hospital as compared to those treated from Gulu regional referral hospital.

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Table 3 Sociodemographic characteristics of qualitative key informants

Participant ID	Age (years)	Gender	Job title	Years of experience	Highest qualification	Department
HCW-01	30	Male	Nurse	5	Diploma	Pediatrics
HCW-02	45	Female	lab technician	15	Diploma	Laboratory
HCW-03	38	Male	Medical officer	10	Bachelor's Degree	Medical ward
HCW-04	29	Female	Medical officer	4	Bachelor's Degree	Pediatrics
HCW-05	50	Male	Clinical officer	20	Diploma	Medical ward
HCW-06	35	Female	Clinical officer	8	Diploma	Medical Ward
HCW-07	42	Male	lab manager	12	Bachelor's Degree	Laboratory
HCW-08	31	Female	Pharmacist	6	Bachelor's Degree	Pharmacy
HCW-09	48	Male	Nurse	18	Bachelor's Degree	NICU

Table 4 Adherence to severe malaria treatment guidelines

Variable	Options	n (%)
Participants managed for severe malaria	Yes	384 (100)
Both medical and physical examinations done (n = 384)	Yes	180 (46.88)
Assessed for patient weight	Yes	164 (42.71)
Assessed for body temperature	Yes	47 (12.24)
Symptoms of severe illness recorded	Yes	288 (75)
History of fever assessed	Yes	327 (85.16)
Presumed diagnosis stated	Yes	368 (95.83)
Suspected for malaria and were tested (n = 384)	Yes	330 (85.94)
Test method used (n = 330)	Microscopy test	207 (62.73)
	mRDT test	103 (31.21)
	Both mRDT and microscopy	20 (6.06)
Test results (n = 330)	Positive	298 (90.3)
	Negative	32 (9.7)
Tested positive and were given IV drugs and orals on discharge (n = 298)	Yes	237 (79.53)
Type of IV drugs (n = 298)	Artesunate injection	296 (99.33)
	Intramuscular Artemether	1 (0.34)
	IV quinine	1 (0.34)
Oral medications given (n = 298)	Artemether Lumefantrine	156 (52.34)
	Dihydroartemisinin/Piperaquine	111 (37.24)
	Others	31 (10.40)
Tested negative and were not given any antimalarial (n = 32)	Yes	24 (75.00)
Treatment in respect to severe malaria treatment guidelines (Adherence)	Yes	127 (33.07)

IV-Intravenous

Facilitators of adherence to the severe malaria treatment guidelines among healthcare workers in public hospitals in the Acholi subregion

Factors facilitating adherence to the severe malaria treatment guidelines were further explored qualitatively with key informants. These facilitators are categorized into four themes: knowledge and training support, institutional and policy support, guidelines accessibility and ease of use, and positive attitudes and motivation as shown below.

Theme 1: knowledge and training support

Two key sub-themes concerning continuous medical education and training at the academic level emerged and are explained in details.

Sub-theme: continuous medical education and training

Participants emphasized that ongoing education, such as on-the-job training, mentorship programmes, refresher courses, continuous medical education sessions (CMEs), and seminars, plays a vital role in improving compliance

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Table 5 Bivariate and multivariable analysis of factors associated with adherence to the severe malaria treatment guidelines among HCW in Public hospitals in Acholi subregion

Variable	Options	Adherence, n (%)		Bivariate analysis		Multivariable analysis	
		No (n = 257)	Yes (n = 127)	cIRR (95% CI)	P-value	aIRR (95% CI)	P-value
Age	≤ 5 years	57	36	1.7 (0.856–3.162)	0.135	1.7 (0.829–3.437)	0.149
	6–19 years	123	64	1.5 (0.785–2.695)	0.234	1.1 (0.577–2.130)	0.758
	20–30 years	38	15	1.2 (0.560–2.570)	0.633	1.4 (0.639–2.935)	0.420
	> 30 years	39	12				
Sex	Male	124	62	1.0 (0.717–1.438)	0.931		
	Female	133	65	Ref.			
Facility	Gulu RRH	107	31	Ref.			
	Anaka GH	41	55	2.5 (1.642–3.961)	**0.001**	2.9 (1.782–4.817)	**0.001**
	Kitgum GH	109	41	1.2 (0.763–1.941)	0.410	1.4 (0.780–2.442)	0.268
Cadre of HCW	Medical officer	173	103	1.5 (0.98–2.422)	0.061	1.7 (1.03–2.794)	**0.035**
	Clinical officer	72	23	Ref.			
	Nursing officer	12	1	0.3 (0.04–2.353)	0.262	0.2 (0.0332–1.851)	0.174

cIRR: Crude Incident Rate Ratio, aIRR: Adjusted Incident Rate Ratio, CI: Confidence Interval

with severe malaria treatment guidelines by keeping healthcare workers informed and current with best practices.

On-job training: Participants noted that on-job training programmes, such as refresher courses, CMEs, and workshops/seminars on malaria guidelines, can enhance adherence to severe malaria treatment guidelines. These courses provided opportunities to refresh knowledge and ensure healthcare workers were up-to-date with the latest protocols.

> *Health workers should be given refresher training, you know, medicine can evaporate with time. We have to train them to cope with the new guidelines.* ***(Participant 4 Medical officer)***

Mentorship programmes: Mentorship programmes were seen as an essential support structure, with senior healthcare workers offering guidance on how to manage complex malaria cases in line with the guidelines. Participants noted that mentorship provided a platform for ongoing learning in a practical and hands-on setting.

> *Mentors, yes. They train the fresh workers and students on what to do and how to deal with the guidelines.* ***(Participant 1, Nurse)***

Sub-theme: training at the academic level

Participants also noted the role of academic training in medical education institutions in enhancing adherence to malaria guidelines. Facilitators such as curriculum content and level of education were noted as quoted below;

Level of qualification: Participants indicated that the level of qualification of the HCW significantly influences their ability to adhere to severe malaria treatment guidelines. Participants observed that individuals with higher qualifications, such as medical doctors or specialist nurses, displayed greater confidence in applying the guidelines accurately. However, some participants with lower qualifications, such as clinical officers or nursing assistants, mentioned that they occasionally felt more prepared than their colleagues.

> *"I think qualification matters. I expect a doctor to be good at treating malaria than maybe a nurse".* ***(Participant 8, Pharmacist)***

Curriculum content: The content of healthcare training curricula was also identified as a key factor in guideline adherence. Participants felt that while severe malaria treatment was well-covered in most programmes, the focus on practical application and updates on new treatments was often insufficient. Some participants suggested that curricula should be continuously revised to include newer treatment regimens.

> *The curriculum content during my training was solid, but it was heavily theoretical. I wish there had been more practical training on how to apply the malaria guidelines in real-world cases, especially when patients have complications.* ***(Participant 6, Clinical officer)***

Theme 2: guideline accessibility and ease of use

One sub-theme emerged concerning the guideline accessibility and ease of use as a major facilitator to adherence to severe malaria treatment guidelines.

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Sub-theme: availability of clear and simplified guidelines

It was noted that the availability of clear and simplified guidelines is a major facilitator to adherence to severe malaria treatment guidelines, as several components that make guidelines simplified and easy to implement were noted as shown below;

Job aids: Participants also noted the presence of job aids such as malaria treatment leaflets as one of the facilitators of adherence to severe malaria treatment guidelines.

> *"Here we have sections of guidelines given out as leaflets, printed out, for people who are lazy. Secondly, we can have screens that show these guidelines or educational series. These help even patients."* ***(Participant 4, Medical officer)***

Wall chart: As one of the facilitators, wall charts were widely regarded as a useful tool in improving adherence to severe malaria treatment guidelines. Participants noted that having simplified treatment wall charts helped them make timely and accurate treatment decisions, especially in busy settings.

> *Do you see this chart, it saves a lot. When you forget the dose, you just look at the wall and you treat the child.* ***(Participant 6, Clinical officer)***

Mobile apps for quick reference: The availability of clear and simplified guidelines on mobile apps for quick reference was reported to improve access to malaria guidelines and hence promote adherence to these guidelines. Participants appreciated the accessibility and convenience of apps that provided real-time access to the latest guidelines and drug doses.

> *"These days, life is easy. We have phones with some apps or books, you even check on the phone when you forget. It's just your problem if you don't follow the guidelines."* ***(Participant 1, Nurse)***

Theme 3: institutional and policy support

Institutional and policy support emerged as a crucial factor influencing adherence to severe malaria treatment guidelines. Participants highlighted the role of strong supervision and monitoring as the sub-theme under this theme as follows;

Sub-theme: strong supervision and monitoring

The majority of the participants noted the role of support supervision and monitoring in promoting adherence to severe malaria treatment guidelines. This supervision takes various forms as shown below;

Regular audits: Participants highlighted that regular audit were an important mechanism for ensuring adherence to severe malaria treatment guidelines. These audits allow healthcare workers to assess their own practices and identify areas of improvement.

> *"Regular audits help us identify where we might be going wrong and areas where we can improve. It's not just about the numbers; it's about making sure we're actually applying the guidelines correctly in practice".* ***(Participant 8, Pharmacist)***

Supportive supervision: Supportive supervision was mentioned as a critical factor in guiding healthcare workers to adhere to malaria guidelines. Participants felt that supportive supervision went beyond simple oversight but promoted a conducive environment for learning.

> *"Everyone has to be supervised, even the boss is supervised. Having supervisors can help clarify things you may be unsure about, and it is easier to follow the guidelines".* ***(Participant 6, Clinical officer)***

Facility recommendations: Recommendations by the health facility to their staff were also noted as a facilitator to adherence to severe malaria treatment guidelines. Participants noted that health facilities that have strict policies on the use of guidelines

> *"I think when a hospital has a policy that for them, they want treatment based on only guidelines, the staff will adhere. It's different when the policies are lousy".* ***(Participant 8, Pharmacist)***

Theme 4: positive attitudes and motivation

This theme identified attitude related facilitators for adherence to severe malaria treatment guidelines. Having a positive attitude facilitated the use of the guidelines.

Sub-theme: HCW commitment to best practices

It was also noted that commitment to best clinical practices by HCWs can enhance adherence to severe malaria treatment guidelines. Factors such as the need to maintain a strong professional ethics, patient-centred care, and evidence-based medicine were noted to promote adherence as shown below.

Strong professional ethics: It was reported that healthcare workers who adhered to strong professional ethics were more likely to follow severe malaria treatment guidelines as compared to those who did not. Participants indicated that maintaining high ethical standards, such as prioritizing patient care and respecting professional duties, helped ensure consistent and guideline-compliant practices.

> *"Strong professional ethics keep us focused on what's*

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best for our patients. When we stay true to our ethical responsibilities, it naturally aligns with following the treatment guidelines". ***(Participant 4, Medical officer)***

Patient-centred care: Likewise, the need to provide patient-centreed care was seen as an essential factor in adhering to severe malaria treatment guidelines. Participants emphasized that when healthcare workers focused on individual patient needs and preferences, it led to better communication, and it made them practice what is recommended.

"Also, patient-centred care. Patient-centred care is important because when we engage with patients, listen to their concerns, and personalize treatment plans, we are more likely to adhere to the guidelines". ***(Participant 4, Medical officer)***

Evidence-based medicine: The use of evidence-based medicine was frequently mentioned as a key factor in ensuring that severe malaria treatment was done according to the guidelines. This is because HCWs know that malaria guidelines are evidence based, and hence have a responsibility to practice them.

"As a healthcare provider, I always ensure that I follow the guidelines because it is my responsibility to provide evidence-based care to my patients. These guidelines promote proper decision making" **(*Participant 6, clinical officer*)**

Sub-theme: Supportive team culture and collaboration

The majority of the participants noted the importance of teamwork and health care worker collaborations as a facilitator to adherence to severe malaria treatment guidelines, as shown below;

Teamwork: A culture of teamwork and collaboration among healthcare workers was identified as a significant facilitator of adherence to severe malaria treatment guidelines. Participants noted that working collaboratively with other healthcare workers, such as laboratory staff, doctors, and nurses, facilitated the proper implementation of the guidelines and improved patient care.

"We work together as a team to cross-check each other's decisions. If the lab person is not sure, he can call us, and then we see what is the best thing to do" **(*Participant 4, Medical Officer*)**

Proper reporting of lab results: Participants however noted that proper communication and reporting of lab results were crucial in ensuring accurate diagnosis and treatment.

"Sometimes even us (nurses) advise the doctors. A child can be very sick and the doctor just gives tablets. It's my role to assess the patient and then tell the doctor to give injections" ***(Participant 9, Nurse).***

Barriers to adherence to the severe malaria treatment guidelines

Barriers to adherence to the severe malaria treatment guidelines were explored. Overall, these barriers were categorized into two themes that emerged from the transcripts: (1) knowledge and awareness gaps, (2) resource availability constraints, and socio-cultural and patient factors.

Theme 1: knowledge and awareness gaps

The theme knowledge and awareness gaps of severe malaria treatment guidelines were noted as major barriers to adherence to severe malaria treatment guidelines, with two sub-themes emerging as described below.

Sub-theme: limited training on updated guidelines

Participants highlighted a lack of regular training on updated severe malaria treatment guidelines as a major barrier to the implementation of severe malaria treatment guidelines. The codes generated under this subtheme are described below.

Lack of continuous medical education and outdated knowledge: Many healthcare workers reported limited access to continuous medical education, leading to outdated knowledge on malaria management. The absence of regular training and refresher courses contributed to knowledge gaps, reducing adherence to updated treatment guidelines.

"The ministry normally updates the guidelines, but for us, they don't give us training on the new guidelines. I think we need some continuous medical education so that we can have good knowledge on the guidelines whenever they are changed." ***(Participant 6, clinical officer)***

Participants noted a lack of updated knowledge on severe malaria treatment guidelines, which limits their ability to effectively apply these guidelines. It was observed that these guidelines are regularly updated, yet efforts are rarely made to educate health workers on the current guidelines, causing some to have outdated knowledge. One of the participants stated:

"Some health workers have outdated knowledge, maybe because we don't give them continuous medical education. This may affect the application of these guidelines." ***(Participant 4, Medical officer)***

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Inadequate refresher courses: the majority of the participants noted that refresher courses were infrequent or completely absent in some facilities, making it difficult to stay updated on proper malaria management protocols.

> *"This government, we don't get refresher trainings. Without refresher courses, we rely on old practices, which may not align with the current treatment guidelines".* ***(Participant 9, Nurse)***

Sub-theme: misinterpretation of malaria guidelines

Some HCWs interviewed expressed difficulties in interpreting the malaria guidelines as one of the major barriers to the implementation of malaria guidelines. Major points of confusion were noted on interpreting drug dosages and diagnostic protocols as shown below.

Confusion about drug dosages: It was noted that HCWs often misinterpret malaria guidelines mainly drug dosages. This confusion was most reported on the use of quinine, artesunate or artemether. One participant explained:

> *"Some doctors don't know the right prescription. They for example, don't know when we should use quinine or artesunate. They are just used to prescribing artesunate even when we have to use quinine."* ***(Participant 1, Nurse)***

Misapplication of diagnostic protocols: It was also noted that health workers often misinterpret diagnostic protocols and results, an act that affects what treatment they give.

> *"Sometimes it can be confusing. Now, when you use the RDTs, you cannot tell whether the malaria is severe or not, and normally we have no microscope to use, especially at night."* ***(Participant 4, medical officer)***
>
> *"The lab results can tell you 3+, but the patient looks like he has a simple malaria. Here you get confused and sometimes you just decide on whether to consider it severe or mild malaria. This obviously, effects the treatment that you are going to give."* ***(Participant 4, medical officer)***

Theme 2: resource availability constraints

This theme identified that the lack of key resources for use in severe malaria treatment is one of the reasons why HCWs may not adhere to severe malaria treatment guidelines. Three sub-themes emerged as follows;

Sub-theme: frequent stock-outs of essential drugs

Participants noted that even when they know what the guidelines say, they find themselves in a difficult situation adhering to them when the drugs recommended are not available. Therefore, they provide what is available. One participant explained:

> *"The guidelines, for example, say artesunate for severe malaria, but when you check, it's not in the store. Here you just have to use whatever is available, maybe quinine or artemether."* ***(Participant 8, pharmacist)***

Sub-theme: inadequate diagnostic tools and supplies

Limited availability of diagnostic tools, particularly rapid diagnostic tests (RDTs) and functional laboratory equipment, emerged as a major challenge to the implementation of severe malaria treatment guidelines.

Shortage of Rapid Diagnostic Test (RDT) kits: The limited availability of RDT kits, forced HCWs to rely on clinical diagnosis rather than confirmed laboratory results. Due to frequent stockouts of diagnostic tools, many HCWs resorted to clinical diagnosis, which is less accurate and may result in the overuse or underuse of antimalarial drugs.

> *You know we have a challenge, when RDT kits are unavailable, we have to diagnose based on symptoms, which sometimes leads to misdiagnosis.* ***(Participant 2, lab technician).***

Malfunctioning microscopes: Also, in some facilities, the microscopes were noted to be faulty and could compromise the results. This made HCWs instead rely on clinical judgment, which is not in accordance with the treatment guidelines.

> *"Here, our lab closes at night. When you have a patient, you have to use the RDT and you know it cannot quantify the malaria. But even our microscope is faulty"* ***(Participant 6, clinical officer)***

Sub-theme: high patient load and staff shortages

Participants also noted heavy workload at their work stations as one of the barriers to adherence to severe malaria treatment guidelines.

Work overload: Participants also noted high patient load as one of the barriers to adherence to severe malaria treatment guidelines. The high number of patients limits HCWs from effectively diagnosing and following up with patients.

> *"Sometimes I have very many samples, and results are needed urgently. Here, I cannot be sure if I have done the right thing or not, and maybe the treatment can be different if I had taken my time to quantify the malaria."* ***(Participant 2, lab technician)***

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Limited time for consultations. Because of high patient volumes, participants noted that patients are often given little time at the OPD. The limited time for patient consultation meant that HCWs sometimes skipped diagnostic steps or defaulted to presumptive treatment.

> *The patient load is overwhelming. Sometimes, we don't have the luxury of following the full history to make a full diagnosis because there are so many people waiting.* ***(Participant 1, Nurse)***

Theme 3: socio-cultural and patient factors

Under this theme, two themes emerged denoting the social-cultural barriers and patient-related factors that hinder adherence to severe malaria treatment guidelines.

Sub-theme: patient preference for alternative treatments

Participants reported that some patients come to the health facilities when they already have some preferred treatment options, which are sometimes contrary to the guidelines and which sometimes make it hard for the HCWs, as quoted below.

Reluctance to accept ACT: Participants reported that patients often come for severe malaria treatment when they already have preferences for treatment, which sometimes deviates from the treatment guidelines.

> *"Some patients, when you prescribe for them Artesunate, Coartem or D-artepp as recommended by the treatment guideline, they refuse, saying that quinine works better for them." (**Participant 5, Clinical officer).***

Demand for injections over oral medication: Participants also reported that some patients try to influence them into prescribing the parenteral medications when their medical conditions do not warrant them to be given. This was highlighted by some participants as quoted;

> *"Also it is noted that many patients insist on injections even when oral ACTs are the recommended treatment. They think tablets are ineffective" (**Participant 1, Nurse**)*

Sub-theme: poor health-seeking behaviours among patients

Poor healthcare-seeking behaviour was another commonly reported challenge to many HCWs, as most patients often presented at health facilities when their condition had worsened, or they first bought medications, which made their conditions complex, making recommended treatment guidelines less effective, as described in detail below.

Late presentation to hospital: it was reported that many patients with malaria symptoms delay seeking medical care, often arriving at health facilities when the disease has progressed to severe or even life-threatening stages. Such delays not only increase the risk of complications and mortality but also limit the effectiveness of first-line antimalarial therapies that are most appropriate for uncomplicated malaria. In these situations, HCWs are frequently compelled to manage emergency symptoms and complications rather than follow standard treatment protocols designed for early-stage malaria. As a result, adherence to national severe malaria treatment guidelines is compromised, with clinical decisions being shaped more by the severity of the condition than by recommended guidelines.

> *"Patients often come late for treatment and you just have to assume its severe malaria and use IV drugs no matter the symptoms." (**Participant 4, medical officer**)*

Self-medication: Self-medication was reported as a common practice among patients, often leading to inappropriate use of antimalarial drugs before they seek professional care. Many individuals purchase over-the-counter medications without proper diagnosis or rely on traditional remedies, which can mask symptoms or lead to drug resistance. This behaviour complicates clinical decision-making for HCWs as patients often present at health facilities in advanced stages of the disease sometimes with unclear treatment histories. Thus, this undermines strict adherence to severe malaria treatment guidelines as HCWs may be forces to deviate from recommended protocols to manage complex or atypical cases.

> *"Our patients first buy drugs from the clinics, and when they come here with symptoms, you can't just give them the same medications again, but have to start on IVs, which I think is against the guidelines." (**Participant 3, medical officer**).*

Discussion

This study aimed to assess the level and factors associated with adherence to the severe malaria treatment guidelines by health care workers in Uganda, a strategy set by the Ministry of Health to ensure effective malaria management and reduce the disease burden.

In this study, the overall level of adherence to severe malaria treatment guidelines among health care workers was generally low (33.07%). The level of adherence observed in this study is lower than the findings reported in a study conducted in Kampala and Kamuli in Uganda, where adherence to severe malaria treatment guidelines among health care workers was 63% and 50.6% respectively [4, 18]. Similarly, studies conducted in

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Mozambique and Nigeria found adherence levels of 72% and 60.8% respectively, significantly higher than the current findings [16, 17]. In Tanzania, 54.6% of healthcare workers adhered strictly to diagnostic and treatment guidelines for malaria [24] while in Kenya, adherence to severe malaria treatment guidelines in private drug outlets was 20% [32] and an adherence to test and treat policy of 65% [33].

The low adherence level reported in the current study is attributed to the high prevalence of malaria in the region, which translates into a heavy patient load for frontline health workers. In many facilities, especially in rural Acholi, a limited number of staff attend to hundreds of patients daily, making it difficult to consistently follow all diagnostic and treatment steps as recommended. Under such pressure, health workers often resort to presumptive treatment without confirmatory testing or may prescribe incomplete regimens in an effort to manage the overwhelming caseloads. This situation is compounded by long waiting times, which increase community expectations for rapid treatment, further pushing providers to prioritize speed over strict adherence to national guidelines.

The variations on adherence levels between different health settings suggest differences in health system structures, training effectiveness, and monitoring mechanisms in different countries. The low level of adherence to severe malaria treatment guidelines noted in this study is likely to accelerate the emergence of antimalarial drug resistance, making severe malaria treatment more challenging. According to the WHO, sub-therapeutic dosing, incomplete treatment courses, and use of antimalarials without parasitological confirmation compromise the parasite kill rate and allow partially resistant parasites to survive and propagate [34].

This study found that adherence to severe malaria treatment guidelines was significantly associated with the cadre of the prescribing health care worker. Medical officers were more likely to adhere to severe malaria treatment guidelines than nursing officers and clinical officers. The current findings are consistent with studies conducted in Kampala in private health facilities [4] but contradict the study in public facilities in Kamuli, Uganda, which reported lower cadre health care workers adhering to the guidelines more than the higher cadres [18]. This could be due to the advanced training among medical doctors (rather than nurses) that comes with better attention and improved clinical performance [4]. However, a study done in Tanzania found no significant difference in adherence levels between doctors and nurses, attributing this to standardized treatment protocols implemented across all health care cadres [35]. The differences in adherence levels among different health cadres can be attributed to differences in curriculum content for these professionals. According to White et al. [36], medical officers undergo extensive training in disease diagnosis, treatment protocols, and clinical decision-making, which equips them with a deeper understanding of malaria management guidelines. In contrast, nursing and clinical officers may have limited exposure to detailed pharmacological and pathophysiological aspects of severe malaria treatment, making it more challenging for them to strictly follow standardized protocols.

Also, the study found that adherence to the severe malaria treatment guidelines was more likely in general hospitals than in regional referral hospital, specifically at Anaka General Hospital highlighting facility-level differences in guideline implementation. This may be due to variations in patient load and case complexity differences as regional referral hospitals often face higher patient volumes and more complex cases, which can strain staff capacity and limit adherence to protocols [37].

While the quantitative results indicated some statistically significant factors, the qualitative findings indicated the major facilitators to adherence to severe malaria treatment guidelines to be institutional and policy support, guideline accessibility, knowledge and training and HCWs positive attitudes and motivation. Institutional and policy support plays a crucial role in ensuring that health care workers have access to up-to-date malaria guidelines, ongoing training and support supervision. Previous studies conducted in Sudan revealed the same findings, where supportive supervision and policy enforcement significantly improved compliance with severe malaria treatment protocols [38], meaning facilities with strong leadership and well-implemented malaria policies demonstrate higher adherence levels. According to the 2021 WHO report, effective implementation of malaria guidelines requires *a strong institutional framework* that facilitates continuous professional development, adequate diagnostic and treatment supplies, and accountability mechanisms within healthcare facilities [29]. The findings highlight the need to align all healthcare cadres with the current standards of treatment, most especially the nursing and clinical officers, who exhibited lower adherence levels.

In this study, participants noted knowledge and awareness gaps among health care workers as one of the major barriers to adherence to severe malaria treatment guidelines. According to a study done in Nigeria, adequate knowledge ensures proper diagnosis, prescription, and administration of antimalarial drugs per national and international guidelines, hence promoting adherence levels [39]. A study done by Oluyomi et al. [17] also noted that proper knowledge helps in avoiding irrational

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prescription and overuse of antimalarial drugs, thereby reducing the risk of drug resistance.

Further, the present study reported resource availability constraints as one of the barriers to adherence to severe malaria treatment protocols. Similar findings were reported in a study done in rural Kenya, where ACT stock-outs significantly affected guideline adherence and resulted in increased prescription of ineffective therapies [40]. These frequent stock-outs may be due to late deliveries by National Medical Stores and poor quantification of the medicines and supplies needed. This highlights the need for robust supply chain management systems to ensure the consistent availability of essential medicines.

A study by Allen et al. [41] emphasized that reliance on clinical judgment rather than confirmed malaria tests increases the risk of misdiagnosis and unnecessary use of antimalarial drugs.

The findings of this study demonstrate the broader implications of resource constraints on adherence to severe malaria treatment guidelines, calling for a need to strengthen supply chain systems to ensure a consistent supply of RDTs and microscopy equipment in all public health facilities.

Strengths and limitations

This study employed a mixed-methods design, allowing for a comprehensive and nuanced understanding of adherence to severe malaria treatment guidelines and the factors influencing it. The integration of quantitative data from patient files provided objective and verifiable evidence of actual adherence, thereby minimizing the biases commonly associated with self-reported measures. This methodological approach strengthens the validity and reliability of the findings by triangulating data sources and offering both statistical and contextual insights. The qualitative findings described the facilitators and barriers, and understanding this is key to improving adherence to severe malaria treatment.

One potential limitation of this study was the variability in the types and comprehensiveness of medical records across different hospitals which could have affected the consistency and depth of data collection. Also, the retrospective file reviews might have missed some undocumented practices, leading to under or over estimation of adherence levels. This study was conducted in public facilities, and the findings may not be generalizable to private health facilities, where service delivery contexts may differ.

Conclusions

Adherence to severe malaria treatment guidelines was suboptimal, falling short of the national target of 90% adherence. The findings revealed that medical doctors adhere to the severe malaria treatment guidelines more than nurses and clinical officers. Despite this low level of adherence, the study identified several facilitators that promote adherence to severe malaria treatment guidelines, which included institutional and policy support and health care workers' positive attitudes which plays a crucial role in improving adherence levels. Key barriers to adherence included knowledge and awareness gaps, resource constraints such as frequent stock-outs of essential drugs and diagnostic tools, and socio-cultural factors such as preferences for alternative treatments which led to the low adherence to the severe malaria treatment guidelines.

Actions to improve adherence should include mandating quarterly clinical audits at district and regional hospitals, ensuring uninterrupted supply of malaria diagnostics and antimalarial drugs through strengthened stock monitoring and timely redistribution and institutionalizing routine refresher training, mentorship and support supervision for healthcare workers on severe malaria treatment guidelines.

Abbreviations

SSA	Sub-Saharan Africa
WHO	World Health Organization
MOH	Ministry of Health
UNMCP	Uganda National Malaria Control Policy 2011
IRS	Indoor Residual Spraying
IV	Intravenous
ACT	Artemisinin-based combination therapy
UMRESP	Uganda malaria reduction and elimination strategy policy 2021–2025
HCW	Health care worker
RRH	Regional referral hospital
MCP	Malaria Control Programme
MOH	Ministry of Health
MTG	Malaria treatment guidelines
HCWs	Health Care Workers
OPD	Out patient department
DHIS2	District health information system 2

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Author contributions

ZA conceptualized the study, coordinated implementation, conducted data collection and analysis, and wrote the manuscript. DA participated in the conceptualization of the study and its implementation, participated in data analysis, and significantly contributed to the writing of the manuscript. JO participated in the study implementation and contributed to the writing of the manuscript. MFM contributed to drafting the manuscript and significantly reviewed the manuscript. All authors approved the final version for submission.

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Data availability

The datasets used in this study are available up on reasonable request.

Declarations

Ethics approval and consent to participate

Approval and clearance to carry on the study were sought from Makerere University School of Health Sciences Research and Ethics Committee (Approval Number: MAKSHSREC-2024-761). Administrative clearance was also obtained from the District Health Officers (DHO) for the districts where these hospitals are located and facility in charges/administrators for the hospitals visited. Informed consent was not obtained as the study involved retrospective review of anonymized inpatient medical records. However, a waiver of consent to access hospital records was obtained from Makerere University School of Health Sciences Research and Ethics Committee. For qualitative data, written informed consent was provided by each consenting participant. During data presentation, only aggregated figures, not individual information, were presented in order to maintain confidentiality. Only the participants who met the eligibility criteria were interviewed by the researcher.

Competing interests

The authors declare no competing interests.

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