

1. Department of Clinical Pharmacology and Therapeutics, University of Benin, Benin City.
 2. Clinical Pharmacology, Therapeutics, and Toxicology Unit, Department of Internal Medicine, University of Benin Teaching Hospital, Benin City.
-

Abstract

Background: Malaria remains a significant cause of morbidity and mortality in Nigeria. Accurate diagnosis and rational prescribing are essential to reduce antimalarial resistance and optimize patient outcomes. This study evaluates malaria diagnosis and treatment practices among patients admitted to the Medical Emergency Room (MER) of a tertiary hospital in Southern Nigeria and explores prescribing behaviour among internal medicine resident doctors.

Methods: A retrospective review of 536 patient case records in 2022 was conducted. Data on presenting symptoms, diagnosis, laboratory tests, and antimalarial prescriptions were analyzed. In parallel, a cross-sectional survey of 36 internal medicine resident doctors was performed to assess their prescribing decisions and awareness of national guidelines.

Results: Of the 536 patients, 108 (20.1%) were diagnosed with malaria, and 136 (25.4%) had positive malaria parasite (MP) results. Antimalarial agents were prescribed to 88 (16.4%) patients, with 68.2% having confirmed MP positivity. Fever, vomiting, and headache were significantly associated with antimalarial prescriptions. The most common agent was intramuscular alpha–beta arteether. Among residents, 97.2% routinely requested MP tests, but only 30.6% waited for the result before treatment. Oral artemether–lumefantrine was the preferred agent, but parenteral artemether was commonly used when injectables were indicated. Only 22.2% of residents had read the national antimalarial policy.

Conclusion: Although diagnostic and treatment practices show partial adherence to guidelines, presumptive treatment and the use of non-recommended parenteral antimalarials remain prevalent. Training, diagnostic support, and guideline dissemination are essential to promote rational antimalarial use.

Keywords: Malaria Diagnosis, Prescribing Patterns, Tertiary Hospital, Nigeria

Introduction

Malaria remains a major global threat to public health and well-being. In 2023, it was estimated to cause 263 million cases and 597,000 deaths across 83 countries, with sub-Saharan Africa bearing the overwhelming share of this burden.^{1–3} According to the World Health Organization (WHO), Nigeria alone accounts for approximately 27% of global malaria cases and 23% of malaria-related deaths. Furthermore, reports indicate that malaria is responsible for 40% of hospital admissions and nearly 50% of outpatient visits in the country. This disproportionately high burden underscores the severity of the malaria challenge in Nigeria compared to other nations. In response, Nigeria revised its antimalarial treatment policy in 2005, in line with WHO recommendations.⁴ The country adopted artemisinin-based combination therapies (ACTs) for the treatment of uncomplicated malaria and artemisinin monotherapies for severe cases. While these interventions initially led to significant progress over the past two decades, recent years have seen a stagnation in these gains, particularly in regions with perennial transmission such as southern Nigeria, despite advancements in control strategies and the widespread use of artemisinin-based treatment. The emergence of partial resistance to artemisinins was first reported in 2008 in the Greater Mekong subregion of Southeast Asia.^{5,6} More recently, confirmed cases of partial artemisinin resistance have been documented in several African countries, particularly Tanzania, Rwanda, Uganda, Ethiopia, and Eritrea.^{7–11} However, to date, there have been no reports of resistance to artemisinin-based combination therapies (ACTs) in Africa. To mitigate the looming threat and potential impact of artemisinin drug resistance on

Corresponding Author,
Dr. S.A. Ayinbuomwan
Department of Clinical Pharmacology
and Therapeutics,
University of Benin, Benin-City.
stephen.ayinbuomwan@uniben.edu
+2348037075435

the continent, one key strategy advocated is the optimization of diagnostic and therapeutic practices to reduce drug pressure. Only patients with positive test results should receive antimalarial drugs.^{12,13} Rational use of antimalarials is, therefore, a critical measure not only for improving clinical outcomes but also for slowing the emergence and spread of drug resistance. In the hospital setting, adherence to evidence-based treatment guidelines is essential for ensuring optimal clinical outcomes and limiting the emergence of drug resistance. The Standard Treatment Guidelines (STG) serve as a critical reference document, outlining diagnostic criteria and therapeutic protocols for disease management. By promoting rational pharmacotherapy, STGs enhance the quality and appropriateness of care and also function as valuable educational tools for healthcare providers.¹⁴ Teaching hospitals, as tertiary referral centers, manage both uncomplicated and severe malaria cases, making them pivotal sites for assessing treatment practices and patterns of drug utilization. However, prescribing practices in such settings may vary due to factors such as prescriber preferences, diagnostic availability, patient characteristics, institutional protocols, and preconceived notions about specific medications. Notably, physicians in training—including house officers and resident doctors—frequently initiate and adjust antimalarial therapy under supervision. Their prescribing behavior, influenced by formal education and

bedside clinical experience, may not consistently align with established guidelines, particularly in resource-constrained environments where diagnostic limitations often lead to empirical treatment.

Previous studies have raised concerns regarding inappropriate antimalarial use, including the administration of monotherapies, non-guideline-based regimens, and presumptive treatments without parasitological confirmation. Such practices undermine the quality of care, increase drug pressure, and heighten the risk of resistance development. However, most existing studies have primarily focused on outpatient populations.^{15–19} There remains a paucity of data examining antimalarial prescribing patterns among medical inpatients in Nigerian teaching hospitals, with even fewer studies specifically addressing the role of trainee physicians in these prescribing decision

This study, therefore, aims to describe the patterns of antimalarial drug prescriptions among medical inpatients in a tertiary hospital in southern Nigeria, with particular emphasis on the prescribing practices of physicians in training. The findings are expected to provide insights that will guide targeted interventions to promote rational prescribing, strengthen pharmacotherapeutic education, and support antimicrobial stewardship initiatives within the hospital setting.

Methods

This study was conducted at the University of Benin Teaching Hospital, a tertiary health care facilities located in the south-south region of Nigeria, sub-Saharan Africa, a country that is endemic for malaria. This descriptive study was in two parts. First we assessed the prescription pattern on antimalarial among patients who were admitted into medical wards

through the medical emergency room for care in the UBTH in 2022 . The medical emergency room of the hospital attends to adults with medically related events and secondly an evaluative questionnaire was shared among the resident doctors in the department of internal medicine.

Procedure

All available medical admissions case records for this period were evaluated and a case reporting form was developed to capture the demographics of the patients, their presenting complaints, the common symptoms attributed to malaria, and the provisional diagnosis at the emergency. We also sought to elucidate if the patient had either a primary or secondary diagnosis of malaria, and if light microscopy for malaria parasite in thick blood film was requested at the medical emergency. The result of malaria parasite test was also recorded. Antimalarial agents prescribed at the medical emergency room was noted.

A follow-up semi-structured evaluative questionnaire (phase 2) was then distributed among internal medicine resident doctors who primarily attend to the patients at the MER. The questionnaire included their age groups, and years of training, their reasons for prescribing antimalarials; oral and parenteral agents inclusive and finally their awareness of the Nigerian national antimalarial policy.

Data Analysis: The main provisional diagnosis was categorized using the International classification of Diseases 11 (Version 02-2022) Antimalarial agents were categorized according to their generic name and ACT (artemisinin-based combination therapy) where indicated as such) and the route of administration is also noted.

Statistical analysis: Data were analyzed descriptively with frequencies, means (standard deviation) as appropriate, and associations between the patient's variables and prescriptions of antimalarial agents were conducted using chi-square, likelihood ratio as appropriate. Logistic regression was also conducted to find out which factors could predict antimalarial prescribing at the MER. Free text responses by the residents regarding their choice of antimalarial was analyzed thematically and presented descriptively. Results were considered significant if p value was ≤ 0.05 .

Ethical approval was obtained from the institution's ethics and research committee and all data kept securely in the

lead researcher's personal computer. The resident doctors gave verbal consent to participate in the study.

Results

A total of 663 patients were admitted to the medical wards through the medical emergency in 2022. Of these, 536 patient case records were successfully retrieved and analyzed, representing a retrieval rate of 80.8%. The mean age of the patients was 51.3 years (SD: 19.1), with ages ranging from 17 to 100 years. There was a higher proportion of females 308 (57.5%), compared to males. The majority of patients were employed 344 (64.2%) (Table 1).

Table 1: Demographics of patients admitted into medical wards of a tertiary hospital in Southern Nigeria.

Characteristics	Proportion n=536 (%)
Age group	
17-40 years	167(31.2)
41-59 years	179 (33.4)
60-100 years	190 (35.4)
Sex	
Male	228 (42.5)
Female	308(57.5)
Occupation	
Employed	344(64.2)
Unemployed	132(24.6)
Student	60(11.2)

At presentation to the Medical Emergency Room (MER), the most common presenting complaints were fever in 120 (22.4%) and vomiting in 82 (15.3%). Based on the ICD-11 classification, the leading diagnostic category was certain infectious and parasitic diseases, recorded in 195 (36.4%). A total of 108 (20.1%) patients had an initial diagnosis of malaria documented in their case records, either as a primary or secondary diagnosis. Light microscopy for malaria parasites (MP) was requested in 373 (69.6%) patients (Table 2).

Among those tested, 136 (36.5%) patients had a positive MP result. The degree of parasitemia was reported as mild (1+) in 130 (95.6%) cases, moderate (2+) in 5 (3.7%) cases, and severe (3+) in 1(0.73%) case, with *Plasmodium falciparum* identified in all positive samples. Of the 108 patients with an initial clinical diagnosis of malaria, 92 (85.2%) were confirmed to have a positive MP result. This association was statistically significant ($\chi^2 = 256.31$, $p < 0.001$).

Table 2: Characteristics of patients' symptoms, diagnosis, and malaria evaluation at the Medical Emergency Room of the UBTH

Characteristics	Proportion n=536(%)
Major presenting complaints	
Fever	120(22.4)
Vomiting	82(15.3)
Weakness	62(11.6)
Abdominal pains	50(9.3)
Loss of consciousness	43 (8.0)
Headaches	26(4.9)
Joint pains	12(2.2)
Nausea	6(1.1)
Cough	59(11.0)
Difficulty breathing	35(6.5)
ICD 11 Disease Classification	
Certain Infectious and Parasitic Diseases	195(36.4)
Diseases of the nervous system	74(13.8)
Diseases of the circulatory system	72(13.4)
Diseases of the digestive system	52(9.7)
Diseases of the urinary system	43(8.0)
Endocrine, nutritional or metabolic diseases	31(5.8)
External causes of morbidity or mortality	23(4.3)
Diseases of the blood or blood-forming organs	15(2.8)
Diseases of the respiratory system	12(2.2)
Mental, behavioural or neurodevelopmental disorder	6(1.1)
Neoplasms	4(0.7)
Diseases of the ear or mastoid process	3(0.6)
Diseases of the genitourinary system	2(0.4)
Diseases of the immune system	2(0.4)
Diseases of the musculoskeletal system or connective tissue	1(0.2)

Diseases of the skin	1(0.2)
Diagnosis of malaria	
Yes	108 (20.1)
No	428 (79.9)
Malaria Parasite requested	
Yes	373(69.6)
No	163(30.4)
Result of Malaria Parasite (n=536)	
Positive	136 (25.4)
Negative	216(40.3)
Result not available	21(3.9)
Not requested	163 (30.4)

Regarding the prescribing patterns of antimalarial agents, 88 (16.4%) patients received antimalarial prescriptions in the MER. Among these, 54 (61.4%) had a clinical diagnosis of malaria ($\chi^2 = 111.16$, $p < 0.001$), and 60 (68.2%) patients had a positive MP result. Antimalarial prescriptions were also significantly associated with presenting symptoms of fever 40 (45.5%), headache 10 (11.4%), and diagnoses classified under certain infectious and parasitic diseases 195 (36.4%) (Table 3).

The most common route of administration for prescribed antimalarial agents was parenteral 55 (62.5%). The most frequently prescribed medication was intramuscular alpha–beta arteether 46 (52.3%). Additionally, 9 (10.2%) patients received oral ACT tablets, and 3 patients (3.3%) were prescribed a combination of both oral and parenteral agents.

Table 3: Association between prescribed antimalarial and patient variables.

Characteristics	Prescribed antimalarial		Chi square (p value)
	Yes n=88(%)	No n=448 (%)	
Sex			
Male	33(37.5)	195(43.5)	1.093 (0.296)
Female	55(62.5)	253(56.5)	
Age group			
17-40 years	29(33.0)	128(30.8)	0.189 (0.910)
41-59 years	28 (31.8)	151 (33.7)	
60-100 years	31 (35.2)	159 (35.5)	
Loss of consciousness			
Yes	8 (9.1)	35(7.8)	0.163 (0.686)
No	80(90.9)	413 (92.2)	
Fever			
Yes	40(45.5)	80 (17.9)	32.24 (<0.001)
No	48(54.5)	368(82.1)	
Vomiting			
Yes	21(23.9)	61(13.6)	5.96 (0.015)
No	67 (76.1)	387 (86.4)	
Headaches			
Yes	10 (11.4)	16 (3.6)	9.68(0.002)
No	78 (88.6)	432 (96.4)	
Abdominal pains			
Yes	9 (10.2)	41(9.2)	0.101 (0.751)
No	79 (89.8)	407 (90.8)	
Weakness			
Yes	23 (26.1)	107 (23.9)	0.203 (0.652)
No	65 (73.9)	341(76.1)	
Diagnosis of Malaria			
Yes	54(61.4)	394 (87.9)	111.15,<0.001)
No	34 (38.6)	54(12.1)	
Result of MP test			
Positive (136)	60(68.2)	76(17.0)	102.80 (<0.001)
Negative(216)	16(20.5)	198 (44.2)	
Not available(21)	2(2.3)	19(4.2)	
Not Requested (163)	8(9.1)	155(34.6)	
Classification			
Certain Infectious and Parasitic Diseases	50(56.8)	145(32.4)	41.995(<0.001) Likelihood Ratio
Diseases of the nervous system	4(4.5)	70(15.6)	
Diseases of the circulatory system	7(8.0)	65(14.5)	
Diseases of the digestive system	7(8.0)	45(10.0)	
Diseases of the urinary system	2(2.3)	41(9.2)	
Endocrine, nutritional or metabolic diseases	2(2.3)	29(6.5)	

External causes of morbidity or mortality	5(5.7)	18(4.0)
Diseases of the blood or blood-forming organs	7(8.0)	8(1.8)
Diseases of the respiratory system	2(2.3)	10(2.2)
Mental, behavioural or neurodevelopmental disorder	1(1.1)	5(1.1)
Neoplasms	1(1.1)	3(0.7)
Diseases of the ear or mastoid process	0(0)	3(0.7)
Diseases of the genitourinary system	0(0)	2(0.4)
Diseases of the immune system	0(0)	2(0.4)
Diseases of the musculoskeletal system or connective tissue	0(0)	1(0.2)
Diseases of the skin	0(0)	1(0.2)

Table 4: Antimalarial agents prescribed at the MER.

Antimalarial agents	n/ N=88(%)
IM Alpha- Beta Arteether	46 (52.3)
Tabs Artemether-Lumenfantrine	33 (37.5)
IM Artemether	5(5.7)
IM Alpha- Beta Arteether and Artemether- Lumenfantrine	2(2.2)
IV Artesunate	1(1.1)
IV Artesunate & Artemether- Lumenfantrine	1(1.1)

IM- intramuscular, IV- intravenous

A total of 36 internal medicine resident doctors responded to the survey. The majority were older than 30 years 34 (94.5%). Regarding duration of training, 9 (25.0%) residents had been in training for less than 1–3 years, 14 (38.9%) for 3–6 years, 7 (19.4%) for more than 7 years, while 6 (16.7%) did not specify their training duration. In terms of prescribing practices at the MER, 35 (97.2%) residents reported that they would routinely request malaria parasite (MP) testing before prescribing. However, only 11 (30.6%) residents indicated that they would wait for the test result prior to initiating antimalarial treatment.

When asked about their management decisions, all respondents 36 (100%) stated they would treat a patient presenting with fever and an MP result of 1+. For patients

without fever, 20 (55.6%) residents would treat an MP result of 1+, 14 (38.9%) would treat only if the MP result was 2+, and 2 (5.6%) did not provide a response. The factors influencing their choice of antimalarial agents included the patient's clinical state, specifically the presence of vomiting 16 (44.4%) and the severity of malaria 16 (44.4%). Other influencing factors were adherence to guidelines recommending oral medications 4 (11.1%) and the desire for a fast onset of action 2 (5.5%).

Regarding the preferred route of administration, 29 (80.6%) residents indicated they would prescribe an oral antimalarial. The most preferred oral agent was artemether–lumefantrine, selected by 34 (94.4%) residents. The reasons cited for prescribing oral antimalarials included the

availability of ACTs 16 (44.4%), tolerability and fewer side effects 8 (22.2%), cost considerations 7 (19.4%), severity of symptoms 6 (16.7%), adherence to guidelines 5 (13.9%), efficacy 3(8.3%), previous use by the patient 3 (8.3%), and dosing convenience 1 (2.8%).

When an injectable antimalarial was required, the residents most commonly preferred alpha-beta artemether 28 (77.8%), followed by artesunate 4 (11.1%), artemether 2 (5.6%), and artemisinin injection 1 (2.8%). The preference for alpha-beta artemether was primarily

influenced by factors such as the patient's clinical state 7 (25%), dosing frequency and convenience of administration 5 (20%), availability 5 (20%), perceived efficacy 4 (14.3%), adherence to WHO guidelines 4 (14.3%), cost-effectiveness 2 (7.1%), and previous experience with the medicine 2 (7.1%). Among those who preferred artesunate, 18 (50%) cited its ready availability and its use in severe malaria as the primary reasons for selection. Regarding knowledge of national policy, 23 (63.9%) residents reported being aware of the National Antimalarial Policy, but only 8 (22.2%) residents had actually read it.

Table 5: Residents preferred antimalarial agents (ACT and parenteral artemisinins)

Antimalarial agents	N (%)
Routine MP request	
Yes	30(83.3)
No	1(2.8)
Sometimes	5(13.9)
Preferred Antimalarial agent Route	
Oral route	29 (80.6)
Parenteral	7 (19.4)
Preferred ACT (oral)	
Artemether-Lumefantrine	34(94.4)
Dihydroartemisin-Piperaquine	1(2.8)
Artemisinin-Combination Therapy(unspecified)	1(2.8)
Preferred Artemisinin Injections	
IM Alpha- beta arteether	28 (77.8)
IV artesunate	4(11.1)
IM artemether	2(5.6)
Injection Artemisinin	1(2.8)

IM- intramuscular, IV- intravenous, ACT- artemisinin Combination Therapy, MP- Malaria Parasite light microscopy

Discussion:

This study presents an in-depth analysis of malaria diagnosis and treatment practices among patients admitted through the Medical Emergency Room (MER) of a tertiary hospital in Southern Nigeria. The findings highlight the persistent burden of malaria in adult populations and reveal the diagnostic challenges and prescribing patterns encountered in emergency clinical settings.

Malaria is frequently diagnosed in the Medical Emergency Room (MER). Although many patients lacked a documented clinical diagnosis of malaria, the majority underwent microscopy for malaria parasites on thick blood film, with 37% testing positive, predominantly with mild parasitemia. Among patients with a clinical diagnosis of malaria, most also had positive microscopy results. The strong association between clinical diagnosis and parasite positivity indicates good diagnostic alignment in most cases. The routine screening for malaria in febrile patients further reflects the endemicity of the disease in this setting.

The study also assessed antimalarial prescription practices and found that fewer than one-fifth of patients received antimalarial treatment. Notably, not all treated patients had a documented diagnosis of malaria, and a considerable proportion lacked positive microscopy results. This finding suggests limited reliance on parasitological confirmation compared to clinical diagnosis. The observed over-reliance on clinical suspicion alone likely contributes to malaria overtreatment, a trend similarly reported by previous studies^{20,21}

Furthermore, there was a high rate of antimalarial prescriptions among patients presenting with fever, headaches, vomiting, and certain infectious or parasitic diseases, even when microscopy for malaria parasites was negative and other differential diagnoses were considered. This practice may stem from the endemic nature of malaria in Nigeria and the delays in obtaining diagnostic results to thoroughly investigate alternative causes. These findings highlight the tendency of clinicians in malaria-endemic settings to prioritize non-specific symptoms when initiating treatment, even in the absence of diagnostic confirmation. This pattern was further supported by the views of most resident doctors, who reported a preference for empirically treating febrile patients for malaria regardless of parasitemia status. Similar trends have been documented in other studies^{22,23}. The integration of point-of-care diagnostic tools, such as procalcitonin and C-reactive protein testing, could help improve diagnostic accuracy and ensure that empirical therapies are more appropriately targeted.

The frequent use of parenteral therapy (62.5%), particularly intramuscular alpha–beta artemethers, even in cases of mild parasitemia, is noteworthy and may reflect entrenched preferences for injectable treatments in emergency settings. Although resident physicians indicated a preference for prescribing oral medications, especially artemether-lumefantrine, the choice of parenteral agents—particularly alpha–beta arteether over the recommended intravenous artesunate—was influenced by factors such as the patient’s clinical condition, the presence and severity of vomiting, perceived drug efficacy, and convenience of administration.

Notably, very few residents had read the national antimalarial policy, highlighting a significant gap in policy literacy. Similar patterns of poor adherence to treatment guidelines and policies have been documented in other studies, although with varying degrees of compliance.^{24,25}

The therapeutic decisions of the resident physicians appeared to be shaped by both pragmatic considerations and the clinical presentation of patients. In a resource-limited environment with inadequate facilities for critical care monitoring, treatment choices are often guided by the need to optimize patient outcomes despite systemic constraints. This was evident in this finding, where over 97% of residents reported requesting malaria parasite (MP) testing but initiated treatment prior to obtaining results due to diagnostic delays. Such delays, leading to treatment without parasitological confirmation, run contrary to WHO recommendations²⁶ and have been similarly reported in other studies^{27–29}. Furthermore, more than half (55.6%) indicated they would treat cases with MP 1+ even in the absence of fever, reflecting a cautious approach but one that may contribute to irrational prescribing practices.

These findings underscore the urgent need to strengthen clinical protocols that mandate parasitological confirmation of malaria before initiating treatment. Greater emphasis should be placed on adherence to national guidelines through regulatory oversight and continuous professional development of healthcare providers. Additionally, hospital formularies must be aligned with national treatment policies, and antimicrobial stewardship programs should be implemented to monitor and optimize the use of both antimicrobial and antimalarial agents.

In conclusion, this study highlights that malaria remains a frequent consideration in the management of patients presenting with common malaria-like symptoms in hospital settings, with many patients receiving antimalarial prescriptions even when diagnostic results are negative. Although parenteral antimalarials are not the preferred option, their use is often inconsistent with existing treatment guidelines. The continued irrational use of antimalarials in tertiary hospital settings poses significant implications for patient safety, healthcare costs, and public health. Targeted interventions to strengthen diagnostic stewardship, promote rational prescribing practices, and ensure adherence to evidence-based treatment guidelines are urgently needed.

References

- 1 World Health Organization. Malaria- Fact Sheets. <https://www.who.int/news-room/fact-sheets/detail/malaria> (accessed 29 Jul2025).
- 2 WHO Regional Office for Africa. Report on malaria in Nigeria 2022 for Africa. Brazzaville, 2023<https://www.afro.who.int/countries/nigeria/publication/report-malaria-nigeria-2022> (accessed 29 Jul2025).
- 3 Eliminating Malaria in Nigeria: Five ways the US President’s Malaria Initiative for States is making a difference - Management Sciences for Health. <https://msh.org/story/eliminating-malaria-in-nigeria-five-ways-the-us-presidents-malaria-initiative/> (accessed 29 Jul2025).
- 4 Federal Ministry of Health. National Antimalarial Treatment Policy. Abuja, 2005.
- 5 Noedl H, Se Y, Schaecher K, Smith BL, Socheat D, Fukuda MM. Evidence of Artemisinin-Resistant Malaria in Western Cambodia. *New England Journal of Medicine* 2008; **359**: 2619–2620.

- 6 Dondorp AM, Nosten F, Yi P, Das D, Phyo AP, Tarning J *et al.* Artemisinin Resistance in Plasmodium falciparum Malaria . *New England Journal of Medicine* 2009; **361**: 455–467.
- 7 Uwimana A, Legrand E, Stokes BH, Ndikumana JLM, Warsame M, Umulisa N *et al.* Emergence and clonal expansion of in vitro artemisinin-resistant Plasmodium falciparum kelch13 R561H mutant parasites in Rwanda. *Nat Med* 2020; **26**: 1602–1608.
- 8 Moser KA, Madebe RA, Aydemir O, Chiduo MG, Mandara CI, Rumisha SF *et al.* Describing the current status of Plasmodium falciparum population structure and drug resistance within mainland Tanzania using molecular inversion probes. *Mol Ecol* 2021; **30**: 100–113.
- 9 Conrad MD, Asua V, Garg S, Giesbrecht D, Niaré K, Smith S *et al.* Evolution of Partial Resistance to Artemisinins in Malaria Parasites in Uganda. *New England Journal of Medicine* 2023; **389**: 722–732.
- 10 Mihreteab S, Platon L, Berhane A, Stokes BH, Warsame M, Campagne P *et al.* Increasing Prevalence of Artemisinin-Resistant HRP2-Negative Malaria in Eritrea. *New England Journal of Medicine* 2023; **389**: 1191–1202.
- 11 Fola AA, Feleke SM, Mohammed H, Brhane BG, Hennelly CM, Assefa A *et al.* Plasmodium falciparum resistant to artemisinin and diagnostics have emerged in Ethiopia. *Nat Microbiol* 2023; **8**: 1911–1919.
- 12 Tackling emerging antimalarial drug resistance in Africa. <https://www.who.int/news/item/18-11-2022-tackling-emerging-antimalarial-drug-resistance-in-africa> (accessed 29 Jul2025).
- 13 Federal Ministry of Health. National Guidelines for the Diagnosis & Treatment 2020 , 4th Edition. Abuja, 2020<https://www.nmcp.gov.ng/2020/09/21/4th-edition-national-guidelines-for-the-diagnosis-treatment-2020/> (accessed 29 Jul2025).
- 14 Kish MA. Guide to development of practice guidelines. *Clinical Infectious Diseases* 2001; **32**: 851–854.
- 15 Bonful HA, Awua AK, Adjuik M, Tsekpense D, Adanu RMK, Nortey PA *et al.* Extent of inappropriate prescription of artemisinin and anti-malarial injections to febrile outpatients, a cross-sectional analytic survey in the Greater Accra region, Ghana. *Malar J* 2019; **18**. doi:10.1186/S12936-019-2967-8,.
- 16 Sears D, Kigozi R, Mpimbaza A, Kakeeto S, Sserwanga A, Staedke SG *et al.* Anti-malarial prescription practices among outpatients with laboratory-confirmed malaria in the setting of a health facility-based sentinel site surveillance system in Uganda. *Malar J* 2013; **12**. doi:10.1186/1475-2875-12-252,.
- 17 Igboeli NU, Ukwe C V., Ekwunife OI. Increasing use of artemisinin-based combination therapy for Treatment of malaria infection in Nigerian hospitals. *Pharm Pract (Granada)* 2010; **8**: 243–249.
- 18 Ezenduka CC, Falleiros DR, Godman BB. Evaluating the Treatment Costs for Uncomplicated Malaria at a Public Healthcare Facility in Nigeria and the Implications. *Pharmacoecon Open* 2017; **1**: 185–194.
- 19 Obieche OA, Odili VU. Evaluation of cost of treatment of malaria in adults in Benin City, Nigeria: patients’ perspective. *Malaria world J* 2016; **7**: 12.
- 20 Oladosu OO, Oyibo WA, Bachani D, Hazir T, Ramharther M, Remoue F *et al.* Overdiagnosis and Overtreatment of Malaria in Children That Presented with Fever in Lagos, Nigeria. *Int Sch Res Notices* 2013; **2013**: 914675.

- 21 Anjorin ET, Olulaja ON, Osoba ME, Oyadiran OT, Ogunsanya AO, Akinade ON *et al.* Overtreatment of malaria in the Nigerian healthcare setting; prescription practice, rationale and consequences. *Pan African Medical Journal* 2023; **45**. doi:10.11604/pamj.2023.45.111.31780.
- 22 Uzochukwu BSC, Obikeze EN, Onwujekwe OE, Onoka CA, Griffiths UK. Cost-effectiveness analysis of rapid diagnostic test, microscopy and syndromic approach in the diagnosis of malaria in Nigeria: Implications for scaling-up deployment of ACT. *Malar J* 2009; **8**: 1–15.
- 23 Ndibuagu EO. Use of Malaria Rapid Diagnostic Tests among Medical Doctors in a Tertiary Hospital, South East Nigeria. *Health N Hav* 2018; **10**: 971–984.
- 24 Ayinbuomwan S, Isah AO. Standard treatment guidelines: Perception and utilization in a tertiary health care facility in South-South, Nigeria. *Ann Afr Med* 2019; **18**: 47–50.
- 25 Omale UI. Knowledge, attitude, and practice of the National Guidelines for Diagnosis and Treatment of Malaria among medical doctors in Ebonyi state, Nigeria: A cross-sectional survey. *PLoS One* 2021; **16**. doi:10.1371/journal.pone.0257600.
- 26 World Health Organization. WHO Guidelines for malaria - (February 2022). World Health Organization: Geneva, 2022<https://mesamalaria.org/resource-hub/who-guidelines-malaria-february-2022> (accessed 25 May2022).
- 27 Sonkong K, Chaiklieng S, Neave P, Suggaravetsiri P. Factors affecting delay in seeking treatment among malaria patients along Thailand-Myanmar border in Tak Province, Thailand. *Malar J* 2015; **14**. doi:10.1186/1475-2875-14-3,.
- 28 Workineh B, Mekonnen FA. Early treatment-seeking behaviour for malaria in febrile patients in northwest Ethiopia. *Malar J* 2018; **17**. doi:10.1186/S12936-018-2556-2,.
- 29 Kaboré JMT, Siribié M, Hien D, Soulama I, Barry N, Nombé Y *et al.* Attitudes, practices, and determinants of community care-seeking behaviours for fever/malaria episodes in the context of the implementation of multiple first-line therapies for uncomplicated malaria in the health district of Kaya, Burkina Faso. *Malar J* 2022; **21**. doi:10.1186/S12936-022-04180-