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Antimalarial Prescription Patterns and Adherence to the WHO 2024 Guidelines among Pregnant Women: A Case Study from a Nigerian Tertiary Hospital

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ABSTRACT

Background: Adherence to the World Health Organization (WHO) treatment guidelines for malaria in pregnancy (MiP) is crucial for improved maternal and perinatal health outcomes. This study assessed antimalarial prescription patterns and adherence of each prescription to the WHO 2024 MiP guidelines using a Nigerian tertiary hospital as a case study.

Methods: A retrospective, cross-sectional study was conducted using antenatal care (ANC) records of pregnant women who attended ANC at FMC Makurdi in 2024. A total of 1,062 eligible prescriptions were selected via systematic random sampling and analysed using R. Descriptive statistics summarized patient demographics and treatment patterns. Adherence to guidelines was subsequently assessed.

Results: Among the 1,062 prescriptions analysed, the majority (96.1%) were for IPTp rather than acute treatment with most for women in their second (44.4%) or third trimester (55.0%). Overall, sulfadoxine-pyrimethamine (SP) was the most prescribed antimalarial medication during pregnancy (96.0%). Artemether-lumefantrine (AL, 92.5%) and SP (99.9%) were mostly prescribed for uncomplicated malaria and IPTp respectively. Adherence to treatment guidelines was high (99.4%); however, trimester-specific deviations were noted where most instances of non-compliance occurred in the first trimester.

Conclusion: While overall adherence to MiP guidelines was high at FMC Makurdi, specific deviations—particularly regarding first-trimester prescriptions and the use of Al for prevention—were observed. These findings underscore the need for continuous education and reinforcement of guideline adherence among healthcare providers to ensure optimal and safe antimalarial management especially in malaria-endemic settings.

Keywords: Malaria in pregnancy, Intermittent preventive treatment, Antimalarials, Prescription patterns, Adherence, WHO guidelines, Nigeria

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INTRODUCTION

Malaria in pregnancy (MiP) poses a substantial risk to pregnant women and their children. Despite being both preventable and treatable, MiP remains a leading cause of maternal and perinatal morbidity and mortality, particularly in malaria-endemic regions.[1,2] In 2023, malaria affected an estimated 263 million people globally (incidence: 60.4 per 1000 people at risk of contracting the disease).[3] The prevalence of MiP is highest in the WHO African region (34% of 36 million pregnancies in 2023), with West Africa experiencing the highest burden (36.4% of 6 million pregnancies in 2023).[3]

Pregnant women are physiologically three times more susceptible to malaria and face higher risks of severe illnesses, anaemia, maternal death, and adverse birth outcomes, including stillbirths, preterm birth, low birth weights, and intrauterine growth restrictions compared to non-pregnant women.[1,3,4] These risks are highest in the first and second trimesters, and co-infections like HIV/AIDS further exacerbate outcomes.[2,5,6] To combat malaria and its devastating effects on pregnancy, WHO advocates a four-pronged strategy combining vector control, chemoprevention, prompt diagnosis, and evidence-based case management. Nigeria, in alignment with the WHO's recommendations, adopted its National Malarial Elimination Programme (NMEP) guidelines, which are designed to optimise maternal and foetal health by promoting safe and effective antimalarial use.[7] Both WHO and NMEP guidelines indicate that Intermittent Preventive Treatment (IPTp) using sulfadoxine-pyrimethamine (SP) remains the cornerstone for preventing MiP particularly in SP-sensitive regions like Nigeria where IPTp-SP remains the most effective approach to reducing the incidence of MiP and its adverse birth outcomes.[2,7] This approach involves administering at least three therapeutic doses of SP (IPTp3+), beginning in the second trimester (after 13 weeks of gestation) and continuing at each scheduled antenatal care (ANC) visit, with doses spaced at least four weeks apart.[2] Furthermore, these guidelines emphasize several other crucial aspects of care for pregnant women including: parasitological confirmation before treatment, the use of oral artemether-lumefantrine (AL) as first-line regimen for uncomplicated MiP, and the immediate initiation of aggressive treatment of severe MiP using parenteral artesunate regimen as first choice or intramuscular artemether or parenteral quinine in cases where artesunate is unavailable.[2,7] Additionally, the guidelines highlight complex prescribing scenarios, such as the contraindication of radical cure agents like primaquine or tafenoquine for relapsing MiP.

While the global strategy for MiP control is robust, implementation failures remain widespread. In 2023, only 44% of eligible pregnant women within the WHO African Region actually received the recommended IPTp3+ doses.[3] Thus, this implies that the WHO's Global Technical Strategy for Malaria (2016–2030) target of at least 80% IPTp3+ coverage remains far from attainment as more than half (56%) of pregnant women at risk missed out on this essential protective intervention. In Nigeria, particularly since the publication of the first edition of NMEP guidelines—now in its third edition (2020)—several studies have assessed the compliance of the Nigerian health system to the MiP guidelines. For example, Ezenduka et al. (2016) reported 68.5% compliance among pregnant women in Anambra, Southeast Nigeria, with ACTs and SP being the most prescribed antimalarials.[8] In contrast, few other studies have reported limited uptake of IPTp among pregnant women in various centres across the country.[9,10] In the North-central region where the Rivers Niger and Benue create conditions for intense and stable malaria transmission, existing data confirm long-standing implementation challenges in preventive measures. For instance, a study reported that the prevalence of IPTp3+ coverage in North-central Nigeria in 2018 was as low as 13.1% to 17%.[11] Another study reported that in 2021, only 35.5% of pregnant women in the North-central region of Nigeria received the recommended IPTp3+ doses.[12] Studies have shown that this issue is not unique to the North-central region alone.[12–14] Even in countries with established malaria control programs, adherence to IPTp regimens remains inconsistent due to factors like late ANC initiation, stock-outs of SP, health worker noncompliance with guidelines, and inadequate patient education and follow-up.[9,15–17]

Despite the national and international treatment guidelines for MiP, there remains a paucity of current evidence in literature that describes real-world antimalarial prescribing patterns and adherence to guidelines in Nigeria—particularly in the North-central region, thereby prompting issues of neglect and lack of data from this important region. Furthermore, adherence is not merely a binary choice between

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administering or withholding a drug, but involves navigating complex, time-sensitive clinical decisions such as trimester-specific treatment choices, dosing and duration, contraindications, and severe case management. Thus, the inconsistent quantitative adherence metrics reported in previous studies mask critical qualitative errors. As such, the true knowledge gap lies in understanding the qualitative failure of prescriptions. Two key questions led us to this study. First, what is the current situation of both preventive and curative antimalarial prescription patterns among pregnant women in Nigeria, particularly in the North-central region? Second, how closely do current practices in Nigerian tertiary hospitals comply with the updated WHO 2024 guidelines for MiP given that most available Nigerian studies predate the Covid-19 pandemic?

To answer these questions in a structured and practical way, this study evaluated the current antimalarial prescription patterns and their adherence to the WHO 2024 MiP guidelines among pregnant women attending ANC at the Federal Medical Centre (FMC) Makurdi. The analysis focused on prescription-level adherence rather than patient-level IPTp3+ coverage, because the manual ANC register records each visit separately without consistent linkage across visits making it almost impossible to link full IPTp coverage to each patient. Nonetheless, the focus on FMC Makurdi, a tertiary healthcare facility in North-central Nigeria, is because it is situated in an intense stable malaria endemic area and serves as the apex of the healthcare system which is expected to demonstrate the highest level of adherence to gold standards and also manage the most complex presentations of MiP. Thus, this study aimed at contributing evidence toward closing the persistent gap between international antimalarial recommendations and real-world implementation in malaria-endemic regions.

METHODS

Study design

A retrospective, cross-sectional study was conducted to evaluate the antimalarial prescription patterns and adherence to the WHO 2024 MiP prevention and treatment guidelines. The study analysed ANC prescription records of pregnant women who received at least one antimalarial prescription at FMC Makurdi, between January 1, 2024 and December 31, 2024.

Study setting

FMC Makurdi is a federal tertiary healthcare facility located in Makurdi, the capital city of Benue State in North-central Nigeria. Makurdi is the most populous city in the state and lies along the Benue River, the second largest river in Nigeria after the Niger River [18,19]. Makurdi serves as a commercial hub for diverse population and has a network of both public and private healthcare institutions [18]. The city is hyperendemic for malaria transmission, and FMC Makurdi provides comprehensive antenatal and obstetric services to a diverse patient population. Given its catchment area and patient diversity, the facility represents a suitable setting for evaluating prescribing patterns and adherence to MiP guidelines.

Sample size and sampling technique

Routine ANC visit entries are documented in the facility's centralised ANC register where each ANC visit is logged as an independent record in the register. Because of this, prescriptions were analysed at the encounter level only, reflecting the quality of prescribing practices per ANC visit rather than cumulative IPTp-SP dosing per woman. The register recorded patient details including patient identifiers, gestational age, and medications prescribed for that visit. At the time of data collection there were 11,152 ANC entries recorded in the register in 2024. These ANC entries served as the study's sampling frame. The minimum required sample size of 386 was calculated using the Taro Yamane formula, assuming a 5% margin of error and 95% confidence level.[20] To obtain the study samples, a systematic sampling approach was applied to the total sampling frame (N=11,152). A randomly selected starting point was utilised and a sampling interval (k-th) of 5 was set, leading to the initial selection of 2,230 prescription records for review (see *Figure 1*). These initially sampled ANC records underwent a rigorous review process. Records were included for analysis only if they demonstrated completeness, consistency, a clear malaria-related diagnosis, and documented antimalarial prescriptions. Conversely, records were excluded if they documented non-malaria-related illnesses, had illegible or missing information, lacked a diagnosis, were duplicates, or fell outside the study period. This screening process yielded a final analytical sample of 1,062 eligible prescription records.

The above sampling approach served a single purpose which is to capture preventive and curative antimalarial

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prescription patterns and adherence to MiP guidelines at the individual prescription-level (i.e., each of the 1,062 eligible ANC entries was treated as a distinct unit of analysis. This way, the dataset was used to describe prescription patterns by diagnosis and gestational trimester and to assess whether individual prescriptions conformed to WHO 2024 recommendations. Notably, the structure of the register did not give room for estimating IPTp completion (IPTp3+) at the individual patient level.

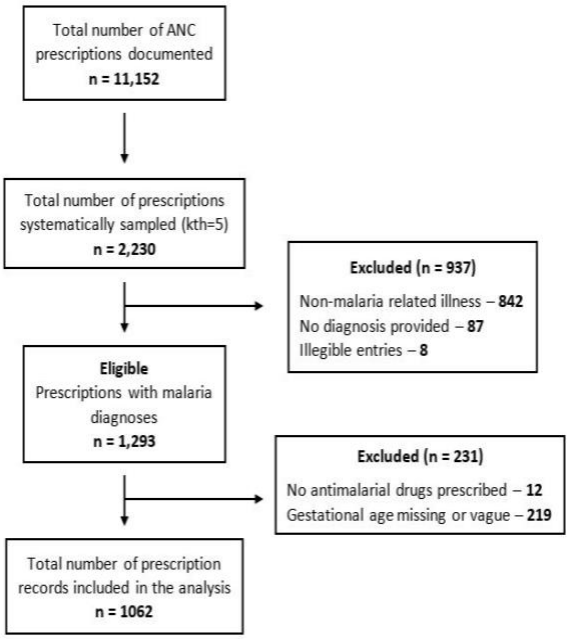

Figure 1: *Schematic flowchart illustrating the selection process for antimalarial drug prescriptions*

Data collection

Data was extracted from the 1,062 eligible records via a predefined data collection sheet. This process was facilitated by nurses at the ANC unit and supervised by an intern pharmacist who reported directly to the researchers in order to ensure a more objective and unbiased data collection process. The collected variables included date of visit, maternal age, gestational age, diagnosis provided, medications prescribed and the treatment purpose.

Statistical analysis

Extracted data were entered into Microsoft Excel 2016 for cleaning and then imported into R version 4.5.1 for analysis.[21] Descriptive statistics (means, standard deviations, frequencies, and proportions) summarised sociodemographic and clinical characteristics, as well as prescription frequencies, trimester distribution, and adherence measures. To assess the conformity of prescriptions to MiP guidelines, each prescription was compared against trimester-specific recommendations for the treatment or prevention of MiP in sub-Saharan Africa.

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Health Research Ethics Committee (HREC) of FMC Makurdi: FMH/FMC/HREC/108/VOL1. No additional patient consent was needed, as there was no contact with any patient, and each record was anonymised.

RESULTS

Demographic and clinical characteristics of the study sample

Table 1 presents the demographic and clinical characteristics of the 1,062 eligible prescription records reviewed. The mean maternal age was 28 ± 4.8 years (range: 15–43 years), with most women (43.4%, n=461) in the 26–30 years age group. The mean gestational age was 27.8 ± 5.8 weeks (range: 11–40 weeks), with nearly all women in their second (44.4%, n=471) or third trimesters (55.0%, n=584); while only a small fraction (0.7%, n=7) were in their first trimester. The majority of cases (96.1%, n=1,021) were diagnosed with asymptomatic malarial, while fewer cases (3.8%, n=40) were diagnosed with uncomplicated malaria and only one case (0.1%) of severe malaria was observed.

Among the 609 unique women represented by the 1,062 eligible prescription records reviewed, the majority contributed one prescription record each (51.7%, n=315), 28.7% (n=175) contributed two records each, and the remaining 19.5% (n=119) contributed three or more records each (see **Table 2**).

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Table 1: *Demographic and clinical characteristics of the study sample* (N = 1,062)

Characteristics	Value/Frequency	Percent *
Mean maternal age (SD)	28.0 (± 4.8) years	-
Range of maternal age	15-43 years	-
Age group		
15-20 years	52	4.9%
21-25 years	273	25.7%
26-30 years	461	43.4%
31-35 years	209	19.7%
>35 years	67	6.3%
Mean gestational age (SD)	27.8 (± 5.8) weeks	-
Range of gestational age	11-40 weeks	-
Gestational Trimester †		
First trimester	7	0.7%
Second trimester	471	44.4%
Third trimester	584	55.0%
Provisional diagnosis		
Asymptomatic malaria	1,021	96.1%
Uncomplicated malaria	40	3.8%
Severe malaria	1	0.1%
Purpose for treatment		
IPTp	1,021	96.1%
Curative	41	3.9%
Number of prescription records contributed by each unique woman (n=609) †		
1 record	315	51.7%
2 records	175	28.7%
3 records	87	14.3%
4 records	25	4.1%
≥5 records	7	1.1%

† Percentages may not sum to 100% owing to rounding

Antimalarial medication prescribing patterns by diagnosis

Table 2 shows the frequency distribution of antimalarials prescribed by diagnosis. For asymptomatic malaria cases, SP was the most commonly prescribed antimalarial medication (99.9%, n=1020). For uncomplicated malaria, AL was the most commonly prescribed treatment (92.5%, n=37); one patient (2.5%) received α-β arteether injection (followed by a 3-day dose of AL), and two patients (5.0%) received SP and AL concomitantly. For severe malaria, only one case was identified and treated with artesunate injection followed by a 3-day dose of AL. No prescriptions for other antimalaria medications (e.g., quinine + clindamycin, artesunate + amodiaquine) were observed.

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Table 2: *Frequencies of antimalarial medications prescribed by diagnosis* (N = 1,062)

Prescribed Medicine	Diagnosis, n(%n) Asymptomatic malaria (n=1021)	Uncomplicated malaria (n=40)	Severe malaria (n=1)
AL	1 (0.1)	37 (92.5)	-
SP	1020 (99.9)	-	-
Inj. Artesunate/AL	-	-	1 (100.0)
Inj. α-β arteether/AL	-	1 (2.5)	-
SP+AL	-	2 (5.0)	-
Quinine + Clindamycin	-	-	-
AS+AQ	-	-	-
ASMQ	-	-	-
DHAP	-	-	-
AS+SP	-	-	-
ASPY	-	-	-

AL: Artemether-Lumefantrine, SP: Sulfadoxine-Pyrimethamine, AS+AQ: Artesunate-Amodiaquine, ASMQ: Artesunate-Mefloquine, DHAP: Dihydroartemisinin-Piperaquine, AS+SP: Artesunate + Sulfadoxine-Pyrimethamine, ASPY: Artesunate-Pyronaridine

Antimalarial medication prescribing patterns by gestational trimester

Table 3 presents the frequency distribution of antimalarial medications prescribed by gestational trimester. As shown, SP was the most prescribed antimalarial medication in the second (96.2% of 471 cases) and third trimesters (96.7% of 584 cases). In the first trimester, however, AL was most common (57.1%, n = 4), although SP was also prescribed (28.6%, n=2). Aside from injectable artesunate and α-β arteether, no prescriptions for other antimalarials, including quinine + clindamycin or dihyroartemisinin + piperaquine, were observed throughout pregnancy.

Table 3: Frequency of antimalarial medication prescribed by gestational trimester *(N = 1,062)*

Prescribed Medicine	Gestational period/trimester n(%n)		
	First (n=7)	Second (n=471)	Third (n=584)
AL	4 (57.1)	17 (3.6)	17 (2.9)
SP	2 (28.6)	453 (96.2)	565 (96.7)
Inj. Artesunate/AL	1 (14.3)	-	-
Inj. α-β arteether/AL	-	1 (0.2)	-
SP+AL	-	-	2 (0.3)
Quinine + Clindamycin	-	-	-
AS+AQ	-	-	-
ASMQ	-	-	-
DHAP	-	-	-
AS+SP	-	-	-
ASPY	-	-	-

AL: Artemether-Lumefantrine, SP: Sulfadoxine-Pyrimethamine, AS+AQ: Artesunate-Amodiaquine, ASMQ: Artesunate-Mefloquine, DHAP: Dihydroartemisinin-Piperaquine, AS+SP: Artesunate + Sulfadoxine-Pyrimethamine, ASPY: Artesunate-Pyronaridine

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Assessment of adherence to the WHO 2024 treatment guidelines for malaria during pregnancy

Figure 2 presents a bar chart illustrating the proportion of ANC cases that adhered to the WHO 2024 guidelines. Overall, adherence to the guidelines was remarkably high, with over 99% of antimalarial prescriptions conforming to the WHO's recommendations. However, adherence varied across trimesters: it was highest in the second (99.6%) and third (99.7%) trimesters but lowest in the first (71.4%) trimester.

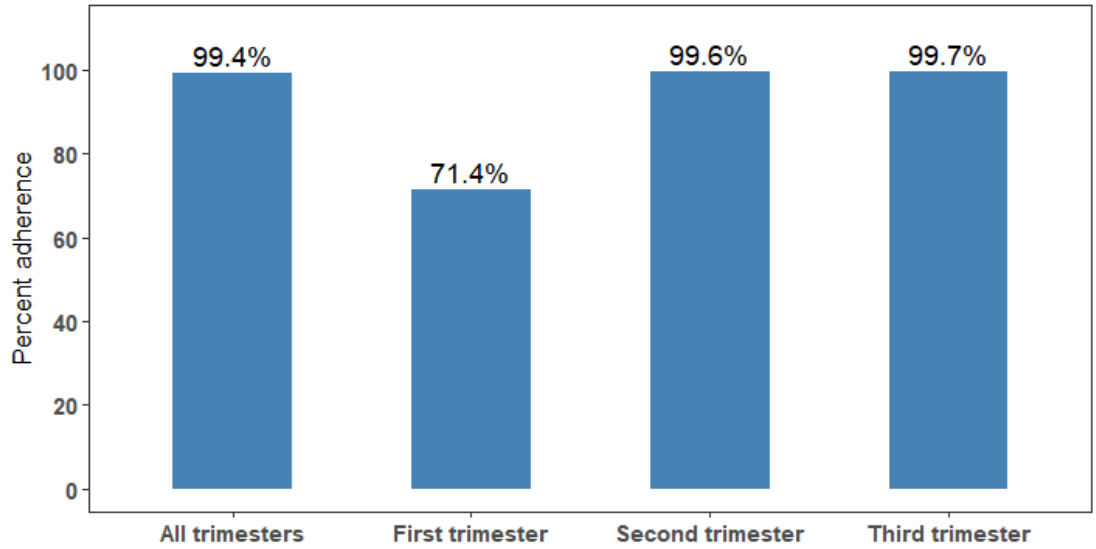

Figure 2: Adherence to the 2024 WHO Guidelines for Malaria Treatment During Pregnancy across Trimesters

Footnote: The figure represents the proportion of antenatal care cases with antimalarial prescriptions consistent with the WHO 2024 recommendations.

Further analysis revealed specific instances of nonadherence to guidelines (see ***Table 4***). For example, the WHO's guidelines advise against administering IPTp-SP before the 13th week of gestation. Despite this, two out of 7 women were prescribed SP in their first trimester, indicating a deviation from the guidelines. Additionally, one woman was prescribed AL for malaria prevention in her second trimester, which was not recommended.

For uncomplicated malaria, the use of AL is recommended in all trimesters, and 37 out of 40 women with uncomplicated malaria received AL therapy during pregnancy. This indicates high adherence to guidelines. However, the concomitant use of AL and SP in any trimester is considered inappropriate, but two women received this combination in their third trimester, thereby indicating nonadherence to the guidelines. Another case of nonadherence was observed when a woman was prescribed intramuscular α-β arteether followed by a 3-day standard course of AL. Guidelines do not recommend the use of parenteral artesunate or α-β arteether for uncomplicated malaria.

For severe malaria, a single patient received artesunate injection followed by a 3-day AL standard dose. No prescriptions were observed for other ACTs (e.g., artesunate-amodiaquine, artesunate-mefloquine, dihydroartemisinin-piperaquine), second-line quinine + clindamycin, or contraindicated drugs such as primaquine and tetracycline. These observations indicate adherence to guidelines.

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Table 4: *Assessment of adherence to the 2024 WHO Guidelines for Malaria Management in Pregnancy*

Guideline	Observed Practice	Adherent
Treatment of Asymptomatic Malaria (Chemoprevention) (n = 1,021 cases)		
IPTp-SP in 1st trimester: Not to be given before week 13 (Contraindicated)	2 out of 7 women received SP in their 1st trimester	No
IPTp-SP in 2nd/3rd trimester: Start in the 2nd trimester	1018 women received SP in their 2nd/3rd trimesters.	Yes
IPTp with other drugs other than SP: Not recommended	1 woman received AL therapy for prevention in her 2nd trimester	No
Treatment of Uncomplicated Malaria (n = 40 cases)		
AL in all trimesters: Recommended	37 women received AL therapy during pregnancy	Yes
AL + SP in all trimester: Not appropriate	2 women received AL+SP in 3rd trimester	No
Other ACTs (AS+AQ, ASMQ, DHAP, ASPY) in all trimesters: Not recommended as 1st line	No prescription for any was found	Yes
Quinine + Clindamycin in all trimesters: Recommended as 2nd line	No prescription was found	Yes
Inj. Artesunate or α-β arteether followed by a 3-day dose of AL: Not recommended	1 woman received α-β arteether followed by 3-day dose of AL	No
Primaquine or Tetracycline in pregnancy: Not recommended	No prescription was found	Yes
Treatment of Severe Malaria (n = 1 case)		
Inj. Artesunate or α-β arteether followed by a 3-day dose of AL: Recommended	1 woman received artesunate (inj.) after which she was given a 3-day dose of AL	Yes

AL: Artemether-Lumefantrine, SP: Sulfadoxine-Pyrimethamine, AS+AQ: Artesunate-Amodiaquine, ASMQ: Artesunate-Mefloquine, DHAP: Dihydroartemisinin-Piperaquine, AS+SP: Artesunate + Sulfadoxine-Pyrimethamine, ASPY: Artesunate-Pyronaridine

DISCUSSION

This study analysed antimalarial prescribing patterns and adherence to the WHO guidelines for malaria during pregnancy at FMC Makurdi by employing a retrospective cross-sectional design. Overall, the findings reveal a high level of adherence to guidelines, with adherence exceeding 99% across all prescriptions. However, a detailed examination revealed notable variations in adherence across gestational trimesters. For example, while adherence remained exceptionally high in the second and third trimesters, a significant decrease was observed in the first trimester. This may be attributed to a combination of factors, including the small proportion of pregnant women who attended ANC in their first trimester and prescribers' limited knowledge of the current recommendations for malaria in early pregnancy. Nonetheless, the high level of adherence in this study aligns with findings from similar studies and reflects that ANC clinicians at FMC Makurdi are well aware of and largely adhere to antimalarial guidelines during pregnancy.[8,15,22] However, this contrasts with other studies that reported clinicians' poor adherence to or limited knowledge of guidelines.[23–27]

Furthermore, the high frequency of SP prescriptions for IPTp in this study aligns with the recommended strategies to initiate IPTp-SP from the second trimester with monthly dosing in sub-Saharan Africa. This highlights the facility's strong focus on malaria prevention during pregnancy and reflects a significant improvement from earlier studies where healthcare providers did not fully embrace the evidence-based guidelines.[28–30] Although this is remarkable, deviations from guidelines were observed. For example, the observation that two women in the study received SP in their first trimester directly contravenes the WHO guidelines, which explicitly recommend against administering IPTp-SP before the 13th week of gestation due to the potential teratogenic risks of SP in humans at therapeutic doses.[2,31] Additionally, the use of AL for IPTp is not recommended, as observed in one case. These inappropriate prescribing practices are not

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unique to FMC Makurdi alone, as noted in similar studies.[8,29,32]

For the treatment of uncomplicated malaria, the study demonstrated high adherence to guidelines, with AL being the primary antimalarial medication prescribed. This finding is consistent with WHO recommendations for the use of AL as a first-line therapy. However, two cases of nonadherence involving the concomitant use of SP and AL, were observed. This combination is not recommended because of its potential contribution to drug resistance and increased risk of adverse reactions without offering additional therapeutic benefits over monotherapy with AL, which has been shown to prevent almost all malaria transmissions with fewer adverse effects than when SP, in combination with amodiaquine, is administered.[33] Evidence also supports the superior efficacy of dihydroartemisinin–piperaquine in the prevention of malaria compared with that of SP, especially in regions where there is emergence of resistance to SP or when SP use is inappropriate.[34–36] While this combination appears to be a potential candidate for IPTp, current guidelines still recommend it and other ACTs solely for the treatment of malaria in sub-Saharan Africa owing to the emergence of resistance to ACTs.[37] As such, rather than prescribing AL and SP concomitantly, it may be more beneficial to administer AL alone for uncomplicated malaria and reserve SP for malaria chemoprevention.

Study limitations

This study has several notable strengths. First, the relatively large sample size derived from routine clinical practice provides a realistic and representative view of antimalarial prescribing patterns at FMC Makurdi. This enhances the external validity of the findings and supports their potential applicability to similar tertiary healthcare settings in Nigeria. Moreover, exceeding the estimated minimum sample size adds statistical robustness and reliability to the data. Another key strength lies in the study's focus on adherence to the updated WHO 2024 guidelines for malaria during pregnancy, which ensures that the findings are current and relevant.

Despite these strengths, the study has several limitations that must be acknowledged. First, the ANC register records each antenatal visit as an independent entry thereby making it difficult to link multiple visits by the same woman. Consequently, this limited the analyses to just prescription-level analysis rather than cumulative IPTp-SP dosing at the individual level. Second, the retrospective design inherently relies on the accuracy and completeness of medical folder documentation, which is subject to recording biases/errors, missing information and inconsistencies across healthcare providers. This limitation may affect the internal validity of the study. Third, the assessment of guideline adherence was based solely on recorded prescriptions and diagnoses, without insight into patient compliance, confirmed laboratory tests or treatment outcomes. This narrow scope limits the ability to fully evaluate the effectiveness or consequences of prescribing practices. Fourth, the study was conducted in a single tertiary facility, which may limit the generalisability of the results to primary or secondary healthcare centres or to other regions with different resource constraints or malaria prevalence rates. Finally, nonclinical factors that may influence prescribing behaviour including drug availability, stock-outs, provider knowledge and institutional policies, were not explored in this study, yet they play a significant role in real-world prescribing decisions.

Implications of the findings

To sustain and improve antimalarial prescription practices and adherence to both the NMEP 2020 and WHO 2024 guidelines for malaria in pregnancy at FMC Makurdi and in similar settings, continuous prescriber education and training, with particular emphasis on trimester-specific recommendation is very vital. Regular prescription audits, integration of pharmacists into ANC services, and collaborative review meetings among obstetric, pharmacy, and laboratory units are also essential to enhancing guideline compliance. Also, transitioning from manual ANC registers to digital record systems will enable linkage of patient visits efficiently, enhance accountability, and support monitoring of preventive interventions. Lastly, multi-centre studies across different healthcare levels are recommended to inform national strategies for optimising antimalarial prescribing practices

CONCLUSION

This study provides an updated perspective into the current antimalarial prescribing practices for pregnant women in a Nigerian tertiary hospital in relation to both the WHO 2024 and the NMEP 2020 treatment guidelines for malaria in pregnancy. Prescriptions at

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FMC Makurdi revealed a high degree of compliance with recommended treatment guidelines, thereby indicating sound prescriber knowledge and awareness. Nonetheless, minor deviations in trimester-specific prescribing and preventive SP use underscore the importance of aligning clinical practice with trimester-specific recommendations to ensure optimal maternal and foetal health outcomes. The identified gaps emphasise the need for continuous education, standardised protocols and system-level interventions to support guideline-compliant prescribing.

List of abbreviations

AL – Artemether-Lumefantrine
ANC – Antenatal Care
AS+AQ – Artesunate-Amodiaquine
AS+SP – Artesunate + Sulfadoxine-Pyrimethamine
ASMQ – Artesunate-Mefloquine
ASPY – Artesunate-Pyronaridine
DHAP – Dihydroartemisinin-Piperaquine
FMC – Federal Medical Centre
IPTp – Intermittent preventive treatment for malaria during pregnancy
IPTp-SP – Intermittent preventive treatment for malaria in pregnancy with sulfadoxine-pyrimethamine
MiP – Malaria in pregnancy
SP – Sulfadoxine-Pyrimethamine
WHO – World Health Organisation

DECLARATIONS

Consent for publication: Not applicable

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

Competing interests: The authors declare that they have no competing interests

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Authors' contributions: S.C.A. and **M.O.I.** led the conceptualisation of the manuscript. **M.O.I.** and **J.M.O.** led data collection and curation. **J.M.O.** led formal analysis, interpretation of results, methodology, and visualisation. **S.C.E.**, and **S.C.O**. led the writing – original draft. **S.C.A.** and **J.M.O.** led the supervision of the research activity and critical revision of the manuscript. All authors read and approved the final manuscript.

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