

Persistent Chloroquine use in Nigeria: Evidence, Drivers, Drug Resistance and Implications for Antimalarial Stewardship

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ABSTRACT

Chloroquine was once the mainstay of uncomplicated malaria treatment in Nigeria because of its low cost, wide availability, simple dosing regimen, and long history of use. However, widespread use and increasing *Plasmodium falciparum* resistance led to declining therapeutic effectiveness and the subsequent adoption of artemisinin-based combination therapies (ACTs) as the recommended treatment for uncomplicated malaria. Despite its withdrawal from national treatment policy, chloroquine remains available and is reportedly used in some Nigerian communities and medicine outlets. This review examines the persistence of chloroquine use in Nigeria, with particular attention to Northern Nigeria, and considers its implications for antimalarial stewardship, drug-resistance containment, and sustainable malaria control. A narrative review of published evidence and relevant malaria-treatment policies was undertaken. Evidence on continued chloroquine use, medicine availability, self-medication, treatment-seeking behaviour, provider and vendor practices, and molecular markers of chloroquine resistance was examined. Available evidence indicates that chloroquine remains accessible and is still used in some settings despite its withdrawal from recommended malaria-treatment protocols. Its continued use appears to be associated with historical familiarity, low cost, easy access, self-medication, presumptive treatment of fever, limited diagnostic services, variable availability or affordability of ACTs, and practices among medicine vendors and health-care providers. Molecular surveillance indicates that chloroquine-resistance markers have declined in some settings following withdrawal of chloroquine, but resistant parasite genotypes remain detectable. However, declining resistance-marker frequencies alone do not provide sufficient evidence to support routine reintroduction of chloroquine. Persistent chloroquine use remains a policy-practice concern with implications for appropriate malaria case management and sustainable malaria control. Strengthening antimalarial stewardship requires reliable access to quality-assured ACTs and rapid diagnostic tests, improved regulation of medicine outlets, provider and vendor training, community education, routine surveillance of antimalarial medicine use, and continued molecular and therapeutic-efficacy surveillance.

Keywords: chloroquine; malaria; antimalarial stewardship; drug resistance; Nigeria; sustainability

1.0 INTRODUCTION

1.1 Background

Malaria remains one of the major public-health challenges in Nigeria and continues to place a substantial burden on households, health facilities, and the health system. Nigeria recorded an estimated 68.1 million malaria cases and 184,700 malaria deaths in 2023, placing the country among those with the highest malaria burden globally (World Health Organization [WHO], 2024). The burden is particularly high among children under five years of age, pregnant women, rural populations, and economically disadvantaged households. Sustainable malaria control therefore depends not only on preventive measures, including insecticide-treated nets and vector control, but also on prompt diagnosis and effective treatment with quality-assured antimalarial medicines.

For several decades, chloroquine was widely used as the first-line treatment for uncomplicated malaria in Nigeria. Its low cost, wide availability, simple dosing regimen, and long history of use made it familiar to health-care providers and community members.

However, widespread and often inappropriate use placed sustained drug-selection pressure on *Plasmodium falciparum*, contributing to the development and spread of resistance and the subsequent decline in treatment effectiveness. Molecular and clinical studies established an important association between mutations in the *P. falciparum* chloroquine-resistance transporter (*pfcr*) gene, particularly the K76T mutation, and chloroquine resistance (Djimé et al., 2001). Nigerian evidence also demonstrated relationships among *pfcr* and *pfmdr1* polymorphisms, in-vitro chloroquine resistance, and treatment outcomes (Ojurongbe et al., 2010).

1.2 Decline in Chloroquine Effectiveness

The decline in chloroquine effectiveness led Nigeria to adopt artemisinin-based combination therapies (ACTs) as the recommended treatment for uncomplicated malaria in 2005. Current treatment recommendations include ACTs such as artemether-lumefantrine and artesunate-amodiaquine for uncomplicated *P. falciparum* malaria, while severe malaria is initially treated with injectable artesunate (WHO, 2024). The

National Malaria Elimination Programme (NMEP) identifies chloroquine as ineffective for malaria case management and does not recommend its routine use (National Malaria Elimination Programme [NMEP], 2020). This policy change was intended to improve treatment outcomes, reduce malaria-related morbidity and mortality, and preserve the effectiveness of available antimalarial medicines.

However, the existence of a national treatment policy does not necessarily translate into adherence at community level. Treatment decisions may be influenced by medicine price and availability, previous treatment experience, informal advice, self-medication, and access to diagnostic services. In Nigeria, antimalarial medicines can be obtained from pharmacies, patent and proprietary medicine vendors (PPMVs), informal outlets, and household medicine supplies. These channels may allow older antimalarials, including chloroquine, to remain available and used despite its withdrawal from recommended treatment protocols. Persistent use should therefore be understood within the broader policy–practice gap involving behavioural, socioeconomic, pharmaceutical, and health-system factors rather than being viewed simply as individual non-compliance.

1.3 Persistence of Chloroquine Use

The persistence of chloroquine use is also important in relation to antimalarial drug-resistance surveillance. Withdrawal of chloroquine drug pressure may favour the return of chloroquine-sensitive parasite populations, but this process is neither immediate nor uniform across locations. Nigerian studies have reported geographical variation in resistance-associated markers, including *pfprt* K76T and *pfmdr1* mutations. For example, a recent study in Benue State reported *pfprt* K76T mutations in 60% of analysed *P. falciparum* isolates, indicating that resistance-associated genotypes may persist in some settings long after changes in treatment policy (Nyamngee et al., 2025). At the same time, recent molecular-surveillance evidence suggests an increasing frequency of chloroquine-sensitive parasite populations in some parts of Nigeria. These findings require careful interpretation because a decline in molecular resistance markers does not establish clinical effectiveness or, on its own, justify the routine reintroduction of chloroquine without supporting therapeutic-efficacy evidence.

Persistent chloroquine use therefore has implications for sustainable malaria control. Continued use may contribute to treatment failure, delay access to effective ACTs, increase the risk of complications, and impose avoidable costs on households. It may also complicate the interpretation of parasite-resistance patterns and weaken efforts to promote appropriate antimalarial medicine use. Antimalarial stewardship, broadly

defined as coordinated action to promote appropriate diagnosis, medicine selection, dispensing, use, and surveillance, is therefore important for preserving the effectiveness of existing therapies and supporting malaria-control and elimination efforts.

1.4 Justification for the Review

Against this background, this review examines the persistence of chloroquine use in Nigeria, with particular attention to Northern Nigeria. It synthesises available evidence on the policy–practice gap, factors that may sustain chloroquine use, the relationship between chloroquine use and molecular resistance markers, and the implications for antimalarial stewardship and sustainable malaria case management. The review also identifies research and policy priorities for improving adherence to recommended malaria-treatment guidelines.

2.0 CONCEPTUALISING ANTIMALARIAL STEWARDSHIP AND SUSTAINABILITY

2.1 Antimalarial Stewardship

Antimalarial stewardship refers to the coordinated use of policies, diagnostic services, medicines, regulation, surveillance, and community education to promote the appropriate use of antimalarial medicines. It requires medicines to be used when indicated, selected according to recommended treatment guidelines, prescribed or dispensed at the correct dose and duration, and monitored for safety and effectiveness.

In malaria case management, stewardship includes parasitological confirmation where feasible, appropriate use of recommended artemisinin-based combination therapies (ACTs), avoidance of ineffective medicines such as chloroquine, and monitoring of treatment outcomes and parasite resistance. It therefore extends beyond the choice of medicine at the point of treatment to include the systems and practices that determine how medicines are accessed, prescribed, dispensed, and used.

Effective stewardship requires the involvement of all major actors in malaria case management, including health-care workers, pharmacists, patent and proprietary medicine vendors (PPMVs), regulators, programme managers, and medicine users. Their decisions and practices influence whether national treatment recommendations are followed in routine community practice.

2.2 Sustainable Malaria Control

Sustainable malaria control also depends on maintaining interventions that remain effective, affordable, equitable, and responsive to changing epidemiological and drug-resistance conditions. This requires accurate diagnosis, reliable access to quality-assured medicines, and adherence to recommended treatment guidelines. Affordability is particularly important because households may resort to cheaper

but ineffective medicines when ACTs, diagnostic tests, or formal health services are inaccessible or unaffordable. Equity also requires rural, poor, conflict-affected, and other underserved populations to have timely access to malaria testing and effective treatment. Resistance containment is an equally important component of sustainability. Declining effectiveness of ACTs would pose a major threat to malaria control in Nigeria and other malaria-endemic countries. The World Health Organization identifies universal access to malaria prevention, diagnosis, treatment, and surveillance as important components of sustained progress against malaria (WHO, 2021).

2.3 Irrational Antimalaria Use

Inappropriate antimalarial medicine use can undermine both health-system performance and the sustainability of malaria-control efforts. Presumptive treatment of fever without diagnostic confirmation may lead to unnecessary antimalarial exposure, failure to identify non-malarial causes of illness, and inefficient use of household and health-system resources. Similarly, the use of ineffective medicines, incomplete treatment courses, poor-quality products, and inappropriate dispensing practices may delay effective treatment and increase the risk of complications. At population level, inappropriate antimalarial exposure may also contribute to the selection and persistence of drug-resistant parasite populations. This can increase treatment failure, raise the cost of malaria case management, and place additional pressure on already limited health-system resources.

Evidence from Nigeria indicates that these challenges are particularly important where diagnostic capacity is limited and treatment is obtained through private medicine outlets without adequate professional guidance (Uzochukwu et al., 2010; Udoh et al., 2013).

For this review, a policy–access–behaviour–resistance framework is used to explain how conditions surrounding malaria treatment may contribute to persistent chloroquine use. National policy establishes recommended diagnostic and treatment practices, including the use of ACTs and the withdrawal of chloroquine from routine malaria treatment (Eze et al. 2026). However, implementation is influenced by access to medicines and diagnostic services, including medicine prices, availability of ACTs and rapid diagnostic tests, distance to health facilities, and the effectiveness of regulatory systems.

These access conditions interact with the behaviour of patients, caregivers, health-care providers, and medicine vendors, influencing medicine selection, dispensing, and use. Where ACTs or diagnostic services are unavailable, unaffordable, or poorly understood, individuals may resort to self-medication or familiar medicines such as chloroquine. Such practices may contribute to continued drug exposure and influence the distribution of resistance-associated parasite markers. Surveillance findings should, in turn, inform treatment policy, medicine procurement, provider training, regulation, and community interventions.

The framework therefore places antimalarial stewardship at the intersection of policy, access, behaviour, and resistance. It is not intended to assume a direct causal relationship between chloroquine use and specific resistance patterns in individual communities. Rather, it provides a basis for examining how medicine availability and treatment practices may interact with broader drug-resistance processes. This distinction is important because parasite resistance is also influenced by factors such as transmission intensity, population movement, treatment adherence, medicine quality, and historical drug exposure, table 1.

Table 1. Conceptual Framework for Antimalarial Stewardship and Persistent Chloroquine Use in Nigeria

Component	Key elements	Relevance to antimalarial stewardship and persistent chloroquine use
National policy and treatment guidelines	Malaria treatment policy; recommended ACTs; diagnostic requirements; withdrawal of chloroquine from routine treatment	Establishes the standard for appropriate malaria diagnosis and treatment. Continued chloroquine use despite its withdrawal indicates a gap between policy and practice.
Access to diagnosis	Availability and affordability of microscopy and rapid diagnostic tests (RDTs); quality of diagnosis	Limited access to testing can encourage presumptive treatment and unnecessary antimalarial use. Parasite-based diagnosis helps reduce inappropriate treatment. (WHO, 2024)
Availability and affordability of recommended medicines	Reliable supply of quality-assured ACTs; medicine prices; geographic accessibility	Limited availability or affordability of recommended treatment may encourage patients or providers to rely on familiar or cheaper non-recommended medicines.
Health-care provider and vendor practices	Prescribing, dispensing, diagnostic practices, adherence to guidelines, referral	Provider and vendor practices influence which medicines are recommended, purchased and used. Weak adherence to guidelines can sustain inappropriate antimalarial use.

Component	Key elements	Relevance to antimalarial stewardship and persistent chloroquine use
Community and household behaviour	Self-medication; previous treatment and experience; familiarity; perceived ease of access may influence continued demand, effectiveness; treatment-seeking behaviour	Familiarity with chloroquine, previous experience and ease of access may influence continued demand, particularly where diagnosis and formal care are less accessible.
Medicine regulation and quality assurance	Regulation of pharmacies and PPMVs; product registration; post-market surveillance; medicine quality	Effective regulation helps limit inappropriate marketing and distribution of non-recommended, substandard or falsified medicines and supports appropriate dispensing.
Antimalarial medicine-use surveillance	Household, facility, pharmacy and PPMV data; medicine availability, dispensing and consumption	Provides evidence on where medicines are available and used and helps identify persistent gaps between policy and actual treatment practices.
Molecular and therapeutic-efficacy surveillance	Resistance markers; therapeutic efficacy studies; treatment outcomes; pharmacovigilance	Tracks changes in parasite susceptibility and treatment effectiveness. Molecular evidence should be interpreted alongside clinical and therapeutic-efficacy data rather than used alone to determine treatment policy. (World Health Organization)
Feedback to policy and programme implementation	Surveillance findings; research evidence; guideline review; targeted interventions	Evidence from medicine-use, resistance and treatment-outcome surveillance should inform programme adjustments, resource allocation and context-specific stewardship interventions. (WHO, 2025)
Sustainable malaria control	Appropriate diagnosis; effective treatment; rational medicine use; resistance containment; equitable access	The desired outcome is consistent use of effective, quality-assured antimalarial treatment while reducing inappropriate medicine use and protecting treatment effectiveness.

Source: NMEP (2020), WHO (2021), WHO (2025), WHO (2025 & 2026), Liu et al. (2015), Oladepo et al. (2019), Ogunwale et al. (2024), Bamikole et al. (2025), WHO & PSI (2025).

Strengthening each component of the stewardship process is therefore necessary to support appropriate malaria treatment and protect the effectiveness of available antimalarial medicines.

3.0 EVOLUTION OF MALARIA TREATMENT POLICY IN NIGERIA

3.1 Chloroquine-era Treatment Policy

For several decades, chloroquine was the cornerstone of malaria treatment in Nigeria. Its low cost, wide availability, relative safety, and familiarity among health-care providers and communities contributed to its widespread use as the first-line medicine for uncomplicated malaria. Sulfadoxine-pyrimethamine was also used as an alternative treatment (FMH, 2005). However, widespread self-medication, incomplete dosing, presumptive treatment of febrile illness, and easy access to antimalarial medicines through medicine outlets increased exposure of *Plasmodium falciparum* to chloroquine. Over time, these practices contributed to declining therapeutic effectiveness and made chloroquine unsuitable for routine malaria case management (WHO, 2020a).

3.2 Emergence of *Plasmodium falciparum* resistance

Chloroquine resistance emerged as a major challenge to malaria control in Nigeria during the 1980s and 1990s (FMH, 2005). Resistance is strongly associated with mutations in the *P. falciparum* chloroquine-resistance transporter (*pfcr*) gene, particularly the K76T substitution. Variations in the *P. falciparum*

multidrug resistance 1 (*pfmdr1*) gene may also modify parasite responses to chloroquine and other antimalarial medicines (WHO, 2020b).

By the early 2000s, therapeutic-efficacy studies from different locations in Nigeria had documented substantial treatment failure with chloroquine and sulfadoxine-pyrimethamine. Continued reliance on medicines with reduced clinical effectiveness increased the likelihood of persistent parasitaemia and contributed to the wider problem of drug-resistant malaria (FMH, 2014).

3.3 Transition to ACT-based Treatment

In response to increasing evidence of antimalarial drug resistance and declining treatment efficacy, Nigeria revised its malaria-treatment policy in 2005 (FMH, 2002). Chloroquine and sulfadoxine-pyrimethamine were replaced by artemisinin-based combination therapies (ACTs) for uncomplicated malaria. Artemether-lumefantrine and artesunate-amodiaquine became the principal first-line treatment options.

The use of an artemisinin derivative in combination with a longer-acting partner medicine was intended to improve parasite clearance and reduce the likelihood of treatment failure associated with antimalarial monotherapy. The policy transition therefore marked an important shift from antimalarial monotherapy to combination treatment and was consistent with World Health Organization recommendations (WHO, 2025). The Federal Government subsequently expanded the procurement and distribution of ACTs and rapid

diagnostic tests (RDTs), together with treatment guidelines and provider-training materials (FMH, 2014), see table 2. However, implementation at community level was not immediate. Chloroquine

remained inexpensive, familiar, and accessible through some formal and informal medicine outlets. As a result, previous treatment practices could persist despite the change in national policy.

Table 2. Timeline of Malaria Treatment-Policy Changes in Nigeria

Period/Year	Policy change or milestone	Recommended treatment approach	Significance
Pre-2005	Chloroquine-era policy	Chloroquine was the first-line treatment for uncomplicated malaria; sulphadoxine–pyrimethamine was used mainly as an alternative.	Chloroquine was inexpensive, familiar, and widely available through formal and informal medicine outlets.
1990s–early 2000s	Increasing chloroquine treatment failure	Continued chloroquine use despite mounting reports of reduced clinical and parasitological efficacy.	Widespread <i>Plasmodium falciparum</i> resistance, associated particularly with <i>pfprt</i> mutations, undermined the effectiveness of treatment.
2005	Adoption of artemisinin-based combination therapy (ACT) policy	of Artemether–lumefantrine (AL) became the first-line treatment for uncomplicated malaria; artesunate–amodiaquine (AS–AQ) was recommended as an alternative.	Nigeria formally withdrew chloroquine as first-line treatment and aligned policy with WHO recommendations for combination therapy.
2010–2014	Scale-up of ACT access and diagnosis	ACTs promoted across public facilities, pharmacies, and medicine-vendor outlets; parasitological diagnosis increasingly encouraged before treatment.	The Affordable Medicines Facility–malaria and related interventions improved ACT availability, although informal chloroquine sales persisted.
2014	Revised National Malaria Policy	Confirmed malaria cases to be treated with quality-assured ACTs; microscopy or malaria rapid diagnostic tests (RDTs) recommended before treatment where feasible.	The policy strengthened the “test, treat, and track” approach and discouraged presumptive treatment.
2020	Fourth edition of National Guidelines for ACT Diagnosis and Treatment of Malaria	RDT or microscopy is recommended before treatment. AL remains the preferred first-line for uncomplicated <i>P. falciparum</i> malaria; AS–AQ is an alternative. Injectable artesunate is recommended for severe malaria.	Reinforced evidence-based case management, appropriate referral, pharmacovigilance, and stewardship of antimalarial medicines.
2021–2025	National Strategic Plan implementation	Malaria Expanded access to diagnosis, ACTs, severe-malaria treatment, surveillance, and community-level malaria services.	Emphasised universal access, equity, quality of care, and progress towards malaria elimination.
Current policy direction	Sustained ACT-based treatment and resistance surveillance	Chloroquine is not recommended for routine treatment of uncomplicated malaria. Confirmed cases should receive quality-assured ACTs according to national guidance.	Continued availability or use of chloroquine represents a policy–practice gap and may compromise treatment outcomes and antimalarial stewardship.

Sources: Federal Ministry of Health (2005, 2014); National Malaria Elimination Programme (2020a, 2020b); World Health Organization (2021).

3.4 Current National Recommendations for Diagnosis and Treatment

Nigeria's malaria-control policy promotes a test-and-treat approach in which suspected malaria cases are confirmed by microscopy or an RDT before treatment where diagnostic testing is available (NMEP, 2021–2025). Confirmed uncomplicated *P. falciparum* malaria should be treated with a recommended ACT, whereas severe malaria requires prompt treatment with injectable artesunate, followed by an appropriate oral antimalarial regimen when the patient is able to take oral medicines.

Chloroquine is not recommended for routine treatment of *P. falciparum* malaria because of its historically poor therapeutic efficacy and the continuing need to preserve effective antimalarial medicines. The national malaria-control strategy also emphasises access to malaria prevention, diagnostic services, effective treatment, surveillance, and quality-assured commodities.

Despite these policy measures, implementation continues to face important challenges. Drug resistance, weaknesses in health systems, inadequate financing, commodity stock-outs, and unequal access to health services can limit the effective implementation of malaria-treatment policy (WHO,

2021). The evolution of treatment policy in Nigeria therefore reflects not only changes in recommended medicines but also the continuing challenge of translating national policy into consistent practice at community level (NMEP, 2021- 2025).

4.0 POLICY IMPLEMENTATION CHALLENGES, ESPECIALLY IN NORTHERN NIGERIA

4.1 Implementation Challenges

Despite the availability of national malaria-treatment guidelines, their implementation remains challenging, particularly in parts of Northern Nigeria. Key barriers include limited access to rapid diagnostic tests (RDTs) and microscopy, inconsistent availability of ACTs and injectable artesunate, inadequate provider training and supervision, weak routine data systems, poverty, long distances to health facilities, and substantial reliance on patent and proprietary medicine vendors (PPMVs). Some caregivers also continue to seek treatment without diagnostic confirmation or prefer medicines with which they have previous experience (NMEP, 2020a).

Evidence from Sokoto and Bauchi States showed that only a small proportion of febrile children received the complete recommended pathway of prompt care-seeking, parasitological testing, and ACT treatment (Millar et al., 2014). Similarly, an assessment of hospital malaria case management in Kano State identified deficiencies in diagnostic capacity, availability of injectable artesunate, health-worker training, and adherence to test-and-treat guidance (Ojo et al., 2020).

These findings show that the effectiveness of malaria-treatment policy depends on more than the existence of national guidelines. Reliable supplies of medicines and diagnostic commodities, accessible health services, competent providers, supportive supervision, community engagement, and effective involvement of the private medicine sector are also required. Where these elements are weak, patients may continue to rely on easily accessible medicines and established treatment practices, even when these are no longer consistent with national recommendations (NMEP, 2020b).

4.2 Transition from chloroquine to ACT-based treatment

The transition from chloroquine to ACT-based treatment was an important response to declining chloroquine effectiveness and increasing parasite resistance. However, maintaining the benefits of this policy requires continued surveillance of antimalarial efficacy and resistance, improved diagnostic capacity, reliable access to quality-assured ACTs, appropriate regulation of medicine outlets, and stronger adherence to national treatment guidelines (NMEP, 201 -2025).

These measures are particularly important in underserved communities of Northern Nigeria, where access to appropriate diagnosis and treatment may remain limited.

5.0 EVIDENCE OF PERSISTENT CHLOROQUINE USE IN NIGERIA

5.1 Persistent Chloroquine Use in Nigeria

Evidence of persistent chloroquine use in Nigeria should be interpreted with caution. Available evidence comes mainly from community surveys, household reports, medicine-outlet assessments, and facility-based studies rather than recent nationally representative surveillance of antimalarial medicine consumption. Although chloroquine was withdrawn from routine malaria-treatment policy in 2005, studies from different parts of Nigeria indicate that it has remained available and has continued to be used in some settings. However, the availability of chloroquine at a medicine outlet, self-reported previous use, and documented consumption are different measures and should not be treated as equivalent indicators of current use.

5.2 Evidence from Communities

Evidence from community and facility-based studies provides examples of this continued use. In Jos North, caregivers of young children commonly reported treating fever at home before seeking formal care, with familiarity with antimalarial medicines, including chloroquine, contributing to self-medication and delayed appropriate treatment (Adah et al., 2009). In another study, chloroquine accounted for 25.2% of complete antimalarial courses obtained from private retail outlets in Sagamu (Adedeji et al., 2011). These findings provide evidence of use in specific settings but should not be interpreted as estimates of current national consumption.

Medicine-outlet studies also indicate that non-recommended antimalarials have remained available after the change in national treatment policy. An assessment of medicine outlets across 12 Nigerian states reported chloroquine in 17% of sampled outlets, including outlets in Bauchi, Yobe, Kaduna, and Kano (Joda et al., 2015). Similarly, a study in Enugu found that non-recommended medicines continued to be dispensed alongside ACTs (Ezenduka et al., 2014). Such findings demonstrate continued availability and dispensing but do not, by themselves, establish the frequency or volume of chloroquine consumption.

Self-medication and treatment through pharmacies and PPMVs are also relevant to understanding persistent use. Evidence from Nigeria shows that patients and caregivers may obtain antimalarials outside formal health facilities, with treatment decisions influenced by previous experience, perceived effectiveness, cost, accessibility, and advice from medicine providers. In Nasarawa State, medicine vendors were an important

source of malaria treatment, while diagnostic testing and appropriate ACT dispensing were limited (Liu et al., 2015). These practices can allow established treatment preferences to persist even after national policy has changed.

The available evidence therefore supports the existence of a policy–practice gap but does not establish that chloroquine use is widespread or uniform across Nigeria. Most studies were conducted in selected communities, facilities, or medicine outlets and at different periods. Consequently, their findings cannot be combined to produce a reliable current national estimate. This limitation is particularly important when interpreting older studies, because reported use may reflect historical treatment practices rather than current consumption.

Another important distinction is between chloroquine availability and actual use. The presence of

chloroquine in a pharmacy, PPMV outlet, or other medicine market indicates that the medicine can be obtained, but it does not demonstrate that it is being purchased or consumed. Similarly, a reported history of chloroquine use does not establish its current use for confirmed malaria. Resistance markers provide a separate type of evidence and should not be used alone to infer recent chloroquine consumption.

Overall, the evidence indicates that chloroquine has persisted in some Nigerian communities and medicine outlets despite its withdrawal from routine malaria-treatment policy (Table 3). However, the available studies do not support a nationally representative estimate of current use. More recent household, medicine-outlet, prescription, and pharmacovigilance studies are needed to determine where chloroquine remains available, who uses it, why it is selected, and the extent to which its use continues to occur alongside recommended ACT-based treatment.

Table 3. Evidence of Persistent Chloroquine Use in Nigeria: Settings, Populations and Key Findings

Study/source	Setting and population	Type of evidence	Key findings relevant to persistent chloroquine use
Oladokun et al. (2009)	Primary health-care facilities; caregivers of febrile children under five years in Jos North, North-Central Nigeria	Household-reported home treatment	33.5% of children had received chloroquine as home treatment before presentation. The finding provides direct evidence of continued community use after the shift in national treatment policy.
Uzochukwu et al. (2010)	Public and private health facilities in South-East Nigeria	Facility-based assessment of diagnosis and treatment	Presumptive treatment remained common, while access to and use of recommended diagnostic tests and ACTs were limited. These gaps created conditions that could sustain the use of older, non-recommended antimalarials.
Udoh et al. (2013)	Public and private health facilities; children under five years in South-East Nigeria	Clinical audit of uncomplicated malaria management	Inappropriate antimalarial prescribing occurred in both public and private facilities, indicating incomplete adherence to ACT-based treatment policy following chloroquine withdrawal.
Ezenduka et al. (2014)	Public and private medicine outlets in Enugu urban area, South-East Nigeria	Prescription and medicine-use survey	Although ACT use had increased, non-recommended antimalarial medicines continued to be prescribed or used. The findings demonstrate a continuing gap between national treatment policy and actual medicine-use practices.
Isiguzo et al. (2014)	Pharmacies and patent and proprietary medicine vendor (PPMV) outlets in Nigeria	Retail medicine-outlet survey	Presumptive treatment of suspected malaria without prior parasitological confirmation was common. Reliance on medicine vendors and treatment without diagnosis may sustain demand for familiar and inexpensive antimalarials.
Liu et al. (2015)	Drug vendors and their clients in Nasarawa State, North-Central Nigeria	Vendor-based study	Medicine vendors were an important source of malaria treatment, while diagnostic testing and appropriate ACT dispensing were limited. Dependence on informal medicine outlets may allow non-recommended medicines to remain accessible or requested.
Oladebo et al. (2019)	Patent and proprietary medicine vendors in rural Nigeria	Knowledge and practice assessment	Gaps existed in vendors' knowledge and practice regarding malaria testing and treatment. Limited adherence to test-and-treat principles may contribute to inappropriate antimalarial recommendations.
National Malaria Elimination Programme (2020a)	National malaria treatment policy and guidelines	Policy and guideline evidence	Chloroquine is not recommended for routine treatment of uncomplicated malaria. Recommended treatment involves parasitological confirmation where feasible and use of quality-assured ACTs. Continued

Study/source	Setting and population	Type of evidence	Key findings relevant to persistent chloroquine use
NAFDAC (2023)	Nigerian medicine market	Regulatory and post-market surveillance evidence	chloroquine use therefore represents a gap between policy and practice. Post-market surveillance is relevant to identifying unregistered, substandard, falsified or inappropriately marketed medicines. Such surveillance provides an important regulatory basis for monitoring antimalarial products outside recommended treatment pathways.

6.0 DRIVERS OF CONTINUED CHLOROQUINE USE

Continued chloroquine use in Nigeria is likely to reflect a combination of economic, behavioural, and health-system factors (Enem-Osuigwe, Ogbonna, & Eze, 2026). Although chloroquine is no longer recommended for routine treatment of uncomplicated malaria, its long history of use may continue to influence treatment choices in communities where it remains accessible. Available evidence points to medicine cost, accessibility, previous treatment experience, diagnostic practices, self-medication, and the practices of medicine providers as important factors shaping antimalarial medicine selection.

6.1 Historical Familiarity and Patient Trust

Chloroquine was used extensively in Nigeria for many years and became familiar to both health-care providers and community members. This long history may have created confidence in the medicine among people who previously perceived it as effective. Patients and caregivers may therefore continue to associate chloroquine with successful treatment, particularly when symptoms improve after its use. This influence may be stronger where knowledge of current treatment recommendations is limited or access to formal health services is difficult (Enem-Osuigwe, 2026).

However, perceived effectiveness should not be equated with confirmed clinical efficacy. Improvement in fever or other symptoms does not establish that malaria was present or that chloroquine cleared the infection. Reliance on previous treatment experience may therefore sustain the use of a medicine that is no longer recommended for routine malaria case management.

6.2 Low Cost and Household Affordability

The cost of malaria treatment can influence household decisions, particularly where patients must also pay for consultation, diagnostic testing, medicines, and transportation. In some retail settings, ACTs are more expensive than older antimalarial monotherapies. In Enugu, the median cost of ACT treatment was reported to be approximately three times that of antimalarial monotherapy, while self-medication accounted for most monotherapy use (Ezenduka et al., 2014).

For households with limited financial resources, the lower immediate cost of an older medicine may influence treatment selection. However, the apparent affordability of chloroquine may be misleading if ineffective treatment results in persistent illness, additional medicine purchases, repeated consultations, or delayed access to appropriate care.

6.3 Easy Access to Medicines

Accessibility is another factor that may sustain the use of older antimalarial medicines. Chloroquine and other medicines may be obtained through pharmacies, PPMVs, and other medicine outlets that are often closer to households and may involve less time and expense than formal health facilities.

Evidence from Oyo State showed that almost 92% of customers purchasing medicines for suspected malaria had identified the illness themselves or through a family member or friend. ACT purchase was lower among PPMV clients than among pharmacy clients, while PPMV clients were generally younger, poorer, and less likely to have obtained a formal diagnosis (Isiguzo et al., 2014). These findings illustrate the important role of medicine outlets in determining how national treatment recommendations are translated into community practice.

6.4 Previous Treatment Experience and Perceived Effectiveness

Previous experience with chloroquine may reinforce its continued selection. Individuals who believe that chloroquine previously relieved fever or other malaria-associated symptoms may regard it as reliable and familiar. This perception may be reinforced by its low cost and accessibility.

However, treatment history alone cannot establish that chloroquine was responsible for clinical improvement. Fever may result from malaria or other illnesses, while spontaneous recovery or the use of other medicines may influence perceived treatment success. Continued reliance on previous experience may therefore contribute to the selection of chloroquine despite its withdrawal from routine malaria treatment.

6.5 Limited Availability or Higher Cost of ACTs

The availability and price of recommended antimalarial medicines can also influence treatment

choices. Where quality-assured ACTs are unavailable, temporarily out of stock, or perceived to be expensive, patients and caregivers may select older and cheaper alternatives. The additional cost of diagnostic testing and consultation may further influence these decisions (NMEP, 2021–2025).

This issue is particularly relevant in communities where medicine vendors are major sources of treatment. Improving access to affordable, quality-assured ACTs is therefore important for consistent implementation of national treatment recommendations. However, the available evidence does not support the assumption that limited ACT availability is the sole or universal explanation for continued chloroquine use across Nigeria.

6.7 Weak Access to Diagnosis and Presumptive Treatment

Limited access to microscopy and RDTs may encourage presumptive treatment of fever as malaria. Where diagnostic testing is unavailable, inconvenient, or unaffordable, patients, caregivers, and medicine providers may make treatment decisions based on symptoms, previous experience, or perceived malaria risk (NMEP, 2021–2025; Eze et al., 2026; WHO, 2025).

Presumptive treatment creates two important problems. First, non-malarial febrile illnesses may be treated unnecessarily with antimalarial medicines. Second, without diagnostic confirmation, it becomes difficult to determine which medicines are being used for laboratory-confirmed malaria. This creates conditions in which familiar medicines such as chloroquine may continue to be selected outside recommended treatment pathways.

6.8 Self-Medication and Provider Practices

Self-medication provides an important pathway for the continued use of non-recommended antimalarial

medicines. Medicines obtained directly from pharmacies, PPMVs, and other outlets may be selected without consultation with trained health professionals. Decisions may be influenced by previous experience, advice from relatives or friends, perceived severity of illness, cost, and medicine availability.

Medicine providers also influence treatment choices through what they recommend, stock, and dispense. Where providers have limited access to diagnostic services or do not consistently follow current treatment guidelines, established patterns of medicine use may persist. The role of PPMVs is particularly important because they are an accessible source of treatment for many communities.

6.9 Health-Seeking Behaviour and Local Treatment Practices

Treatment-seeking behaviour is also shaped by the accessibility and acceptability of health services. Evidence cited in the review indicates that waiting time, overcrowding, trust in informal providers, and the use of traditional remedies may influence where and when people seek malaria treatment (Ogunwale et al., 2024). Such factors may increase reliance on community medicine outlets and self-treatment, particularly where formal services are difficult to reach or perceived as inconvenient.

Overall, continued chloroquine use should not be attributed to a single factor. Historical familiarity, cost, accessibility, previous treatment experience, limited diagnostic services, variable access to ACTs, self-medication, and provider practices may interact in different ways across communities. Their relative importance is likely to vary according to socioeconomic conditions, geographical location, health-service availability, and local medicine markets. Further community-based research is therefore needed to identify the factors that most strongly predict current chloroquine use, particularly in underserved areas of Northern Nigeria.

Table 4; Determinants of persistent chloroquine use and proposed stewardship responses

Determinant of persistent chloroquine use	How it may sustain chloroquine use	Proposed antimalarial stewardship response
Historical familiarity and patient trust	Long-term use has created familiarity among patients, caregivers, medicine vendors and some providers.	Strengthen community education on current malaria treatment recommendations and explain clearly why chloroquine is no longer recommended for uncomplicated malaria.
Low cost and household affordability	Chloroquine may be perceived as cheaper than recommended ACTs, particularly by low-income households.	Improve affordability and availability of quality-assured ACTs through public and private-sector mechanisms, particularly in underserved communities.
Easy access without prescription	Chloroquine may remain accessible through pharmacies, PPMVs and other informal medicine outlets.	Strengthen enforcement of medicine regulations and post-market surveillance, while improving the capacity of licensed outlets to provide appropriate antimalarial treatment.

Determinant of persistent chloroquine use	How it may sustain chloroquine use	Proposed antimalarial stewardship response
Previous treatment experience and perceived effectiveness	Patients may continue to use chloroquine and because they or their relatives previously experienced perceived benefit.	Promote test-based treatment and targeted communication on treatment failure, drug resistance and the importance of recommended ACTs.
Limited availability or higher cost of ACTs	Where ACTs are unavailable or relatively expensive, patients may select cheaper or more readily available alternatives.	Maintain reliable supply of quality-assured ACTs and RDTs and address price and supply barriers in private and public outlets.
Weak access to malaria diagnosis	Lack of convenient diagnostic services encourages presumptive treatment and medicine selection based on symptoms or previous experience.	Expand access to malaria microscopy and RDTs and promote parasite-based diagnosis before treatment.
Self-medication and informal treatment-seeking	Patients may purchase antimalarials without consultation with trained health professionals.	Strengthen public education, improve regulation of medicine sales, and train PPMVs and other relevant providers in appropriate malaria case management.
Provider and vendor practices	Medicine sellers and providers may influence drug choice through dispensing practices, recommendations and availability of particular products.	Provide regular training, supportive supervision and monitoring of antimalarial dispensing practices in pharmacies and PPMV outlets.
Health literacy and treatment-seeking behaviour	Limited knowledge of drug resistance and appropriate malaria treatment may contribute to continued use of familiar medicines.	Use sustained, locally appropriate health-education programmes involving communities, schools, health workers and medicine vendors.
Weak monitoring of antimalarial use	Limited information on household consumption, medicine sales and dispensing practices makes it difficult to identify where inappropriate use persists.	Establish routine surveillance of antimalarial availability, dispensing, purchase and consumption, with particular attention to underserved areas.
Medicine-quality and regulatory gaps	Availability of non-recommended or poor-quality antimalarial products can undermine adherence to national treatment policy.	Strengthen regulatory inspection, post-market surveillance and enforcement against non-compliant antimalarial products.
Geographic and socioeconomic barriers	Rural, poor and hard-to-reach populations may have less access to diagnostic and treatment services and may depend more on informal medicine sources.	Prioritise underserved communities for ACT/RDT supply, community-based diagnosis, health education and targeted stewardship interventions.

Source: Compiled from evidence reviewed in this article, including Ezenduka et al. (2014), Isiguzo et al. (2014), Liu et al. (2015, 2016), Oladepo et al. (2019), Ogunwale et al. (2024), Udoh et al. (2013), Uzochukwu et al. (2010), and WHO (2025).

7.0 CHLOROQUINE USE AND ANTIMALARIAL DRUG RESISTANCE

Chloroquine resistance in *Plasmodium falciparum* was a major factor in the withdrawal of chloroquine from routine malaria treatment in Nigeria. Prolonged exposure to chloroquine created selective pressure that favoured resistant parasite populations and contributed to declining clinical effectiveness (Enem-Osuigwe, Ogbonna, & Eze, 2026). Chloroquine acts within the parasite's digestive vacuole by interfering with haem detoxification during haemoglobin digestion. Genetic changes in resistant parasites reduce the effectiveness of the drug and allow them to survive exposure.

7.1 Molecular Markers of Chloroquine Resistance

The principal molecular marker associated with chloroquine resistance is the *P. falciparum* chloroquine-resistance transporter (*pfcr*) gene. The K76T substitution is a major marker of chloroquine resistance and occurs within resistant *pfcr* haplotypes, including the CVIET haplotype widely reported in

Africa. However, the presence of K76T alone does not fully define the clinical resistance phenotype. Other

pfcr mutations and the genetic background of the parasite may influence the level and expression of resistance.

Polymorphisms in the *P. falciparum* multidrug resistance 1 (*pfmdr1*) gene may also modify parasite responses to chloroquine and other antimalarial medicines. Variants such as N86Y and Y184F have been associated with altered responses to antimalarial drugs. Resistance should therefore be interpreted using multiple molecular markers rather than relying on a single mutation (WHO, 2025).

Nigerian studies have documented the persistence and geographical variation of chloroquine-resistance-associated markers. Ojurongbe et al. (2010) detected *pfcr* and *pfmdr1* variants among Nigerian *P. falciparum* isolates and demonstrated relationships between molecular markers, in-vitro resistance, and treatment outcomes. More recent evidence has continued to show geographical variation in resistance-

associated markers, supporting the need for ongoing molecular surveillance (Njiro et al., 2022).

7.2 Drug Pressure and Persistence of Resistant Parasites

Repeated or inappropriate exposure to chloroquine may contribute to the selection and persistence of resistant parasite populations. Self-medication, inappropriate dispensing, incomplete treatment, and continued use of old medicine stocks may all contribute to drug pressure (Nyamngee et al. (2025). However, the relationship between chloroquine use and resistance is not necessarily direct at the individual or

community level. Parasite genetic composition is also influenced by transmission intensity, population movement, treatment adherence, medicine quality, and previous patterns of antimalarial exposure.

The use of related 4-aminoquinoline medicines, including amodiaquine, may also influence the distribution of some *pfprt* and *pfmdr1* variants. Resistance surveillance should therefore consider the broader history of antimalarial exposure rather than attributing observed molecular patterns solely to current chloroquine use (Ojurongbe et al. (2010).

Table 4. Evidence on chloroquine-resistance markers and their implications for antimalarial stewardship in Nigeria

Study/Period	Location/Scope	Resistance marker evidence assessed	or Major finding	Stewardship implication
Ojurongbe et al. (2010)	Nigeria	pfprt pfmdr1	and Chloroquine-resistance-associated molecular variants were detected among <i>P. falciparum</i> isolates.	Supports continued avoidance of chloroquine for routine malaria treatment and the need for resistance surveillance.
Ajibaye et al. (2022)	Nigeria	Molecular markers of antimalarial resistance	Evidence showed geographical variation in resistance-associated markers and the continuing value of molecular surveillance.	Resistance monitoring should be maintained across different parts of Nigeria.
Bamikole et al. (2025)	Nigeria; systematic review	pfprt K76T and related markers	The review found a decline in the prevalence of the major chloroquine-resistance marker in some Nigerian settings, but resistant genotypes remained present and varied geographically.	Declining markers do not by themselves justify routine reintroduction of chloroquine. Continued surveillance is required.
Nyamngee et al. (2025)	Benue State	pfprt K76T	The K76T mutation remained detectable at substantial frequency, showing persistence of chloroquine-resistance-associated genotypes.	Historical resistance may persist despite withdrawal of chloroquine; local surveillance remains important.
Ajibaye et al. (2026)	Six geopolitical zones of Nigeria	pfprt codons 74–76	Wild-type chloroquine-sensitive genotypes were common, but the CVIET resistance haplotype was still detected in a substantial proportion of isolates.	Molecular evidence of increased sensitivity should not be interpreted as proof that chloroquine can be routinely reintroduced.
Current evidence	Nigeria	Molecular markers and therapeutic efficacy	Molecular markers provide evidence of parasite genotype but do not replace therapeutic efficacy studies or clinical treatment outcomes.	Decisions on any future treatment-policy change should be based on therapeutic efficacy, molecular surveillance, medicine quality and clinical outcomes.

Source: Compiled from Ojurongbe et al. (2010), Ajibaye et al. (2022), Bamikole et al. (2025), Nyamngee et al. (2025), and Ajibaye et al. (2026).

7.3 Evidence of Declining Resistance Markers

Withdrawal of chloroquine from routine treatment can reduce the selective pressure favouring resistant parasites. Evidence from Nigeria indicates that the frequency of some chloroquine-resistance markers has declined following the transition to ACT-based treatment, although the extent of decline varies across geographical areas and study periods. A systematic review by Bamikole et al. (2025) reported an overall

decline in *pfprt* K76T prevalence in some Nigerian settings, but resistant genotypes remained detectable. Recent molecular surveillance has similarly reported substantial representation of chloroquine-sensitive parasite genotypes while resistant CVIET haplotypes remain detectable. Ajibaye et al. (2026), studying isolates from Nigeria's six geopolitical zones, reported common wild-type genotypes but continued detection of the CVIET resistance haplotype. In Benue State, Nyamngee et al. (2025) also reported *pfprt* K76T at

substantial frequency, indicating that resistance-associated genotypes can persist long after changes in treatment policy.

These findings suggest that reduced chloroquine selection pressure may alter the parasite population, but resistance has not necessarily disappeared. The pattern also appears to vary geographically, reinforcing the importance of local and national molecular surveillance.

7.5 Molecular Evidence Does Not Establish Clinical Efficacy

A decline in molecular markers of chloroquine resistance should not be interpreted as evidence that chloroquine can automatically be restored to routine malaria treatment. Molecular markers provide information about parasite genotypes and resistance trends, but they do not directly measure clinical or parasitological treatment efficacy.

Any future consideration of a change in malaria-treatment policy would therefore require evidence from therapeutic-efficacy studies and clinical treatment outcomes, supported by molecular surveillance and medicine-quality monitoring (WHO, 2025). The presence of sensitive parasite genotypes alone is insufficient to establish that chloroquine would provide adequate clinical treatment.

7.6 Implications for Antimalarial Stewardship

Persistent chloroquine use remains relevant to antimalarial stewardship because inappropriate exposure may contribute to treatment failure, delay access to effective ACTs, and increase the risk of avoidable complications and costs. It may also complicate interpretation of resistance patterns when information on actual medicine use is limited. Effective stewardship therefore requires integration of medicine-use surveillance with molecular resistance monitoring, therapeutic-efficacy studies, treatment-outcome data, and medicine-quality surveillance (NMEP, 2021 - 2025).

Overall, the evidence indicates that chloroquine-resistance markers have declined in some Nigerian settings but have not disappeared. Resistant genotypes continue to occur, while their distribution varies geographically. The appropriate response is continued surveillance and careful interpretation of molecular findings rather than assuming that declining resistance markers demonstrate renewed clinical usefulness of chloroquine.

8.0 Strengthening Antimalarial Stewardship in Nigeria

Strengthening antimalarial stewardship in Nigeria requires coordinated action across diagnosis, treatment, medicine regulation, surveillance, and community practice. The continued availability and

use of chloroquine in some communities and medicine outlets highlight the need to support changes in national treatment policy with measures that make appropriate diagnosis and treatment accessible, affordable, and acceptable to patients, caregivers, and medicine providers.

Reliable access to quality-assured ACTs and rapid diagnostic tests (RDTs) is fundamental to appropriate malaria case management. Stock-outs, high medicine prices, limited diagnostic services, and geographical barriers may encourage patients to rely on familiar or cheaper medicines. Continuous availability of recommended ACTs and RDTs, particularly in rural and underserved communities, can reduce presumptive treatment and improve adherence to national treatment recommendations.

Access programmes should also consider the total cost of treatment to households. Medicine availability alone may not be sufficient where patients cannot afford diagnostic testing, consultation, or transportation. Improving affordability and reducing geographical barriers should therefore form part of antimalarial stewardship.

8.1 Strengthen Medicine Regulation and Post-Market Surveillance

Effective regulation is needed to limit the circulation and inappropriate dispensing of non-recommended antimalarial medicines. Regulatory authorities should strengthen inspection of pharmacies, PPMV outlets, and other medicine-distribution channels, with attention to medicine registration, quality, availability, and dispensing practices.

Post-market surveillance should complement regulatory inspection by identifying unregistered, substandard, falsified, or inappropriately marketed medicines. Routine monitoring of medicine outlets can also provide information on changes in the availability of chloroquine and other non-recommended antimalarials. Regulation should be accompanied by education and supportive supervision so that medicine providers understand current treatment recommendations and their responsibilities in appropriate dispensing (WHO, 2025).

8.2 Engage Pharmacies and Medicine Vendors in Stewardship

Pharmacies and PPMVs are important sources of malaria treatment in Nigeria and should be incorporated into antimalarial stewardship programmes. Their proximity to communities makes them particularly important for improving access to diagnostic testing and recommended treatment.

Stewardship programmes should provide appropriate training on malaria symptoms, RDT use, ACT selection

and dosing, recognition of severe malaria, referral procedures, and counselling on treatment adherence. Supportive supervision and accreditation can reinforce these practices. Monitoring of dispensing practices should form part of this engagement, together with measures to ensure that recommended medicines are available when patients seek treatment.

8.3 Strengthen Community Education on Diagnosis and Treatment

Community education should explain the importance of testing before treatment and the use of recommended antimalarial medicines. Messages should make clear that familiarity with a medicine or previous improvement in symptoms does not establish its current effectiveness against malaria.

Educational activities should be adapted to local languages, levels of health literacy, and treatment-seeking practices. They should also address common reasons for self-medication, including perceptions of cost, convenience, previous treatment experience, and trust in informal providers (Enem-Osuigwe, Ogbonna, & Eze, 2026).. Community leaders, health workers, pharmacies, PPMVs, and other trusted local actors can help communicate consistent messages on diagnosis, treatment, adherence, and referral.

8.4 Improve Routine Surveillance of Antimalarial Medicine Use

Nigeria needs stronger routine surveillance of antimalarial medicine use to determine where chloroquine and other non-recommended medicines remain available and whether they are being purchased or consumed (NMEP, 2021-2025). Current evidence is largely derived from selected communities, health facilities, and medicine outlets and does not provide a recent nationally representative estimate of chloroquine consumption.

Surveillance should distinguish between medicine availability, dispensing, purchase, and actual consumption. Where possible, data should include the medicine used, source of treatment, diagnostic status, treatment regimen, and treatment outcome. Combining household surveys with medicine-outlet and facility data would provide a stronger basis for identifying geographical and population-level differences in antimalarial medicine use.

8.5 Expand Molecular and Therapeutic-Efficacy Surveillance

Molecular surveillance remains important for monitoring changes in parasite populations and resistance-associated markers. Relevant markers may include *pfcr* and *pfmdr1* for chloroquine and related antimalarial resistance, together with markers relevant to current medicines, including *pfk13*, *pfdhfr*, and *pfdhps*.

Molecular surveillance should not, however, replace therapeutic-efficacy studies. Changes in resistance-marker frequencies provide information about parasite populations but do not establish clinical treatment effectiveness. Molecular findings should therefore be interpreted alongside therapeutic-efficacy data, treatment outcomes, medicine-quality monitoring, pharmacovigilance, and antimalarial medicine-use patterns.

8.6 Prioritise Northern Nigeria for Context-Specific Stewardship

Northern Nigeria warrants particular attention because of its substantial malaria burden, large rural population, socioeconomic constraints, seasonal transmission, and reliance on private medicine outlets in many communities. Existing evidence also indicates gaps in diagnostic access, appropriate treatment, and malaria case-management practices in parts of the region.

Stewardship interventions should therefore be adapted to local conditions rather than assuming that a single approach will be equally effective across Nigeria. Research and interventions should consider medicine affordability, distance to health facilities, diagnostic access, medicine availability, provider practices, and treatment-seeking behaviour. Rural and underserved communities should receive particular attention in the provision of ACTs, RDTs, community-based diagnosis, health education, and medicine-use surveillance.

8.8 Overall Stewardship Priority

Effective antimalarial stewardship requires alignment between policy, medicine availability, diagnostic services, provider practices, community behaviour, regulation, and surveillance. Restricting chloroquine availability without ensuring affordable access to appropriate diagnosis and effective treatment may have limited impact where households continue to face barriers to recommended care.

The central stewardship priority is therefore to make correct malaria diagnosis and recommended treatment the most accessible and reliable option for communities, while maintaining effective regulatory and surveillance systems.

9.0 Research Gaps and Future Directions

Despite evidence that chloroquine remains available and may still be used in some Nigerian communities, important gaps remain in the evidence base. Most studies have been conducted in selected states, communities, health facilities, or medicine outlets and differ in design, population, and period of data collection. Consequently, there is no reliable recent national estimate of chloroquine use, nor sufficient evidence to explain how its use varies across geographical and socioeconomic settings. Addressing

these gaps is important for effective antimalarial stewardship and evidence-based malaria-treatment policy.

9.1 Need for Recent Nationally Representative Estimates of Chloroquine Use

A major gap is the absence of a recent nationally representative estimate of chloroquine use in Nigeria. Existing studies provide useful evidence from specific locations but cannot establish the current national prevalence of chloroquine purchase, dispensing, self-medication, or consumption. Future national surveys and household medicine-use studies should distinguish between suspected and confirmed malaria and document the medicine used, source of treatment, diagnostic status, dose, duration, and reason for medicine selection.

Studies should also distinguish between medicine availability, dispensing, purchase, and actual consumption. The presence of chloroquine in a medicine outlet does not, by itself, demonstrate that it is being purchased or used.

9.2 Limited Evidence from Rural and Conflict-Affected Northern Communities

Evidence from rural, conflict-affected, and hard-to-reach communities in Northern Nigeria remains limited. These populations may experience different treatment pathways because of insecurity, seasonal malaria transmission, limited health-facility coverage, transport difficulties, poverty, medicine stock-outs, and dependence on community medicine vendors.

Future studies should therefore include rural households, caregivers of under-five children, women, internally displaced populations where feasible, health-care providers, pharmacies, and PPMVs. Studies should capture local differences rather than assuming that findings from urban or relatively accessible communities apply uniformly across Northern Nigeria.

9.3 Need for Mixed-Methods Studies of Consumer and Vendor Behaviour

Quantitative studies can estimate the frequency of chloroquine availability and reported use, but they provide limited information on why consumers and medicine providers make particular treatment decisions. Mixed-methods studies combining household surveys with qualitative interviews and focus-group discussions could provide a better understanding of medicine-selection practices.

Such studies should examine medicine price, perceived effectiveness, previous treatment experience, trust in medicine vendors, health literacy, cultural beliefs, distance to health facilities, waiting time, availability of ACTs and RDTs, and perceptions of formal health services. Similar attention should be given to vendor knowledge, dispensing practices, response to consumer

demand, medicine procurement, and understanding of current malaria-treatment guidelines (WHO, 2015).

9.4 Mapping Informal Medicine Supply Chains

Further research is needed to understand how antimalarial medicines move through formal and informal supply chains. Studies should examine the roles of manufacturers, importers, wholesalers, pharmacies, PPMVs, itinerant medicine sellers, and community-level distribution channels.

Supply-chain mapping could identify where non-recommended antimalarials enter local markets, how they are distributed, how prices change along the supply chain, and where regulatory gaps occur. This information would support stronger medicine regulation and post-market surveillance. The importance of medicine vendors as sources of basic health care in Nigeria also makes their role in medicine supply and distribution an important area for further investigation (Liu et al., 2016).

9.5 Linking Medicine-Use Data with Resistance Surveillance

An important research priority is to examine antimalarial medicine-use patterns alongside molecular surveillance of drug resistance. Future studies could combine household and medicine-outlet data with parasite samples collected from the same or comparable geographical areas. Molecular analysis could include relevant markers such as *pfprt*, *pfmdr1*, *pfk13*, *pfdhfr*, and *pfdhps*, depending on the medicine and resistance mechanism being investigated.

Recent evidence from Nigeria shows geographical variation in resistance markers and supports continued molecular surveillance. However, molecular findings should not be interpreted as direct evidence of medicine consumption or clinical treatment efficacy. They should be considered alongside treatment history, therapeutic-efficacy data, medicine quality, adherence, and transmission patterns.

9.6 Evaluating Antimalarial Stewardship Interventions

There is also a need for rigorous evaluation of interventions designed to improve antimalarial stewardship. These may include improved access to RDTs and quality-assured ACTs, training and supportive supervision of PPMVs and pharmacy staff, community education, medicine-quality monitoring, improved referral systems, and stronger regulatory enforcement.

Evaluation should focus on changes in actual practice rather than knowledge alone. Important outcomes include diagnostic testing before treatment, appropriate ACT dispensing, avoidance of non-recommended medicines, adherence, referral of severe cases,

medicine availability and affordability, and treatment outcomes. Implementation research should also assess which interventions are feasible and sustainable in rural and underserved settings.

The National Malaria Elimination Programme identifies monitoring and evaluation, disease surveillance, resistance monitoring, and operational research as important components of malaria programme decision-making. Strengthening these activities with better-quality and more geographically representative data would improve the evidence available for national and subnational malaria policy.

9.7 Future Research Priority

Future research should move beyond documenting whether chloroquine is available and determine where it is being used, by whom, why it is selected, through which supply channels it is obtained, and what relationship, if any, exists between its use and local resistance patterns. This will require integration of epidemiological, behavioural, pharmaceutical, molecular, and health-system data.

Importantly, evidence of increasing molecular sensitivity to chloroquine in some Nigerian parasite populations should not be interpreted as sufficient evidence for routine reintroduction. Molecular surveillance can identify changes in parasite populations, but decisions on malaria-treatment policy require clinical and therapeutic-efficacy evidence.

A stronger evidence base will enable Nigeria to distinguish genuine changes in chloroquine use from historical reports of availability and provide a more reliable basis for antimalarial stewardship, resistance management, and future malaria-treatment policy.

10.0 CONCLUSION

Persistent chloroquine use in Nigeria represents an important policy–practice and sustainability concern. Although chloroquine was withdrawn from routine malaria treatment because of widespread *Plasmodium falciparum* resistance and declining therapeutic effectiveness, the evidence reviewed indicates that it remains available and continues to be used in some communities and medicine outlets. However, available evidence does not support the assumption that its use is uniform across Nigeria, and there is no recent nationally representative estimate of current consumption.

The persistence of chloroquine use reflects the interaction of economic, behavioural, pharmaceutical, and health-system factors. Historical familiarity and trust, low cost, easy access, previous treatment

experience, limited diagnostic services, variable access to affordable ACTs, self-medication, and provider and vendor practices may all influence medicine selection. These factors show that changes in national treatment policy alone cannot ensure appropriate malaria treatment unless recommended medicines and diagnostic services are accessible and acceptable to the populations that need them.

The evidence on chloroquine resistance also requires careful interpretation. Although resistance-associated markers have declined in some Nigerian settings following the withdrawal of chloroquine, resistant parasite genotypes remain detectable. A decline in molecular resistance markers does not, by itself, demonstrate adequate clinical efficacy or provide sufficient evidence for routine reintroduction. Molecular surveillance should therefore be complemented by therapeutic-efficacy studies, treatment-outcome monitoring, medicine-quality surveillance, and information on antimalarial medicine use.

Sustainable malaria control in Nigeria requires coordinated antimalarial stewardship. Key priorities include improving affordable access to quality-assured ACTs and reliable rapid diagnostic tests, strengthening medicine regulation and post-market surveillance, engaging pharmacies and PPMVs in appropriate malaria case management, improving community knowledge of diagnosis and treatment, and strengthening surveillance of antimalarial medicine use and drug resistance. Particular attention is needed in rural and underserved communities in Northern Nigeria, where barriers to diagnosis and effective treatment may be greater and evidence on persistent chloroquine use remains limited.

Ultimately, national malaria-treatment policy must be consistently reflected in community practice. This requires not only restricting the use of ineffective antimalarial medicines but also ensuring timely diagnosis and affordable access to quality-assured, effective treatment. Stronger stewardship, surveillance, and context-specific research will provide a better basis for protecting the effectiveness of available antimalarial medicines and supporting Nigeria's long-term malaria-control and elimination efforts.

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