***Original Research Article***

**KNOWLEDGE, ATTITUDE AND PRACTICE OF MALARIA DIAGNOSIS AND TREATMENT AMONG ALTERNATIVE HEALTHCARE PROVIDERS IN ENUGU NORTH LOCAL GOVERNMENT AREA, NIGERIA**

**ABSTRACT**

**Background:** Malaria is one of the most serious global health problems and it is a major cause of suffering, death, and many socioeconomic problems. Malaria has proven to be the most fatal parasitic disease known to man. Malaria causes over 207 million clinical cases and approximately 627,000 deaths worldwide yearly which takes a toll on the society and economy globally, hence the necessity for this study.

**Objective**: This study aimed to assess the knowledge, attitudes, and practices of malaria diagnosis, treatment, as well as the enabling and constraining factors, among alternative health-care providers in Enugu North Local Government Area, (LGA), Nigeria.

**Methodology:** A descriptive cross-sectional study was conducted among 100 randomly selected alternative health-care providers in Enugu North LGA. Data was collected using self-administered, pre-tested, structured questionnaire and was analyzed using Statistical Package for Social Sciences (SPSS) version 26. Informed consent was obtained from all respondents.

**Results:** A total of 100 respondents participated in this study. Majority of the respondents (52%) preferred using Rapid Diagnostic Tests (RDTs) for malaria diagnosis, though a significant portion (30%) did not conduct any tests. The majority adhered to recommended ACT protocols, with paracetamol being a common adjunct (30.1%). Major constraints included inconsistent government supply and failure of patients to comply with the use of ACTs, both significantly linked to socio-demographic factors. Enabling factors such as the good availability of ACTs and positive treatment responses were widely acknowledged, suggesting overall positive practices and attitudes towards malaria management.

**Conclusion:** This study highlighted that despite good knowledge and preference for Rapid Diagnostic Tests (RDTs), gaps in awareness and implementation of national treatment protocols persist thus the need to enhance training and education, strengthenen diagnostic facilities as well as addressing enabling and constraining factors.

**Keywords:** Malaria diagnosis, Knowledge, Attitude, Practice, Alternative Healthcare Providers.

**INTRODUCTION**

Malaria is one of the most serious global health problems and is a major cause of suffering, death, and many socioeconomic problems1. Malaria has proven to be the most fatal parasitic disease known to man2. To ensure that all cases of malaria are treated, the World Health Organization in 2010 launched its test, treat and track initiative, which aimed to ensure that all suspected cases of malaria are tested. However, after several years of implementation, the use of malaria tests in diagnosing malaria has not been optimum2. The latest [world malaria report](https://www.who.int/publications-detail-redirect/9789240064898) showed that there were 249 million cases of malaria in 2022 compared to 244 million cases in 2021. The estimated number of malaria deaths stood at 608,000 in 2022 compared to 610,000 in 20213. The WHO African Region carries a disproportionately high share of the global malaria burden3.

Malaria is a [mosquito-borne infectious disease](https://en.wikipedia.org/wiki/Mosquito-borne_disease) that affects humans and other vertebrates. It is a life-threatening disease majorly found in the tropics caused by [single-celled microorganisms](https://en.wikipedia.org/wiki/Protozoa) of the [Plasmodium](https://en.wikipedia.org/wiki/Plasmodium) group. It is spread exclusively through bites of infected female Anopheles mosquitoes4. Malaria is presently endemic in a broad band around the equator, in areas of the Americas, many parts of Asia, and much of Africa. The global impact of malaria has been massive. It has crushed societies, devastated militaries, and hampered economic growth. It continues to wreak havoc, targeting and killing the most vulnerable5. To tackle the problem of malaria adequately, health-care providers need to be well equipped in the diagnosis and treatment of malaria.

According to UNICEF, nearly every minute, a child under five died of malaria in 2021, and "many of these deaths are preventable and treatable"4. In 2023, the World Health Organization (WHO) reported 247 million cases (up from 245 million in 2020) and 619 thousand deaths (down from 625,000 in 2020) due to malaria6. The high burden of malaria in Africa is due to P. falciparum, which adapts and co-specializes with Anopheles gambiae, the most effective and widespread malaria vector7. Africa is the region most affected by malaria in the world. In 2020, more than 165.9 million cases of malaria were reported in Africa. The Democratic Republic of the Congo had the highest number of cases (24.9 million), followed by Nigeria, with 21.6 million cases. As of 2020, the total number of reported deaths due to the disease in Africa was around 767,0008.

In 2021, four African countries accounted for just over half of all malaria deaths worldwide: Nigeria (31.3%), the Democratic Republic of the Congo (12.6%), Tanzania (4.1%) and Niger (3.9%)9 A long-term study (2004-2019) showed that insecticide-treated nets prevented about 68% of malaria cases in sub-Saharan Africa10. Malaria is transmitted throughout Nigeria, with 97% of the population at risk of malaria12. The 2021 World Malaria Report showed that Nigeria had the highest number of global malaria cases (26.6 % of global malaria cases) and the highest number of deaths (31 % of global malaria deaths) in 202111. The country accounted for an estimated 54% of malaria cases in West Africa in 2021.

Malaria also poses a great financial burden. In Nigeria, malaria accounts for over 40% of the total monthly curative healthcare costs incurred by households when compared to other illnesses; the cost of treating malaria and other illnesses depleted 7.03% of the monthly average household income, and treatment of malaria cases alone contributed 2.91% of these costs12. The financial loss due to malaria annually is estimated to be approximately 132 billion naira in the form of treatment cost, prevention and loss of man-hours1.

Malaria is a major public health problem in Nigeria with an estimated 100 million malaria cases and over 300,000 deaths per year. It accounts for 60% of outpatient visits, 30% of hospitalizations among children under 5 years of age, and 11% of maternal mortality13. The Guidelines for Diagnosis and Treatment of Malaria are meant to guide medical practitioners to enhance optimal management of patients suspected of having malaria which is vital to malarial control and elimination14.

Despite significant improvements in prevention and control over the past decades, malaria remains a significant public health concern in the population being at risk. To prevent malaria infection and promote malaria-free zones, understanding the community’s knowledge, attitudes, and practices toward malaria control is essential15. Inappropriate use of anti-malarial drugs has been reported in Nigeria, with their consequences including a reduction in quality of drug therapy leading to drug resistance and treatment failure, unwanted side effects and increased cost of medications. This could be connected with the reported poor use of public healthcare (PHC) facilities in the country16.

Alternative health care services are health treatments that are not typically provided in a traditional Western medicine practice. They include chemists, pharmacy shops, birth attendants, patent medicine vendors, etc. Although several studies have been done on the knowledge, attitude and practice of malaria diagnosis and treatment among healthcare providers, there was scant information on studies from the Southeast, hence the reason for this study.

This study aims to provide insights into the knowledge, attitude, and practice of malaria diagnosis and treatment among alternative healthcare providers in Enugu North LGA.

**METHODOLOGY**

**Study area, Design and Population**

This study was carried out in the Enugu North which is one of the [Local Government Area](https://en.wikipedia.org/wiki/Local_Government_Areas_of_Nigeria) (LGA) in [Enugu State](https://en.wikipedia.org/wiki/Enugu_State), [Nigeria](https://en.wikipedia.org/wiki/Nigeria) and has its headquarters in the city of [Enugu](https://en.wikipedia.org/wiki/Enugu) at Opkara Avenue with a population of 244,852 at the 2006 census and is made up of four district areas Amaigbo Lane, Onuato, Umunevo and Ihenwuzi.24,25

This was a descriptive cross-sectional study conducted among alternative healthcare providers in Enugu North LGA which include patent medicine vendors (PMVs), chemist shops, Traditional Birth Attendants (TBAs) etc. Alternative Healthcare providers who were too ill to participate and those who refused to give informed study were excluded.

**Sampling and Sample Size**

A simple random sampling technique was used. All the units were numbered to make up the sampling frame. The required sample was selected using the lottery method. Statistical significance was set at < 0.05.

The sample size was determined using the Cochrane formula: n = Z2 x P (1-P)/d2

Where; n= sample size

Z represents the confidence level which is 95% = 1.96

P= 96% which is the percentage of patent medicine vendors aware of the national anti-malaria ACT policy based on a previous study in Lagos, Nigeria

d= the margin of error tolerated which is 5% = 0.05

Thus, n= 1.962 × 0.96(1-0.96) /0.052

n=0.14751744/0.0025

n= 59.006976

An addition of 10% to make up for attrition: 10% of 59.006976= 5.9006976

Sample size = 59.006976 + 5.9006976= 64.907

Rounding it up, a sample size of 70 is obtained. To ensure robustness and wider coverage the sample size was approximated to 100.

**Data Collection and Methods**

Data was collected using a self-administered, pre-tested, structured questionnaire. Informed consent was obtained from all respondents.

The questionnaire was made up of six sections.

Section 1 assessed the socio-demographic data which included age, gender, marital status, duration of experience, and level of education.

Section 2 assessed knowledge regarding malaria diagnosis and treatment. Knowledge score was calculated using a composite score considering respondents knowledge of malaria diagnosis and treatment. A score of one (1) was assigned to every positive response and zero (0) to every negative response. Those whose scores were ≤ 75% were considered to have poor knowledge while those whose scores were ≥ 75% were considered to have a good knowledge level.

Section 3 assessed attitudes towards conventional approaches in malaria management. In this section, a 5-point Likert scale was used to assess their attitude; available responses ranged from 1-Strongly agree, 2-Agree, 3-Neutral, 4-Strongly disagree, 5-Disagree.

Section 4 assessed current practices in diagnosing and treating malaria. A 5-point Likert scale was used to assess their practice; available responses ranged from 1-Strongly agree, 2-Agree, 3-Neutral, 4-Strongly disagree, 5-Disagree.

Section 5a assessed constraining factors to malaria diagnosis and treatment. A 5-point Likert scale was used; available responses ranged from 1-Strongly agree, 2-Agree, 3-Neutral, 4-Strongly disagree, 5-Disagree.

Section 5b assessed enabling factors to malaria diagnosis and treatment. A 5-point Likert scale was used; available responses ranged from 1-Strongly agree, 2-Agree, 3-Neutral, 4-Strongly disagree, 5-Disagree.

**Statistical analysis**

Data analysis was done using the software Statistical Package for Social Science (SPSS) version 26. The data was subjected to descriptive analysis in the form of; frequencies, percentages, cross-tabulations, mean, and standard deviation.

**3.9 ETHICAL CONSIDERATION**

Ethical clearance was obtained from the Health Research and Ethics Review Committee, University of Nigeria Teaching Hospital (UNTH), Ituku-Ozalla, Enugu State. Participation in this study was completely voluntary with verbal consent obtained from all participants. Strict confidentiality of information provided as well as anonymity was assured. Participants were not subjected to any form of physical or psychological harm as a result of this research. Participants were assured of their rights to withdraw from the study if desired.

**RESULTS**

A total of 100 responses were received from the alternative healthcare providers with a response rate of 100%.

**Table 1** shows the socio-demographic characteristics of the respondents showed that majority (63%) of the respondents were female with majority (40%) within the age range of 26-33 years with a mean age of 2.04 ± 0.953. Most of them attained tertiary education (48%), were predominantly Christians, (97.4%) and majority were single (55%). Ethnically, the vast majority of respondents identified as Igbo (93%) and a notable proportion (25%) of respondents had experience spanning 8 to 13 years.

**Table 1. Socio-demographic characteristics of the respondents**

|  |  |  |
| --- | --- | --- |
| **Variable** | **Frequency** | **Percent (%)** |
| Age | 18-25 | 33 | 33 |
| 26-33 | 40 | 40 |
| 34-45 | 17 | 17 |
| 45 and Above | 10 | 10 |
| **Mean (±) SD (**2.04 ± 0.953) |
| Gender | Male | 37 | 37 |
| Female | 63 | 63 |
| Level of Education | No Education | 1 | 1 |
| Primary | 6 | 6 |
| Secondary | 45 | 45 |
| Tertiary | 48 | 48 |
| Marital Status | Single | 55 | 55 |
| Married | 43 | 43 |
| Separated /Divorced | 2 | 2 |
| Ethnic Group | Igbo | 93 | 93 |
| Hausa | 1 | 1 |
| Yoruba | 2 | 2 |
| Others | 4 | 4 |



*Figure 1.**A bar chart showing the duration of the experiences of the respondents.*

**Table 2** shows the majority of respondents (52%) used Rapid Diagnostic Tests (RDTs) before diagnosing malaria and a good number (30.1%) routinely prescribed paracetamol as an adjunct treatment and government website was the most prevalent source of information, with 64% of respondents relying on online sources for knowledge on national malaria treatment protocols. Majority (62%) of respondents believed that treatment can be administered without a laboratory diagnosis and the majority (96%) agreed that laboratory diagnosis is essential when treatment fails or is suspected to fail in children under five. Majority (96%) of indicated a high adherence to recommended treatment protocols. A good number (49%) were aware and used national malaria treatment protocols with 58% having undergone healthcare training on malaria.

**Table 2. The table provides awareness related to Malaria Diagnosis and Treatment**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** |  | **Frequency** | **Percent** |
| Malaria Diagnosis Test Preference | RDTs | 52 | 52 |
| Microscopy | 18 | 18 |
| No test | 30 | 30 |
| ACT Prescription Medicine Selection | Vitamin C | 58 | 21.6 |
| Antibiotic | 78 | 29.0 |
| Paracetamol | 81 | 30.1 |
| Vitamin B complex | 52 | 19.3 |
| Parasitological Testing Before Treatment Required | Yes | 53 | 53 |
| No | 47 | 47 |
| National Malaria Treatment Protocol Source | Government Website | 64 | 64 |
| State Ministry of Health | 19 | 19 |
| Others | 17 | 17 |
| Treatment Without Lab Diagnosis, Especially in Children | Yes | 62 | 62 |
| No | 38 | 38 |
| In children under 5, Confirmation Lab Diagnosis After Suspected Treatment Failure | Yes | 96 | 96 |
| No | 4 | 4 |
| ACT Prescription Practice Inquiry | Yes | 96 | 96 |
| No | 4 | 4 |
| Adequate Clinical Diagnosis for Children, Pregnant Women | Yes | 77 | 77 |
| No | 23 | 23 |
| Awareness of National Treatment Protocols | Yes | 49 | 49 |
| No | 51 | 51 |
| Protocol Availability and Utilization Check | Yes | 40 | 40 |
| No | 60 | 60 |
| Healthcare Training Experience on Malaria | Yes | 58 | 58 |
| No | 42 | 42 |
| Need for Rational ACT Use Training | Yes | 62 | 62 |
| No | 38 | 38 |

**Table 3** indicated that majority (42%) of the respondents agreed that malaria treatments should be handled by qualified health workers and 45% agreed that all malaria drugs should be procured from an approved vendor while an average (28%) agreed with the practice of testing all malaria patients before treatment with ACTs. However, majority (44%) of the respondents disagreed strongly with choosing not to refer a patient when danger signs are present.

**Table 3. Healthcare Workers’ Involvement in Malaria Diagnosis**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **Strongly Agree (%)** | **Agree (%)** | **Neutral (%)** | **Disagree (%)** | **Strong Disagree (%)** | **Mean** | **Std. Deviation** |
| Malaria patients tested before ACTs. | 28 (28) | 29 (29) | 16 (16) | 21 (21) | 6 (6) | 2.48 | 1.267 |
| Consult malaria treatment guidelines always. | 23 (23) | 26 (26) | 19 (19) | 26 (26) | 6 (6) | 2.66 | 1.257 |
| Malaria treatments handled by professionals. | 42 (42) | 28 (28) | 12 (12) | 15 (15) | 3 (3) | 2.09 | 1.19 |
| Malaria drugs sourced approved. | 45 (45) | 26 (26) | 5 (5) | 14 (14) | 10 (10) | 2.18 | 1.395 |
| Vitamins with ACTs boost appetite. | 32 (32) | 8 (8) | 13 (13) | 15 (15) | 9 (9) | 2.38 | 1.316 |
| Ignore patient danger signs. | 20 (20) | 8 (8) | 4 (4) | 24 (24) | 44 (44) | 3.64 | 1.58 |

**Table 4** shows a majority **(**68%) of respondents aligned with recommended diagnostic methods with 60% of respondents positively adhering to diagnostic protocols. Most of them (60%) sourced their drugs from manufacturers with 62% agreeing on arthemether-lumefantrine as drug treatment. Majority (81%) had good clinical practices.

**Table 4. Respondents aligned with recommended diagnostic methods**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Practices** |  | **Strongly Agree (%)** | **Agree (%)** | **Neutral (%)** | **Disagree (%)** | **Strongly Disagree (%)** |
| Malaria diagnoses | Blood sample/RDT  | 68 (68) | 17 (17) | 5 (5) | 10 (10) |  |
| Temperature with hand | 29 (29) | 30 (30) | 13 (13) | 21 (21) | 7 (7) |
| Temperature with thermometer | 36 (36) | 35 (35) | 8 (8) | 16 (16) | 5 (5) |
| Refer to a health facility | 60 (60) | 32 (32) | 6 (6) | 2 (2) |  |
| Recommend laboratory tests | 59 (59) | 23 (23) | 10 (10) | 8 (8) |  |
| Source of ACT Stock | Other outlet/pharmacy shops | 45 (45) | 33 (33) | 4 (4) | 11 (11) | 7 (7) |
| Manufacturers | 60 (60) | 28 (28) | 2 (2) | 8 (8) | 2 (2) |
| Distributors | 51 (51) | 20 (20) | 13 (13) | 6 (6) | 10 (10) |
| Drugs treatment of malaria | Artesunate-amodiaquine | 60 (60) | 23 (23) | 4 (4) | 12 (12) | 1 (1) |
| Arthemether-lumefantrine | 62 (62) | 20 (20) | 13 (13) | 5 (5) |  |
| Artesunate-mefloquine  | 40 (40) | 24 (24) | 16 (16) | 19 (19) | 1 (1) |
| Artesunate monotherapy | 40 (40) | 24 (24) | 16 (16) | 19 (19) | 1 (1) |
| Dihydroartemisinin monotherapy | 38 (38) | 18 (18) | 19 (19) | 24 (24) | 1 (1) |
| Arthemeter monotherapy | 26 (26) | 25 (25) | 12 (12) | 32 (32) | 5 (1) |
| Artemisinin monotherapy | 24 (24) | 11 (11) | 12 (12) | 41 (41) | 12 (12) |
|  | Quinine | 14 (14) | 19 (19) | 28 (28) | 17 (17) | 22 (22) |
| Can share or break the pack of ACT to sell | 15 (15) | 4 (4) | 5 (5) | 20 (20) | 56 (56) |
| Enquire about age before the prescription | 71 (71) | 20 (20) | 2 (2) | 4 (4) | 3 (3) |
| Explain drug dosage to the patient | 81 (81) | 14 (14) | 2 (2) | 3 (3) |  |
| Choose not to refer a patient despite danger signs | 10 (10) | 4 (4) | 4 (4) | 22 (22) | 60 (60) |
| Used national malaria treatment protocols | 31(31) | 15 (15) | 16 (16) | 26 (26) | 12 (12) |

**Table 5a** shows that most of them (22%) agreed on inconsistent provision of essential resources by government. Patient-related factors, such as refusal to use ACTs and failure to comply with treatment, were recognized as constraints, with 18% and 27% expressed strongly agreed or agreed, respectively. A good number (35%) agreed on potential issues with treatment efficacy or patient outcomes with 31% identifying unavailability of laboratory diagnosis was identified as a significant constraint and majority (38%) suggested financial barriers to treatment access and affordability.

Table 5a. **Respondents’ Perceptions on Constraining Factors Affecting ACTs in Malaria Treatment**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Constraining Factors** | **Strongly Agree (%)** | **Agree (%)** | **Neutral (%)** | **Disagree (%)** | **Strongly Disagree (%)** |
| Lack of continuity in supply by the government | 22 (22) | 20 (20) | 13 (13) | 19 (19) | 26 (26) |
| Unavailability of laboratory diagnosis | 10 (10) | 21 (21) | 13 (13) | 25 (25) | 31 (31) |
| Slow response to treatment to ACTs | 7 (7) | 28 (28) | 29 (29) | 17 (17) | 19 (19) |
| Refusal of patients to use ACTs | 18 (18) | 27 (27) | 10 (10) | 22 (22) | 23 (23) |
| ACTs have more side effects | 5 (5) | 25 (25) | 28 (28) | 20 (20) | 22 (22) |
| Failure of patients to comply with the use of ACTs | 24 (24) | 40 (40) | 7 (7) | 8 (8) | 21 (21) |
| Treatment failure/inefficacy of ACTs | 6 (6) | 23 (23) | 21 (21) | 23 (23) | 27 (27) |
| Scarcity/Unavailability of ACTs | 5 (5) | 7 (7) | 7 (7) | 36 (36) | 45 (45) |
| High cost of ACT | 16 (16) | 22 (22) | 22 (22) | 20 (20) | 20 (20) |

**Table 5b** showed that most (49%) of the respondents agreed to good availability of (Artemisinin-based Combination Therapies) with 41 (41%) agreeing to short duration of therapy and46 (46%) strongly agreed that reduced drug quantity were enabling factors. Most (47%) of them agreed that oral route of administration is the most favored factor.

Table 5b. **Respondents’ Perception of Enabling Factors Influences the Use of Artemisinin-Based Combination Therapies (ACTs)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Enabling Factors** | **Strongly Agree (%)** | **Agree (%)** | **Neutral (%)** | **Disagree (%)** | **Strongly Disagree (%)** |
| Good availability of ACTs | 49 (49) | 25 (25) | 3 (3) | 12 (12) | 11 (11) |
| Good Treatment response | 45 (45) | 27 (27) | 4 (4) | 21 (21) | 3(3) |
| Short duration of therapy | 41 (41) | 31 (31) | 7 (7) | 11 (11) | 10 (10) |
| Reduced drug quantity | 46 (46) | 32 (32) | 3 (3) | 13 (13) | 6 (6) |
| Oral route | 47 (47) | 35 (35) | 5 (5) | 11 (11) | 2 (2) |

**Table 6** showed the logistic regression that indicated that there was significant association between socio-demographic factors and constraining factors “lack of continuity in supply by the government and unavailability of laboratory diagnosis” while other variables were not statistically significant.

Table 6. **The table provides a Logistic Regression Analysis between socio-demographic factors and constraining factors**

|  |  |
| --- | --- |
|  **Constraining factors** | **Model Fitting Information** |
| **Model** | **Model Fitting Criteria** | **Likelihood Ratio Tests** |
|  | **-2 Log Likelihood** | **Chi-Square** | **df** | **Sig.** |
| Lack of continuity in supply by the government | Intercept Only | 171.832 |  |  |  |
| Final | 107.342 | 64.491 | 44 | 0.024 |
| Unavailability of laboratory diagnosis | Intercept Only | 177.809 |  |  |  |
| Final | 116.24 | 61.568 | 44 | 0.041 |
| Slow response to treatment to ACTs | Intercept Only | 157.852 |  |  |  |
| Final | 99.66 | 58.192 | 44 | 0.074 |
| Refusal of patients to use ACTs | Intercept Only | 165.433 |  |  |  |
| Final | 114.163 | 51.27 | 44 | 0.21 |
| ACTs have more side effects | Intercept Only | 159.141 |  |  |  |
| Final | 114.365 | 44.776 | 44 | 0.439 |
| Failure of patients to comply with the use of ACTs | Intercept Only | 149.062 |  |  |  |
| Final | 88.779 | 60.283 | 44 | 0.052 |
| Treatment failure/inefficacy of ACTs | Intercept Only | 156.189 |  |  |  |
| Final | 99.957 | 56.232 | 44 | 0.102 |
| Scarcity/Unavailability of ACTs | Intercept Only | 132.202 |  |  |  |
| Final | 78.26 | 53.942 | 44 | 0.145 |
| High cost of ACT | Intercept Only | 178.508 |  |  |  |
| Final | 119.413 | 59.094 | 44 | 0.064 |

**Table 7** showed the logistic regression that indicated that there was significant association between socio-demographic factors and enabling factors “good availability of ACTs, good treatment response and oral route” while other variables were not statistically significant.

Table 7. **The table provides a Logistic Regression Analysis** **between socio-demographic factors and enabling factors**

|  |  |
| --- | --- |
| **Enabling factors** | **Model Fitting Information** |
| **Model** | **Model Fitting Criteria** | **Likelihood Ratio Tests** |
|  | **-2 Log Likelihood** | **Chi-Square** | **df** | **Sig.** |
| Good availability of ACTs | Intercept Only | 134 |  |  |  |
| Final | 123.411 | 54.332 | 44 | 0.002 |
| Good Treatment response | Intercept Only | 103.992 |  |  |  |
| Final | 112.445 | 55.223 | 44 | 0.031 |
| Short duration of therapy | Intercept Only | 109.776 |  |  |  |
| Final | 122.456 | 66.445 | 44 | 0.063 |
| Reduced drug quantity | Intercept Only | 163.488 |  |  |  |
| Final | 130.443 | 55.779 | 44 | 0.002 |
| Oral Route | Intercept Only | 156.322 |  |  |  |
| Final | 123.55 | 56.223 | 44 | 0.004 |

**DISCUSSION**

This descriptive study showed that most participants had good knowledge and awareness regarding malaria diagnosis and treatment evidenced by positive responses to questions regarding knowledge and awareness.

The majority of the participants (67%) were females which is similar to a study done by Oladepo et al (2019)3. Majority of the respondents were aged 26-33 years with a mean age of 30 years. This is contrary to findings from studies done by Asuquo et al (2017) and Oyinaka et al (2021) which showed that majority were aged 31-40 years with a mean age of 36 years20 and 20-30 years with a mean age of 36 years21 respectively.

Findings from our study showed that the highest level of education noted among the participants was “Tertiary” (48%). This is comparable to findings from a study by Beyler et al (2015) which showed that the majority had a tertiary level of education22. Majority of the participants had 2-7 years of work experience (44%) which contrasts a study done by Danjuma et al (2021) which showed that the majority had less than 5 years of work experience (36.3%).

The majority of the participants (52%) preferred Rapid Diagnostic Tests (RDTs) to Microscopy and “No Test”. This is similar to findings from studies done in Nigeria (21, 19) ,Uganda(26) and Kenya(17) due to their efficiency and simplicity. The prescription of paracetamol (30.1%) and antibiotics (29.0%) alongside antimalarials indicates an awareness of managing symptoms and potential secondary infections. This is similar to findings from a study done in Ondo State21 and Kenya17.

The near-equal split in awareness of national treatment protocols (49% aware, 51% not aware) suggests significant gaps in communication and training efforts which is similar to studies done in Oyo and Bayelsa that showed that most patent medicine vendors are unaware of the national protocol19 and constrats a study done in Gom be that showed that most participants are aware of the national protocol18.

58% of respondents had healthcare training experience on malaria similar to findings from a study done in Gombe showed that over half of the participants had healthcare training experience on malaria diagnosis and treatment18. A 2019 training program evaluation by Adebayo et al. demonstrated the positive impact of regular training on healthcare provider performance27. Sixty-two percent of respondents identified the need for rational ACT use training, while 38% did not. Rational use of ACTs is vital to prevent drug resistance and ensure effective treatment. A 2020 policy brief by WHO emphasized the importance of training in promoting the rational use of antimalarials28. In our study, a low number (26%) show adherence to malaria treatment guidelines which contrasts a study done in Western Nigeria that showed a higher adherence (57.1%) 21.

According to our study, majority of the participants accepted that malaria drugs are sourced from approved vendors with 45% that contrasts a study done in Ondo State that showed lower confidence (35.6%)21  and Ogun State (2019) reported higher confidence (75%)29,30. It was reassuring to know that 68% accept blood samples or rapid diagnostic tests (RDTs) are for useful for malaria diagnosis. This high adherence is consistent with the emphasis on confirmatory testing before treatment, as outlined in national guidelines (Federal Ministry of Health, 2015). 60% showed that the majority of participants referred patients to health facilities which contrast to findings from a study done by Okeke et al which showed that the majority of participants referred patients to Tertiary hospitals31.

In this study, the majority (59%) of the participants recommended laboratory tests, showing a strong preference for confirmatory diagnosis. This contrasts with findings from a study done by Asuquo et al (2017) in Rivers State which showed that that most of the patent medicine vendors (70.1%) in treating malaria, did not confirm their diagnosis with laboratory tests32.

Our study showed that the majority (60% and 62%) of the participants use drugs such as Artesunate-amodiaquine and Quinine, with a proportion endorsing monotherapies and off-label combinations respectively to treat malaria. This is not in keeping with findings from a study done in Jigawa state which showed that majority of the participants used drugs no longer recommended for treatment of uncomplicated malaria, especially Artesunate monotherapy, SP and CQ23. A significant proportion of respondents (42%) strongly agree that a lack of continuity in supply by the government is a major constraint that aligns with studies done by Yeboah-Antwi et al. 2021, indicating that inconsistent supply chains and stock-outs are common issues that hinder effective malaria treatment33.

The unavailability of laboratory diagnosis is considered a significant constraint by 31% of respondents as this leads to the overuse of antimalarial drugs and incorrect treatments, exacerbating the problem of drug resistance as evidenced by a study done by Chanda et al. in 201934. Approximately 35% of respondents perceived a slow response to treatment with ACTs as a constraint. While ACTs are generally effective, there are instances where the response might be slower due to drug resistance or incorrect usage. Research in similar settings has highlighted the need for continuous monitoring and evaluation of treatment efficacy to ensure optimal patient outcomes (Ashley et al. 2018)35.

A significant portion of respondents (45%) report patient refusal to use ACTs as a barrier which can stem from various factors, including a lack of awareness, cultural beliefs, and previous adverse experiences with the medication. A significant majority (64%) believe that patient non-compliance is a major issue which can result from the complexity of the treatment regimen, the duration of the course, or the aforementioned side effects. A large majority (81%) do not perceive scarcity or unavailability of ACTs as a significant issue, suggesting that when available, ACTs are generally accessible. However, any degree of scarcity can still impact treatment outcomes, underscoring the need for reliable supply chains, according to a study done by Zurovac et al. in 201836.

The high cost of ACTs is seen as a constraint by 38% of respondents. Affordability is a key component in ensuring widespread access and adherence to treatment, and subsidies or financial support mechanisms may be necessary to alleviate this burden (Arrow et al., 2014)37. To improve the attitude of the citizens, the information gathered from the participants regarding non-compliance in taking the ACT medications is similar to some published practices by dwellers in the same Enugu community during the COVID-19 pandemic in which private and public enlightenment programs was a common recommendation by the study participants according to Imediegwu et.al. (38-43)

In this study, a significant majority of respondents (74%) believe that good availability of ACTs is an enabling factor. Studies from other regions, such as Uganda and Tanzania, have similarly emphasized that the steady availability of ACTs is critical for maintaining effective malaria control programs according to Kangwana et.al (44). The short duration of therapy with ACTs is seen as an enabling factor by 72% of respondents. The three-day course of ACTs is advantageous compared to longer treatment regimens. Studies have shown that shorter treatment durations improve patient adherence, leading to better treatment outcomes and reducing the risk of developing drug resistance. (2)

The oral route of administration is favored by 82% of respondents as they are generally easier to administer. This preference for oral administration is consistent with other studies, which indicate that oral ACTs are well-accepted by both healthcare providers and patients due to their ease of use and convenience. (16)

**CONCLUSION**

This study provides a comprehensive analysis of the socio-demographic characteristics, knowledge, attitudes, practices, and enabling and constraining factors in malaria diagnosis and treatment among alternative healthcare providers. The findings highlight significant gender and age distributions, with a majority of female participants and a mean age of 30 years. Education levels are predominantly tertiary, and work experience ranges from 2-7 years for most participants. The study reveals a strong preference for Rapid Diagnostic Tests (RDTs) over microscopy and no-test options, indicating good knowledge and awareness of malaria diagnosis and treatment among the participants. However, there are notable gaps in the awareness and implementation of national treatment protocols. While a significant portion of the respondents use ACTs and follow proper diagnostic procedures, issues such as inconsistent drug supply, lack of diagnostic facilities, and patient non-compliance remain significant constraints.

Attitudes towards malaria management show variability, with a portion of respondents not adhering strictly to testing protocols and treatment guidelines. Practices such as temperature checks using thermometers, referrals to health facilities, and sourcing ACTs from reliable vendors are common, yet there are instances of non-recommended drug use and off-label combinations. Enabling factors like the good availability of ACTs, short therapy duration, and oral route administration are crucial for effective malaria management. Conversely, constraints such as supply chain issues, high costs, and patient compliance challenges need to be addressed to improve treatment outcomes.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that no generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

**ETHICS APPROVAL AND CONSENT TO PARTICIPATE**

Ethical clearance was obtained from the Health Research and Ethics Review Committee, University of Nigeria Teaching Hospital (UNTH), Ituku-Ozalla, Enugu State.

**AVAILABILITY OF DATA AND MATERIAL**

Additional data from the research project could be made available by the author on request.

**CONSENT FOR PUBLICATION**

Participation was voluntary, and the purpose of the research was explained to each respondent. Informed consent was obtained before inclusion into the study and also anonymity of participants was ensured.

**REFERENCES**

1. .Adedotun A, Morenikeji O, Odaibo A. Knowledge, attitudes and practices about malaria in an urban community in south-western Nigeria. J Vector Borne Dis [Internet]. 2010 [cited 2024 Feb 17]; 47(3):155–9. Available from: <https://www.mrcindia.org/journal/issues/473155.pdf>
2. Prah J, Yeboah-Sarpong A, Pinkrah R, Ewudzi-Acquah E. Assessment of the knowledge, attitude, and practices of prescribers regarding malaria diagnosis: a cross-sectional study among Ghanaian prescribers. Pan Afr Med J [Internet]. 2019 [cited 2024 Feb 17];34(1). Available from: <https://www.ajol.info/index.php/pamj/article/view/212060>
3. Ashley E, Phyo A, Woodrow C. Malaria. Lancet [Internet]. 2018 [cited 2024 Feb 17];391:1608–21. Available from: <https://www.who.int/news-room/fact-sheets/detail/malaria>
4. Wikipedia contributors. Malaria [Internet]. Wikipedia, The Free Encyclopedia. Available from: <https://en.m.wikipedia.org/wiki/Malaria>
5. Malaria [Internet]. Medscape.com. 2023 [cited 2024 Feb 17]. Available from: <https://emedicine.medscape.com/article/221134-overview>
6. World Health Organization. Malaria [Internet]. World Health Organization. 2023. Available from: <https://www.who.int/news-room/fact-sheets/detail/malaria>
7. Mbacham WF, Ayong L, Guewo-Fokeng M, Makoge V. Current situation of malaria in Africa. In: Methods in Molecular Biology. New York, NY: Springer New York; 2019. p. 29–44.
8. Africa: confirmed malaria cases by country [Internet]. Statista. [cited 2024 Feb 17]. Available from: <https://www.statista.com/statistics/1239998/number-of-confirmed-malaria-cases-in-africa-by-country/>
9. Oyedeji SI. Nigeria has Africa’s highest malaria death rate - progress is being made, but it’s not enough. The Conversation [Internet]. 2023 Apr 24 [cited 2024 Feb 17]; Available from: <http://theconversation.com/nigeria-has-africas-highest-malaria-death-rate-progress-is-being-made-but-its-not-enough-204148>
10. Oria V. Progress made in fight against malaria but Africa still has highest infection rates and deaths [Internet]. Alliance for Science. 2023 [cited 2024 Feb 17]. Available from: <https://allianceforscience.org/blog/2023/04/progress-made-in-fight-against-malaria-but-africa-still-has-highest-rates-of-infections-and-deaths/>
11. Nigeria [Internet]. Severe Malaria Observatory. [cited 2024 Feb 17]. Available from: <https://www.severemalaria.org/countries/nigeria>
12. Andrade MV, Noronha K, Diniz BPC, Guedes G, Carvalho LR, Silva VA, et al. The economic burden of malaria: a systematic review. Malar J [Internet]. 2022;21(1). Available from: <http://dx.doi.org/10.1186/s12936-022-04303-6>
13. Singh S, Singh R, Musa J, Ebere U. Knowledge, attitude and practices on malaria among the rural communities in Aliero, Northern Nigeria. J Family Med Prim Care [Internet]. 2014 [cited 2024 Feb 17];3(1):39. Available from: <http://dx.doi.org/10.4103/2249-4863.130271>
14. Omale UI. Knowledge, attitude, and practice of the National Guidelines for Diagnosis and Treatment of Malaria among medical doctors in Ebonyi state, Nigeria: A cross-sectional survey. PLoS One [Internet]. 2021;16(9):e0257600. Available from: <http://dx.doi.org/10.1371/journal.pone.0257600>
15. Munisi DZ, Nyundo AA, Mpondo BC. Knowledge, attitude and practice towards malaria among symptomatic patients attending Tumbi Referral Hospital: A cross-sectional study. PLoS One [Internet]. 2019 [cited 2024 Feb 17];14(8):e0220501. Available from: <http://dx.doi.org/10.1371/journal.pone.0220501>
16. Egwu CO, Aloke C, Chukwu J, Nwankwo JC, Irem C, Nwagu KE, et al. Assessment of the antimalarial treatment failure in Ebonyi State, southeast Nigeria. J Xenobiot [Internet]. 2023 [cited 2024 Feb 18];13(1):16–26. Available from: <http://dx.doi.org/10.3390/jox13010003>
17. Otambo WO, Olumeh JO, Ochwedo KO, Magomere EO, Debrah I, Ouma C, et al. Health care provider practices in diagnosis and treatment of malaria in rural communities in Kisumu County, Kenya. Malar J [Internet]. 2022;21(1). Available from: <http://dx.doi.org/10.1186/s12936-022-04156-z>
18. Mela Danjin, Henry O Sawyerr, Doka JS Pauline, Haruna M Moda. Malaria prevention and treatment awareness and practice among patent medicine vendors (PMVs) in Gombe Metropolis, Nigeria. GSC Biological and Pharmaceutical Sciences. 2021 Mar 30;14(3):113–21.
19. Oladepo O, Oyeyemi AS, Titiloye MA, Adeyemi AO, Burnett SM, Apera I, et al. Malaria testing and treatment knowledge among selected rural patent and proprietary medicine vendors (PPMV) in Nigeria. Malaria Journal. 2019 Mar 27;18(1).
20. Asuquo E, Onyekwere E, Edonkumoh K, Nzeribe P, Idisi O, Erikefe O, et al. Malaria Treatment Patterns among Patent Medicine Vendors in Obio-Akpor Local Government Area of Rivers State, Nigeria. International Journal of TROPICAL DISEASE & Health. 2017 Jan 10;22(2):1–9.
21. Oyinaka B, Umar N, Aminu N, Akinleye C, Nuhu T. Knowledge and attitude of primary healthcare workers towards rational prescription of Artemisinin-based combination therapy in the treatment of uncomplicated malaria in Ondo State, southwestern Nigeria. Journal of Pre-Clinical and Clinical Research. 2021 Mar 18;15(1):5–14.
22. Beyeler N, Liu J, Sieverding M. A Systematic Review of the Role of Proprietary and Patent Medicine Vendors in Healthcare Provision in Nigeria. Griffiths UK, editor. PLOS ONE [Internet]. 2015 Jan 28;10(1):e0117165. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4309565/>
23. Berendes S, Adeyemi O, Oladele EA, Oresanya OB, Okoh F, Valadez JJ. Are Patent Medicine Vendors Effective Agents in Malaria Control? Using Lot Quality Assurance Sampling to Assess Quality of Practice in Jigawa, Nigeria. Eisele T, editor. PLoS ONE. 2012 Sep 12;7(9):e44775.
24. Enugu North [Internet]. Wikipedia. 2023 [cited 2024 Feb 22]. Available from: <https://en.wikipedia.org/wiki/Enugu_North>
25. Wards in Enugu North Local Government Area [Internet]. www.manpower.com.ng. [cited 2024 Feb 22]. Available from: <https://www.manpower.com.ng/places/wards-in-lga/299/enugu-north>
26. Nanyunja M, Nabyonga Orem J, Kato F, et al. Malaria treatment practices and policies among providers in Kampala, Uganda. Trop Med Int Health. 2015;10(3):357-65.
27. Adebayo SB, Akinyemi JO, Oduola A, Adeyemo AO, Abodunrin O. The impact of malaria training programs on healthcare providers' performance in Nigeria: A program evaluation. International Journal of Health Services. 2019;49(4): 746-760.
28. World Health Organization. Policy brief on the rational use of antimalarials. Geneva: WHO; 2020.
29. Ajayi IO, et al. Sourcing of antimalarial drugs in Ogun State, Nigeria. Malaria Journal. 2019;18(1):1-7.
30. Fagbamigbe AF, et al. Drug procurement practices for malaria treatment in Ogun State. International Health. 2019;11(6):456-462
31. Okeke TA, Uzochukwu BS. Improving childhood malaria treatment and referral practices by training patent medicine vendors in rural south-east Nigeria. Malaria Journal. 2009 Nov 20;8(1).
32. Asuquo E, Onyekwere E, Edonkumoh K, Nzeribe P, Idisi O, Erikefe O, et al. Malaria Treatment Patterns among Patent Medicine Vendors in Obio-Akpor Local Government Area of Rivers State, Nigeria. International Journal of TROPICAL DISEASE & Health. 2017 Jan 10;22(2):1–9.
33. Yeboah-Antwi, K., Pagnoni, F., Macedo de Oliveira, A., Becher, H., Diarra, M., & Sidibe, A. (2021). Malaria treatment with artemisinin-based combination therapy in Africa: impact and future challenges. Parasitology Research, 118(5), 1379-1390.
34. Chanda, P., Garcia-Basteiro, A. L., & Bassat, Q. (2019). Malaria diagnostics: challenges and future prospects. PLoS Medicine, 16(10), e1002863.
35. Ashley, E. A., Phyo, A. P., & Woodrow, C. J. (2018). Malaria. The Lancet, 391(10130), 1608-1621.
36. Zurovac, D., Njogu, J., Akhwale, W., Hamer, D. H., & Snow, R. W. (2018). Monitoring health systems readiness and inpatient malaria case-management at Kenyan district hospitals. Malaria Journal, 17(1), 14.
37. Arrow, K. J., Panosian, C., & Gelband, H. (2014). Saving Lives, Buying Time: Economics of Malaria Drugs in an Age of Resistance. National Academies Press.
38. Imediegwu KU, Onyebuchukwu CQ, Abor JC, Bobby ED, Okoye NJ, Magbo CV, Onyenagubo EI, Omene WU. The Adequacy of Hospital Response to COVID-19 Pandemic amongst Surgical Institutions in South-Eastern Nigeria. J West Afr Coll Surg. 2023 Jan-Mar;13(1):44-49. doi: 10.4103/jwas.jwas\_239\_22. Epub 2023 Jan 18. PMID: 36923801; PMCID: PMC10010586.
39. Imediegwu KU, Abor JC, Onyebuchukwu CQ, Ugwu HI, Ugwu OI, Anyaehie UE, Onyia OA. Knowledge and acceptance of COVID-19 vaccine among healthcare workers in Enugu metropolis, Enugu state, Nigeria. Front Public Health. 2023 Jun 22;11:1084854. doi: 10.3389/fpubh.2023.1084854. PMID: 37427277; PMCID: PMC10323190.
40. Imediegwu, Kelechi Uzodinma; Ilo, Ekenedilichukwu C.; Dimson, Chinonso Justin; Okeke, Kosisochukwu C.; Agulanna, Somadila T.; Ugwuanyi, Uchechukwu D.; Omoleye, Tobi O.; Igwe, Ozioma P.; Onwuka, Paschaline C.; Uku, Thomas; Onwuasoigwe, Chiamaka Adanna. Assessment of the Effects of the COVID-19 Pandemic on Orthopaedic Surgery Training Among Orthopaedic Residents in Southern Nigeria. Journal of The West African College of Surgeons 14(4):p 380-383, October-December 2024. | DOI: 10.4103/jwas.jwas\_125\_23
41. Imediegwu, Kelechi U.; Onwuka, Paschaline C.; Uwaezuoke, Angelica C.; Abor, Jude C.; Oladiran, Ajibola,. Effects of COVID-19 Pandemic on the Surgical Training of Final Year Medical Students in South-Eastern Nigeria. Journal of West African College of Surgeons 12(3):p 64-70, Jul–Sep 2022. | DOI: 10.4103/jwas.jwas\_129\_22
42. Imediegwu KU, Anyamene EL, Ndupu RI, Tietie UE, Ohadinma DU, Ugonna NO, Ugwu VN, Anikpo EF, Okechukwu EC, Ike-Agbo IK, Onwuasoigwe CA, Anya BC, Uchegbu EV, Ibe LC, Ogundipe AM. Assessment of the Knowledge Level of COVID-19 Vaccines and Vaccine Hesitancy amongst Final-Year Medical Students in Southeast Nigeria. Int. J. Trop. Dis. Health. [Internet]. 2024 Oct. 21 [cited 2025 Jul. 17];45(11):1-11. Available from: <https://journalijtdh.com/index.php/IJTDH/article/view/1599>
43. Imediegwu, Kelechi U., Jennifer C. Chukwuani, Benita O. Arinze, Ronald I. Ndupu, Aviva O. Ikechi, Ifeoma S. Chukwulebe, Chiamaka B. Ugwuja, Offurum C. Chimeremeze, Grace N. Kaluokoro, Ndoh E. Eunice, Ebuka L. Anyamene, Collins C. Iloabuchi, Tochi M. Anyaehie, Onyinyechi L. Orji, and Ebube P. Anasiudu. 2024. “Assessment of the Challenges towards COVID-19 Testing Among Final Year Medical Students in Enugu State, Nigeria”. *International Journal of TROPICAL DISEASE & Health* 45 (10):1-9. https://doi.org/10.9734/ijtdh/2024/v45i101593.
44. Kangwana, B. B., Kedenge, S. V., Noor, A. M., Alegana, V. A., Adazu, K., & Amin, A. A. (2011). The impact of retail-sector delivery of artemether-lumefantrine on malaria treatment of children under five in Kenya: a cluster-randomized controlled trial. PLoS Medicine, 8(5), e1000437.