

# A Review of the Effectiveness of Adopted, Applied, and Recommended Malaria Control Techniques within the Southeast Region of Nigeria

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**Abstract** Malaria is a parasitic disease endemic in tropical and subtropical regions of the world. Nigeria accounts for about 51 million cases globally and 207000 deaths annually. Different control measures have been adopted to control malaria in the south Eastern region of Nigeria. These measures includes vector control, chemotherapy etc. The most recommended is vector control and it is achieved through the use of insecticide treated nets, pesticides etc. ITNs are effective vector control tools and positively reduces mosquito abundance and serves as barrier to contacts with human hosts but the set back with the ITN use is the difference between ownership and usage . Most people who own ITNs don't use it. Diagnosis of malaria is vital in the control and treatment of malaria however, in the south eastern part of Nigeria, outcome of studies revealed gap in microscopy expertise and it has led to lots of false positive results. Chemotherapy using ACT is currently subdued due to counterfeit anti malaria drugs in the markets. There are emerging malaria control methods but they are yet to be adopted and applied in the southeastern part of Nigeria. Currently the malaria control methods adopted in Southeastern Nigeria are effective but may not adequately lead to malaria control. It is imperative to augment with emerging malaria control methods or optimize current methods to achieve the desired results.

**Keywords:** malaria, vector, control, diagnosis, mosquitoes, Nigeria

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## 1. Introduction

Malaria from time immemorial has been a substantial disease burden, despite series of efforts towards reduction, elimination, and eradication of malaria globally [1,2]. According to [3], there was an estimated 228 million cases and 405000 deaths worldwide in 2018. The report further stated that the WHO African and India region accounts for 93% of the global burden and mostly children under the age of five are affected. [4] Reported that there is a 37% estimated reduction in the global burden between 2000 and 2016. They suggested that the improvements may be as a result of economic development and urbanization in many endemic countries, coupled with a significant increase in investment in combating malaria thus leading to an increase in preventive activities, improved

diagnostics, and treatment. [5,6] Pointed that vector control remains the most effective measure to prevent malaria transmission and as such, it is one of the four basic technical elements of the Global Malaria Control strategy. It further splits Mosquito vector control into two kinds, viz: those targeting the adult and those targeting the aquatic stages. Meanwhile WHO recommends integrated vector management (IVM) as a process for managing vector populations to reduce or interrupt transmission of disease. IVM entails the use of a range of interventions of proven efficacy, separately or in combination for the implementation of locally costeffective control. Two important techniques used as a control option against malaria vector includes indoor residual spraying (IRS) with insecticide and insecticide-treated net (ITN) [4,7]. Meanwhile, these control strategies may fail to eliminate malaria in an area with a high parasite transmission rate and in areas where the vector is resistant to existing

control measures (this could be as a result of the mosquito being exophilic or insecticide resistance) [8]. Hence the need to look forward to emerging control techniques such as sterile insect technique (SIT). SIT in as much as it is an old idea is recently gaining renewed interest for control of the Mosquito population [8]. In the southeast, malaria is endemic but control measures are currently in place. There is a gap in knowledge of the effectiveness of the control measures currently in place. This review aims to explore the malaria control measures in the southeast, challenges and recommendations. It will establish knowledge on the effectiveness of the adopted control measures in the south eastern part of Nigeria.

## 2. Vector Control Methods

Insecticide-treated nets (ITN) are a form of meshed curtains treated with insecticide of class pyrethroid [9]. According to [10], about 173 million ITNs were distributed by manufacturers globally in 2018 and about 87% were delivered to Sub-Saharan Africa of which Nigeria received the highest number of ITNs. Series of studies have shown that ITN can reduce malaria cases when used appropriately [7,11,12]. [12] Reported 44.6% prevalence among users of ITN compared to 72.5 recorded among non-users in Aguleri. Also, another study showed a higher prevalence of malaria among non-users 35% when compared to ITN users 2.87% [13]. Records have shown that ITN has provided about two-thirds of universal protection against malaria since 2000 [14]. However, these protections are not without hindrance, as series of studies has shown a gap between the ownership and usage of ITN in South-Eastern Nigeria. One of such studies conducted in Aguleri in Southeastern Nigeria by [12] reported that only 26% of those who own bed net used them regularly and properly among the studies samples. Another study reported that 42% of those that own the net used them appropriately [7]. These gaps found could be a result of poor orientation about the use of the net. ITN could be effective and efficient in the region if used appropriately.

## 3. Indoor Residual Spraying (IRS)

Fewer people at risk of malaria are being protected by IRS, this method involves spraying the inside walls of dwelling with insecticide. Globally IRS protection declined from a peak of 5% in 2010 to 2% in 2018 [3]. This drop could be in response to increasing pyrethroid resistance. The success of the IRS depends on high coverage in a community [15]. [16] listed the high cost of procuring IRS materials and lack of expertise as the major problems of accepting IRS. Other vector control methods include larva source management and personal protection measures, these methods have not been widely used in Africa [17]. Meanwhile, there has been awareness in the region to help reduce the breeding site of mosquitoes through environmental cleanliness. Using personal protection measures is yet to gain the needed attention in the Eastern part of Nigeria. This could be attributed to the fear of the

use of chemicals, allergies, and cost implications. Moreover [18] recommends integrated vector management as one of the major ways to combat the menace of malaria in the region. Thus the necessity of integrating various approaches in the control of malaria in the Southeastern region of Nigeria.

## 4. Emerging Malaria Control Methods

In the coming decades, malaria control will be near achievable in Nigeria. In other to reach this climax there is a need to embrace emerging malaria control methods. Of such emergence is the potency of ivermectin against malaria parasites and vectors. One study reported by [19] shows that residual ivermectin in the human bloodstream after the standard oral dose has the potency to kill malaria vectors as well as the parasites. There is an urgent need to critically investigate this potency of ivermectin over a variety of parasitic diseases. Ivermectin has been used to eliminate onchocerciasis in the continent to near blink through mass drug administration. Vaccines also can be used to control malaria. About 20 vaccine candidates are at different stages of production. The most advanced of them being RTS, S/AO1 is undergoing its clinical trials. It has been shown to provide partial protection against *Plasmodium falciparum* in young children. [20]. A urine malaria test kit is another innovative strategy that needs improvement on its sensitivity [21]. This when made readily available will make home/self-testing for malaria achievable [20]. Sterile insect technique although an old idea, but in recent times garnered more attention as it can be used to control malaria vectors. New promising advances have been recorded in the release of transgenic sterilized mosquitoes [8]. These and continuously emerging control methods can aid in the control, elimination, and outright eradication of malaria in the region.

## 5. Diagnosis

Diagnosis of malaria is imperative in the control of malaria and is made before the commencement of treatment. While the diagnosis of malaria is essential, challenges exist. A study conducted by [22], at the University of Nigeria Teaching Hospital (UNTH), Enugu involved a comparison of malaria results from microscopy tests carried out at the UNTH laboratory. The study revealed a disparity in the results of Rapid tests and microscopy where false-positive parasitemia was found in the microscopy results against false negative in RDT. Misdiagnosis of malaria leads to treatment failure and could make a mockery of malaria control in the southeast. In another study by [23], on the differential diagnosis of malaria, the study revealed that malaria differential was not included or excluded before treatment using antimalarial was instituted and thus seen as resistance/treatment failure. Also, a study [24] in Owerri compared the performance of four RDTs commercially available in South-Eastern Nigeria. The study revealed that HRP 2/pLDH RDTs HRP-2 RDTs as the most sensitive and can be reliably used as an alternative to microscopy.

## 6. Chemotherapy

The use of chemotherapy is the primary means of treating an ongoing malaria infection. The use of Artemisinin-based combined therapy (ACTs) was initiated in February 2005, while the combination of Artemether + Lumefantrine (Coartem®) was officially adopted as the first-line antimalarial [25]. Undoubtedly, the failure of malaria chemotherapy for the treatment of Malaria can be attributed to the high prevalence of counterfeit drugs. Out of the 12 widely used anti-malaria drugs, 8 are shown to be adulterated (Counterfeited) [26]. A study conducted in Anambra, a Southeastern state in Nigeria showed a high prevalence of substandard anti-malaria drugs (sulphadoxine-pyrimethamine, quinine, chloroquine, and amodiaquine) [27]. The outcome of the study revealed that some of the anti-malaria drugs used in Southeastern Nigeria did not meet the pharmacopeia specification for active ingredients amount, it further revealed that some of the drugs showed sub-optimal amount of active ingredients. The study also revealed that 78% of the drugs that are sub-standard were from low level providers. A randomized control trial investigated the effectiveness of Artemether-Lumefantrine (ACT therapy) among 100 residents of the Nnewi community of Anambra State Nigeria. The study subjects were recruited from the General Outpatients Department (GOPD) of the Nnamdi Azikiwe University Teaching Hospital, Nnewi, who showed signs and symptoms of malaria. The trial reported that 63% of the patients treated with artemether-lumefantrine were free of Plasmodium parasites (parasitaemia) after four days of treatment. The study concluded that the cure rate among patients after 4 days of treatment with Artemether-Lumefantrine were 52% among paediatric < 16 years and 72% among adult >16 years while after 8 days of treatment, patient < 16 years and >16 years of age had 89% and 94% cure rate respectively. Treatment after 10 - 14 days yielded cure rate of 98% among patient <16 years and 100% among adult > 16 years [28]. Another study carried out in Enugu evaluated the curative efficacy of Artemether-Lumefantrine for the treatment of uncomplicated Plasmodium falciparum in 154 outpatient from 3 hospitals in 3 local governments. The study reported a significant decrease between parasite mean density on day 0 and the values on days 3,7,14 and 28, with a high prevalence of delayed parasite clearance after initiation of treatment. The study concluded that Artemether-Lumefantrine failed to clear parasite density, an indication of reduced therapeutic efficacy but reported a decrease in body temperature (from 40 - 37°C) between 0 to 28 days of initiation of treatment [29].

## 7. Disease Surveillance and Notification (DSN)

Disease surveillance is an integral part of healthcare management. As defined, Disease surveillance is the ongoing systematic collection, collation, analysis, and interpretation of data, on a particular disease or infectious agent (Vectors), which is essential to the planning, implementation, and evaluation of disease occurrences, closely integrated with the timely dissemination of these

data to those who need to know, so that early action may be taken [30]. Disease Surveillance involves the definition of the case (Disease status) as well as data computing, analysis, and making an informed report [31].

There is an urgent need to increase the entomological research capacity that would enable detailed ecological studies on mosquitoes in the Southeast region of Nigeria to aid in malaria control efforts. A search of Literature showed very few or no published studies on malaria mosquitoes in this region, indicating a lack of research activities related to this topic as a way of active surveillance.

## 8. Conclusion

Malaria control strategies in the south eastern part of Nigeria is indeed effective but has not achieved the aim of its adoption. This is based on challenges such as use of fake anti malaria drugs, lack of usage of insecticide treated nets due to unavailability/lack of accessibility, misdiagnosis and false positive test results, reduced government funding, Poverty and ignorance, lack of adequate training and retraining of healthcare personnel. These challenges are currently hindering malaria control.

It is imperative to address these current challenges and maximally adopt the control measures to ensure that malaria control is achieved in the south eastern region of Nigeria.

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