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Effectiveness of malaria control programs in West Africa: a narrative review

T.O. Sokunbi[1], T.B. Adesanya[2], F.O. Aremu[1]

[1]Department of Pharmacy, Obafemi Awolowo University, Ile-Ife, Nigeria
[2]Department of Physiotherapy, University of Ibadan, Ibadan, Nigeria

ABSTRACT:

Malaria is a major public health challenge in Africa, especially in West African countries. Its impacts on the individuals and families in these countries go beyond the physical health status to the financial crises it leaves them to nurse. Different strategies and programs are deployed every day in an attempt to control and eliminate the endemic. Among the numerous programs to control the malaria burden in West Africa are Seasonal Malaria Chemoprevention (SMC), indoor residual spraying, and the use of insecticide-treated mosquito nets. These malaria control programs must be evaluated regularly to assess their impact and effectiveness in terms of malaria elimination.

In addition to that, each country's government should attach importance to the most effective program for malaria elimination. And not only that, priority must be given to enlightenment campaigns, mass education of citizens on malaria control and elimination, as well as continuous and conscious investment in research and development towards achieving the World Health Organization (WHO) 2030 goal of zero malaria in West Africa.

Keywords: Effectiveness, Malaria, Control, Program, West Africa.

INTRODUCTION

Despite decades of efforts to control and eradicate malaria endemic in Sub-Saharan Africa, the endemic remains a concern to public health[1]. Malaria is a vector-borne disease affected by climate change, and the most severe outbreak usually occurs in sub-Saharan Africa[2]. In 2017, more than 200 million cases were recorded in the region, with about 400,000 deaths; the majority of them were under-5-year-old children[1]. According to the World Health Organization (WHO), in 2020, there was a global record of 241 million cases of malaria, with 627,000 deaths recorded. Out of the number of deaths recorded, 96% occurred in the African region, and 80% of the deaths recorded were children under the age of five[3].

Among the four species of *Plasmodium* responsible for human infection, Plasmodium falciparum is the known species accountable for the severity of malaria in Africa, which is transmitted by female anopheles mosquitoes[4]. Female anopheles' mosquitoes usually survive in the tropical climate, where water bodies provide ideal breeding conditions for the mosquitos[5]. The environment influences their growth and biting rate[2]. The different species of anopheles include Anopheles arabiensi, Anopheles funestus, and Anopheles gambiae sensu stricto, which are commonly found in Africa[6].

Many households suffer the socio-economic impact of malaria infection even though it can be seamlessly prevented and treated[4]. The impacts go beyond the financial consequences on an individual or household to an individual's health status. Malaria complications can have severe neurological effects on children leading to developmental or cognitive impairments[6].

The high malaria prevalence in Africa is due to the widespread *Anopheles gambiae* in the African region responsible for the transmission of Plasmodium falciparum, known to cause malaria severity[7]. The prevalence can also be traced to high temperature and rain-

Corresponding Author: Taiwo Oluwaseun Sokunbi, MSc; e-mail: taiwoemmanuel070@gmail.com

fall, poor health care facilities and epileptic health care systems, high poverty index, antimalarial drugs resistance, and lack of governmental support in implementing malaria control programs[8].

The malaria mortality rate is drastically reducing owing to the financial and global commitment to malaria control and elimination programs and interventions[9]. These programs include preventive treatment for pregnant women, distribution of insecticide-treated bed nets, and seasonal malaria chemoprevention[9]. These programs have drastically reduced malaria morbidity and mortality[10].

In this review, a general overview of malaria control programs in West African countries is examined. The challenges faced by these countries in implementing these programs are also highlighted in this paper. The paper aims to narratively review malaria control programs in each West African country to recommend the most effective program or programs to other malaria-endemic countries.

Program Review on Malaria Control

For the past 10 years, there has been a global reduction in malaria cases and mortality owing to the various malaria control programs implemented in every country of the world[11]. A study[12] reported that almost half of the world's countries have been certified malaria-free, and this great feat was possible because of the good policy and programs put in place to fight malaria in these countries. No West African country does not have a malaria control program.

The goal of the National Malaria Control Program (NMCP) in Ghana was to reduce malaria death and morbidity by more than 75% by the end of the year 2020[13]. The NMCP included Seasonal Malaria Chemoprevention (SMC), intermittent preventive treatment for pregnant women, indoor residual spraying, and insecticide-treated mosquito nets[13]. The SMC was accepted in communities where it was carried out[14]. It has also been found to be cost-effective and reduces morbidity and mortality in children[15]. However, for the seasonal malaria chemoprevention, frequent enlightenment of communities on the benefits of SMC has been advised to increase its acceptability among these communities[14]. The strategies of the national malaria control program are still in use in Ghana; however, the program is challenged by the inability to quantify its impacts and also, by the cost of implementation of the interventions[16].

The NMCP in Cote d'Ivoire is based on the use of insecticide-treated mosquito nets, intermittent preventive treatment for pregnant women, and simple environmental hygiene[17]. Cote d'Ivoire is one of the countries supported by the President Malaria Initiative (PMI). PMI is the United States of America President's Malaria Initiative for the global fight against malaria. It aims to reduce malaria mortality in malaria-burden countries through partnership with these countries[18]. The PMI was implemented in Coted'ivore in 2017, and since then, more than $45M has been invested in the country towards malaria elimination. This includes distribution of insecticide-treated mosquito nets, pregnant women preventive treatment, provision of insecticidal for vector control, ensuring medications availability, and also in the support of the national malaria control program[19].

Guinea is another country in West Africa with a high malaria burden[20]. The National Malaria Control Program in Guinea includes the distribution of long-lasting insecticide-treat mosquito nets, rolling out of rapid diagnostic test (RDT), mass campaign, and increasing the availability of artemisinin-based combination therapies[21]. In 2017, the US PMI funded a malaria control project known as StopPalu+ in collaboration with the national malaria control program to implement, the "Religion Leaders against Malaria" program. The program involves fighting malaria in the country at the community level by educating the people in the communities on the need to sleep under mosquito nets every night, preventing their under 5 years old children from mosquito bites, and creating awareness of antimalarial drugs through their religious leaders[20]. As a result of the religious leaders' intervention, the percentage of children who received the SMC increased favorably from 72% in 2017 to about 90% in 2020, the same as the percentage of households who now make use of long-lasting insecticidal nets in the country. The program was found to be effective as about 70,000 people were impacted through the StopPalu+ program in the country[20].

In 2010, Burkina Faso started an insecticide-treated mosquito bed-net campaign to reduce childhood malaria. The campaign led to an increase in the use of insecticide-treated nets in almost all the households in the country. It was shown that the campaign had little to no significance in the malaria cases in the children[22]. In the same year, the ministry of health of Burkina Faso implemented the National Malaria Control Program (NMCP) which provided mosquito nets and home-based treatment for children[23]. In 2014, Malaria Consortium partnered with the government and some non-governmental organizations to implement the Seasonal Malaria Chemoprevention (SMC), targeting malaria reduction in less than 5 years children during the rainy season[24]. The SMC has been found effective in the regions where the program was implemented, reducing about 80% of malaria occurrence in children[24].

The National Malaria Control Program in Liberia includes larval source management, indoor spraying residual, and the use of insecticide-treated mosquito nets[25]. The Strategic Technical Assistance for Improved Health System Performance and Health Outcome (STAIP) also supported the national malaria control program to prevent Malaria in Pregnancy (MIP)[26]. Poor acceptance of insecticide-treated mosquito nets by pregnant women was reported for various reasons ranging from poverty, ignorance, and lack of awareness of malaria control policy and corruption[27]. There is a need to strengthen the NMCP in Liberia to encourage its acceptability among pregnant women and the general populace[27].

In Cape Verde, a new malaria control program was implemented in 2017 as a supplement to their 1970s semi-annual indoor residual spraying (IRS) campaign[28]. The new policy includes the introduction of injectable

primaquine, vector control through insecticides, case surveillance with rapid response, environmental hygiene, and community sensitization[28]. In early January 2021, it was reported that Cape Verde has gone three consecutive years without a record of local malaria transmission which made them eligible for the zero malaria certification from the World Health Organization[29].

The Republic of Niger is one of the poorest countries in West Africa. Their main strategy for malaria control and prevention is through the use of Insecticide-treated mosquito nets[30]. The National Malaria Control Program in partnership with the Medecins Sans Frontieres (MSF) also implemented the Seasonal Malaria Chemoprevention (SMC) program in 2013 which was supported by the ACCESS-SMC for easy delivery[31]. Within the region where the SMC was implemented, more than 140,000 children between the age of 3 months and 4 years benefitted from the program, and it was recorded that the program was well accepted by the people of the region[32].

Despite the implementation of long-lasting insecticidal nets and intermittent preventive programs in Mali, malaria cases among children between 3-59months are still rampant[33], because a large number of the Mali population lives in malaria-burden areas[34]. The Seasonal Malaria Chemoprevention program was introduced in 2012 by the WHO, and Mali is one of the early adopters of this program[35]. The intervention is efficient and cost-effective[35]. A study[33] has shown a decreased level of malaria in the region where the Seasonal Malaria Chemoprevention program was implemented in Mali. Many reports from different scholars[33] have also confirmed the efficacy of SMC.

Uses of the long-lasting insecticidal net and indoor residual spray are the major National Malaria Control Program in Nigeria. The latter complemented the use of long-lasting insecticidal nets[36]. Training of community role model caregivers is another malaria control program in Nigeria. This was found to be effective in malaria control[37]. In partnership with the Roll Back Malaria (RBM) initiative, the NMCP also implemented malaria case management, intermittent preventive treatment in pregnancy, and the vector control program as part of the NMCP in the country[38]. As part of the World Health Organization recommendations, seasonal malaria chemoprevention in children below 5 years is also part of the malaria control program with proof to be effective and safe and has tremendously reduced malaria morbidity and mortality in children. The effectiveness of SMC in the reduction of malaria prevention in children where it was adopted was tripled, doubled the children's hematocrit values, and significantly reduced the number of fever occurrences in children[39].

In The Gambia, The National Malaria Control Program (NMPC) was established to tackle malaria as a public health threat. The program was designed to manage, control, and prevent the disease[40]. The Gambian National Malaria Control Program involves the use of indoor residual spray, long-lasting insecticidal nets[41], seasonal malaria chemoprophylaxis for children less than 5 years, and prompts treatment of the clinical case of malaria[42]. The vector control through the use of long-lasting insecticidal nets and indoor residual spray has led to a more than 70% decrease in childhood malaria mortality in the under-5years old children in the country, same with the seasonal malaria chemoprevention[43].

The government of Mauritania came up with quadrennial strategic plans for malaria control in the country. The strategies are based on reliable case surveillance and prompt response, laboratory-based diagnosis and appropriate and effective treatment of malaria, distribution of Insecticide-treated bed nets, and intermittent preventive treatment for pregnancy in malaria[44]. The programs faced different challenges such as financial challenges in procuring Artemisinin-based combination therapy. These challenges have led to an increase in the malaria burden in the country[44].

In Senegal, the National Malaria Control Program strengthens the vector control intervention policy through the distribution of long-lasting mosquito nets, expanding the Seasonal Malaria Chemoprevention campaigns, intermittent preventive treatment in pregnancy, and also village-based active and passive case detection[45]. The policies are effective in reducing the malaria burden in the country[45].

The national malaria control program in Sierra Leone includes case management and diagnosis, use of long-lasting insecticide nets, advocacy, communication and social mobilization, surveillance, and indoor residual spray[46]. According to the Sierra Leone national malaria strategy, by 2018, about 80% of the population and individuals would have adequate information on malaria control and prevention and also have access to the malaria diagnostic test to confirm their statuses, and people in malaria burden places would have access to malaria prevention interventions[47].

The National Malaria Control Program in the Benin Republic monitors and evaluates malaria control in the country[48]. The distribution of long-lasting insecticidal nets, intermittent preventive treatment for pregnant women, and the recent adoption of Artemisinin-based Combinations Therapies (ACT) are the current malaria control program in the Benin Republic[49]. In a study conducted by Damien et al[50] in 2016, the use of long-lasting insecticidal nets was found to reduce malaria cases among children and pregnant women in areas where there was a mass distribution of the nets. Another study[51] confirmed that the use of the insecticidal net in Benin has significantly reduced the clinical cases and the mortality of malaria in the past 15 years, with an estimated percentage of 42% and 60%, respectively. The national control program is backed and supported by the Roll Black Malaria (RBM) and also assists with the healthcare professionals' training to aid malaria control and management in the country[49].

The use of the long-lasting insecticidal net is the major intervention of the national malaria control program in Guinea-Bissau[52]. As the use of long-lasting insecticidal nets increases in Guinea Bissau, the percentage of malaria cases reduced significantly[53]. Between 2010 and 2016, there were more than 100 fewer malaria mortality cases. It was also reported that at the end of 2016, the number increased to almost 200[53]. Other programs include intermittent preventive treatment in pregnancy and case findings. The use of bed nets has been reported to improve malaria

control in the country. And also, the creation of a malaria enlightenment campaign along with the bed nets distribution has been recommended to improve its efficacy[52].

The Togolese national malaria control program is based on universal health coverage from the community level[54]. The program involves the distribution of long-lasting insecticide nets, seasonal malaria chemoprevention, and intermittent preventive treatment for pregnant women[54]. Eight months after the use of the long-lasting insecticidal nets policy implementation in 2011, the program has led to an increase in the 1.1% percentage of individuals and households that use insecticide-treated bed nets in the country[55].

Summary of the Effectiveness

The SMC implementation is the major game-changer in the countries with effective malaria control programs in comparison with the countries with low effectiveness of malaria control programs in West Africa[56,57]. The program is found to reduce more than 70% of malaria cases, especially in children and pregnant women in countries like Ghana, Burkina Faso, Niger, Mali, Nigeria, Gambia, Mauritania, and Togo[14,33,24,32,39,50,56]. Also, in countries with high malaria burden like Guinea[20], the PMI contributed heavily to the effectiveness of their malaria programs resulting in a more than 25% decrease in malaria occurrences and about 60% decrease in malaria mortality in these countries[58]. The PMI partnership in these countries has led to a significant reduction in malaria mortality in the countries such as Cote d'Ivoire, Nigeria, and Guinea which are beneficiaries of the initiative[21,58].

Challenges of Malaria Control Programs in West Africa

Despite the substantial progress that has gone forth in policy development, malaria elimination, and control interventions; malaria remains a major public health concern in West Africa. There has been a decline in mortality but the rise in morbidity is still alarming especially in high-burden countries[59]. Insufficient funding is one of the major challenges in ensuring the effectiveness of malaria control programs in West Africa. It slows down the rate of performance and implementation even in the face of convincing supportive evidence[60]. Overlooking the operational costs of executing a policy change *via* training, proper supervision, and processing of guidelines and other implementation tools during financial planning poses challenges too[60].

Delayed and ineffective policy utilization from important stakeholders at the global, regional, national, district, and community levels may have detrimental effects of reducing the willingness of health workers or prospective users to adhere to the laid down guidelines and use. The mode of dissemination, style, and content must be streamlined to the specific needs and concerns of the population residing there[61]. For instance, frequent Rapid Diagnostic Test (RDT) stock-outs and a lack of diagnosing facilities like a microscope have led to low health outcomes which also contribute to malaria morbidity[62].

Furthermore, there are difficulties in demulsifying and demonstrating the impacts of National Malaria Control Program interventions because of insufficient evidence[63]. For example, when WHO recommended the Seasonal Malaria Chemoprevention (SMC) for *Plasmodium Falciparum* malaria control, the SMC was advised to be deployed into an existing program such as Community Health Workers Scheme because of insufficient evidence that would ascertain it as the best approach to malaria control in Sahel sub-region in Africa[63].

Finally, it is shown that the intermittent preventive treatment for pregnant women (IPTp) and Artemisinin-based combination therapies (ACT) coverage rates are higher in the city than in rural settlements, making the malaria control programs less effective in the rural areas[63].

Recommendations

Seasonal Malaria Chemoprevention (SMC) is seen to be one of the most effective malaria control and elimination programs with a high rate of efficacy in the countries where it is implemented. Therefore, SMC should be mandatory and compulsorily incorporated into the National Malaria Control Program (NMCP) of all West African countries, especially in countries where the malaria burden is high.

In addition to this, the use of insecticide-treated nets which are found to be common in the national malaria control programs of all these countries should be strictly recommended to be used along with the seasonal malaria chemoprevention. This will make the program to be more effective. And to promote the wider use of insecticide-treated nets among vulnerable groups like pregnant women, intensified approaches for information dissemination and management are encouraged. An ideal information system will also support the elimination of malaria. For example, in Guinea, community and religious leaders help in creating awareness about malaria control and elimination[20], and this approach should be replicated in other West African countries.

In ensuring sustainable financing for malaria control and elimination programs, it is so crucial that governments should set some funds apart for malaria elimination as part of their national expenditures and also seeks foreign interventions and partnership like the President Malaria Initiative (PMI), Roll Back Malaria (RBM). While releasing such funds, the population size of each geographical location must be considered and this is to ensure the universal coverage of the four Roll Back Malaria (RMB) priority interventions; free insecticide-treated nets (ITN) distribution, intermittent preventive treatment for pregnant women (IPT) for pregnant women and treatment of all active cases with artemisinin-based combination therapy[64]. For better efficiency, more strategies of distribution are advised to be adopted outside the formal healthcare system and this is in view of ameliorating the financial burden of families and individuals that resort to self-treatment.

Finally, to achieve the long-term success of the World Health Organization of 2030 goal of zero malaria, a combination of universal intervention coverage and the development of a strong surveillance system that collects, transmits, and analyzes data about cases and program activities in real-time to inform quick reaction strategies is essential[65], as well as continuous investment in research and development and prompt placement of new resources and tools[66].

CONCLUSIONS

Just as the malaria control programs of each West African country have been carefully examined, the overall findings from the narrative review study found Seasonal Malaria Control (SMC) as the topmost effective program and it is highly recommended to other malaria-endemic countries in West Africa. Other Malaria control programs and strategies come in the domain of prevention and case management. They all work together and collaboratively against the transmission of the malaria parasite from its vector to humans. In it all, priority must be ascribed to the effective malaria control program to eliminate malaria in West Africa.

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The authors declare that they have no conflict of interests.

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