



Beyond Drugs in Eliminating Malaria Scourge in Nigeria; Scaling-up Vector Control Strategies

**B. O. Ogbonna^{1*}, C. E. Ejim², G. N. Ele³, I. G. Ohiaeri⁴, L. N. Ezenekwe¹,
C. N. Nwako¹ and O. N. Ilonzo¹**

¹Department of Clinical Pharmacy and Pharmacy Management, Faculty of Pharmaceutical Sciences, Nnamdi Azikiwe University, Awka, Nigeria.

²Department of Pharmacy, Enugu State University Teaching Hospital, Parklane, Enugu, Nigeria.

³Department of Pharmacy, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria.

⁴Pharmacists Council of Nigeria, Enugu, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Author BOO designed the study and wrote the protocol. Authors BOO, CEE, GNE, IGO, LNE, CNN and ONI managed the literature search and evaluation of selected articles based on inclusion criteria. Author BOO reviewed the article and wrote the first draft of the manuscript. Authors CEE, GNE, IGO, LNE, CNN and ONI wrote part of the manuscript while author BOO reviewed the entire work and wrote the final draft. All authors read and approved the final manuscript.

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ABSTRACT

Integrated vector control management strategy plays a pivotal role and occupies a vantage position today in World Health Organizations (WHO) road map to malaria elimination and Nigeria has the highest malaria burden in Sub-Saharan Africa. So much attention and huge financial and economic resources have been invested in chemotherapy for malaria prevention and control. The article identified feasible non- drug measures in malaria prevention and control, and suggested a paradigm beyond drug use in combating the scourge. Electronic search of relevant materials in official search engines was used in this study. Key words like mosquito, vector, malaria, prevention,

*Corresponding author: E-mail: bo.ogbonna@unizik.edu.ng;

control, and Nigeria were used individually and in combination for search of relevant articles. Search was carried out using Embase, Medline and Google scholar to download published articles using the keywords individually and in combinations. Articles were sorted based on defined inclusion criteria. Official sites were used to extract vital information relevant to the subject. Malaria causes over 300 000 deaths annually in Nigeria. Under five mortality due to malaria was 168 per 1000 live births. She losses N132 billion (\$900 million USD) to malaria related cost annually. Huge resources channeled towards chemotherapy and chemoprophylaxis coupled with high cost of therapy has complicated the prevention and control efforts. Evidence abounds of countries that attained elimination status and complete eradication through non-drug measures. A gap exists in over the years in malaria prevention and control programmes and policies through suboptimal use of non-drug measures. Huge efforts and resources have been invested in drug measures of the control mechanism. Integrated vector control mechanism suggests being the way forward beyond chemotherapy and chemoprophylaxis.

Keywords: Mosquito; malaria; prevention; eradication; control; vector; Nigeria.

1. INTRODUCTION

In recent times, the attention of the World Health Organization (WHO) has shifted from curative to preventive health care. The cost of antimalarial drugs is on the increase and catastrophic spending for health facilities, encouraged medication non-adherence that lead to treatment failure with huge morbidity and mortality figures. Using population protective and preventive methods that place more of the burden on the government might produce better result through improved funding and orientation. Inter sectorial collaboration of government agencies will in no doubt promote the operations. The under five mortality rate in Nigeria was 128 per 1000 live birth while infant mortality rate was 64 per 1000 live birth from 2009 to 2013. Malaria cause over 300 000 deaths annually in Nigeria of which majority are children and account for 60% of outpatient visit to hospitals, 30% of childhood deaths and 11% of maternal death in Nigeria. Statistics show that malaria and/or in comorbidity with other disease conditions account for over 75% of childhood mortality [1-5].

Literatures reveal non-sustainability of vector control mechanisms spanning decades in sub-Saharan Africa. Only 2% of households received indoor residual spray for 12months before 2013 while 23% had at least one insecticide treated nets for every two persons [6,7]. In sub-Saharan Africa where most of the people live below \$2 USA Dollar per day, most of the ACTs cost an average of \$3.6 to \$5.0 [8-11]. Access to the Artemisinins based Combination Therapy has been a limitation to malaria treatment since most of the people from remote villages to big cities cannot afford the drugs for treatment. This has further compounded the use of the ACTs leading to development of resistance in most cases.

Resistance is usually associated with incomplete information on the use of the medicines leading to non-adherence. This is further compounded by marked differences in health care delivery between the urban and rural dwellers complicated by caregivers' education status, patients or caregivers' economic status, cost of medicines and their availability [12-14]. This suggests that the ACTs may likely fail with time. Hence, the most rational approach will be preventive approach. Preventive measures are usually implemented on a large scale and coverage is not dependent on individual contribution abilities or catastrophic spending. The preventive approach comprises of chemoprophylaxis and vector control activities.

Vector control utilizes biological, environmental, chemical, and personal control and community mobilization in eliminating mosquito population. There is a growing need to take into consideration the socio-cultural aspect of people's belief in mass mobilization for the prevention and control of malaria [15-17]. Understanding these issues is essential to synthesizing information to gear government and policies towards a workable and rational alternative. This underscored the need to explore and suggest ways of combating the malaria scourge through non-drug measures. The non-drug measures of combating malaria scourge have been explored in this study. This article identified feasible non- drug measures in malaria prevention and control, and suggested a paradigm beyond drug use in combating the scourge.

2. METHODS

The study was carried out between March 2015 and April 2016 following the Preferred Reporting

Items for Systematic Reviews and Meta-Analyses (PRISMA Group) 2009 format [18]. Electronic search was conducted using Embase, Medline and Google scholar to download published articles using the search terms: malaria, prevention, control, mosquito, Nigeria, and antimalarials, individually and combination of two items and above. Additional search and cross-referencing was conducted to obtain vital documents and official publications from agencies, organizations, government, and parastatals relevant to the subject. Preference was given to detailed and most recent articles written in English Language. The eligibility criteria was documents without conflicting reports, funding by organization or agencies who cannot influence the report, unbiased documents, documents with official web address and those with ethical approval. This was to ensure authenticity and eliminate any form of publication bias and selective reporting. Data extraction was done independently while some were carried out in duplicated to enhance validity. Data were summarized qualitatively through narrative synthesis.

3. RESULTS AND DISCUSSION

Remarkable success has been made in combating malaria globally. Results show that 55 countries have recorded 75% reduction in malaria-associated morbidity between 2000 and 2015, which necessitated the holistic review of strategies for prevention and control [19-21]. Vector control is one out of the three major springboards and pivotal measures of combating the scourge. This was in line with the 1988 declaration, which sought to use all available knowledge, tools, and skills to combat malaria [22-24]. Nigeria losses N132 billion to malaria related cost [25]. Landing cost accounts for 44% of the price of medicines in Nigeria while 43% is attributable to mark-ups. Hence, antimalarial drugs are not affordable to majority of the people leading to non-adherence, increased morbidity, and mortality [26,27]. This underscores the need for alternative prevention and control mechanism, which takes majority of the burden of the shoulders of the majority of the population.

About 58 million insecticide treated nets (ITN) were freely distributed in Nigeria from urban to rural communities between 2009 and 2013. However, the state of those nets and the modalities for sustained replacement leaves much to be desired. Besides, families with an average of seven people and four beds receive an average of two nets to cover 4 to 5 family

members while mosquito feed on the rest. Demand has to be created for the ITN and the price greatly subsidized to encourage continual replacement by households who need them at minimal cost. The ITN has to be made readily available to eliminate the activities of intermediaries. This will encourage continuity and sustainability of the malaria control programmes. This should be backed up with effective education since people who are not used to sleeping under the net complain of discomfort associated with heat, which is common in tropical climate. Long-lasting ITN and ITN have been in use in Philippines, Namibia, Bhutan, and Malaysia, which are under malaria eliminating countries today with the hope of eliminating the scourge. It will be necessary to learn from countries like Mauritius who obtained first elimination certification from WHO in 1969. Even though she lost it to resurgence in 1975 but was able to achieve complete elimination again by 1998. Namibia is already on her way to achieving elimination by the year 2020 while Sri Lanka achieved near elimination in 1963, had an outbreak between 1967 and 1968. They achieved zero local cases by November 2012 and on her way to receiving WHO certification for total elimination shortly [20,28-31].

3.1 Advocacy, Social Mobilization and Environmental Management

Promotion of inter-sectoral collaboration couples with massive environmental management activities have yielded much results in many malaria-eliminating countries. Mass mobilization of all stake holders at local state and national level with accelerated dissemination of information across board through the ministry of information, National Orientation Agency, federal ministries and parastatals, in collaboration with malaria control agencies, Non Governmental Organizations should be strictly upheld at all levels with special considerations for rural dwellers. This should be without prejudice to disseminating information on prompt diagnoses, treatment, well-coordinated movement, and building a stronger health system. Enforcement of environmental protection services with massive environmental sanitation, clearing of irrigation canals, strict sewage disposal and management mechanisms, and drainage of stagnant waters depending on the need of the region involved. Turkey used mash draining, Philippines and Sri Lanka employed cleaning of streams and irrigation canals, while Cape Verde used intermittent cleaning and drying of

reservoirs, protection of water tanks and filling of water collection points and germ pits to attain their present status [32-36].

3.2 Effective Management Information Systems, Situation Management and Evidence Based Decision-making

Strict data generation, interpretation, and use with follow-up and feedback are still lacking in most developing countries and Nigeria is not an exception. Effective management requires proactive, and technical, dissemination of information, maintenance of network and systematic decision-making, consultations, and proactive and tactical problem solving while demonstrating high level of integrity. These should be brought to bear on program management to ensure success, sustainability, and continuity. Strategic planning, program planning and work plan should be evidence based and powered through following critical path, project evaluation and review, logical framework and tailored to conventional software packages [37-39].

Planning for programmes must be targeted, and program officers should be realistic in their planning and show commitment, involve stakeholders and implementers, plan for the right reasons at all levels, monitor and evaluate implementations regularly with measureable indicators and benchmarks. Government and funding agencies are expected to make funds and staff available and closely monitor budgets input, process, outputs, and outcomes. Program managers should ensure regular and sustained supervisory monitoring of implementation and progress, routine reporting and tracking of data through the management information systems, use of sentinel sites for detailed reporting and intensive monitoring for rapid expansions with additional information for special studies. Selection of indicators and setting of performance targets should never be compromised at all levels. Monitoring systems should be used to improve performance by communicating plans and targets, reviewing progress, giving feedbacks, and taking actions. Actions should be based on available authentic data [37-41].

3.3 Economic Status, Developmental Projects and Community Mobilization

In an enabling environment, community participation complements government efforts

and adds value to health programmes. Members provide labor, materials and financial support, and protect and safeguard projects within their locality. They are involved in decision-making and control of resources. Programmes and projects are defined in terms of the people's real needs and priorities. Information dissemination and capacity building is greatly upheld. However, this can succeed through politically enabling environment to promote participation, decentralization of health services, existence of a comprehensive health structure, and development of grassroots managerial capacity. They should be fully involved from program planning to execution and monitoring [42-44].

This approach is lacking in most of our malaria control programmes today. Economic status and development is a strong determinant of programmes in countries. It determines the level of infrastructural development, supply of basic amenities, health care, environmental status, level of urbanization and resource allocation. Improves housing conditions contributed greatly to the success countries like Philippines, Sri Lanka, Bhutan, Mauritius, and Turkmenistan which have made tremendous positive impacts in malaria control [30,45]. Environmental sanitation needs education, equipment, and training which is capital intensive. Funds for their cost and logistics is provided through integrated programmes. Brazil launched a malaria control programme to contain resurgent malaria and prevent its spread to other regions in the Amazon [46,47]. Some of these programmes have not yielded desired dividends in Nigeria due to lack of sustainability and poor funding.

3.4 Mosquito Mapping, Surveillance and Control, Indoor Residual Spray and Integrated Vector Management

The Vectors Research Centre (NAVRC) in Nigeria has completed plans for the launch of mosquito surveillance system via the integration of Geo-informatics (Geographical Information Systems- GIS) in real time vector surveillance. Over the year's attention have been focused in pharmacotherapy in the prevention, and control of malaria. This is the first time such project will be taking place in line with malaria prevention and control through comprehensive [48,49]. This could be coupled with the promotion of indoor residual spray (IRS), larval control, personal protection and integrated vector management. The integrated vector management (IVM) was

introduced by WHO to improve the cost effectiveness of vector control strategies through integration of interventions. Large-scale use of insecticides on breeding areas with continuous monitoring for the incidence of resistance should be encouraged by the government. Anopheles mosquito species develop resistance rapidly to chemicals. The use of IVM stems the development of resistance to insecticides and chemotherapeutic agents. This is in line with the principle of multiple prevention recommended by WHO [31].

Indoor residual spray has a record of effective receptivity reduction. This could be employed in a universal dimension to be borne by the government or at focal level based on available resources. Laval control by use of carnivorous fishes may not be effective in our country where people still depend largely of natural water sources for their water needs. Chemical agents used as lavisides are expensive and prone to development of resistance. Individuals through public enlightenment should be educated on the use of personal protection agents like lotions and ointment mosquito repellants. However, this might not make much impact in rural areas due to literacy level, cost, and the forces of demand and supply especially in remote villages where local herbal repellants are not available. Research and development should be intensified into the development and use of many indigenous herbs with mosquito repellent and insecticidal properties. Vaccine development could be invaluable. It will help in exploring other ways of integrated and mutual benefits [50-51].

This integrated and multidimensional approach when sustained and encouraging the involvement of all stakeholders suggests being invaluable in combating the scourge [51-55]. The insecticides used for malaria vector control is also used by the agricultural sector for the pest control activities. Collaborative operations between the two sectors geared towards production, procurement, use and sustainability can go a long way in strengthening the vector control measures. Joint procurement could reduce cost [46,47].

4. CONCLUSION

Integrated vector management has proven to be a realistic approach, which has worked for many countries and has set many on the track of malaria elimination and eradication when it is

consistently implemented and sustained. Nigeria is a malaria endemic country where people have incidence of malaria throughout the year with huge economic burden. Embracing the IVM without prejudice to pharmacotherapy could place the country on a fast track to achieving elimination and outright eradication. This should be powered on the platform of people oriented policies and sound management framework.

CONSENT

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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