

**BEYOND DRUGS IN ELIMINATING MALARIA SCOURGE IN
NIGERIA; SCALING-UP VECTOR CONTROL STRATEGIES**

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, 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

39 drugs is on the increase and catastrophic spending for health facilities,
40 encouraged medication non-adherence that lead to treatment failure with
41 huge morbidity and mortality figures. Using population protective and
42 preventive methods that place more of the burden on the government might
43 produce better result through improved funding and orientation. Inter
44 sectorial collaboration of government agencies will in no doubt promote the
45 operations. The under five mortality rate in Nigeria was 128 per 1000 live
46 birth while infant mortality rate was 64 per 1000 live birth from 2009 to
47 2013. Malaria cause over 300 000 deaths annually in Nigeria of which
48 majority are children and account for 60% of outpatient visit to hospitals,
49 30% of childhood deaths and 11% of maternal death in Nigeria. Statistics
50 show that malaria and/or in comorbidity with other disease conditions
51 account for over 75% of childhood mortality [1, 2, 3, 4, 5].

52
53 Literatures reveal non-sustainability of vector control mechanisms spanning
54 decades in sub-Saharan Africa. Only 2% of households received indoor
55 residual spray for 12months before 2013 while 23% had at least one
56 insecticide treated nets for every two persons [6, 7]. In sub-Saharan Africa
57 where most of the people live below \$2 USA Dollar per day, most of the
58 ACTs cost an average of \$3.6 to \$5.0 [8, 9, 10, 11]. Access to the
59 Artemisinin based Combination Therapy has been a limitation to malaria
60 treatment since most of the people from remote villages to big cities cannot
61 afford the drugs for treatment. This has further compounded the use of the
62 ACTs leading to development of resistance in most cases. Resistance is
63 usually associated with incomplete information on the use of the medicines
64 leading to non-adherence. This is further compounded by marked
65 differences in health care delivery between the urban and rural dwellers
66 complicated by caregivers' education status, patients or caregivers'
67 economic status, cost of medicines and their availability [12, 13, 14]. This
68 suggests that the ACTs may likely fail with time. Hence, the most rational
69 approach will be preventive approach. Preventive measures are usually
70 implemented on a large scale and coverage is not dependent on individual
71 contribution abilities or catastrophic spending. The preventive approach
72 comprises of chemoprophylaxis and vector control activities.

73
74 Vector control utilizes biological, environmental, chemical, and personal
75 control and community mobilization in eliminating mosquito population.
76 There is a growing need to take into consideration the socio-cultural aspect
77 of people's belief in mass mobilization for the prevention and control of
78 malaria [15, 16, 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 [27]. 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.

2.5 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 [18, 19, 20]. 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 [21, 22, 23]. Nigeria losses N132 billion to malaria related cost [24]. 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 [25, 26]. 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 [19, 28- 31].

2.6 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].

2.7 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,

194 giving feedbacks, and taking actions. Actions should be based on available
195 authentic data [37-41].

196 197 **2.8 Economic status, developmental projects, and community** 198 **mobilization**

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

210
211 This approach is lacking in most of our malaria control programmes today.
212 Economic status and development is a strong determinant of programmes
213 in countries. It determines the level of infrastructural development, supply
214 of basic amenities, health care, environmental status, level of urbanization
215 and resource allocation. Improves housing conditions contributed greatly to
216 the success countries like Philippines, Sri Lanka, Bhutan, Mauritius, and
217 Turkmenistan which have made tremendous positive impacts in malaria
218 control [30, 45]. Environmental sanitation need education, equipment and
219 training which are capital intensive. Funds for their cost and logistics
220 through integrated programmes. Brazil launched a malaria control
221 programme to contain resurgent malaria and prevent its spread to other
222 regions in the Amazon [53, 54]. Some of these programmes have not
223 yielded desired dividends in Nigeria due to lack of sustainability and poor
224 funding.

225 226 **2.9 Mosquito mapping, surveillance and control, indoor residual** 227 **spray and integrated vector management**

228 The Vectors Research Centre (NAVRC) in Nigeria has completed plans for
229 the launch of mosquito surveillance system via the integration of Geo-
230 informatics (Geographical Information Systems- GIS) in real time vector
231 surveillance. Over the year's attention have been focused in
232 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 [46, 47]. 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 [48-50].

This integrated and multidimensional approach when sustained and encouraging the involvement of all stakeholders suggests being invaluable in combating the scourge [49-52]. 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 [53, 54].

3. 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.

REFERENCES

1. Federal Ministry of Health (FMOH) Nigeria; Pharmaceutical Country Profile Nigeria 2011. Available at: <http://www.who.int/hna/country/nga.pdf>
2. Federal Ministry of Health (FMOH) Abuja, Nigeria. National Malaria Control Programme Report.
3. Federal Ministry of Health (Nigeria) 2009. *National malaria strategic plan 2009-2013*. Abuja, Nigeria: Federal Ministry of Health.
4. Federal Ministry of Health [Nigeria]. 2011b. *National guidelines for diagnosis and treatment of malaria, 2011*. Abuja, Nigeria: Federal Ministry of Health.
5. Federal Ministry of Health [Nigeria]. 2012. *Malaria advocacy brief for policy makers*. Abuja, Nigeria: Federal Ministry of Health.
6. Federal Republic of Nigeria [Nigeria]. 2010a. *MDG report 2010: Nigeria Millennium Development Goals*.
7. National Population Commission. *Nigeria Demographic and Health Survey 2013*. Abuja, Nigeria.
8. Negri B, Brown L, Hernandez O, Rosenbaum J, Roter D. Improving interpersonal Communication between health care providers and clients. Quality Assurance Methodology Refinement Series. Quality Assurance Project, 1997. (Accessed on 2 March at: pdf.usaid.gov/pdf_docs/Pnace294.pdf).
9. Stewart M. Effective physician-patient communication and health outcomes: a review. *Can Med Assoc J*. 1995; 152:9.
10. Njau J, Goodman C, Kachur S, Palmer N, Khatib R, Abdulla S, et al. Fever treatment, and household wealth: the challenge posed for rolling out combination therapy for malaria. *Trop Med Int Health*. 2006; (11):299–313.

11. Ezenduka C, Ogbonna B, Ekwunife O, Okonta M, Esimone C. Drugs use pattern for uncomplicated malaria in medicine retail outlets in Nigeria urban, southeast Nigeria: Implications for malaria treatment policy. *Malar J.* 2014; 13:243.
12. Okeke TA, Uzochukwu BSC, Okafor HU. An in-depth study of patent medicine sellers' perspectives on malaria in a rural Nigerian community. *Malar J.* 2006; 5:97.
13. Onwujekwe O, Uzochukwu B, Eze S, Obikeze E, Okoli C, *et al.* Improving equity in malaria treatment: Relationship of socio-economic status with health seeking as well as with perceptions of ease of using the services of different providers for the treatment of malaria in Nigeria. *Malaria Journal* 2008; 7: 5.
14. Brieger WR, Osamor PE, Salami KK, Oladepo O, Otusanya SA. Interactions between patent medicine vendors and customers in urban and rural Nigeria. *Health Policy Plan* 2004; 19: 177–182.
15. Clémence E, Jürg U, Andres BT, Giovanna R, Constanze P, Stefanie G Benjamin GK, Eliézer KNG, Guéladio C, Olivier G, Marcel T, Brigit O. Social and cultural aspects of 'malaria' and its control in central Côte d'Ivoire. *Malar J.* 2008, 7:224
16. Williams HA, Jones COH: A critical review of behavioural issues related to malaria control in sub-Saharan Africa: what contributions have social scientists made? *Soc Sci Med.* 2004, 59:501-523.
17. Beiersmann C, Sanou A, Wladarsch E, De Allegri M, Kouyaté B, Müller O: Malaria in rural Burkina Faso: local illness concepts, patterns of traditional treatment and influence on health seeking behavior. *Malar J.* 2007, 6:106.
18. Global Malaria Programme. *World malaria report*, 2014. Geneva: World Health Organization; 2014.
19. Smith Gueye *et al.* Strategies and approaches to vector control in nine malaria-eliminating countries: a cross-case study analysis *Malar J.* 2016;15:2-14.
20. Roll Back Malaria. Action and investment to defeat malaria 2015–2030. Geneva: World Health Organization, on behalf of the Roll Back Malaria Partnership Secretariat. 2015.
21. Global Malaria Programme. Malaria elimination: a field manual for low and moderate endemic countries. Geneva: World Health Organization; 2007.

22. WHO. Guidance Note on capacity building in malaria entomology and vector control. Geneva: World Health Organization. 2013.
23. WHO Global Partnership to Roll Back Malaria. The use of antimalarial drugs: report of a WHO informal consultation, 13- 17 November 2001 [WHO/CDS/RBM/2001.33]. Geneva: World Health Organization, 2001.
24. Federal Ministry of Health Nigeria (FMOH) 2004. National Antimalarial Treatment Policy; November 2004.
25. Federal Ministry of Health Nigeria (FMOH) 2006. Medicine prices in Nigeria: prices people pay for medicines.
26. Udezi WA, Usifoh CO. Profit margins and project 3ed affordability of first line antimalarial drugs. *West Afric J of Pharm.* 2011; 22(1): 67-74.
27. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009) Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PloS Med* 6(7): e1000097.
28. Sochantha T, Van Bortel W, Savonnaro S, Marcotty T, Speybroeck N, Coosemans M. Personal protection by long-lasting insecticidal hammocks against the bites of forest malaria vectors. *Trop Med Int Health.* 2010; 15:336–41.
29. Ministry of Health Malaysia, World Health Organization and University of California, San Francisco. Eliminating malaria: Case-study 8. Moving towards sustainable elimination in Malaysia. Geneva: World Health Organization; 2014.
30. Ministry of Health Philippines, World Health Organization and University of California, San Francisco. Eliminating malaria: Case-study 6. Progress towards sub national elimination in the Philippines. Geneva: World Health Organization; 2014.
31. WHO. Global strategic framework for integrated vector management. Geneva: World Health Organization. 2004.
32. Walshe DP, Garner P, Abdel-Hameed AAA, Pyke GH, Burkot T. Larvivorous fish for preventing malaria transmission. *Cochrane Database Syst Rev.* 2013; 12:CD008090.
33. Williams HA, Jones COH: A critical review of behavioural issues related to malaria control in sub-Saharan Africa: what contributions have social scientists made? *Soc Sci Med.* 2004, 59:501-523.
34. Kusumawathie PHD, Wickremasinghe AR, Karunaweera ND, Wijeyaratne MJ. Use of Sri Lankan larvivorous fish species in

- 390 mosquito control. In: Karunaratne SH, editor. Programme and
391 proceedings national symposium on mosquito control. Colombo:
392 Postgraduate Institute of Science. 2005; 58–69.
- 393 35. Heggenhougen HK, Hackenthal V, Vivek P: The behavioural
394 and social aspects of malaria and its control. An introduction and
395 annotated bibliography. World Health Organization on behalf of the
396 Special Programme for Research and Training in Tropical Diseases,
397 TDR/STR/SEB/VOL/03.1; 2003.
- 398 36. Kusumawathie PH, Wickremasinghe AR, Karunaweera ND,
399 Wijeyaratne MJ. Larvivorous potential of the guppy, *Poecilia*
400 *reticulata*, the anopheline mosquito control in riverbed pools below
401 the Kotmale dam, Sri Lanka. *Asia Pac J Public Health*. 2008; 20:56–
402 63.
- 403 37. Management Science for Health (MSH). *Managing Drug*
404 *Supply*. Ed 2, rev and exp. In collaboration with WHO.1997; Part 4.
405 Management support systems.
- 406 38. Adenike FB. Principles of essential drugs management.1992;
407 Ibadan Nigeria: Shaneson CI.
- 408 39. Reynolds J, Fransisco M, Gearon S. Better management: 100
409 tips (managers guide). *In primary health advancement programme*.
410 Geneva Ag Foundation
- 411 40. Blanco SM. Health projects within the health care system. In
412 health and diseases in developing countries. 1992; Ed KA Lankinen,
413 S Bergstrom, PH Makela, and M Peltomaa. London: Macmillan.
- 414 41. Management Science for Health (MSH). Improving efficiency
415 and performance indicators (Trainers and participants guide). *In*
416 *Managing Drug Supply series*. Part 2, Financing and financial
417 management of drug supply. Boston: MSH.
- 418 42. Fox J. Rhetoric and reality: A commentary on the UNCHS
419 Community development programmes in Ghana, Uganda, and
420 Zambia. Printed at UNCHS Seminar; 1993. Copenhagen United
421 Nations Center for Human Settlements (Habitat).
- 422 43. McPake B, Hanson K, Mills K. Community financing of Health
423 care in Africa: An evaluation of Bamako Initiative. *Social Sci and Med*.
424 1993; 36:1383-95.
- 425 44. United Nations Childrens Fund (UNICEF). The Bamako
426 Initiative: Rebuilding health systems. 1995; New York: Baamako
427 Initiative Unit.
- 428 45. Ministry of Health Sri Lanka and the World Health Organization
429 and the University of California, San Francisco. Eliminating Malaria:

- Case study 3. Progress towards elimination in Sri Lanka. Geneva: World Health Organization; 2012.
46. Global Malaria Programme. Malaria elimination: a field manual for low and moderate endemic countries. Geneva: World Health Organization; 2007.
47. Anumba JU, Chukwuokezie OC. National Abovirus and Vector Research Center (NAVRC); Nigeria. Vector Surveillance and Control in Nigeria: Mapping Of Mosquito Species In the Six Geopolitical Zones. (Accessed on 18 April 2016 at: http://www.academia.edu/6118214/INTEGRATED_VECTOR_MANAGEMENT_SURVEILLANCE_and_CONTROL_IN_NIGERIA_Mapping_Of_Mosquito_Species_In_the_Six_Geopolitical_Zones).
48. Carrington A. Malaria: Its Human Impact, Challenges, and Control Strategies in Nigeria. *Harvard Health Policy Review*. 2001; 2: (2) 1-3.
49. Okeibunor JC, Orji BC, Brieger W, Ishola G, Otolorin EO, Rawlins B, Ndekhedehe EU, Onyeneho N, and Fink G. Preventing malaria in pregnancy through community-directed interventions: evidence from Akwa Ibom State, Nigeria. *Malar J*. 2011; 10:227.
50. AngloGold A. A national model for malaria control in Ghana. (Accessed on 15 April 2016 at <http://www.anglogold.com/subwebs/informationforinvestors/reports09/obuasimalaria.htm>).
51. Invest in the Future: Defeat Malaria. World Malaria Day Theme 2013–2015 Roll Back Malaria. Accessed on 30 March 2016 at <http://www.rbm.who.int/worldmaliaday/docs/wmd2013theme.pdf>.
52. CAMA. Company Management Guide for Implementing an Integrated Malaria Control Program. (Accessed on 2 April 2016 at <http://www.gbchealth.org/files/reports/CAMA%20Company%20Management%20Guide-Malaria%20Final%20document.pdf>).
53. Akhavan D, Musgrove P, Abrantes A, Gusmão RA. Cost-effective malaria control in Brazil: cost-effectiveness of a malaria control program in the Amazon Basin of Brazil, 1988–1996. *Soc Sci Med*. 1999; 49:1385–99.
54. Ferreira MU, Castro MC. 84. Challenges for malaria elimination in Brazil. *Malar J*. 2016; (15):284: 1-18.