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Letter to the Editor **Open Access**

Harness innovation to reduce the malaria disease burden and save lives

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Exploiter l'innovation pour réduire le fardeau du paludisme et sauver des vies

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Dear Editor,

The World Health Organization (WHO) theme for the year 2022 on the World Malaria Day is "Harness innovation to reduce the malaria disease burden and save lives". This theme raises a few questions relating to the issue of controlling malaria. These are; (1) Can malaria be eliminated without a vaccine? (2) As the theme suggests, what are the innovations needed to eliminate malaria? (3) What are the current figures in terms of annual malaria mortality, incidence and economic costs in Nigeria? (4) What is the Nigerian situation with respect to resistance of malaria vector to insecticides and malaria parasites to the antimalarial drugs of choice (artemisinin combination therapy ACT), which has been reported in most parts of the world? (5) With China's *Artemisia annua* (Chinese salad plant) for ACTs, showing that plants are the future of medicine, what should Nigeria do about this considering the fact that there are effective herbal drugs available for malaria therapy in the country? and (6) How has Nigeria fared with the issue of proliferation of fake and adulterated antimalarial drugs?

We have provided below brief answers to these questions for the benefit of the scientific, research and development community.

1. Can malaria be eliminated without vaccine?

It is unlikely that malaria will be eliminated without vaccine because in recent years, there has not been a significant reduction in morbidity and mortality especially in areas where malaria is endemic despite the preventive and treatment measures that have been in place for years. The availability of vaccine may also not be sufficient to eliminate malaria because the efficacy of the current vaccine (RTS,S/AS01) is 36.3% at first dose against clinical malaria in children, 25.9% in infants while efficacy against severe malaria

stands at 32.2% and 17.3% in children and infants respectively (1). Although people in endemic regions develop immunity to malaria in adulthood, they are not immune to new infection and therefore the spread of the parasite is inevitable.

The early candidate vaccines were based on sporozoite antigens however, it became evident that they did not completely block infection (2). On the other hand, those vaccine candidates based on synthetic peptides (3) and recombinant proteins that combined sporozoite antigens with blood stages (4), had produced mixed efficacy results. Unless vaccines that are able to prevent infection are developed and backed up with 100% uptake, it is most unlikely that the current vaccines would be able to eliminate malaria. Bearing in mind that malaria vaccines are developed to reduce disease and deaths, but not to completely eliminate disease, it will take a combination of strategies, including the use of existing control and preventive measures as well as development of new tools to control and ultimately eliminate malaria.

2. As the theme suggests, what are the innovations needed to eliminate malaria?

There is need to scale up available preventive and control measures currently in use which include; use of long-lasting insecticide treated bed nets (LLINs), indoor residual spraying (IRS), larviciding, seasonal chemoprevention, intermittent preventive therapy in pregnancy, prompt diagnosis with RDT/microscopy and treatment with artemisinin combination therapy (ACT). In addition, other innovative measures that are needed include; research and development of new generations of highly effective vaccines, newer drugs to prevent resistance, new generation of chemicals required for IRS and larviciding, and research into sterilization of mosquitoes, amongst others.

3. What are the current figures in terms of annual malaria mortality, incidence and economic costs in Nigeria?

The Nigeria Demographic and Health Survey (DHS) data (5) shows that over 110 million malaria cases occur yearly, and this is responsible for 11% maternal mortality, 25% infant mortality, and 30% of under-five mortality, with associated social and economic burdens including retardation of the country gross domestic products (GDP) by 40% annually and estimated 480 billion Naira loss due to malaria related out-of-pocket (OOP) treatment, prevention costs, absenteeism and productivity losses (5).

The 2015 National Malaria Indicator Survey (NMIS), which was the second malaria indicator survey in Nigeria, however showed that prevalence of malaria reduced to 45% by RDT and 27% by microscopy, from 52% by RDT and 42% by microscopy in the 2010 NMIS data (6). The 2018 DHS data also showed a reduction in malaria prevalence in children from 42% in 2010 to 27% in 2015 and 23% in 2018 (5). However, global estimates from the 2021 World Malaria Report (7) showed that Nigeria recorded an increase in the proportion of cases and deaths attributable to malaria from 23% in 2020 to 27% in 2021, which made Nigeria the country with the highest number of malaria cases and deaths worldwide, put at approximately 200,000 deaths (7). Malaria therefore remains a foremost public health challenge for Nigeria and a major cause of morbidity and mortality, which government should be determined to change.

Nigeria is tackling this challenge through the National Malaria Policy, launched in February 2015, which expresses the desire and commitment of the Government at all levels to ensure the elimination of malaria. The National Malaria Strategic Plan (NMSP) 2021-2025 target is to reduce malaria parasite prevalence to less than 10% and mortality attributable to malaria to less than 50 deaths per 1,000 live births by 2025 (8). However, there are concerns that Nigeria may miss the 2025 malaria elimination target as Nigeria did not make the list of countries that met the 2020 milestone of NMSP 2014-2020, and hence not projected by the WHO with the potential to stamp out malaria by 2025 (9).

4. What is the Nigerian situation with respect to resistance of malaria vector to insecticides and malaria parasites to the antimalarial drugs of choice (artemisinin combination therapy ACT)?

There is evidence to show that there is widespread resistance of *Anopheles* mosquitoes to a number of the insecticides used for IRS, such as deltamethrin, and DDT. Extreme resistance of malarial vector to DDT and possible resistance to bendiocarb have been reported (10,11). In a report (11), *Anopheles coluzzii*, and *Anopheles gambiae* showed resistance to three classes of insecticides (DDT, permethrin and bendiocarb) approved by the WHO. These underscore the need for constant analysis and improvements in research and development to ensure that newer, more effective insecticides are developed.

Unlike in Asia and some other countries around the world where there is high resistance to ACTs, there has not been significant resistance of malaria parasites to ACTs in Nigeria (12,13). This is good news but also a reason to be cautious to ensure that ACT use is not abused so as to prevent resistance.

5. With China's *Artemisia annua* (Chinese salad plant) for ACTs, showing that plants are the future of medicine, what should Nigeria do about this considering the fact that there are

effective herbal drugs available for malaria therapy in the country?

Focus group discussions and interviews (14) were held about plants often found useful for malaria therapy in the community. Fifty species (local names) of plants including *Morinda lucida* (Oruwo), *Enantia chlorantia* (Awopa), *Alstonia boonei* (Ahun), *Azadirachta indica* (Dongoyaro) and *Khaya grandifolia* (Oganwo) were found to be in use for malaria therapy at Okeigbo, Southwest, Nigeria (14). Many other drugs have been developed from plant extracts but the main issues with the direct use of these plants are possible harm to people from certain toxic components in them and lack of information on appropriate dosages.

Nigeria should henceforth begin to conduct her own research and analysis of the natural resources within the country to extract the components in the plants which are beneficial for therapy of malaria and other disease conditions.

6. How has Nigeria fared with the issue of proliferation of fake and adulterated anti-malarial drugs?

Research has shown that 1 in 5 anti-malarial products in circulation is fake (15). Fake and adulterated drugs are a major challenge especially in low-and-middle income countries (LMICs) where there is lack of advanced technology and inadequate regulatory bodies necessary to combat this challenge. Tackling this issue will require; improving the economy, strengthening technical capacity, providing regulatory oversight, ensuring punitive action, improving consumer and health worker knowledge about product authenticity, and regulating the private sectors purchase of drugs.

7. When is Nigeria going to deploy the new malaria vaccine?

The Federal Government of Nigeria has begun setting up mechanisms to facilitate implementation of the malaria vaccine by putting together a committee to implement national response, while collaborating with various stakeholders, including discussions with Program for Appropriate Technology in Health (PATH) to develop a roadmap for vaccine deployment in Nigeria and to ensure smooth roll out (15).

Financing malaria vaccine purchase is being supported by GAVI, the vaccine alliance, the Global Fund to fight AIDS, TB and malaria, and UNITAD, while the Federal Government is expected to provide counterpart funding. The Nigerian Government and Prince Ned Nwoko malaria eradication foundation have applied for purchase of the vaccine which will be rolled out in phases starting with States with the highest malaria burden (16). Deploying the vaccine will require adequate planning (17) to ensure successful implementation.

Contribution of authors:

AO and AB designed the topic; MBTO, BM, SO, NM and ASA reviewed literature on different aspects of the work; AB and MBTO merged the various write-up and edited the final manuscript.

Conflict of interest:

No conflict of interest is declared

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