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need to be considered as part of the routine care of these patients.

I will like to conclude by emphasizing that we continue to welcome high quality articles from across the entire spectrum of the medical and surgical specialities and sub-specialities. We will continually strive to ensure prompt and excellent review and publication of the such manuscripts while improving on the high standard of the journal. We however solicit the support and co-operation of all stake-holders including our contributors, reviewers and editors, and our various institutions.

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Malaria: Burden and Challenges of Eradication

INTRODUCTION/EPIDEMIOLOGY

Malaria, a parasitic disease caused by the genus Plasmodium that is both preventable and treatable, remains one of the leading causes of illness and death worldwide but affects most countries in the tropics and subtropics, with over 3.3 billion people in 106 countries at risk of contracting the disease. Pregnant women and non-immune immigrants are also at risk of dying. There were an estimated 247 million cases of the disease and 619 deaths globally in the year 2021, increasing from 229 million cases and 409,000 deaths in 2019.[1] From the year 1955 to 2023, a total of 42 countries have been certified malaria-free by the World Health Organisation (WHO), mainly consisting of countries in Europe, Asia and the Americas, rekindling our hope of the possibility of eliminating this disease of poverty from Sub-Sahara African countries and especially Nigeria where the disease is most prevalent.[2]

Africa, especially the sub-Sahara, is disproportionately affected by the disease, sharing 95% of the disease burden. Nigeria, the Democratic Republic of Congo, and Uganda account for 44% of the disease burden, with Nigeria remaining the highest-burden country with 26.6% of the global share of malaria cases.[1] Four countries in sub-Saharan Africa accounted for half of the malaria death globally, namely Nigeria, the Democratic Republic of Congo, Tanzania, and Niger. Nigeria, the highest-burden country, has the highest number of deaths from malaria globally, with 31% of the world's total, mostly from children under five.[1]

Economic Implication

Malaria imposes direct and indirect costs on families and the affected countries. To the family, it includes the costs of antimalarial drugs at home; transport fare to the hospital and cost of hospitalisation; lost days of work by caregivers; absenteeism from school; expenses for procuring insecticides, window, and door nets; besides expenses for burial in case of deaths.[3] The government uses a portion of the gross domestic product for public health initiatives to combat malaria, such as insecticide spraying, procurement, and distribution of long-lasting insecticidal nets, providing malarial drugs and test kits, and staffing and maintaining medical facilities.[3,4] Haakenstad, *et al* estimated, based on the national accounting system of 10 countries, the global spending on malaria to be 4.3 billion USD in 2016 (95% UI 4.2–4.4), accounting for both government and out-of-pocket spending per year.[5] Households in Nigeria spend about ₦2,730.46 (US$18.34) on average for treating an episode of malaria.[3]

In comparison, the indirect and direct costs accrued to an episode of malaria in Nigeria are estimated to be ₦1 906.08 billion (US $12,801.07 million), translating to about 8% of the Gross Domestic Product.[4] The paucity of accurate data from affected countries poses many challenges to planners and policymakers in strategies. Quantifying the economic cost of malaria is critical for policymakers to appropriately allocate resources, select control and prevention strategies, and evaluate the cost-effectiveness of interventions.

Stratification by malaria burden, a principle that facilitates optimising the selection of malaria interventions, was recommended for adoption by WHO.[6] This principle is considered the most effective when applied locally by the affected as it supports decision-making and factor into consideration the available financial resources for malaria control. It ought to assist governments in achieving the best outcome despite limited resources. The proposed framework for analysis of the economic cost of malaria by different stakeholders (Healthcare providers, individuals, and community), productivity loss by farmers, civil servants, and students etc.,

are generally scarce as policymakers don't have them to design templates for planning.

Effectiveness of Control Tools

The golden age of malaria control witnessed a tremendous reduction in malaria cases and mortality, with some countries eliminating the disease. Considerable gain has been made worldwide in the control and elimination of the malaria parasite, and this was primarily a result of the deployment of combinations of control tools developed through research which includes; Long lasting Insecticide Bednets (LLINs), Indoor Residual Spray(IRS), Rapid Diagnostic Test (RDTs), Artemisinin Based Combination Therapy (ACT), Intermittent Preventive Treatment in Pregnancy and Infants (IPTpg), Seasonal Malaria Chemo-prevention (SMC) through Mass Drug Administration (MDA). The successful implementation of combinations of these tools in endemic countries was primarily made possible through Funding mechanisms provided by Global Fund, US Presidential Malaria Initiative, and Bill and Melinda Gates Foundation, all help to save 7.6 million deaths and 1.5 billion cases in the first twenty years of this century.[7]

The LLINs remain the cornerstone of vector control in most Sub-Saharan African countries, with an efficacy of 45% in preventing malaria cases caused by *P. falciparum* by killing the mosquito. The challenges of developing resistance to embedded chemicals by the mosquito, mostly pyrethroids, the quality and integrity of the nets, and the perception of locals to adoption all contributed to the effectiveness of this tool.[8,9]

Medication, Limitations and Challenges

Artemisinin-based combination therapies (ACTs) are the most acceptable form of treatment for malaria.[10] They are highly potent, rapidly acting anti-malarial drugs and have been used to save many lives. The recent emergence of artemisinin resistance in the Greater Mekong sub-region and growing evidence of declined effectiveness of the ACTs in other parts of the world is a threat to the gains in the fight against malaria.[11–13] Artemisinin resistance and its resultant treatment failure lead to increased risk of morbidity and increased healthcare cost. Triple ACTs in which artemisinin is combined with two partner drugs with are the current approach to prolong the utility of the existing antimalarial drugs.[14]

Malaria Vaccine

The success of the rapid development and deployment of Covid-19 convinced the world community of the role of vaccines in controlling communicable diseases, including malaria. RTS, S/AS01 (RTS, S), a first-generation malaria vaccine based on a recombinant protein that targets the circumsporozoite protein of *Plasmodium falciparum,* has been shown to reduce cases of severe malaria by 40% in moderate-to-high malaria transmission areas.[7] Following large-scale studies in three African countries, namely Ghana, Malawi and Kenya, the WHO in October 2021 considers the vaccine safe, effective and feasible for delivery through routine National Immunization Programme.[7]

WHO has recently approved a second malaria vaccine R21/Matrix-M (R21), for children, and it appears to be more effective based on initial clinical trials.[15] Aside from Burkina Faso, where the vaccine was initially tested**,** Nigeria has also adopted this vaccine which is indicated for preventing malaria in children from 5 months to 36 months of age. As the current vaccines are only limited to children under-five, effective only against *P. falciparum* and require a booster dose after 18 months[15], much effort in research on the improvement of existing vaccines is expected to develop a candidate vaccine that will lead to the eradication of malaria along with high efficacy in preventing infection and with a long duration of protection for both children and adults.

Role of Emerging Technology

Several Technological innovations developed over the years have positively impacted malaria control worldwide. Web-based applications primarily relied on smart Apps, SMS and USSD Codes.[16] Web-based applications like the Malaria Atlas Project (MAP) store information on malaria via multiple reporting sources, giving an understanding of the mosquito distribution system and allowing surveillance-based intervention.[17] Drone-based technology has and can play a significant role in the massive spraying of biological insecticides in swamps targeting mosquito larvae and breeding sites to reduce mosquito populations.[16] Drones have been adopted in some communities to deliver antimalarial medication and vaccines.[16] A new nanotechnological innovation Nanomal DNA analyser, a hand-held device that can be used to confirm malaria diagnosis and detect drug resistance in malaria parasites within minutes and at the patient's bedside as well as medical Events Monitoring Device (MEMS) are, both played an essential role in medical adherence as well as detection of resistance.[16]

The drawback of the emerging technology is the individuality of the Apps and lack of integration into a national malaria control and information system that can utilise regional and global structures which will allow cross-border sharing of information on malaria hot spots for easy deployment of practical control tools like medication administration, insecticide bed net and mass spraying with insecticide. Malaria screening Apps like the Malaria Consultant and Artificial Intelligence (AI) automated slide processing for malaria diagnosis will require expertise that African countries, through collaboration with WHO, will have to train to benefit maximally.

What it takes to move to Eradication in Sub-Sahara Africa

The possibility of eradicating malaria is not in doubt, factoring the best evidence data of intervention or combination of control tools and treatment that has the best impact in a particular country or region.

The malaria-related target of the 2000 Millennium Development Goals, which called for stopping and starting to reverse the global incidence of malaria by 2015, has been achieved to a greater

extent globally, with a decline in the malaria mortality rate by 60% since 2000.[18] However, the masked differences in the progress made in malaria control between and within countries and the confinement of 90% cases of cases and mortality in African countries led to the inclusion of malaria in the 2015 Specific Development Goal (SDGs).[1] Concerning the total budget for the control and elimination of malaria globally, there has been a steady increase from 2018 to 2020, with a total amount of US$2·7 billion, US$3·0 billion, and US$3·3 billion spent in 2018, 2019, and 2020 respectively.[1] This amount though staggering, is still less than the yearly projection of US$6·8 billion by the Global Technical Strategy to eliminate malaria.[1,18]

The limited availability of financial estimates and comprehensive figures from both societal and healthcare perspectives of highly burdened countries of sub-Saharan African countries is a significant impediment to the proper allocation of resources and selection of prevention and control strategies.[4] This paucity of comprehensive and comparable estimates of malaria costs across endemic countries invariably puts a barrier to evaluating the cost-effectiveness of interventions; more research will therefore be needed to develop strategies for sub-Saharan African countries specifically tailored to each country's need to move to the pre-elimination stage.

Sustaining the Gain of Malaria Control

The doubling of the population of sub-Saharan African countries in the last 20 years contributed to the apparent increases in cases recorded in 2019 (215 million) than in 2000 (204 million).[1] Hence, more financial resources need to be committed by individual affected countries. Strengthening the health system by ensuring strong Primary healthcare and Universal health coverage as a robust and well-equipped health system with laboratory support is essential to tackle malaria. Investing in a Quality Health information management system will lead to the collection of quality-rich data that can be used for surveillance.

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