

## Uncertainty in Malaria Control in Tanzania: Crossroads and Challenges for Future Interventions

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**Abstract.** In Tanzania malaria is the leading cause of morbidity and mortality, especially in children under 5 years. The disease ranks number one in both outpatient and inpatient statistics. The socio-economic impact of malaria is so high that it contributes highly to poverty and underdevelopment. Efforts made during the past century to combat and control malaria have not been successful. The prospects of achieving the Abuja declaration targets are uncertain within the remaining period of time. Currently, the Ministry of Health through a 5-year strategic plan advocates four main approaches in the fight against the disease. These include improved case management, vector control using insecticide treated mosquito nets, prevention and control of malaria in pregnancy and epidemic preparedness, prevention and control. However, these strategies face various challenges including inadequate human, financial, and material resources; inefficiency in the healthcare system that is incapable of providing quality health services and access to prompt diagnosis and treatment; lack of an effective disease surveillance system; and an inefficient health education communication mechanism. Tanzania is at the crossroads and is challenged with the need to introduce a new antimalarial treatment regimen and the reintroduction of DDT for indoor residual spray. Unless malaria control strategy adopts an integrated approach its success is far from being realized. This article reviews the current malaria control strategies and its challenges in Tanzania and proposes new strategies.

### INTRODUCTION

Malaria remains a major public health problem in sub-Saharan Africa, with approximately 1 million deaths and more than 400 million cases a year. In Tanzania, over 95% of the 37.4 million people are at risk for malaria infection. The disease is responsible for more than one-third of deaths among children under the age of 5 years and for up to one-fifth of deaths among pregnant women. Malaria contributes to 39.4% and 48% of all outpatients less than 5 years of age and aged 5 years and above, respectively.<sup>1</sup> In terms of hospital admissions, malaria accounts for 33.4% of children under the age of 5 years and 42.1% in children aged 5 years and above. Malaria is implicated in decreased learning capacity in children, students, and trainees in the 5–25 age range and in loss of economic productivity in the workforce age range 15–55 years.<sup>2</sup> In general, \$2.14 is spent on malaria control per person per year, representing 39% of the country's health expenditure and 1.1% of its GDP.<sup>3</sup> Malaria accounts for over 30% of the national disease burden, making it a top health priority for allocation of resources for its prevention and control. It features strongly in the National Package of Essential Health Interventions, and ranks high in the National Health Research Priorities.<sup>4</sup>

There are both direct and indirect costs related to malaria. Directly, malaria causes illness, death, and disability. Indirectly, it causes loss in terms of time spent with sickness and treatment costs in terms of family time spent to care for the sick, loss of productive time, time spent by families and communities to grieve for the dead, and funeral costs. As the foremost cause of illness in many rural areas of sub-Saharan Africa, malaria undermines agricultural productivity and incomes, especially because the peak period of transmission often coincides with the peak period of agricultural activity and labor operations.<sup>5</sup> The combined effects of malaria-

caused mortality, morbidity, and debility on household labor force and on community members as a whole manifest in reduced quantity and quality of labor inputs, reduced economic output, and resource under-utilization.<sup>6</sup> The economic impact of malaria is so high that, in developing countries, it is considered the major cause of poverty. The objective of this article is to review the current malaria control strategies, challenges, and prospects for future interventions in Tanzania.

### STRATEGIES FOR MALARIA CONTROL IN TANZANIA

Control of malaria in Tanzania appears difficult, and prospects for a lasting solution have in the past decade diminished with the advent of widespread antimalarial drug resistance.<sup>7</sup> The Tanzania National Malaria Medium Term Strategic Plan (2002–2007) aims to reduce malaria to a level where it is neither a major public health problem nor an obstacle to socio-economic development. The objective is to prevent mortality and reduce morbidity due to malaria by 25% by 2007 and by 50% by 2010.<sup>8</sup> There are currently four operational and two supportive strategies for malaria control. These include malaria case management; malaria vector control using insecticide treated mosquito nets (ITN); malaria intermittent treatment in pregnant mothers; malaria epidemics prevention and control; information, education and communication; and operational research. However, with only a few months until the end of 2007 and 3 years to 2010, malaria cases and deaths have been increasing in the country. For instance, deaths attributable to malaria increased from 34.3% in 2003 to 37.3% in 2004 (Table 1),<sup>1</sup> are mainly attributed to use of less effective antimalarial drugs, delayed health seeking, and reliance on clinical judgment without laboratory confirmation in most peripheral health facilities.

Support for malaria control at both the national and district levels has increased considerably over the past few years. However, a substantial impact on the disease burden has not yet been observed. Serious obstacles in the control of malaria remain, which include poor access to health care and poor

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TABLE 1  
Proportion of outpatient attendance, admission, and deaths due to malaria, 2003–2004\*

	Year	< 5 year			> 5 year			All age groups		
		Total	Malaria	%	Total	Malaria	%	Total	Malaria	%
OPD	2003	11,698,800	5,046,387	43.1	15,572,407	6,119,241	39.3	27,271,207	11,165,628	40.9
	2004	12,604,668	5,405,208	42.9	15,399,899	5,813,137	37.7	28,004,567	11,218,345	40.1
IPD	2003	706,665	310,093	43.9	683,608	217,929	31.9	1,390,273	528,022	38.0
	2004	1,180,081	421,079	35.7	945,307	358,073	37.9	2,125,388	779,152	36.7
Death	2003	20,355	7,865	38.6	21,578	6,499	30.1	41,933	14,933	34.3
	2004	26,721	10,718	40.1	21,240	7,162	33.7	47,961	17,880	37.3

\* Adapted from ref. 1.  
OPD = outpatient; IPD = inpatient.

performance of health service delivery, poor availability of proper diagnosis and treatment, increased drug resistance, high costs, under-utilization of health facilities, high use of non-formal private sector (including traditional medical practitioners) for cases of cerebral malaria as well as lack of an effective malaria surveillance system.

**Malaria case management.** Several achievements regarding malaria case management have been realized since the introduction of sulfadoxine–pyrimethamine (SP) in 2001. These include ensuring the availability of recommended antimalarial drugs at all times at healthcare facilities; effective monitoring of antimalarial drug resistance; and development and implementation of epidemic preparedness plans in malaria epidemic-prone districts.<sup>9</sup> However, according to the National Malaria Control Program, the current statistics indicate that appropriate management of uncomplicated malaria in children aged less than 5 years in Tanzania is at 34%. The target is to have 80% of the uncomplicated and severe malaria cases in “underfives” appropriately treated at health facilities by 2007. It is unlikely that this target can be met by the end of 2007.

On the other hand, unpublished data from the Ministry of Health indicate that IPT during pregnancy is being provided at all health facilities. (The target is to have 60% of pregnant mothers use IPT by 2007.) By end of 2005, 65% and 47% of mothers had their first and second IPT, respectively. Unfortunately, over the years, SP resistance in the country has increased, thus threatening the usefulness of the IPT strategy.<sup>10</sup>

**Vector control.** The use of ITNs in Tanzania has increased markedly over the past few years. Statistics indicate that the proportion of households with at least one untreated net has increased from 14% in 2001 to 58% in 2005. On the other hand, the proportion of households with at least one ITN has increased from 14% in 2001 to 25% in 2005 (Table 2). However, the use of ITN in “underfives” has remained lower in

rural areas (14%) than in the peri-urban (25%) or urban areas (28%).

Tanzania has advanced considerably in the implementation of social marketing of insecticide treated nets. This strategy has been developed through various studies and is currently being implemented at a nation-wide scale.<sup>11</sup> To scale up ITN, the government is currently spearheading the so-called voucher scheme strategy, which harnesses the strength of the private sector to distribute highly subsidized ITNs throughout the country. The program has found a successful formula for distributing the ITNs to pregnant women and their infants while ensuring long-term and widespread commercial availability.<sup>12</sup> However, after over a year of its implementation, the program has not reached the whole country. Moreover, it is facing some obstacles, including the fact that the program covers pregnant women who must ask for money from their husbands.

In addition, several studies reveal that even when access to ITNs is expanded, many households do not use them. It has been shown in western Kenya that even when nets were given away for free, approximately 30% of them were unused.<sup>13</sup> Likewise, in southern Tanzania, a year after free net distribution, nets were found stored in their bags and had not been utilized by a number of households.

The Global Malaria Program at the WHO has recently reaffirmed the importance of indoor residual spraying (IRS) as one of the primary interventions for reducing or interrupting malaria transmission.<sup>14</sup> IRS is the application of long-lasting chemical insecticides on the walls and roofs of all houses and domestic animal shelters in a given area, to kill the adult mosquitoes that land and rest on these surfaces. Tanzania plans to introduce IRS using DDT in epidemic-prone districts, where little data on the mosquito diversity and behavior are available.

**Malaria epidemics prevention and control.** Twenty-five percent of the districts of Tanzania are malaria epidemic prone. To mitigate epidemics, early detection and epidemic preparedness mechanisms have been established in 19 and 13 of the districts, respectively. Such mechanisms are being supported by an integrated disease surveillance and response strategy, introduced in 1998.<sup>15</sup> The malaria epidemic early detection (MEED) system is based on plotting weekly and monthly malaria cases into a monitoring chart designed with a threshold representing alert and action lines derived from retrospective data for each health facility.<sup>8</sup> Through this system, districts are required to note and report any drastic increase in the number of malaria cases and deaths.

Although most (68.4%) of the malaria epidemic-prone dis-

TABLE 2

Ownership of ITN in household and their usage in vulnerable groups for 2001, 2003, and 2005\*

Indicator (%)	2001	2003	2005
Household with at least one untreated net	14%	50%	58%
Households with at least one ITN	14%	25%	—
Underfive children sleeping under untreated net	31%	21%	16%
Underfive children sleeping under ITN	9%	18%	22%
Pregnant mothers sleeping under untreated net	28%	21%	20%
Pregnant mothers sleeping under ITN	8%	21%	27%

\* Ministry of Health, unpublished data.

districts in Tanzania are under the epidemiologic surveillance for MEED system, Muleba district has continued to experience outbreaks. Unfortunately, little has been done to thoroughly study the causes of epidemics in the district. It is important that a monitoring and evaluation system is installed to provide necessary data that will be used to improve the MEED system.

#### CHALLENGES TO THE CURRENT MALARIA CONTROL STRATEGIES

The epidemiology of malaria in Tanzania is probably the most challenging factor in its control. The relationship between intensity of transmission and malaria-attributable morbidity and mortality is not fully understood. Most of the researchers on malaria have concentrated in the northeast, northern, and southeast of the country; hence little is known of the disease epidemiologic profile in the rest of the country. Efforts are needed to determine district-specific malaria epidemiologic profiles to be used for planning of specific appropriate interventions.

To achieve a suitable and significant gain in the reduction of morbidity and mortality by reduction of transmission it is probably necessary to reduce parasite exposure to low levels. With the present interventions this has not been achieved in the high-transmission zones. Sustainability of control measures by households has been difficult. Mosquito nets worn out are not replaced and re-treatments are not done in time to provide a continuous protection against mosquito bites. It is important that research therefore focuses on the dynamics of malaria transmission, its prevention, and its public health impact at different epidemiologic profiles.

In Tanzania the national policy is to implement malaria control as part of the primary healthcare approach, and not as a separate vertical activity. However, over the years, malaria control has been delegated to a national control program. The traditionally vertically organized malaria control program has built up its expertise and networks by which interventions are implemented. The recent introduction of health sector reform in Tanzania has shifted responsibilities for the implementation of disease control activities from the national level to district levels. However, most districts in Tanzania fail to develop effective malaria control programs. Their capacity is often insufficient to perform proper situation analysis, selection, and implementation of effective interventions and monitoring and evaluation. Moreover, recent studies have shown that the primary healthcare approach does not work for malaria control and an integrated approach is required to accommodate all appropriate strategies.<sup>16</sup>

The current strategy for malaria control in Tanzania is to prevent death, reduce illness, and decrease socio-economic loss due to the disease. This requires effective drugs for early management of the disease, management of severe and complicated cases, and IPT.

**Malaria case management.** To provide adequate early diagnosis and treatment (EDT) at the primary healthcare level is one of the aims of the Roll Back Malaria strategy. EDT provides secondary prevention and halts progress of the disease process to incurable stages. An important threat to this strategy is poor diagnosis. Presumptive treatment as a strategy for malaria management is common in most rural health

facilities in Tanzania where laboratory facilities are inadequate. Its potential benefits are questionable in areas with low malaria transmission. Various studies in Tanzania have not been able to show whether the level of endemicity affects the sensitivity and specificity of clinical malaria case definition or not.<sup>17,18</sup>

Most malaria diagnoses in Tanzania are based on clinical grounds. Only a few facilities are equipped with basic laboratory services to provide confirmatory diagnoses. Recently, in addition to the problem of the lack of laboratory services, where these services are available, malaria is commonly over-diagnosed. For example, the fraction of malaria-attributable fevers in health facilities in Dar es Salaam is low suggesting that patients presenting with fever are much more prone to suffer from diseases other than malaria.<sup>19</sup> It has been reported that 87% of patients who received antimalarial treatment at the Muhimbili National Hospital in Tanzania for presumed severe malaria did not have detectable parasitaemia resulting in over-treatment of malaria and neglecting other potentially threatening conditions.<sup>20</sup> Recently, in northeastern Tanzania it has been observed that 53.9% of patients treated for malaria were smear-negative for *Plasmodium falciparum*.<sup>21</sup> This has important implications for the management of febrile illnesses, and over-diagnosing malaria patients may also distract from other causes of fever, some of which may be fatal.<sup>19</sup> This may lead to a substantial number of unnecessary treatments, a problem that is likely to be much more serious with the introduction of the more expensive artemisinin-based combination therapy.<sup>22</sup>

Chloroquine-resistant falciparum malaria is widespread in Tanzania.<sup>23</sup> This has necessitated change in the National Policy in the first-line treatment of malaria in the country in August 2001. Until recently, sulfadoxine-pyrimethamine (SP) was the first-line antimalarial drug. Resistance to SP has been observed in a number of places in Tanzania.<sup>24,25</sup> This prompted another change in policy in the first antimalarial drug in November 2006. Another major barrier to the successful malaria case management is the poor adherence to drug regimens. Under-dosing is quite a common practice in many households because of poverty and the fact that clinical cure of fever is what matters to many individuals.

**Vector control.** Malaria vector control activities in Tanzania focus mainly on the use of ITNs. The implementation of effective vector control strategies requires requisite information on the vector population structure and their distribution and efficiency in malaria transmission. Studies in Tanzania have shown that the intensity and duration of transmission as well as the vector species, vary greatly between different ecological zones, from perennial transmission in the coastal areas to seasonal and unstable transmission in the central plateau and highland areas.<sup>26</sup> By and large, whether ITNs have long-term sustainable beneficial effects and whether the effect is the same for different ranges of transmission is not yet certain. In fact the beneficial effects of ITNs would only be sustained if insecticide resistance does not occur and the malaria vector species remain highly exophilic. Research on mosquito behavior where ITNs have been extensively used is necessary to avoid widespread disasters similar to those that followed the malaria eradication campaigns of the 1950s–1960s.<sup>27</sup>

Insecticide resistance is becoming a problem among vector populations, therefore posing a threat to malaria control activities. While it is known that certain populations of *An.*

*funestus* in Southern African countries<sup>28</sup> and *An. gambiae* in Kenya<sup>29</sup> are resistant, there is little information on this situation in Tanzania. The recent spread of pyrethroid resistance in *An. gambiae* and *An. funestus* threatens to reduce the potency of ITNs and to undermine the present gains.<sup>30,31</sup> Continuous monitoring of mosquito susceptibility to insecticides is required for early detection of resistant strains of malaria vectors, especially now with the introduction of long-lasting nets (LLNs).

Despite intense promotional efforts in the use of ITNs, low net retreatment rate has been a common problem.<sup>32</sup> The most promising solution to the low re-treatment rates of nets is the introduction of LLNs. Studies in Tanzania have shown that insecticide incorporated within polyethylene fiber remained effective after four years of regular use.<sup>33</sup>

In Tanzania, the current move is to re-introduce and scale-up IRS. However, it must be noted that previous attempts to eradicate malaria using this technique were abandoned due to various technological and socio-economic reasons. Large-scale IRS attempts in Tanzania included those of the Pare-Taveta Malaria Scheme of 1955–1960<sup>27</sup> and the Urban Malaria Control Program of 1986–1996.<sup>34,35</sup> Previous use of IRS in Dar es Salaam showed poor acceptance from the communities because it had little impact in the control of *Culex quinquefasciatus*, the main cause of mosquito biting nuisance in urban areas.<sup>36</sup>

Larval control has the potential to reduce malaria transmission both in rural and urban settings.<sup>37,38</sup> It is now being reconsidered as a complementary intervention to current priorities such as ITNs and access to early diagnosis and prompt treatment.<sup>39,40</sup> Control of immature aquatic stages of *Anopheles* mosquitoes may have particular promise in urban settings where large numbers of people can be protected in a relatively small area and rural settings with focal, seasonal breeding sites.<sup>41,42</sup> However, mosquito larval control is given little value in Tanzania. Such efforts have only been revived recently. Pilot projects on the use of *Bacillus thuringiensis* and *B. sphaericus* in the control of malaria in the city of Dar es Salaam, Mvomero and Bagamoyo districts, have been initiated recently. Larval control is generally a quite labor intensive undertaking. This particularly applies to the *An. gambiae* s.l., which colonizes a large variety of habitats distributed widely over space and time.<sup>43–45</sup> In contrast, *An. funestus* often requires substantial environmental manipulation or modification because this species is known to prefer large water bodies partly shaded by vegetation that are often inaccessible by foot.

**Malaria surveillance system.** Accurate epidemiologic data are essential for adequate malaria control. Effective malaria control requires prompt and adequate action towards the reduction of predisposing factors toward malaria acquisition and transmission. Such actions can only be made if correct information reaches those required to take action timely. This has been difficult to achieve in Tanzania because of a poor surveillance system. The health management information system (HMIS) in the country is still underdeveloped.<sup>46,47</sup> This hampers communication between the respective levels of health service delivery and planning, monitoring of results, and evaluation at district and national levels. Without good HMIS using the right indicators, the national malaria control program faces difficulties to monitor and evaluate the activities at all levels.

**Socio-economic and human behaviors.** Malaria is mostly a disease of rural communities in Tanzania, where agriculture is the backbone of the household economy. Nonetheless, little is known on the impact of agriculture on malaria.<sup>48</sup> In Africa, where malaria reaches a peak at harvest time, a single bout of the disease costs an estimated equivalent of 10 lost working days. As a result, affected families manage to work only 40% of land available for crops, compared with healthy families who are able to work up to 75% of the available land.<sup>49</sup> The knowledge of the specific interactions between agricultural production systems and malaria remains relatively weak. A better understanding of the interrelationship between agricultural practices and the malaria burden needs to be researched. Such studies are currently being carried out in central Tanzania,<sup>50</sup> where certain agricultural practices have been shown to contribute highly to the malaria burden.

The community's socio-economic situation, cultural beliefs, and understanding of the disease influence the search for treatment in the face of disease.<sup>49</sup> Determinants of the demand for malaria treatment are diverse and they include malaria endemicity; family members' susceptibilities to malaria; household size; the perceived quality of care; current health status; accessibility to health services as well as the ability to pay for the services.<sup>51</sup>

It is clear, for example, that there are still important gaps in people's understanding of and knowledge about malaria, with many people in rural communities still unaware of the causal link between mosquitoes and malaria.<sup>52</sup> Moreover, studies of treatment seeking behavior for malaria show a clear preference for biomedicine in uncomplicated malaria. However, in cases involving convulsions, people tend to prefer traditional medicine.<sup>53</sup> In addition, home medication with herbs or drugs purchased from shops is widespread in Tanzania,<sup>54</sup> resulting in mismanagement of cases and delay in seeking care from health facilities. Socio-economic impact studies are needed to better quantify the impact of malaria on economic productivity, human nutrition, food security, and poverty.

**Health education and communication.** Health education communication is one of the key components in malaria control and prevention. Serious obstacles in most disease control strategies include lack of effective health information, education, and communication programs. Community and health providers need to understand the problem in all its relevant aspects, as well as be aware of the options available for improvement.<sup>55</sup> This means it is important for health providers and communities to appreciate the epidemiologic and technical dimensions of the malaria problem as well as the factors that affect whether particular control options will be feasible, technically possible, socially acceptable, environmentally friendly, and politically advantageous. For individuals and households, effective health communication can help raise awareness of health risks and solutions to provide the motivation and skill needed to reduce these risks, help them find support from other people in similar situations, and affect or reinforce attitudes.

In Tanzania, available information indicates that health education and information communication provided to the community has had limited impact on behavioral changes and hence disease prevention and control. In part, this is due to the ineffective communication strategies used in health education communication programs between systems and between systems and providers. Although various studies in the

country<sup>55–57</sup> have indicated that healthcare facilities are the most reliable source of health education, such facilities are often not accessed by many people particularly in rural areas because of healthcare charges, long distances, inadequate and unaffordable transport systems, poor quality of care, equity, poor governance, and inadequate human resource.<sup>55</sup>

### CONCLUSION

Malaria remains the most important public health problem in Tanzania. The disease is preventable but multiple factors including environmental, political, and socio-economic determinants hamper its effective prevention and control. In addition, malaria continues to cause a lot of suffering through illness, disability, and death because of the inadequate health education communication and weak malaria surveillance system.

Better intervention technologies for malaria control are clearly desirable. However, it is also clear that their cost-effective delivery remains the dominant obstacle to effective application and adoption. Recent experiences with social marketing of ITNs,<sup>58</sup> public-private partnerships,<sup>59</sup> decentralization,<sup>60</sup> and community participation<sup>45,50</sup> have all provided renewed cause for optimism and shown that even the most isolated communities can be protected from malaria through sustainable delivery mechanisms. However, the deployment of these interventions requires an effective health system that improves the appropriate delivery or that minimizes malaria transmission by improving intersectoral management of the ecosystem. Great progress has been made with horizontal community-based health programs for delivering technologies such as drugs, diagnostics, and bednets. Systems interventions for public health or ecosystems management should be introduced with the active involvement of the community and various relevant sectors.<sup>50</sup>

Reduction of human exposure to infective mosquitoes is a critical element of the malaria control program in Tanzania. However, most interventions rely on techniques that kill adult mosquitoes. Methods that target suppressing productivity or killing mosquito larvae are not given due importance because they are more labor-intensive and include source reduction. Such techniques can be sustainably used where communities are involved in malaria control.

Over the years, malaria control strategies in Tanzania have been based on chemotherapy and vector control through the use of ITN. It should be realized that each of these methods is cost effective in some settings but may be ineffective, or too costly, in others. It is important that several strategies are integrated and promoted equally if we are to achieve a sustainable malaria control in the country. The Ministry of Health should strive to strengthen strategies of addressing the whole array of the health system including provision of adequate resources, reliable data on malaria burden, and adequate tools for an integrated malaria control. Strengthening of surveillance should be one of the current priorities in Tanzania. The use of rapid diagnostic tests could be introduced for rapid epidemiologic mapping and for routine screening of suspected cases of malaria especially now that the country has introduced artemisinin-based combination therapy as the first-line antimalarial drug. More research is needed and should include mosquito ecological behavioral studies, systematic monitoring of drug and insecticide resistance, diag-

nostic techniques, and socio-cultural behavior that hinder malaria prevention and control at household and community levels.

In conclusion, as Tanzania struggles to strengthen the national, district, and household programs for prevention and control of malaria, it is faced with even more challenging problems as pertaining to ecological, systemic, technical, political, and human behavior aspects. Recognizing and addressing the identified constraints in malaria control, the country must embark seriously on research in areas targeted for the reduction of the malaria burden. These research priorities must take into account the fact that malaria control and prevention strategies are changing fast to accommodate the current changing world. Only through an integrated approach to malaria control will the goal to roll back malaria be achieved in Tanzania.

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