Surmounting the Seven Major Obstacles against Eradication of Malaria in Nigeria: A Review

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Abstract

A review of the scourge of malaria in Nigeria was undertaken. Malaria would continue to attract the attention of many for a very long time to come. Malaria is caused by the presence of Plasmodium species (P. falciparum, P. malariae, P. vivax, P. ovale or P. knowlesi) in the blood of an individual through the bite of an infected female anopheles mosquito. Though, malaria is a curable disease and timely diagnosis and treatment are a basic human right of all populations in endemic or mesoendemic areas, whatever their social or economic circumstances; its eradication has posed so much problems which has failed to abate. Seven major obstacles against the eradication of malaria have been identified and therefore needs to be surmounted. This review article therefore is aimed at proffering practicable solutions towards dealing with this age-long problem. These seven major obstacles are; the environment, human behaviour (patients' attitude), clinical diagnostic inadequacies (medical doctors' attitude), medical laboratory diagnostic inadequacies, therapeutics inadequacies, drug resistance and government policies.

In conclusion, you would agree with me that all health professional groups having something to do with malaria patients' have contributed in one way or the other to the obstacles against eradication of malaria in Nigeria. Malaria patients and their relatives are equally major culprits in this matter. I am very positive that if all hands (all stakeholders) are on deck, and government having the political will to enforce the practicable solutions, a great relief would be actualized by practically reducing the burden of malaria to the barest minimum.

Keywords: Surmounting, major obstacles, eradication, malaria, Plasmodium, Nigeria.

INTRODUCTION

The scourge of malaria would continue to attract the attention of many individuals, families, communities, agencies, NGOs, and governments at all levels – Local Government Area (LGA), State and Federal for a very long time to come. Malaria being a household name in this part of the globe has caused so much misery and pain in the life of many; hence its eradication or at least reduction of its occurrence is a task that must be seen to be done. Malaria is caused by the presence of Plasmodium species (P. falciparum, P. malariae, P. vivax, P. ovale or P. knowlesi) in the blood of an individual through the bite of an infected female anopheles mosquito; which itself get the gametocyte (stage of the parasite) from an infected human blood meal. Note that the Plasmodium parasites undergo a sexual phase of development in the female anopheles mosquito (Anopheles gambiae and A. funestus in West African sub region) and an asexual phase of development in red blood cells of the human host.

Malaria is a curable disease and timely diagnosis and treatment are a basic human right of all populations in endemic or mesoendemic areas, whatever their social or economic circumstances.

Over the years, several individuals, researchers, agencies, NGOs, various governments, development partners etc, have tried to eradicate malaria in Nigeria through funding of activities/programmes, researches, policy statements and advocacy amongst others. However, the problem fails to abate. Seven major obstacles against the eradication of malaria have been identified and therefore needs to be surmounted.

This review article therefore is aimed at proffering practicable solutions towards dealing with this age-long problem. These seven major obstacles are;

1. The environment
2. Human behaviour (Patients’ attitude)
3. Clinical diagnostic inadequacies (Medical doctors’ attitude)
4. Medical Laboratory diagnostic inadequacies
5. Therapeutics inadequacies
6. Drug resistance
7. Government policies

THE ENVIRONMENT

The physical environment has a direct effect on both the parasite and the vector. Thus, altitude, temperature, rainfall, the rate of flow of rivers and streams, the presence of collections of water and the availability of animals all influence human malaria transmission.

Many factors affect the susceptibility of anophelines (of which around 60 species can transmit malaria) to specific *Plasmodium* species. Air temperature, relative humidity and types of breeding places can affect gonotrophic maturation, the longevity of the adult mosquito and the development of the aquatic stages. The density of the vectors in relation to humans, their parous rates, the frequency of mosquitoes feeding on humans or animals (anthropophilic or zoophilic), the duration of sporogony, the sporozoite rates, the peak biting time, the preference for biting indoors or outdoors (endophagy, exophagy) and the choice of resting place (endophily, exophily), are important determinants which affects the transmission dynamics and which are usually measured to quantify the malaria risk (Bockarie *et al.*, 1994; Service and Townson, 2002).

The effect of global warming could represent a risk of epidemics in the highland areas of tropical Africa, by pushing malaria transmission uphill into these populated areas (Bradley, 1995).

The following can all have a significant impact on malaria endemicity: increases in agricultural colonization; the construction of large economic projects such as dams, irrigation schemes and highways, mining; as well as deforestation. The cultivation of rice and cotton cultivation is often associated with increased malaria risk (Coluzzi *et al.*, 1979).

Environmental factors may interact with social, political and economic pressures, e.g. illegal logging, and the existence of ethnic and marginalized communities. From all available indicators, our environment provides natural and favourable climatic conditions for the propagation of mosquitoes. So, do we fold our arms and allow the proliferation of these mosquitoes in our environment? Of course NO.

For us to surmount these environmental challenges, we have to enhance the following strategies;

(i) Seasonal aerial spraying should be carried out to prevent swarm formation referred to as ‘dance of the gnats’ – periods when mating of mosquitoes occur shortly after emergence to the adult stage.
(ii) Both constructed dams’ site and rice fields should be regularly sprayed to kill the aquatic developing stages of mosquitoes.
(iii) There should be the re-introduction and enforcement of National Environmental Sanitation Days aimed at the conscious clearing/cleaning of our surrounding environments – this will destroy any developmental stages of mosquitoes if present, thereby leading to the reduction of mosquitoes breeding sites.
(iv) A large number of Environmental Sanitation Officers should be engaged by all tiers of government to see to the general cleanliness of our environment and enforcement of environmental laws. The common saying that ‘prevention is better than cure’ is still true and a better option in dealing with malaria.
(v) Better and more committed approaches should be adopted in the distribution of treated mosquito bed nets especially to the rural dwellers.

HUMAN BEHAVIOUR (PATIENTS’ ATTITUDE)

Man’s attitude towards self-help by way of self-medication is a major concern. This, they do by just walking into the pharmacy store or chemist and request for antimalarial drugs because of the feverish feelings they have. Although, malaria is a common cause of fever in endemic or mesoendemic areas, it is not the only cause. Determining which fevers can be attributed to malaria is greatly simplified when a parasitological diagnosis can be made.

In 2002, Warrell *et al.*, stated that self-medication is increasingly common, almost universal, yet knowledge among those who provide or sell antimalarial drugs is abysmally low, resulting in inappropriate or incomplete treatment. The report also indicated that evidence from several countries shows that self-medication accounts for as much as half of all consumption of antimalarial drugs in rural areas.

In a lecture delivered at the Nigerian Institute of Medical Research, Yaba, Lagos, Agbonlahor (2002), stated that it has
become customary in our society that any feverish condition is first treated for malaria. If this fails, then treatment for typhoid automatically follows and if the patient at this stage fails to respond, it is only then that laboratory investigations are remembered!

In 1995, WHO reported that the problem of drug resistance could be attributed primarily to increased selection pressures on *Plasmodium falciparum* in particular, due to indiscriminate and incomplete drug use for self-treatment.

This situation therefore calls for attitudinal change by all patients aimed at self-restrain towards self-treatment but should rather seek early medical intervention in health facilities for prompt laboratory diagnosis and subsequent treatment.

**CLINICAL DIAGNOSTIC INADEQUACIES (MEDICAL DOCTORS’ ATTITUDE)**

No doubt, medical doctors have a great role to play in the treatment and management of patients suffering from malaria amongst other infections. However, some attitudes being practised by these honourable health providers have resulted to one of the seven major obstacles against eradication of malaria in Nigeria and elsewhere.

The most important factor in the clinical diagnosis of malaria is a high index of suspicion (Doherty *et al*, 1995). It is also true that malaria diagnosis based on clinical symptoms alone is not reliable (Chessbrough, 1998). Malaria can mimic many diseases and there are no absolute diagnostic clinical features. The golden rule is always to exclude malaria, irrespective of the clinical presentation, if a history of exposure is elicited. The commonest misdiagnoses in non-immune individuals are influenza, viral hepatitis, viral encephalitis, meningitis, psychosis and viral haemorrhagic fever (Hommel and Gilles, 1998).

The attitude of some medical doctors in the prescription of antimalarials to suspected malaria patients based on presumption ‘presumptive treatment’ is a major obstacle against the eradication of malaria. In 1991, Oliver *et al*; reported that the use of presumptive treatment for malaria has the potential for facilitating resistance by greatly increasing the number of people who are treated unnecessarily but will still be exerting selective pressure on the circulating parasite population. In some areas and at some other times of the year, the number of patients been treated unnecessarily for malaria can be very large.

The way out of this obstacle is of three-fold;
(a) There should be attitudinal change by medical doctors towards treatment and management of malaria patients. While their diagnosis is based on suspicion; they need a precise result from the laboratory which is evidence based.
(b) Presumptive treatment of malaria should be highly discouraged.
(c) Prescription of antimalarial drugs should be as much as possible based on authentic/reliable laboratory results.

**MEDICAL LABORATORY DIAGNOSTIC INADEQUACIES**

Of a truth, proper medical laboratory diagnosis of malaria and indeed all diagnosable diseases is sequel to appropriate and effective treatment of such diseases. For malaria patients to be better managed, adequate laboratory diagnosis is a necessity. However, there are inadequacies observed in diagnostic procedures of malaria in Nigeria; which vis-à-vis has posed one of the major obstacles against eradication of malaria in Nigeria.

(a) Though, we had been tutored that thick blood films stained by Giemsa methodology gives best results if the blood films have dried overnight (WHO, 1991); yet, unnecessary delay in the release of malaria results has posed as an obstacle.

The way out of this inadequacy is to ensure that, the turn-around time for malaria parasitological diagnosis should be drastically reduced so that such patients get their results same day (within two (2) hours) and those with positive results see their doctors’ again for appropriate treatment prescription before going back home. If this is actualized, we would have taken care of the situation whereby some clinicians/doctors prescribe antimalarials for most (all) patients seen at clinic including those sent to the Parasitology laboratory for malaria parasite test. The usual instruction has been, make sure that your blood sample is collected for the test before commencing the administration of the antimalarial drugs; see me in the clinic with your result during your next appointment.

(b) Lack of sufficient expertise by some Medical Laboratory Scientists or microscopists in the preparation and staining of blood films as well as in the recognition and identification of the characteristic stages of malaria parasites usually found in human blood, yet saddled with the responsibility of diagnosing malaria parasitological. Results emanating from such professionals would be unreliable and so misleading to the medical doctor who is expected to make use of such results for treating the patients.

The way out of this is through capacity building by continuous training and re-training on diagnosis of malaria parasites and other haemoparasites.
(c) The employment and utilization of professionally unqualified persons (quack) by some agencies (government or private clinics or hospitals) in the diagnosis of malaria is a major obstacle. Malaria results being generated by such unqualified persons cannot be seen to be reliable because they lack the required training/expertise. In Nigeria, those trained and saddled with the responsibility of diagnosing malaria parasitologically are the licenced Medical Laboratory Scientists and the Medical Laboratory Technicians certified by the Medical Laboratory Science Council of Nigeria (MLSCN). So, establishments or organizations that engage persons that are professionally unqualified and so incompetent should do the right thing by way of engaging the right professionals.

(d) The use of malaria rapid diagnostic tests (MRDTs) methodologies in Nigeria is certainly a diagnostic inadequacy. While the microscopy of a thick blood film has a remarkable sensitivity capable of detecting parasitaemia as low as 0.0001% (5 parasites/µl of blood or one parasite/100 thick film fields – 1⁺), the best antigen detection assays described have a maximum sensitivity of 0.01 – 0.001% (5000, 500 parasites/µl of blood – 3⁺) parasitaemia and are 5-10 times inferior to good quality microscopy (Mackey et al, 1982; Fortier et al, 1987; Taylor and Voller, 1993). The detection of parasite lactase dehydrogenase (pLDH) assays are not species specific, can detect a parasitaemia as low as 0.1% (>5000 parasites/µl of blood – 4⁺) a level of parasitaemia just below the threshold of 10 000 parasites/µl of blood (Piper et al, 1996).

In 2005, VanderJact et al, reported a parasite detection limit of 400 parasites/µl of blood for OptiMAL assay as against the 40 parasites/µl of blood being the parasite detection limit of slide microscopy. This confirms the ten times inferior of such assays to good quality microscopy as reported by some researchers already stated above. Their report (VanderJact et al, 2005) also stated specifically that of 20 thick film microscopy positives, only four (20%) were positive with OptiMAL assay.

In their study at Benin, Tatfeng and Bawo (2008) reported that the detection rate of thick blood film technique was significantly higher than that of the ICT test kit. The report also stated that there was no significant difference in the detection rate of the thick film microscopy and ICT test techniques with parasitaemia 1000 parasites/µl of whole blood (3⁺).

Adesanmi et al (2011) reported in their study at Enugu that one of the rapid immunochromatographic test methodology – ‘Paracheck pf’ had malaria parasites detection limit of 397 parasites/µl of blood.

Peletiri and Ibecheozor (2013) reported a parasite detection limit of 500 parasites/µl of whole blood from four Malaria Rapid Diagnostic Tests (MRDTs) – OptiMal by Diamed, Malaria pLDH cassette by Unlimited Diagnostics, CareStart™ Malaria HRP-2 by DiaSys, and Paracheck pf. These four kits were found to give negative results on all slide microscopy positive cases of < 500 parasites /µl of blood (2⁺).

In their study, Peletiri and Ibecheozor (2013) reported that of the 26 593 (32.9%) malaria positive cases encountered; 506 (1.9%) had parasite density of > 5000 parasites/µl of blood (4⁺); 970 (3.6%) had between 500 – 5000 parasites/µl of blood (3⁺); 3744 (14.1%) had between 50 – 500 parasites/µl of blood (2⁺); while 21 373 (80.4%) had between 5-50 parasites/µl of blood (1⁺). This means that of the 50 – 500 parasites density group (2+) in their study – 3744, only patients having between 397 – 500 parasites/µl of blood (20.8% - 779 patients) would give a positive test result all things being equal. The remaining 79.2% (2971 patients) would give a negative result. So, using the limit of 397 parasites/µl of blood, 90.4% would have been missed in their study (10% for those that had between 50 – 500 parasites/µl of blood 2+ and 80.4% for those that had between 5 – 50 parasites/µl of blood 1+). It therefore mean that, if rapid diagnostic test methodology was used in that study, only about 5.5 – 9.6% of positive cases would have been recorded as against the 32.9% encountered.

From the afore mentioned, and a parasite detection limit of 397 – 500 parasites/µl of whole blood reported by various independent researchers referenced under this section (4 d); if MRDTs methodologies are used for diagnosis, patients having between 5 – 396 parasites/µl of blood (1⁺, 2⁺) in them would give a negative malaria result.

The implication of the continued use of these malaria rapid diagnostic tests (MRDTs) methodologies includes underdiagnosis, misdiagnosis of malaria and mismanagement of non-malarial fever, which wastes limited resources, erodes confidence in the health care system, and contributes to drug resistance and eventual administration of unnecessary antimalarial drugs aimed at mopping-up all negative results where patients may still present with symptoms.

Therefore, the use of these rapid diagnostic test kits in Nigeria should be discontinued for individual diagnosis of malaria.

(e) Ill-equipped Parasitology Laboratory: Certainly, Parasitology laboratories that are ill-equipped pose as one of the diagnostic inadequacies. This aspect is attributable to government or various medical establishments’ management that are supposed to provide the required equipment and man-power.

Satisfactory diagnosis of malaria by light microscopy requires the availability of a functioning, well maintained microscope, an adequate source of illumination and an operator experienced and competent in the preparation and staining of blood films, as well as in the recognition and identification of the characteristic stages of malaria parasites.
As much as possible, a binocular microscope with a substage illumination should be used in preference to a monocular instrument. Substandard equipment, which is irregularly maintained, can seriously affect the effectiveness of microscopy. Operating fatigue is also a limiting factor and it has been suggested that the examination of 50 thick films daily is the absolute maximum for any microscopists, and that no more than 20 films should be examined without a brake of at least 30 minutes of non-microscope activity (Milne et al., 1994). In actual practise, about 30 blood films should be examined because both the thick and thin films are viewed for each patient. Standard practise requires that the thick film should be examined for at least 5 minutes (corresponding to approximately 100 microscopic fields under oil immersion).

THERAPEUTICS INADEQUACIES

Although chemotherapy is mandatory in the treatment of malaria (White 1988), other factors associated with therapeutics inadequacies pose one major obstacle against the eradication of malaria in our country. These therapeutics inadequacies include:

(a) Indiscriminate sale of antimalarial drugs;
(b) Manufacture/sale of substandard (fake) antimalarial drugs

Indiscriminate Sale of Antimalarial drugs

Agreed, the setting-up of Pharmacy stores or Chemist shops by individuals or groups has a business undertone. Though, it is true to it, yet, the uncontrolled sale of drugs especially the antimalarials amongst others commonly referred to as ‘indiscriminate sale of drugs’ to the general public without prescriptions from a medical doctor is posing as one of the obstacles to the eradication of malaria in our country.

In 1998, Chessbrough reported that most resistant strains of *P. falciparum* have developed due to inadequate drug doses mainly as a result of unregulated drug distribution and prescription, lack of adequate drugs, poor quality of drugs, and incorrect taking of antimalarials by patients. When insufficient drug is taken to kill all the parasites, the stronger parasites survive and multiply.

The way out of this inadequacy is simple, through attitudinal change by those dispensing such drugs and insists on presentation of doctor’s prescription before selling.

(a) Manufacture/sale of substandard (fake) antimalarial drugs

The manufacture and presence of substandard (fake) antimalarial drugs in the market through various distribution/dispensing outlets pose a very great problem too. Such drugs when taken by patients do not work because it lacks the required potency hence leads to complications such as drug resistance amongst others.

Drug quality has been implicated in ineffective treatment and possible drug resistance (Shakoor et al., 1997). The way out of this inadequacy is simple and straightforward. With the current activities of the National Food, Drug Administration and Control (NAFDAC) – using ‘True Scan’ methodology and other techniques, the issue of fake and substandard drugs would be a thing of the past. Therefore, as stake holders, we must all support the NAFDAC efforts.

DRUG RESISTANCE

Antimalarial drug resistance is defined as ‘the ability of a parasite strain to survive and/or multiply despite the administration and absorption of a drug which must gain access to the parasite or the infected red blood cell for the duration of the time necessary for its normal action, given in doses equal to or higher than those usually recommended but within tolerance of the subject’ (Bruce-Chwatt et al., 1986). This definition of resistance requires demonstration of malaria parasitaemia in a patient who has received an observed treatment dose of an antimalarial drug and simultaneous demonstration of adequate blood drug and metabolite concentrations using established laboratory methods (such as high performance liquid chromatography) or in vitro tests (Slutsker, 1990).

Drug resistance in malaria is a measure of the ability of the parasite to respond, through innate genetic diversity, to adverse conditions. Resistant genotypes with the ability to escape drug action survive chemotherapy at the expense of more sensitive organisms. All drugs represent a compromise between specificity and patient safety. The eventual emergence of parasite resistance is therefore the fate of all current treatments (Warrell et al., 2002).

The development of resistance to drugs poses one of the greatest threats to malaria control and has been linked to
recent increases in malaria morbidity and mortality. Drug resistance has been confirmed in only two of the four human malaria parasite species, *P. falciparum* and *P. vivax* (CDC, 2004). In 1995, WHO reported that the problem of drug resistance could be attributed primarily to increased selection pressures of *P. falciparum* in particular, due to indiscriminate and incomplete drug use for self-treatment. In the good old days, chloroquine was very effective in the treatment of malaria. However, based on the increasing rate of resistance of *Plasmodium* species to various antimalarial drugs showed by way of treatment failures, the Artemisinin Combination Therapy (ACT) regimen was introduced in Nigeria. So, how well will the ACTs fare in the treatment of malaria in Nigeria, only time will tell.

**GOVERNMENT POLICIES**

Government policies with all intentions and purposes are geared towards service actualization for the masses or the good people of Nigeria. The implementation of such policies at the various service points often time poses an uphill task.

(a) One of such policies that have proved rather difficult to implement in most places is that of the specialization status of Parasitology as enshrined in all available Schemes of Service for Medical Laboratory Scientists’ cadre (1972, 1979 and 2001). In all these schemes of service, the Parasitology Laboratory is identified as a specialized unit having her own Chief Medical Laboratory Scientist (CMLS). But what we see in actual practise in most places is the merging of Parasitology Laboratory with that of the Medical Microbiology and named ‘Department of Medical Microbiology and Parasitology’. Under such arrangement, the diagnosis of malaria and other haemoparasites and parasitic diagnosis in general are performed under Microbiology. Under such instances, the specialized nature of Parasitology is lost; and the diagnosis of malaria and other parasites becomes an all comers affair (giving the responsibility of malaria laboratory diagnosis to non-parasitologists).

(b) Government policy on the implementation of the Roll Back Malaria (RBM) strategy in the country is found inadequate. The vision of the current five-year strategic plan (2009 - 2013) is to ensure that malaria no longer becomes a major public health problem in Nigeria as illness and death from malaria gets significantly reduced. This is to be achieved by ensuring that families will have universal access to malaria prevention and treatment. This latter aspect should rather read “access to malaria prevention, early laboratory diagnosis and treatment”. This therefore means that the missing component of the RBM strategy – laboratory diagnosis should be incorporated – by way of providing laboratory facilities and manpower at all health facilities including the rural areas.

(c) Government position (policy) on the use of malaria rapid diagnostic tests (MRDTs) methodologies in Nigeria for individual diagnosis of malaria is seen as an inadequate procedure (see item 4d above under Medical Laboratory diagnostic inadequacies for up to date report on this issue). The use of these rapid diagnostic test kits in Nigeria should be discontinued for individual diagnosis of malaria.

**CONCLUSION**

In concluding this review, you would agree with me that all health professional groups having something to do with malaria patients’ have contributed in one way or the other to the obstacles against eradication of malaria in Nigeria. Malaria patients and their relatives are one of the major culprits in this matter. Can you excuse yourself from blames associated with any of the seven major obstacles or inadequacies mentioned in this review article or peradventure that inadequacy which is not mentioned here; if the answer is no, then there is need to turn a new leaf by doing the right thing. If we fail to change, for sure, the scourge of malaria will continue to torment us and the current young generation and generations yet unborn will not pardon us. But my prayer is that God will help every one of us to stand and do the right thing, more so now that we have the opportunity to do it.

I am very positive that if all hands (all stake-holders) are on deck, and government having the political will to enforce the practicable solutions, a great relief would be actualized by practically reducing the burden of malaria to the barest minimum.

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