



Malaria status in India with focus on Odisha State having maximum disease burden

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ABSTRACT

Worldwide malaria remains a major public health problem. The situation is worst in South East Asian Region & Sub-Saharan Africa. In India more than 90% of people live in malaria endemic areas. Apart from increased morbidity & mortality malaria affects the socio-economic status of a country. Odisha, a State with only 4 % of India's population records maximum disease burden. In last decade a changed epidemiology is being observed and malaria has spread from rural and tribal areas to urban and newer territories due to urbanization, industrialization and developmental projects. Many decades have passed after launch of National Malaria Control Program but the rate of decrease in malaria caseload seems unsatisfactory. The various challenges involved in malaria control are under-reporting, increased drug and insecticide resistance, inaccessible areas and poor health infrastructure in high burden areas. Various newer interventions have been included in malaria control program such as Insecticide treated bed net; Artesunate-based combination therapy for P falciparum cases, bivalent Rapid diagnostic test etc. In addition to robust surveillance and appropriate treatment, a strong political commitment, community awareness and more funding is required to reduce disease burden.

Keywords: Malaria, Trend, Newer Interventions, Challenges

INTRODUCTION

Malaria which poses a global threat, is an entirely preventable and treatable condition spread by mosquitoes. Worldwide 300-500 million cases and 1.5 to 2.7 million deaths occur annually due to malaria. Ninety percentage of total deaths occur only in tropical Africa.¹ It is estimated that out of 1.4 billion people at risk of malaria, 1.2 billion reside in malaria endemic region of South-East Asia and 65% of them live in India.² Malaria poses a major public health problem in the developing countries including India.

India contributes to 80% of total case load of SEAR region.³ During epidemics the disease burden might become double. According to World Malaria Report 2011, India contributed around 5% P. vivax cases, 1%

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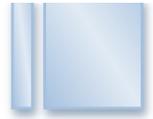
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Conflict of Interest—none

P falciparum cases and 1.7% of world's malaria burden. Malaria is not only responsible for significant morbidity and mortality but it hampers the productivity, agriculture & economic status of a country if not controlled successfully.

Funding—none

Odisha, a state with only 4 % of total population of India, records highest number of Malaria cases followed by Chhattisgarh. Also it ranks second in reported deaths due to malaria. Odisha contributes to 25% of total case load and 30% of total malarial deaths in India.⁴ Even 43% of total PF cases are reported from Odisha. More than two third of case load is reported from 10 Southern districts which are mostly backward and tribal areas.^{5,6}



TREND OF MALARIA

Highest incidence of malaria occurred in 1950s, with an estimated 75 million cases and 0.8 million deaths per year. In 1953 after launch of National Malaria Control Programme (NMCP) a dramatic reduction in cases was seen i.e., less than 50,000 cases and nil death.⁷ But in 1960 India suffered a massive setback after resurgence of malaria. A consistent declining trend is observed between 2001 to 2012 and the number of cases has gone down from 2.08 million to 1.06 million. The number of deaths has shown a declining trend also. Annual Parasite Incidence too has decreased from 2.12 to 0.88 per thousand during the same period. The PF cases have decreased from 1.14 million to 0.67 million between 1995 to 2011. But the proportion of *P falciparum* among the malaria positive cases has increased from 39% to 50.7% during the same period, which is an alarming trend. This trend might be due to increased resistance of *P falciparum* to Chloroquine drug. In Odisha in recent years a gradual decrease in caseload is being observed also.⁷

DISTRIBUTION OF MALARIA CASES IN INDIA

About 90% of people in India reside in malaria endemic areas but 80% of case load is from areas where only 20% of people reside i.e, in hilly, tribal, forested and hard to reach areas. Malaria is mostly reported from Eastern and Central region and particularly from states namely Odisha, Jharkhand, Chhattisgarh, West Bengal, Madhya Pradesh and North eastern states. Apart from these states, Gujarat, Maharashtra & Rajasthan also contribute to malaria case load in Western zone of India. The poverty stricken tribal, hilly and forest fringe areas are affected the most.^{4,8}

The Annual Parasite Incidence (API) which is the important malaria-metric indicator is used as the proxy indicator to know the burden in an area. In most parts of India the API is less than 2, except few states i.e., Rajasthan, Gujarat, Karnataka, Goa, Southern Madhya Pradesh, Chhattisgarh, Jharkhand, Odisha and North-eastern states where API is more than 5.

In Odisha 10 southern districts i.e., Rayagada, Nowarangpur, Kalahandi, Nuapada, Bolangir,

Kandhamal, Gajapati, Ganjam, Malkangiri and Koraput has a very high prevalence of malaria. These districts contribute to 70% of total positive cases and 64% of total malarial deaths in Odisha in 2011 whereas only 27% of state's population and 50% of tribal population reside there.^{5,9} The distribution of cases also varies within districts. Only 43% of sub centres in remote, tribal and difficult to reach blocks have API more than 5 & PF% around 85%.The most common reason for high case load in these areas is, operational deficiency in program management in inaccessible and resource poor settings.

RURAL URBAN DISTRIBUTION

Malaria is called as a disease of the poor. Presently in India majority of malaria cases i.e., more than 90% cases are from rural areas and only 5 to 10% cases are reported from urban areas. Due to construction of dams, rapid urbanization, mining, deforestation, industrialization, newer irrigation projects and inadequate water, waste management and improper vector control measures, malaria has encroached urban and plain areas. The non-existing surveillance & preference of patients towards private health facilities could be the reason for decreased malaria incidence in urban localities.

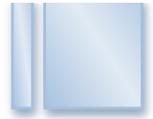
VECTORS

More than nine species of Anopheles are present in India, but only Anopheles culicifacies is responsible for 60 – 65% of malaria burden. This species has five sibling species also. Anopheles culicifacies and An. stephensi are major vectors in rural and urban India, respectively. An. fluviatilis is the principal vector in forest and hilly areas whereas An. minimus, An. dirus are major vectors in North-eastern states. An. sundaius is restricted to Andaman & Car Nicobar islands.⁴ In Odisha An. fluviatilis is the major vector.

PROTOZOA

The two major species are *P. Falciparum* and *P. Vivax*. Historically *P vivax* was the major species affecting humans but gradually *P falciparum* has taken over and throughout India the ratio remains at 50:50.¹⁰

In areas such as Indo-gangetic planes, northern hilly areas, north-western India the proportion of malaria



cases due to *P. Falciparum* is less than 10% and rest are due to *P. Vivax*. The situation is reverse in hilly, foothill and forested areas in eastern and north-eastern states inhabited by ethnic tribes where the proportion of *P falciparum* cases are around 30-90%.⁴

Plasmodium falciparum is the major cause of malaria & is responsible for 80 to 90% of malaria cases in tribal districts of Odisha. It is followed by *P.vivax* cases. Few cases of *P. Malariae* and *P.knowlesi* were reported in southern districts of Odisha as well.

CLIMATE

Malaria burden is related to climatic conditions such as humidity, temperature (18- 30 degree centigrade), rainfall etc. In India the combination of these climatic factors exists in most of the areas which favors the spread of disease throughout the year.⁹ However case load is maximum at the onset of rainfall.

Factors which are influenced by human activities and/or natural calamities such as excessive rainfall, flood, drought and disasters are responsible for providing mosquitogenic conditions and rapid spread of malaria and other vector borne diseases like Dengue.⁴

MALARIA CONTROL MEASURES IN INDIA

Govt. of India launched the National Malaria Control Programme (NMCP) in 1953 with the objective to decrease the malaria transmission. The strategy adopted then was vector control through indoor residual DDT spraying. In 1955 the 8th World Health Assembly urged all Governments to intensify nationwide control measures to achieve malaria eradication. This led to launch of National Malaria Eradication Programme (NMEP) in 1958 in India. This resulted in record decrease in caseload to 0.1 million from 75 million of previous years and nil deaths by 1965.³ Then started the diversion of resources to more demanding programs and the NMEP program received a setback.¹¹ In 1971 the Urban Malaria Scheme (UMS) was launched with the aim of containment of malaria in towns and it covered 131 cities and towns. The main focus was on anti-larval measures.¹²

In 1976 another epidemic of malaria resulted in 6.47 million cases, highest ever recorded in India. The resurgence was attributed to various operational, technical and administrative reasons. Also the drug resistance in *Plasmodium* species and insecticide resistance in vectors emerged as other important issues. After this setback, in 1977 attempts at malaria eradication were given up and Modified Plan of Operation (MPO) was launched with the objectives of preventing deaths, reducing morbidity and maintenance of industrial and green revolution due to freedom from malaria. The program was incorporated with the Primary Health Care delivery system.

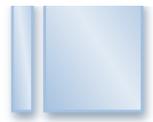
After implementation of MPO the malaria incidence showed a gradual decline.³ In 1997, the Govt. of India changed the program to National Anti-Malaria Program (NAMP) and this program became a part of National Vector-Borne Disease Control Program (NVBDCP) in 2002. The NVBDCP is an umbrella program for prevention and control of Malaria and other vector borne diseases e.g. Filariasis, Dengue, Kalaazar, Japanese Encephalitis and Chikungunya. This program is also responsible for formulating policies and guidelines, monitoring and evaluation of control measures.¹³ The program focuses on resource challenged settings and vulnerable groups. The control measures are implemented through Primary Health Care system. NVBDCP became integral part of National Rural Health Mission (NRHM) in 2005.

The laboratory services are decentralized to the Primary Health Centre (PHC) and Medical Officer in PHC supervises laboratory, surveillance and spray activities. At community level the ASHA and volunteers are entitled to provide diagnostic & therapeutic services using newer interventions such as Rapid Diagnostic Tests & Artemisinin-based Combination Therapy for treatment of PF cases.

CHALLENGES AHEAD

Emergence of widespread drug resistance

The presence of Chloroquine resistant *P falciparum* is widespread in India. It is more pronounced in areas where *P. falciparum* transmission is intense such as north-eastern states and Odisha. It is also seen in project and construction sites, big metropolitan cities



and along the International border. The problem of drug resistance in *P. vivax* is not a major issue till date but vigilance and drug resistance studies should be continued because of its propensity to cause relapse. A national drug policy has been formulated to halt the progress of drug resistance and improve treatment efficiency.⁹

Under reporting of malaria cases

Various longitudinal studies conducted in India shows a huge gap in exact and reported incidence of malaria and the gap in the incidence may range from 68 to 98 %. The factors responsible for this huge gap are inadequate surveillance and under reporting of cases and deaths. The World Health Organization in 2006 estimated the cases and deaths due to malaria was 10.6 million and 15,000, respectively which was several times more than what was reported.⁴

Vulnerability during pregnancy

Pregnancy constitutes an important risk factor for malaria infection. Pregnant women suffer more from malaria both *P. vivax* & *P. falciparum* in comparison to non-pregnant women. Additionally propensity to develop severe/ complicated infection is higher in primi than in multi gravida and non-pregnant state.³ The various complications of malaria infection include congenital malaria, Intra uterine growth retardation, low birth weight, prematurity, Intra Uterine Death, increased peri-natal mortality and maternal mortality. The reasons for increased maternal deaths are cerebral malaria and anaemia. Birth weight of newborn babies of infected mothers are 300-350 grams less than babies born to non-infected mothers.^{4,14}

Burden of complications in malaria

It was observed that numbers of complicated cases are increasing gradually and more instances of multi organ failure are rising in PF malaria infection. Also complicated *P. vivax* infection has also been proved from various studies in India.

NEWER INTERVENTIONS FOR CONTROL OF MALARIA Rapid Diagnostic Test (RDK)

RDK was introduced in India after the launch of World Bank assisted Intensified Malaria Control Project (IMCP). This is a simple test and can be used by ASHA

and Community Volunteers in remote, high burden areas where immediate laboratory facilities are not available. The intention is to diagnose early and provide complete treatment to reduce transmission of malaria. Bivalent RDT kits were introduced in 2013.¹⁵

Insecticide Treated bed Net (ITN)

ITNs were introduced to protect vulnerable groups e.g. pregnant ladies and children. It is provided free of cost to people living below poverty line. An improved variety of ITN i.e., long lasting insecticidal treated net (LLIN) was introduced as a world bank assisted programme in certain districts in 2009.^{15,16}

National Drug Policy

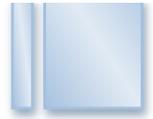
The national drug policy was formulated in 1982 and subsequently revised at periodic intervals. Recently in 2013 drug policy has been revised taking in to consideration drug resistance status and availability of efficacious drugs. Early diagnosis and complete treatment with appropriate medicines to all malaria confirmed cases, remains the mainstay of drug policy. All clinically suspected fever cases should be confirmed initially by either microscopy or RDT. In high Pf burden areas ASHAs and volunteers provide ACT (Artesunate and Sulphadoxine-Pyrimethamine) to all Pf confirmed cases. Chloroquine is still recommended for management of *P. vivax* cases.^{17,18}

In addition to above mentioned problems the other challenges in Odisha are cultural & language barrier in tribal areas; remote, inaccessible areas; inadequate health staff and various construction activities leading to increase in mosquito breeding sites and vector density.

Status of Malaria vaccine

Development of malaria vaccine is a difficult task because of complexities associated with the parasite. Over 20 Subunit vaccines are being evaluated and are in different stages of clinical trials. Among them the most advanced candidate vaccine against *P. falciparum* is RTS,S/ASo1. A phase III clinical trial is continuing in seven countries of Sub Saharan Africa.

In India a candidate vaccine against widespread *P. vivax* is being developed by researchers of



International Centre for Genetic Engineering & Biotechnology in New Delhi.

CONCLUSION

Mortality due to malaria affects mainly the productive group of the society. Proportion of death due to malaria is 21%, 56% and 23% in the <14 years, 15 – 54 years and > 55 years respectively. DALY lost due to malaria is approximately 1.86 million in India. The impact on economy and overall human development is very high in malaria affected countries. The estimated economic loss due to malaria was 75,000 million Indian currencies annually. Considering the disability, mortality, economic loss and industrial insufficiency of the affected nation, the cost of control measures are worthwhile.⁴

Between 2006-2012 due to scale up of various interventions the incidence and mortality from malaria was reduced by 25% & 42% respectively, globally. The available funding is far below the resources required to achieve universal coverage of appropriate interventions.^{1, 19} These obstacles need to be looked in to at a global level to achieve millennium development goals.

DISCUSSION

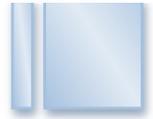
Malaria continues to threaten mankind with high morbidity and mortality even after 60 years of implementation of National Programs. The challenges towards control of malaria are many. Till date much stress is being given on rapid diagnosis and treatment, which is a method under secondary prevention. The effort towards control of vector, a method of primary prevention is still neglected. Though operations such as Indoor Residual Spray, larvicidal fish were carried out in blocks with high disease burden, we have failed to achieve the target.

In hilly, forested or forest fringe areas, the vector control is difficult to achieve due to its varied topography. But the increasing malaria burden in urban areas is mainly man made owing to uncontrolled construction activities related to roads, houses; improper drainage facilities, uncovered drains; littering of roads and poor waste management. The situation in rural areas is still worse because of poor infrastructure, lack of

manpower, etc. Measures like strict enforcement of laws for construction activities, community awareness are vital for decreasing the vector density. Also under-reporting of malaria cases can be tackled with strengthening of Primary Health Centres and Sub centres with requisite manpower and resources. This article tries to give emphasis on the fact that control of Malaria is possible only after tackling various ground issues such as environmental modification for cessation of breeding sites, strengthening of manpower in health sector, early detection and proper treatment and research on parasite and vector resistance.

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