International Journal of Health Sciences and Research
Vol.13; Issue: 7; July 2023
Website: www.ijhsr.org
Review Article *ISSN: 2249-9571*

Ending Malaria in India by 2030: A Comprehensive Overview of Progress, Challenges and Strategies

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DOI: https://doi.org/10.52403/ijhsr.20230722

ABSTRACT

Malaria still has a terrible impact on people's lives, especially in developing countries. According to the world malaria report (2022), the WHO South-East Asia Region accounts for approximately 2% of the worldwide malaria case burden. The incidence of malaria cases in this region has significantly decreased from approximately 18 cases per 1,000 at-risk individuals in 2000 to around three cases per 1,000 at-risk individuals in 2021, representing a remarkable 82% reduction. India was responsible for 79% of the cases in this region. Sri Lanka was declared malaria-free in 2016 and continues to be so. India has made significant strides in lowering its malaria load during the past 15 years towards achieving its goal of ending malaria by 2030. The National Vector Borne Disease Control Programme (NVBDCP) has implemented a number of strategies and interventions to prevent and control malaria, including rapid diagnostic tests (RDTs), artemisinin-based combination therapy (ACT), long-lasting insecticide-treated nets (LLINs), and more recent insecticides and larvicides. There is also ongoing research and the development of novel solutions to resistance-related challenges in order to curb the impact of malaria in India. In order to hasten the process of malaria elimination, the essay emphasises the necessity of fair distribution of malaria interventions and cooperative collaborations across public and commercial sectors of government and international organisations. Comprehensive malaria control initiatives in India have made tremendous progress towards the objective of eliminating malaria by 2030, but further investment and collaboration will be necessary to make further progress towards this lofty goal.

Keywords: "Malaria elimination," "Integrated Vector Management", "India", "Progress and Challenge"

INTRODUCTION

Malaria is one of the oldest and most lethal illnesses, wreaking havoc on families, communities, and nations. The number of malaria cases increased from 245 million in 2020 to 247 million in 2021, according to the most recent World Malaria Report. In 2021, 619 000 malaria-related fatalities were anticipated, down from 625 000 in 2020.(1) Ninety-nine nations accounted for 96% of all malaria cases worldwide, with four countries accounting for nearly half of all cases: Nigeria (27%), the Democratic Republic of the Congo (12%), Uganda (5%), and Mozambique (4%). The WHO African Region accounted for approximately 95% of global cases, while the WHO South-East Asia Region accounted for approximately 2% of global cases. India alone was responsible for 82.5% of malaria instances in the South-East Asian nations, with Indonesia (15.6%) coming in second and Myanmar (1.6%) coming in third.(2) Approximately 95% of India's population lives in malaria-endemic regions, and according to public

information, 80% of malaria recorded in the nation is limited to people living in tribal, mountainous, difficult, and remote areas.(3) Over the previous three years, the number of deaths brought on by malaria remained mostly stable, with India accounting for 82.4% of all malaria deaths in the WHO South-East Asia Region in 2021.(4) Malaria has a major economic effect on Indian households, with immediate out-of-pocket expenses varying from US$ 0.34 to 7.66 (on average around US$ 2.67) and resulting in 2-4 days of missed output. The national malaria load has been estimated to be around US$1940 million per year.(5) A study carried out in central India found that the mean total cost (TC) was INR 2201.5 ± 417.7 in high transmission areas, and 1549.9 ± 232.3 in low transmission areas. The mean total direct costs between high and low transmission areas showed that families in high transmission areas spent considerably more money on counselling fees, medications, hospitalisation, transport, and meals for both patients and caretakers.(6) Plasmodium falciparum or Plasmodium vivax infection, the two most common Plasmodium species, has been linked to stunted physical development in children, according to research. Malaria-free nations have five times the economic development of malaria-infected countries. A 10% reduction in malaria has been linked to a 0.3% increase in GDP.(7) In this regard Ministry of Health and Family Welfare on February 11, 2016 has launched The National Framework for Malaria Elimination (NFME) in India 2016–2030 with a vision of eliminate malaria nationally and contribute to improved health, quality of life and alleviation of poverty. In line with the WHO Global Technical Strategy for Malaria 2016–2030 (GTS) and the Asia Pacific Leaders Malaria Alliance Malaria Elimination Roadmap, the goals of the National Framework for Malaria Elimination in India 2016–2030 are: Eliminate malaria (zero indigenous cases) throughout the entire country by 2030; and Maintain malaria–free status in areas where malaria transmission has been interrupted and prevent re-introduction of malaria.(8)

In this paper, the author has reviewed the literature on progress towards malaria elimination, challenges and strategies towards it. The article discusses the various interventions implemented in India, such as the use of insecticide-treated bed nets, indoor residual spraying, and the provision of prompt diagnosis and treatment. The review also sheds light on the challenges faced in malaria elimination, including issues with the availability and accessibility of healthcare facilities, inadequate surveillance systems, and the emergence of drug-resistant strains of the malaria parasite. The article concludes by emphasizing the need for sustained efforts and collaborations between government and non-governmental organizations to achieve the goal of malaria elimination in India.

METHOD

In contrast to a typical systematic review, more attention was taken when searching the literature to discover the most relevant articles that suit the particular goal rather than the breadth of the available evidences. A thorough literature search for published peer-reviewed papers was conducted using multiple internet sources such as PubMed, Google Scholar, Science Direct, and the Directory of Open Access Journals (DOAJ) by using the keywords like “malaria elimination,” “integrated vector management”, “India”, “Progress and Challenge”. Newspapers, organizational reports, and government documents were also used to gather documented evidence. Studies that were both published in English and pertinent to the subject of the paper only met the inclusion criteria.

DISCUSSION

It is crucial to comprehend the fact that Malaria transmission in India is complicated, with numerous sociopolitical and social variables at play. Year-round, the weather and environmental factors favor the growth of Plasmodium spp. parasite carriers

and their spread. The discussion covers the comprehensive progress until date, strategy and challenges towards Malaria elimination in the country by 2030.

Progress (Figure 2) - The National Vector Borne Disease Control Programme (NVBDCP) in India has established numerous innovative new technologies for malaria prevention and control. Monovalent rapid diagnostic tests (RDTs) for P. falciparum detection were first established in 2005, and then in 2006 and 2009, long-lasting insecticide-treated nets (LLINs) and Artemisinin-based Combination Therapy (ACT) were introduced. Bivalent RDTs that can detect antigens for both P. falciparum and P. vivax were also introduced in 2013. In addition, more recent pesticides and larvicides were released in 2014 and after. In order to lessen the impact of malaria and stop its spread in India, specific approaches are essential.(9)

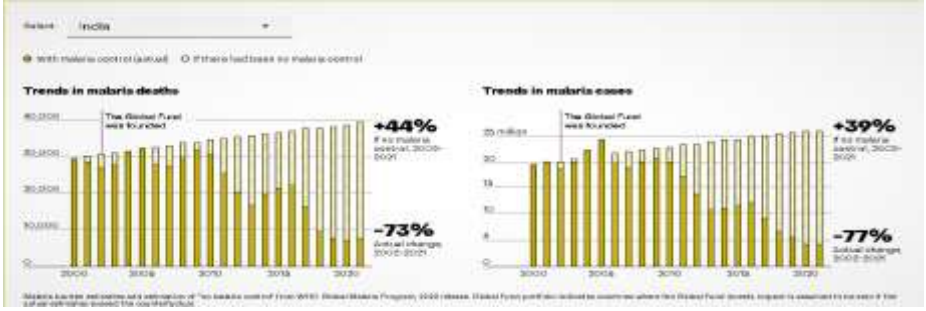
The National Strategic Plan for Malaria Elimination (2017-22) was released, and it provides year-by-year elimination goals in different areas of the country based on the Malaria endemicity in the next 5 years. North East India have yielded promising results, and now the concentration is centralized in other states such as Jharkhand, Orissa, Chhattisgarh, Madhya Pradesh, and Maharashtra.(10)

Between the years 2000 (20, 31,790 cases, 932 deaths) and 2019 (3, 38,494 cases, 77 deaths), India reduced malaria morbidity by 83.34% and fatality by 92%, meeting Goal 6 of the Millennium Development Goals (a 50–75% decline in case frequency). Despite Covid-19 disruptions, the load has decreased to 338,494 cases and 77 fatalities in 2019 and 158,326 cases and 80 deaths in 2021.(11)

The governments of Odisha and India are now receiving assistance from "Malaria No More" and its network of advisors and collaborators, including UNICEF and Abbott, to spread Odisha's success throughout India. Odisha has the greatest malaria load in India and saw a more than 80% drop in malaria cases between 2017 and 2018. They have become a creative champion in saving lives quickly, lowering malaria cases, and lessening the burden it places on rural health systems.(12) In the case of malaria, Global Fund has aided in the widespread dissemination of insecticide-treated nets. From October 2015 to January 2018, 29.8 million long-lasting insecticide-treated nets were dispersed in seven North Eastern states, including Odisha, Jharkhand, and Chhattisgarh, with Global Fund assistance.(13)

India has long been a significant partner of the Global Fund, serving as both a grantee and a contributor. The Government of India has boosted its contribution to the Global Fund to US$25 million for the next three years, underscoring India's leadership in global efforts to eliminate AIDS, tuberculosis, and malaria and to strengthen health systems. Since the Global Fund was established in 2002, malaria mortality has decreased by 26% in nations where it has investments. Malaria mortality would have climbed by 84% during the same time without these measures. (Figure 1)(14)

Fig1: Global Fund Portfolio: India (13)



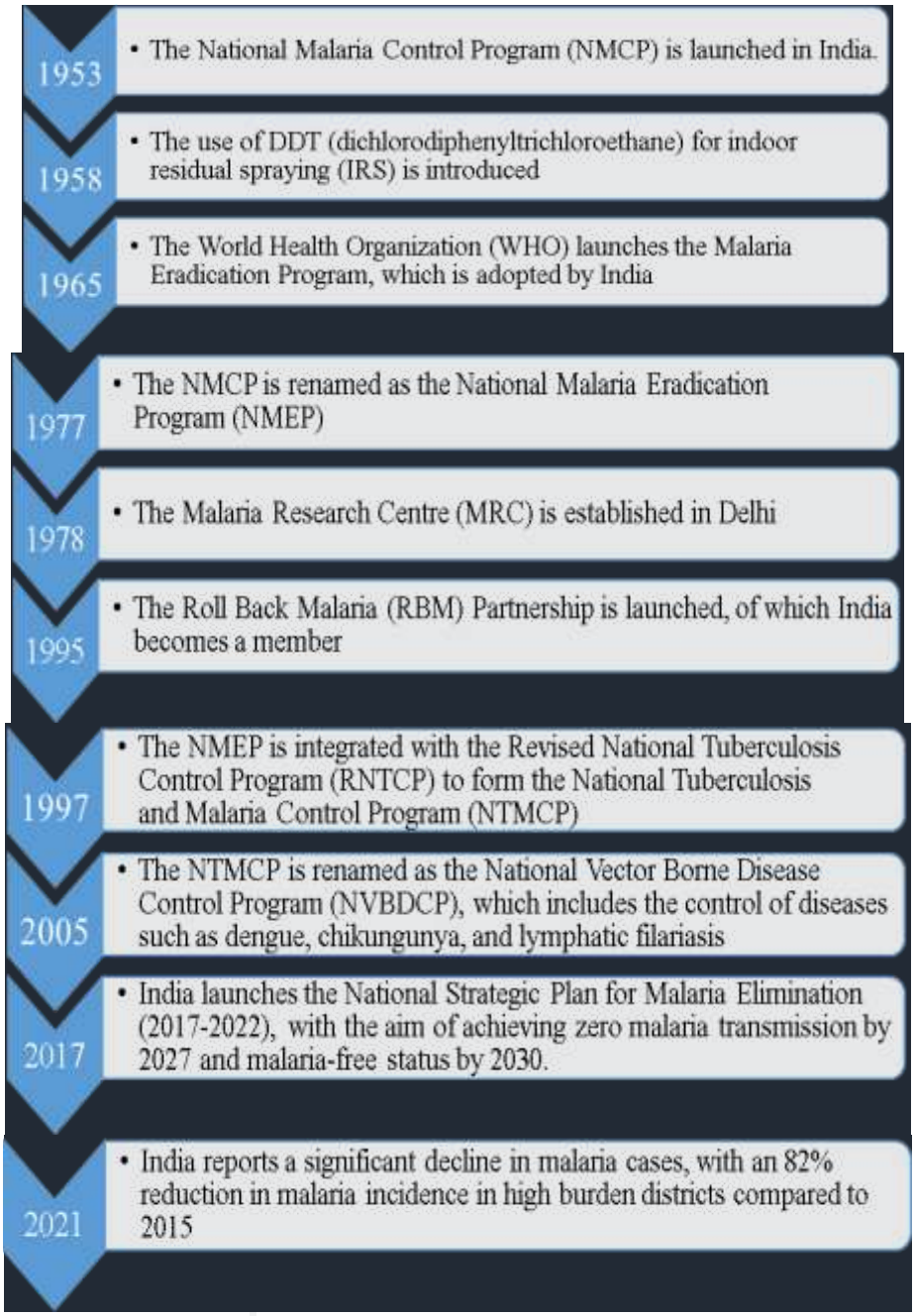


Figure 2- Major milestones of malaria control activities in India.

Challenges-

Migratory population- India's urbanization is accelerating. A significant number of people move to metropolitan areas to work as casual laborers and reside in neighborhoods spread throughout the city. They usually make frequent trips to their hometowns with high malaria endemicity and are thought to be significant carriers of infection for the city's local population. In general, the health department's available resources are centered in steady communities in rural and metropolitan regions. Health care services are scarce in remote regions where employees live.

A survey of migrant workers in Bhubaneswar, Odisha discovered that 94% of the migrants came from high endemic regions, i.e. SPR>5.(15) Another study in Gujrat conducted in 2011 found that the percentage of P. falciparum in the migrant community was greater than 50%.(16)

Surveillance strategy in India-

Surveillance has been identified as a critical measure for malaria elimination. In

elimination settings, surveillance is a core intervention and is Pillar 3 of WHO's Global Technical Strategy 2016–2030. Surveillance thus should include malaria data collection, analysis and outputs so that interventional responses are quick. Surveillance data monthly reported from every district in this programme. The minuteness of the data is lost, though, because the reporting is weekly and combined at the level of the district. While the current system has helped to reduce malaria in India somewhat, it is still thought to have a number of flaws, including 1) insufficient connections to private healthcare practitioners and other nongovernmental organizations. 2) Absence of monitoring of people in urban slums, forests, tribal areas, and mobile groups 3) inadequate supervision of cross-border activity and interstate monitoring 4) delay lag in reporting caused by paper-based data gathering etc.

Plasmodium vivax and its problem- In 2019, India recorded 181,554 Plasmodium vivax malaria cases, and WHO estimates that India accounts for nearly half of the global vivax burden. P. vivax has another way of surviving, which is through a reserve of inactive hypnozoites in the liver. Following the introduction of P. vivax sporozoites into the bloodstream by an infected mosquito, some of the sporozoites become hypnozoites and lie dormant in the liver for years before being activated to initiate new blood-stage infections, and this cycle continues to the patient's detriment.(17)

A study conducted in 2021 found that poor adherence to the 14-day Primaquine (PQ) treatment plan because patients typically experience symptomatic alleviation within a few days of beginning Chloroquine (CQ).(18)

PQ can cause dose-related severe hemolytic anemia in people with G6PD dysfunction, which can be fatal. In India, the regions of Maharashtra, Odisha, Uttar Pradesh, and Rajasthan have a greater incidence of G6PD deficiency.(19)

PQ contraindications in pregnant and nursing women exclude a significant percentage of malaria patients, leaving them untreated and vulnerable to P. vivax relapses.(18)

Potential malaria threat in urban area- Though malaria is usually regarded as a rural illness, India is a notable exception. Anopheles stephensi, the primary malaria vector in India, is well adapted to Indian metropolitan settings that provide perfect breeding habitats: water holding receptacles, wells, drains, and building sites.(20)

Drug resistance and malaria burden- Monitoring medication resistance is another worry, particularly in the northeast, where resistance to Artemisinin-based Combination Treatment (ACT) has already been found in India along the Indo-Myanmar border. Drug resistance has been observed in nearby countries such as Myanmar for many years**.** (21)

Strategies to overcome Malaria burden-

1) Strengthening of surveillance mechanism- For the strengthening of surveillance of Malaria in India some of the strategy has been newly launched.

a) Fever tracker application- A study happened in 2021 to create Fever Tracker, an integrated surveillance graphical software intended to aid community and health care workers in digital monitoring and thus help to malaria control and elimination by National Institute of Malaria Research in collaboration with North Eastern Space Application Centre, Meghalaya, and ICMR-Regional Medical Research Centre, Dibrugarh, India. It was used to assist in the surveillance of 1880 suspected malaria patients and confirmed malaria infection in 93.4% (114/122; Plasmodium falciparum), 4.9% (6/122; P vivax), and 1.6% (2/122; P falciparum/P vivax mixed infection) of cases. Fever Tracker and other digital tools will be

crucial in integrating disease monitoring because they provide immediate data digitization for downstream processing.(22)

b) Molecular diagnosis and surveillance- Molecular diagnostics and surveillance have proven critical in the closing phases of polio elimination and will most likely play a similar role for malaria eradication. Detecting and monitoring the onset and regional spread of drug and insecticide resistance in order to guarantee suitable and prompt response.(23)

c) Malaria Dashboard (MDB)- The Malaria Dashboard (MDB) was created by the National Institute of Malaria Research using district-level statistics provided by the national malaria program from 2000 to 2019. This digital platform can be readily expanded to include data on vector abundance, drug and insecticide resistance, and other factors, as well as data from other healthcare practitioners.(11)

d) Malaria Card- A novel approach for 'health and epidemiological record keeping of malaria cases, species and co-morbidities, G6PD deficiency status, and therapies provided' has been proposed through the implementation of 'Malaria Card'.(24)

2) Tackling P.vivax with Tafenoquine- Tafenoquine is a longer-acting antihypnozoite drug that has recently been approved by the Food and Drug Administration and the Australian Therapeutic Goods Administration for the complete treatment of P. vivax malaria. In terms of ease, Tafenoquine has a significant benefit over the 14-day course of primaquine when administered in a single dose of 300 milligrammes in conjunction with a schizonticide.(25)

3) Malaria prevention and control strategies for the migratory community - Regular malaria surveillance in seasonal workers, drug resistance monitoring among migrants, and infrastructure improvement in primary health centers must all be prioritised in order to guarantee early discovery and treatment. In order to stop the spread of malaria by local vectors at brick kilns and construction sites in the state, insecticide-impregnated nets, bio-larvicides, or insect growth regulator compounds would be effective. This is because indoor residual spray in makeshift hutment is not very effective for vector control.(16)

4) Tackling strategy for controlling urban Malaria- In addition to the NVBDCP for rural regions, the control of malaria in metropolitan places was seen as a crucial tactic. In 1971, a modified plan of operation (MPO) was created, presented, and authorized. Urban Malaria Scheme currently protects 142.9 million people in 131 cities across 19 States and a Union Territory from malaria as well as other mosquito-borne illnesses. Under the scheme, Malaria Control strategy will comprise of (i) Parasite control & (ii) Vector control. In parasite control methods, passive institutions, such as private practitioners, hospitals, and clinics in both the public and private sectors, provide therapy. Every health sector/malaria control agency, including municipal corporations, railroads, and defense forces, has created malaria clinics in megacities. Vector control consists of the following element i.e. source reduction, employing larvicides, use of larvivorous fish, Space spray, Minor engineering and legislative measure.(26)

5) Strategies related to diagnostics- The widespread use of RDT kits other than via the national malaria programme are improving access and acceptance of molecular diagnostic instruments like PCR, helps in the detection of non-Pf/Pv species, mixed infections, peripheral parasitemia, placental malaria, and gametocytes.(11)

6) Drug resistance and its tactical strategy- The government's decision to switch to AL in 2013 was driven by the emergence of ACT AS-SP resistance in the

northeastern states. In collaboration with the National Institute of Malaria Research, new guidelines have been created and are being updated, which, in order to increase compliance, explain treatment policy in a way that is both public and private physicians able to comprehend.(27)

7) Malaria Vaccine and its uses- Various interventions have been undertaken in India to reduce the malaria load. The WHO licensed the RTS, S/AS01 (RTS, S) malaria vaccine for administration in four planned doses in children five months of age in October 2021 in order to minimise the burden and severity of malaria.(28) The Jenner Institute at the University of Oxford invented the R21 malaria vaccine, also known as Matrix-M, in conjunction with SII in 2020 to create and develop the vaccine for widespread administration.(29)

8) Initiatives to end malaria- The current scenario underscores the necessity for a single platform, as well as a shared research objective and resources, as demonstrated by the establishment of the Malaria Elimination Research Alliance (MERA) India by ICMR. MERA India's mission is to identify, clarify, prioritise, and respond to the country's research requirements in order to eradicate malaria from India by 2030. (30)

CONCLUSION

In conclusion, eliminating malaria in India by the year 2030 is a difficult but doable objective. Over the past decade, India has made considerable strides in lowering the prevalence of malaria, but more work remains. The nation has to keep funding efforts to control and eradicate malaria, especially in high-burden areas and among vulnerable populations. This entails boosting vector control initiatives, bolstering surveillance systems, and expanding access to diagnosis and treatment.

Furthermore, India must address the underlying socioeconomic and environmental drivers of malaria, such as poverty, insufficient housing, and poor health services. This necessitates a multisectoral strategy involving coordination across the health, education, and environmental sectors, as well as other stakeholders. Adoption of new technology and novel tactics, such as the use of drones for monitoring and the deployment of genetically modified mosquitoes, also offers potential for hastening malaria eradication efforts.

Overall, a comprehensive and integrated strategy that tackles the disease's fundamental causes, enhances health systems, and makes use of new technology and innovations would be needed to completely eliminate malaria in India by 2030. Although there is, still a long way to go, the progress done so far provides encouragement that a malaria-free India is feasible. All players, including the government, civic society, the commercial sector, and communities themselves, will need to work together and show commitment. Together, we can end malaria in India and create a healthier, more prosperous future for all.

Declaration by Authors

Ethical Approval: *Not required*

Acknowledgement: *None*

Source of Funding: *None*

Conflict of Interest: *The authors declare no conflict of interest.*

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How to cite this article: Shubhajit Pahari, Sankha Subhra Debnath. Ending malaria in India by 2030: a comprehensive overview of progress, challenges and strategies. *Int J Health Sci Res.* 2023; 13(7):153-161.
DOI: *https://doi.org/10.52403/ijhsr.20230722*

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