Special Article

Health Inequalities in India – Will Looking through the Social Determinants Lens, Make a Difference?

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Introduction :

Shrinking the global malaria map is one of the most remarkable successes of modern public health since the end of Second World War. More than 100 countries have successfully eliminated malaria since the early 20th century. Consequently, 20% additional population got the opportunity to live in malaria-free areas in the 60-years period between 1950 and 2010.[1]Currently, the disease is endemic in only 31 countries and India is featured in the list of top 20 malaria-endemic countries that together contributed 85% the global malaria burden.[2]India is also the only country outside Africa to be featured in that list.

Government of India has set the target to eliminate malaria by 2030. In order to achieve the elimination certificate, the country has to be freed of malaria transmission by 2027 and the re-establishment of transmission is to be prevented in the subsequent years. With this ambitious goal set in 2016, the country has taken a tremendous stride in reducing the malaria cases over the past five years from about 1.1 million in 2014[3] to about 0.43 million in 2018[4]. The percentage reduction in malaria cases during this 5-years period has been more than what India had achieved during the 15-years period since 2000. More importantly, the steep decline in malaria burden has been witnessed during a period when the global malaria response is at the crossroads with a static annual incidence of the disease since 2014.[5]

India's success against malaria had, however, been short-lived in the previous decades. The first ever success in controlling malaria could be traced back to late 1950s, after the launch of National Malaria Control Programme (NMCP) in 1953. Through this programme, which focused on “indoor residual spray (IRS) with DDT”; “monitoring and surveillance of cases”; and “treatment of patients”, India's malaria cases dropped steadily from an estimated 75 million cases in 1947.[6] Encouraged by the success and following the recommendation of the Sixth WHO Expert Committee, 1956, Government of India intensified the effort to end malaria through National Malaria Eradication Programme (NMEP), beginning in 1958[7]. However,malaria cases started increasing from early 1960s and the most massive resurgence took place between 1969 and 1976. Repeated outbreaks led to the increase in the reported malaria cases to 6.46 million by 1976 from only 0.35 million cases in 1969[6], which ultimately led to the discontinuation of eradication efforts.

Since the 1970s setback, India has witnessed resurgence in malaria multiple times after initial successes through modified strategies and intensified operations, until recently after 2000, when the country witnessed a steady decline in cases with less frequent outbreaks. In order to consolidate the current gains and sustain the progress through the coming decade, it is important to revisit the historical causes of failures, understand the current factors propelling the accomplishments as well as the future threats that may hinder the achievement of elimination goal. In this article, we have advanced a perceptual map of administrative and operational factors, technical factors and socio-economic factors that can potentially influence India's chance to succeed in eliminating malaria through a narrative review of scientific articles, policy and strategy documents, various reports, guidelines as well as anecdotes.As a next step towards eliminating malaria, understanding of these factors will help in forming the basis of defining the problem statement to be resolved by India's malaria end-game strategies.

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1. Historical Causes of India's Failure to Control and Eliminate Malaria

Reversal of declining trend and sudden upsurges for malaria have been observed in multiple countries globally, including in India. Some classical examples include the resurgence in Iraq between 1970 and 1975; and re-establishment of transmission in Caucasus, Central Asian Republics, and Russia in 1980s and 1990s.[8]

1.1. Technical, administrative and operational challenges through eradication era

1.1.1. Resistance to DDT

One of the most popularly cited reasons behind global malaria resurgence in the 1960s across the malaria endemic countries was the emergence of vector resistance to DDT.During this period, residual spraying using DDT was considered critical for interrupting transmission. The 10th WHO Expert Committee, 1964,recognized the areas having persistence of malaria transmissionin spite of "total, complete, regular and sufficient coverage" of DDT and absence of administrative and operational factors, as "Problem Areas".[9]Presence of these areas were considered to delay the interruption of malaria transmission. However, this reason was not found sufficient to explain the setback of 1968 and 1976 in India by the experts of National Vector Borne Disease Control Programme (NVBDCP).[7]

1.1.2. Shortage in DDT supply

An in-depth review of malaria situation in India by Madhok committee led to recognition of shortage of insecticide (DDT) supply in India in 1969.[10]The supply shortage resulted from indigenous insecticide shortage and late receipt of insecticides from USA.[10,11]The supply shortage was more than 25% between 1965 and 1967.[11]

1.1.3. Emergence of urban malaria problem

The urban malaria problem stemmed from rapid urbanization post 1961. While the vector breeding could be prevented through insecticide spraying in rural areas, the anti-larval measures, which had been the mainstay of vector control in urban areas, failed due to understaffed local bodies and financial inadequacy.[12,13]

1.1.4. Administrative and operational gaps

The NVBDCP experts attributed the overall failure of NMEP to slow development of infrastructure, inadequate surveillance, inadequate budget and delayed release of funds to periphery, lack of staff at the periphery where they were needed and creation of mosquitogenic condition through large number of developmental projects.[7]

1.1.5. Global policy attributes affecting malaria eradication

Over and above the country-level factors, policy attributes under the Global Malaria Eradication Programme (1955-1969) might also have compounding effect on the malaria eradication programme. Three important issues incriminated for failure of GMEPthat might have relevance are –

i. International funds were available to countries who aligned with the goals and means set by the WHO.

ii. A short-sighted transformation of malaria fight under GMEP to engage malariologists, who were field scientists, in the management of a gigantic enterprise of malaria eradication.

iii. The "exaggerated extrapolation" of local experiences, which failed to tailor solutions to the general epidemiological problems and reliance on the expertise of newly trained malariologists

1.2. Consequences of modified strategies and challenges

Recognizing the resurgence of malaria especially in the urban areas, Government of India launched the Urban Malaria Scheme in 1971-72.[11]In 1977 the Government was compelled to entirely revisit its eradication policy and lay down a "Modified Plan of Operation" (MPO) as a control measure for malaria[9].

1.2.1. Development without health impact assessment and scarcity of resources

Although the urban malaria scheme impacted vivax malaria[11], the challenges that hindered absolute success of the scheme resulted from haphazard growth and spatial spread of urban areas, unplanned township with poor water supply and drainage and low lands, intermittent water supply and water scarcity in cities and towns, development projects without health impact assessment, inadequate health infrastructure and staff shortage in urban areas, lack of active surveillance under the programme.[12,15]

1.2.2. Emergence of drug resistance

Under the MPO, a special initiative, Plasmodium falciparum Containment Programme (PfCP) was launched in 1978, with support from the Swedish International Development Agency (SIDA). PfCP was scaled from 18 districts in north-eastern (NE) states in 1978 to 110 districts in 1988.[16,17] However, between 1977 and 1988, Pf malaria followed an overall inclining trend the purpose of the PfCP programme was defeated due to emergence of resistance to Chloroquine.[15]One of the key factors that contributed to emergence of drug resistance was the use of presumptive treatment, which was earlier advanced as an intervention for use during eradication programme by the 12th WHO Expert Committee in 1966.[18]

1.3. Resistance to insecticides and drugsin 1980-2000

In late 1980s and through 1990, newer paradigms and ecotypes of malaria were recognized, and emergence of drug and insecticide resistance became the primary challenges that impeded control measures.

While malaria used to be a rural illness till 1960s, as many as five paradigms of malaria could be analysed in mid

1990s– (a) tribal malaria, (b) rural malaria, (c) urban malaria, (d) industrial malaria, and (e) border malaria.[19]While these strategic paradigms are important for designing control operations, intervention allocation has also been found to be complex across different eco-types of the disease. This is because the behaviour of vector mosquitoes are different per ecotype[20]and vector exophilism or outdoor resting behaviour affects the effectiveness of indoor residual spraying (IRS). An. dirus, an efficient vector in forest areas of NE, breeds in temporary water collections and shows exophilic behaviour.[20,21] An. minimus22 and An. fluviatilis[23] in forests and foothills respectively of malaria endemic regions of eastern and central India also show exophilic behaviour at times. However, for An. fluviatilis IRS has been found to be still effective due to its nocturnal resting behaviour.[24]

An analysis of insecticide susceptibility between 1991-2016 in India shows that the predominant malaria vector of India, An. culicifacies became resistant[25] to DDT in most parts of India, except parts of North India and Assam. DDT resistance for the vector has become almost universal across the country post 2000. Growing resistance to Malathion and synthetic pyrethroids was recorded through the previous and current decade. Other Anopheline species (An. stephensi, An. fluviatilis, An. dirus, An. nivipes, etc.) have shown better susceptibility to insecticides.

While first report of resistance of Pf to CQ was first noted in 1973, the resistance became widespread through 1980s.[26]India's first antimalarial drug policy came into effect in 1982[27] only after reports of resistance to CQ[28]. Multiple revisions of the drug policy took place until 2013. However, presumptive treatment was only discontinued after 2007.[27]In the meantime, the CQ resistance increased steadily with a slope of 0.73 between 1978 and 2007.[26]However, policy reaction to resistance have been quicker in the recent years as Artesunate monotherapy was banned in India in 2009 and Artesunate Sulfadoxin-Pyrimethamine was replaced in the NE states with lumefantrine containing ACT in 2013.

1.4 Operational challenges in Externally Supported Projects

1.4.1. Enhanced Malaria Control Project

Fight against malaria was intensified with support from The World Bank under Enhanced Malaria Control Project (EMCP), launched in 1997. In the EMCP, Malaria Link Volunteers (MLV) were identified from the community, who were provided with honorarium to test and treat malaria. An evaluation in Orissa revealed that “unrest” among Anganwadi Workers (AWW) during the implementation of the project erupted becausefor the same activities in fever treatment depot some (those in EMCP block) AWWs were paid, while the rest were not paid.[29] Even in the EMCP blocks all AWWs could not be paid as the number of MLVs were much lesser than the actual number AWWs. Other challenges included poor patient compliance to antimalarials, stemming from the need of consuming large number of tablets under the treatment regimen; indiscriminate use of RDTs in areas covered with presumptive treatment for all febrile cases; shortage of manpower for malaria microscopy and overload on microscopists responsible for undertaking testing for both malaria and tuberculosis; inadequate monitoring of IRS at PHCs; and lack of training of staff leading to non-functioning of hatcheries for production of larvae-eating fish.[29] An analysis in Madhya Pradesh also revealed that Pf malaria remained unchanged and associated mortality increased in spite of availability of effective intervention tools under EMCP.[30] Some of the important factors attributing to the failure, recorded in the study, were–

a. Implementation of interventions in selective geographies and non-inclusion of affected PHCs in non-tribal districts;
b. Growing resistance of Pf to CQ, which was ultimately overcome through the change in the drug policy in 2008-09 to switch to blister pack of ACT.
c. Low coverage and poor upkeep of insecticide treated nets;
d. Lack of training for conducting RDTs resulting in non-use of RDTs in most peripheral areas, where it was needed;

1.4.2. Intensified Malaria Control Project (IMCP)– Round 4, Round 9 and IMCP-3

The Intensified Malaria Control Project began in India with support from The Global Fund in 2005 in 7 NE states and 16 districts of Odisha. >30% decline in malaria incidence was observed against baseline in the very first round, i.e. Round 4.[31]Following implementation of Round 9 an Intensified Malaria Control Project 3, the annual incidence declined from 4.39 in 2008 to 1.34 in 2016.[32]During this period, the primary challenges identified were–

Lack of human and financial resources, especially shortage of male health workers and laboratory technicians;

Inadequate public health infrastructure and training facility;

Procedural delays in supply chain management;

Inadequate micro-planning and monitoring at grassroot level;

Lack of coordination between health and non-health sectors;

Lack of involvement and ownership of civil societies and communities;

Delayed outbreak warning, investigation and control.

2. Perceptual mapping of opportunities for malaria elimination

Among the different factors that have contributed to India's success in reducing malaria, the two most important enablers are the highest-level political commitment to end the disease and the grassroot level efforts by the primary care workers, who are responsible for community-based testing and treatment of malaria. In addition, advances in technology and intensified programming have created an opportunity to sustain the country's progress to malaria elimination. In addition, future opportunities exist in prioritizing malaria in India's healthcare programming.

2.1. Elevated political will

The elevation of political will to end malaria in India can be traced back to the year 2014, when India's Ministry of Health and Family Welfare demonstrated its willingness in the Asia Pacific Leaders' Malaria Alliance (APLMA) Task Force's target to end malaria by 2030[6]. In 2015, the honourable Prime Minister of India pledged to end malaria by 2030 along with 17 other regional leaders of Asia Pacific during the East Asia Summit. In the same year, the honourable Prime Minister (PM), himself, congratulated the ASHA worker of India's the then highest malaria endemic state, Odisha, for grassroot level fight against malaria in Mann Ki Baat[6], an Indian programme hosted by the honourable PM. However, with declining cases and deaths due to malaria, the mention of malaria has declined in the parliamentary question-answers through the decade. In order to sustain the elevated level of commitment advanced by the highest national leadership, it is important to intensify parliamentary discussions on malaria elimination.

2.2. Prioritizing malaria in highest level oversight

Malaria has been prioritized for high-level review in different national and state-level monitoring and review initiatives, including Joint Monitoring Mission and review by India Country Coordination Mechanism. In India's Health Index[33], Tuberculosis and HIV have been prioritized for assessment of intermediate outcomes. Featuring malaria related indicator in the Health Index along with these two other important targets of Sustainable Development Agenda would enable state's to further prioritize malaria and improve the quality of implementation through increased accountability.

2.3. Resourcing of malaria elimination interventions

In the longer run, malaria elimination is costlier to achieve than control[34] and therefore, increase in budgetary allocations are critical for malaria elimination in India. India needs a financial allocation of INR 10,653 crore between 2017 and 2022 for implementation of its National Strategic Plan for Malaria Elimination.[35]Total spending for malaria in India was estimated at US$ 118.6 million in 2016, with government sharing 61.6% of the total spending.[36] While the external support by The Global Fund to India's malaria programme has steadily declined, India's domestic commitment to eliminate malaria has substantially increased and the current domestic commitment stands at about US$ 180 million in 2019. Among the 11 countries under High Burden High Impact (HBHI) approach, India's domestic share in malaria programming is highest.[4] Sustaining this elevated commitment through the elimination period is crucial to achieve and maintain malaria elimination status.

2.4. Role of private sector in malaria reporting

Only nearly 30% of all episodes of ailments are treated across the government sector in India.[37]However, the private sector reporting is minimal in India and minimal compliance to the malaria treatment guideline has been reported across private sector (explained under 2.6). Lack of private sector reporting hinders the precise understanding of the burden and distribution of malaria across the country. The burden estimate of the World Health Organization has been many fold higher than the burden reported through the programme information system.[2] Stringent implementation of reporting norm is therefore needed along with a user-friendly reporting platform for private sector reporting. India's National Tuberculosis Elimination Programme, a forerunner in this regard, can be an example.

2.5. Improved diagnostic quality and accuracy

In recent years, high quality rapid diagnostic tests (RDTs) provide a unique opportunity to detect malaria infection in time at point-of-care and treat the positive cases. This is especially useful when microscopy is unavailable, or the result would be delayed. RDT-based mass screening programmes have also shown substantial yield to combat asymptomatic malaria in high burden states like Odisha.[38] While mass screening now requires more precise targeting for judicious utilization of RDTs through the period of elimination as well as more sensitive tests to improve the diagnostic accuracy, a generic global concern also exists with regard to false negative RDT results due to hrp 2/3 deletion.[39] The deletion has also been reported from India with low prevalence.[39] According to WHO, greater suspicion is needed regarding false negative result in RDT if the RDT positivity rate is lower than microscopy and the discordance is 10-15% or more.[39] Therefore, continuous effort to sustain and further improve the reach and quality of malaria microscopy and monitoring of positivity rates through RDT and microscopy are crucial for malaria elimination in India.

2.6. Overcoming drug resistance due to malaria

One of the major concerns towards regional malaria elimination in South East Asia has been the increase in frequency of the kelch 13 mutation, responsible for Artemisinin resistance between 2007 and 2013[40]. The mutation has also been reported from India.[41]Indiscriminate use of monotherapy with injectable Artesunate, especially across the private sector, is incriminated for the emergence of resistance. A 2011 study revealed availability of the Artemisinin monotherapy in 72.6% pharmacies and minimal compliance to national drug policy in the private sector.[42] In recent years, scientific articles continue to report indiscriminate use of Artesunate monotherapy[43] as well as inappropriate prescription of Artesunate in vivax malaria[44]. In the post-presumptive treatment ban era, this seems to be a major challenge in malaria elimination. While malaria has been made notifiable in a number of states and Artesunate monotherapy has been banned[42], stricter vigilance of inappropriate treatment of malaria across the private health sector and increased provider level awareness regarding treatment guidelines are the need of the hour. The mass media communications in this regard can play an important role in promoting provider awareness.

2.7. Data-driven malaria programming

"Digital India" initiative has been identified as a crucial enabler to India's malaria elimination in national strategy. Leveraging the insights generated through data requires wider awareness regarding the utility of data and its use for decision making; capacity to generate insights from data; as well as the responsiveness of the system to quickly act upon the generated information. An Integrated Health Information Platform (IHIP) is being set up by the Government of India and piloted "to enable the creation of standards compliant Electronic Health Records (EHRs) of the citizens on a pan-India basis along with the integration and interoperability of the EHRs through a comprehensive Health Information Exchange (HIE)". This provides a unique opportunity to integrate malaria information. In addition, opportunities exist to collect as well as validate malaria data from various sources, including that from private providers and point-of-sales.[45]

2.8. Communitization of the fight against malaria

The fight against malaria in India at the community level is spearheaded by about 900000 Accredited Social Health Activists.[46]Engaging ASHAs in antimalarial activity and their capacity building as part of the overall programming have shown to nearly halved malaria incidence over a decade in Odisha between 2003 and 2013.[47] However, effectiveness of ASHAs and the community sensitization are not uniformly optimal across the country. In 2015, the self-reported effectiveness of ASHAs in malaria control work was found to be only 32% in the state of Karnataka.[48]In a recent study in Chhattisgarh, the major challenges identified by "Mitanins" (local ASHAs) were found to be lack of supportive supervision, lesser incentives, delayed payment, lack of appreciation and intermittent supply of antimalarials In another study conducted in Manipur, influence of power structure in ASHA selection and poor community sensitization of the ASHA programme were identified as important constraints to the success of the programme.[49]Furthermore, treatment seeking from ASHAs in far flung tribal hamlets is a challenge as it has been shown that timely and appropriate treatment seeking for fever reduces in case of tribal communities and where the provider is situated more than five kilometres away.[50] This is critical in the context that malaria in India is mostly concentrated in the tribal predominant districts as 46% of the cases and 47% of the deaths are shared by districts having 30 percent or more tribal population.[51] At this outset, innovative communitization strategies, for example, intensive training programmes[52], ASHA-supported women groups for participatory learning and action[53] would be critical to engage and mobilize communities in rural and tribal areas to improve health seeking, use of personal protection and vector control for malaria elimination.

Conclusion

On balance, malaria elimination is an achievable, but difficult target for India and the current progress has set the momentum for the country to achieve the same. Given that a general declining trend of malaria has been recorded in India since 2001 India has got the opportunity to interrupt transmission for the second time only since its independence.Traditionally the approach to fight malaria problem in India had been reactive, i.e. modification of strategies and/or intensification of interventions following resurgence of malaria. It is now imperative to systematically address the challenges learnt through the country experience to pro-actively intensify the fight through sustained systemic will and commitment, improved use of data and implementation fidelity, as well as inclusive programming engaging the private sector.

References:

1. Feachem RG, Phillips AA, Hwang J, et al. Shrinking the malaria map: progress and prospects. Lancet. 2010;376(9752):1566-1578. doi:10.1016/S0140-6736(10)61270-6
2. World Health Organization. World Malaria Report 2019. Geneva; 2019. doi:CC BY-NC-SA 3.0 IGO
3. World Health Organization. World Malaria Report 2015. Geneva; 2015.
4. World Health Organization. World Malaria Report 2019. Geneva; 2019.

5. World Health Organization. Regional and global trends in burden of malaria cases and deaths. World Malaria Report 2019: This year's report at a glance.
6. Mann Ki Baat. Official Website of Narendra Modi. https://www.narendramodi.in/mobile/pm-modi-s-mann-ki-baat-november-2015-. Published 2015. Accessed December 24, 2019.
7. Sharma RS, Sharma GK, Dhillon GPS. Epidemiology and Control of Malaria in India. First. Delhi: National Malaria Eradication Programme, Ministry of Health and Family Welfare, Government of India; 1996.
8. World Health Organization. World Malaria Report 2009. Geneva; 2009.
9. Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India. History of Malaria Control in India.
10. Ministry of Health and Family Welfare. Madhok Committee Report of the Special Committee to Review the Working of the National Malaria Eradication Programme and to Recommend Measues for Improvement. New Delhi; 1970.
11. Sharma VP. Re-emergence of malaria in India. Indian J Med Res. 1996;103:26-45. http://www.ncbi.nlm.nih.gov/pubmed/8926025.
12. Sharma SN, Srivastava PK, Singh S, Sharma RS, Sonal GS, Dhariwal AC. Urban Malaria Scheme - Past, Present & Future. J Commun Dis. 2014;46(2):77-84.
13. Sharma SN. Malaria and mining practices – a survey note with possible control methods. Environ Ecol. 1994;12(4):973-975.
14. Nájera JA, González-Silva M, Alonso PL. Some Lessons for the Future from the Global Malaria Eradication Programme (1955–1969). PLoS Med. 2011;8(1): e1000412. doi:10.1371/journal.pmed. 1000412
15. Sharma VP. Battling malaria iceberg incorporating strategic reforms in achieving Millennium Development Goals & malaria elimination in India. Indian J Med Res. 2012;136(6):907-925. http://www.ncbi.nlm.nih.gov/pubmed/23391787.
16. Sharma VP. Battling the malaria iceberg with chloroquine in India. Malar J. 2007;6(1):105. doi:10.1186/1475-2875-6-105
17. Ray AP. Some aspects of P. falciparum containment programme. Indian J Med Res. 1979;70 Suppl:1-13. http://www.ncbi.nlm.nih.gov/pubmed/398330.
18. World Health Organization. WHO Expert Committee on Malaria – Twelfth Report. Geneva; 1966. https://apps.who.int/iris/bitstream/handle/10665/39822/WHO_TRS_324.pdf?sequence=1&isAllowed=y.
19. Pattanayak S, Sharma VP, Kalra NL, Orlov VS, Sharma RS. Malaria paradigms in India and control strategies. Indian J Malariol. 1994;31(4):141-199. http://www.ncbi.nlm.nih.gov/pubmed/7556784.
20. Das MK, Prajapati BK, Tiendrebeogo RW, et al. Malaria epidemiology in an area of stable transmission in tribal population of Jharkhand, India. Malar J. 2017;16(1):181. doi:10.1186/s12936-017-1833-9
21. Dev V, Sharma VP. The Dominant Mosquito Vectors of Human Malaria in India. In: Anopheles Mosquitoes - New Insights into Malaria Vectors. InTech; 2013. doi:10.5772/55215
22. Sahu SS, Gunasekaran K, Vanamail P, Jambulingam P. Seasonal prevalence & resting behaviour of Anopheles minimus Theobald & An. fluviatilis James (Diptera: Culicidae) in east-central India. Indian J Med Res. 2011;133:655-661. http://www.ncbi.nlm.nih.gov/pubmed/21727666.
23. Nanda N, Bhatt RM, Sharma SN, et al. Prevalence and incrimination of Anopheles fluviatilis species S (Diptera: Culicidae) in a malaria endemic forest area of Chhattisgarh state, central India. Parasit Vectors. 2012;5(1):215. doi:10.1186/1756-3305-5-215
24. Gunasekaran K, Sahu SS, Jambulingam P, Das PK. DDT indoor residual spray, still an effective tool to control Anopheles fluviatilis-transmitted Plasmodium falciparum malaria in India. Trop Med Int Heal. 2005;10(2):160-168. doi:10.1111/j.1365-3156.2004. 01369.x
25. Raghavendra K, Velamuri PS, Verma V, et al. Temporo-spatial distribution of insecticide-resistance in Indian malaria vectors in the last quarter-century: Need for regular resistance monitoring and management. J Vector Borne Dis. 54(2):111-130. http://www.ncbi.nlm.nih.gov/pubmed/28748832.
26. 26. Shah NK, Dhillon GP, Dash AP, Arora U, Meshnick SR, Valecha N. Antimalarial drug resistance of Plasmodium falciparum in India: changes over time and space. Lancet Infect Dis. 2011;11(1):57-64. doi:10.1016/S1473-3099(10)70214-0
27. Anvikar AR, Arora U, Sonal GS, et al. Antimalarial drug policy in India: past, present & future. Indian J Med Res. 2014;139(2):205-215. http://www.ncbi.nlm.nih.gov/pubmed/24718394.
28. Pattanayak S, Roy RG, Phukan D, Barkakuty BN. Chloroquine resistance in P. falciparum in Assam State. Indian J Med Res. 1979;70 Suppl:14-19. http://www.ncbi.nlm.nih.gov/pubmed/398331.
29. 29. Patil R, Kumar R. World bank EMCP malaria project in Orissa, India - A field reality. Trop Parasitol. 2011;1(1):26. doi:10.4103/2229-5070.72111
30. Singh N, Dash AP, Thimasarn K. Fighting malaria in Madhya Pradesh (Central India): Are we loosing the battle? Malar J. 2009;8(1):93. doi:10.1186/1475-2875-8-93.

31. The Global Fund Proposal Form - Round 9 India.; 2009.
32. India CCM. The Global Fund Funding Request Application Form.; 2017.
33. NITI Aayog, Government of India. Performance of Health Outcomes. New Delhi; 2016.
34. Shretta R, Avanceña AL V., Hatefi A. The economics of malaria control and elimination: a systematic review. Malar J. 2016;15(1):593. doi:10.1186/s12936-016-1635-5
35. National Vector Borne Disease Control Programme. Directorate General of Health Services. Ministry of Health & Family Welfare. Government of India. National Strategic Plan for Malaria Elimination in India 2017-2022.; 2017.
36. Haakenstad A, Harle AC, Tsakalos G, et al. Tracking spending on malaria by source in 106 countries, 2000–16: an economic modelling study. Lancet Infect Dis. 2019;19(7):703-716. doi:10.1016/S1473-3099(19)30165-3
37. National Statistical Office, Ministry of Statistics & Programme Implementation, Government of India. Key Indicators of Social Consumption in India: Health– NSS 75th Round.; 2019.
38. Pradhan M, Meherda P. Malaria elimination drive in Odisha: Hope for halting the transmission. J Vector Borne Dis. 2019;56(1):53. doi:10.4103/0972-9062.257775
39. World Health Organization. False-Negative RDT Results and P. Falciparum Histidine-Rich Protein 2/3 Gene Deletions.; 2019. https://apps.who.int/iris/bitstream/handle/10665/258972/WHO-HTM-GMP-2017.18-eng.pdf?sequence=1.
40. Ménard D, Clain J, Ariey F. Multidrug-resistant Plasmodium falciparum malaria in the Greater Mekong subregion. Lancet Infect Dis. 2018;18(3):238-239. doi:10.1016/S1473-3099(18)30071-9
41. Mishra N, Prajapati SK, Kaitholia K, et al. Surveillance of Artemisinin Resistance in Plasmodium falciparum in India Using the kelch13 Molecular Marker. Antimicrob Agents Chemother. 2015;59(5):2548-2553. doi:10.1128/AAC.04632-14
42. Mishra N, Anvikar AR, Shah NK, et al. Prescription practices and availability of artemisinin monotherapy in India: where do we stand? Malar J. 2011;10(1):360. doi:10.1186/1475-2875-10-360
43. Akunuri S, Shraddha P, Palli V, MuraliSantosh B. Suspected Artesunate Resistant Malaria in South India. J Glob Infect Dis. 2018;10(1):26. doi:10.4103/jgid.jgid_180_16
44. Singh AK. Prescribing Pattern of Anti-malarial Drugs with Particular Reference to the use of Artesunate in Complicated Plasmodium Vivax Cases. J Clin DIAGNOSTIC Res. 2014. doi:10.7860/JCDR/2014/11253.5336
45. Government of India. Integrated Health Information Platform. https://www.nhp.gov.in/integrated-health-information-platform-(ihip)_ms. Accessed December 26, 2019.
46. World Health Organization. In Its Quest to Eliminate Malaria, India Focuses on Odisha and the Tribal States.; 2018.
47. Pradhan A, Anasuya A, Pradhan MM, et al. Trends in Malaria in Odisha, India-An Analysis of the 2003-2013 Time-Series Data from the National Vector Borne Disease Control Program. PLoS One. 2016;11(2):e0149126. doi:10.1371/journal.pone.0149126
48. Fathima FN, Raju M, Varadharajan KS, Krishnamurthy A, Ananthkumar SR, Mony PK. Assessment of 'accredited social health activists'-a national community health volunteer scheme in Karnataka State, India. J Health Popul Nutr. 2015;33(1):137-145. http://www.ncbi.nlm.nih.gov/pubmed/25995730.
49. Saprii L, Richards E, Kokho P, Theobald S. Community health workers in rural India: analysing the opportunities and challenges Accredited Social Health Activists (ASHAs) face in realising their multiple roles. Hum Resour Health. 2015;13:95. doi:10.1186/s12960-015-0094-3
50. Das A, Ravindran TS. Factors affecting treatment-seeking for febrile illness in a malaria endemic block in Boudh district, Orissa, India: policy implications for malaria control. Malar J. 2010;9(1):377. doi:10.1186/1475-2875-9-377
51. Rotter JB. No Title. Psychol Monogr Gen Appl. 1966;80(1):1-28.
52. Chourasia MK, Raghavendra K, Bhatt RM, Swain DK, Dutta GDP, Kleinschmidt I. Involvement of Mitanins (female health volunteers) in active malaria surveillance, determinants and challenges in tribal populated malaria endemic villages of Chhattisgarh, India. BMC Public Health. 2018;18(1):9. doi:10.1186/s12889-017-4565-4
53. Tripathy P, Nair N, Sinha R, et al. Effect of participatory women's groups facilitated by Accredited Social Health Activists on birth outcomes in rural eastern India: a cluster-randomised controlled trial. Lancet Glob Heal. 2016;4(2):e119-e128. doi:10.1016/S2214-109X(15)00287-9
54. Kengnal P, Holyachi S. Epidemiology of Malaria Cases in India: A Statistical Analysis. Int J Trop Dis Heal. 2016;18(2):1-8. doi:10.9734/IJTDH/2016/26940

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