# Outcome Report

# Assessment of Cost-effectiveness of Mass Testing and Treatment (MTaT) of Malaria in Inaccessible Areas in India


## User Department

## National Vector Borne Disease Control Programme

## HTAIn Regional Resource Hub


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Dr Sanghamitra Pati

Principal Investigator

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# List of Abbreviations

API: Annual Parasite Index

ACD: Active Case Detection

BCC: Behavioural Change Communication

DAMaN: Durgama Anchalare Malaria Nirakarana

HTA: Health Technology Assessment

ICERs: Incremental Cost-Effectiveness Ratios

IEC: Information, Education and Communication

ICMR: Indian Council of Medical Research

MDA: Mass Drug Administration

LLINs: long-lasting insecticide-treated nets

LMIC: Low-and Middle-Income Countries

MTaT: Mass Testing and Treatment

NMCP: National Malaria Control Programme

NMEP: National Malaria Elimination Programme

NVBDCP: National Vector Borne Diseases Control Programme

WHO: World Health Organization

# Executive Summary

**Background**

Malaria is a significant health problem in India contributing to >85% of the estimated cases in South East Asia. In 2021, India accounted for 79% of all cases and 83% of all malaria deaths in the WHO South East Asian Region. In India, approximately 539 million people reside in high transmission areas. Malaria is a major challenge in rural/tribal areas of the central eastern and northeastern states of India. These are all inaccessible areas including hilly terrains, forest areas or regions with seasonal cut offs, having large population of ethnic groups. The National Vector Borne Disease Control Programme (NVBDCP) is responsible for malaria control and provides technical and operational guidance whereas the on-ground services and oversight are provided by the State Vector Borne Disease Control division. The key elements of India's malaria control strategy include early case detection and complete treatment (EDCT) identified through active and passive case surveillance; along with vector control measures, information education and communication (IEC) strategies, and surveillance.

It was observed from the operational research that the persistence of malaria transmission occurs in remote villages/hamlets where there are poor surveillance and the presence of asymptomatic malaria cases (no fever, but they test positive for malaria). These asymptomatic cases act as silent reservoirs for malaria transmission. Hence, the Government of Odisha has initiated a program in 2016-17, called "*Durgama Anchalare Malaria Nirakarana* (DAMaN); Malaria Control in Inaccessible Areas" to combat the asymptomatic reservoirs through mass testing and treatment (MTaT) of positive cases. The main focus of MTaT was to kill malaria-parasites from the entire population in remote and inaccessible pockets, along-with addressing the equity concerns. Asymptomatic malaria remains a challenge for malaria control programs as it significantly influences the transmission dynamics. Odisha has reduced malaria by 80% between 2017 and 2018 through mass testing and treatment (MTaT) in high endemic regions. The reductions in the incidence of malaria in Odisha are attributed to MTaT intervention. In India, Odisha, Chhattisgarh, Madhya Pradesh, and Jharkhand states account for 74.1% of the total malaria cases reported in the country which requires a cost-effective intervention along with a Budget Impact Analysis, which could be useful for large scale implementation of interventions in other parts of the country where the malaria burden is high. Hence, we reviewed the malaria trend in MTaT interventions and control settings and assessed the cost-effectiveness of this intervention along with routine NVBDCP.

**Methods**

P: Population – High-risk groups for malaria transmission (all age group)

I: Intervention – Mass Testing and Treatment (MTaT)

C: Comparator/Control – Routine malaria control program by NVBDCP

O: Outcome – Incremental cost-effectiveness ratios (ICERs) for MTaT, averted cases (through API)

T: Time Horizon – Six-years

**Findings**

An overall significant reduction in the API was observed in intervention districts as compared to control districts post implementation of MTaT intervention. Although, the pace of the slope or reduction plateaued around 2020 which could be due to disruptions caused by COVID-19 pandemic that led to halt in conduction of MTaT camps (social distancing restrictions). The per unit cost of implementing MTaT was 57 INR and that of NVBDCP was 197 INR for the year 2021 in six intervention sites. The total per unit cost of conducting NVBDCP along with MTaT was 254 INR in intervention districts. We found that the per unit cost of conducting NVBDCP in control sites was Rs. 246 INR. Hence, we observed that among intervention sites, there is an additional expenditure of 8 INR on malaria control programme as compared to that of the control site.

**Conclusions and Implication**

We observed that the API trend is decreasing in both intervention and control sites, yet there is a steep slope close to zero in the intervention group which highlights that MTaT along with NVBDCP will be more effective in controlling malaria burden. Additionally, we observed that the cost of implementing NVBDCP is slightly higher in intervention sites as compared to control. This suggests that MTaT is a cost-effective intervention which could help in reducing the cost of routine programme (NVBDCP) in long run as lesser the cases, reduced cost of diagnosis and treatment.

States deemed at high risk for malaria transmission are identified for prompt MTaT implementations. According to the experts' opinion, the states are encouraged to classify their districts for MTaT interventions, with a particular emphasis on selecting districts with an API of 2 and above per 1000 population. Furthermore, districts may subdivide their blocks based on API, and within each block identify the sub-centres based on API (more than 2 per 1000) for MTaT intervention. Moreover, the implementation of MTaT, along with NVBDCP, is encouraged in villages that are geographically inaccessible due to factors such as dense forest areas, absence of road connectivity, seasonal cut-off, a shortage of community health workers (ASHA), and a high density of tribal population.

# Background of the Project

## Malaria: Global Epidemiology and Economic Burden

According to World Health Organization (WHO) Malaria Report 2022, globally (in 84 malaria-endemic countries), there were an estimated 247 million cases of malaria in 2021. In there year 2021, there was an overall increase in 2 million malaria cases as compared to that of the year 2020 [1]. The highest burden of the increase was observed in countries based in the WHO African Region. Moreover, this has also increased from the baseline year of the Global Technical Strategy for Malaria 2016-2030 when there were only 230 million cases in the year 2015 [1]. Nonetheless, malaria case incidence decreased from 82 in 2000 to 57 in 2019, but in the year 2020, it again rose to 59 owing to the disruptions caused by the COVID-19 pandemic, with no change in subsequent years i.e. 2021 [1]. An estimated 13.4 million cases were attributed to disruptions owing to COVID-19. However, the world noticed a reduction in the proportion of cases due to *Plasmodium vivax* which reduced from about 8% in 2000 to 2% in 2021 [1]. Twenty-nine countries in the world account for 96% of malaria cases globally which includes India also. Although, WHO African Region has the highest malaria burden with four countries (Nigeria, the Democratic Republic of Congo, Uganda, and Mozambique) accounting for almost half of all cases globally. Nonetheless, Cabo Verde reported zero indigenous cases for consecutive 3 years in 2021, thus ending the malaria epidemic [1]. The WHO South-East Asia Region accounted for 2% of malaria cases globally. Malaria cases reduced significantly in South-East Asia from 23 million in 2000 to about 5 million in 2021 [1]. The incidence of malaria reduced by 82% in South-East Asia i.e. from 18 cases per 1000 population in 2000 to about 3 cases per 1000 population at risk in 2021. Sri Lanka was certified malaria-free in 2016 and remains malaria free. Between 2020 and 2021, there was an increase in 400000 cases in the region with over half of these cases reported in Myanmar [1]. Malaria cases reduced by 37% in the WHO Eastern Mediterranean region by 38% between 2000 and 2015, however the region witnessed an increase of 44% between 2016 and 2021 [1]. The WHO Western Pacific region had a decrease of 49% cases in 2021 as compared to 2000. Papua New Guinea accounted for majority (87%) of cases in the region in 2021. China was certified malaria-free in 2021 and Malaysia had no cases of non-zoonotic malaria for four consecutive years [1]. The WHO Region of the Americas witnessed a reduction of 60% case incidence in 2021 as compared to 2000 with majority of cases being reported from Brazil, Colombia, and The Bolivarian Republic of Venezuela in the region [1]. The WHO European Region has been malaria free since 2015. Globally, malaria deaths reduced over the period of 2000-2019, but then surged in 2020. However, mortality has again declined in 2021 [1]. Globally, an estimated 2 billion cases and 11.7 million deaths were averted in the period 2000-2021 [1]. Haakenstad et al., estimated that global malaria spending—accounting both for government and out-

of-pocket spending—amounted to $4.3 billion (95% UI 4.2–4.4) in 2016, which is an 8.6% (95% UI 8.1–8.9) per year increase over malaria spending in 2000 [2, 3].

## Malaria: Indian Scenario

Malaria is a significant health problem in India contributing to >85% of the estimated cases in South East Asia. In 2021, India accounted for 79% of all cases and 83% of all malaria deaths in the WHO South East Asian Region [4, 1]. Although, *Plasmodium falciparum* is the most prevalent malarial parasite globally, India accounts for almost half of the *Plasmodium Vivax* cases globally. In India, approximately 539 million people reside in high transmission areas [5]. Malaria is a major health problem in rural/tribal areas of the central eastern and northeastern states of India [6]. These are all tribal dominated states having large population of ethnic groups [7]. Out of 609 districts, 124 districts with 30% or more tribal population comprising about 8% country's population contributed to 46% of the total malaria cases, 70% of *P. falciparum* and 47% of malarial deaths in the country [8]. Thus, tribal areas are heartlands of malaria and there should be the focus on malaria elimination strategies specific to these areas.

## Malaria Control Program in India

India has a long history of success and struggles with malaria control. Prior to the launch of the National Malaria Control Programme (NMCP) in 1953, 75 million cases and about 0.8 million deaths were reported annually for malaria (Figure 1). The widespread use of DDT indoor residual spray (IRS) resulted in a sharp decline in malaria cases, and in 1958, the NMCP was converted to the National Malaria Eradication Programme (NMEP) [9]. The NMEP was initially a great success with the malaria incidence dropping to 0.1 million cases and no deaths were reported due to malaria in 1965. In 1971, the urban malaria scheme (UMS) was also launched to cover 131 cities and towns [10]. These gains were short-lived, and in 1976, 6.4 million cases of malaria re-emerged. The resurgence was attributed to complacency and various operational, administrative, and technical reasons. The emergence of drug resistance in the parasites and insecticide resistance in the vectors also contributed to the resurgence. In 1977, the modified plan of operation (MPO) was initiated with the objectives to reduce malaria morbidity and prevent deaths due to malaria. Under the MPO, in addition to early diagnosis and prompt treatment, IRS was recommended in areas with annual parasite incidence (API) $\geq 2$ [11]. The malaria incidence dropped to 1.66 million cases in 1987. The limited resources in many states, however, allowed spray coverage in areas with API > 5 only. In 1977, the eradication goal was officially shelved and the programme was changed to the National Anti-Malaria Programme (NAMP). By 1996, there was another malaria upsurge with reported 3.03 million cases and 2803 deaths [10]. In 2002, the NMCP became a part of the National Vector Borne Disease Control Programme (NVBDCP).

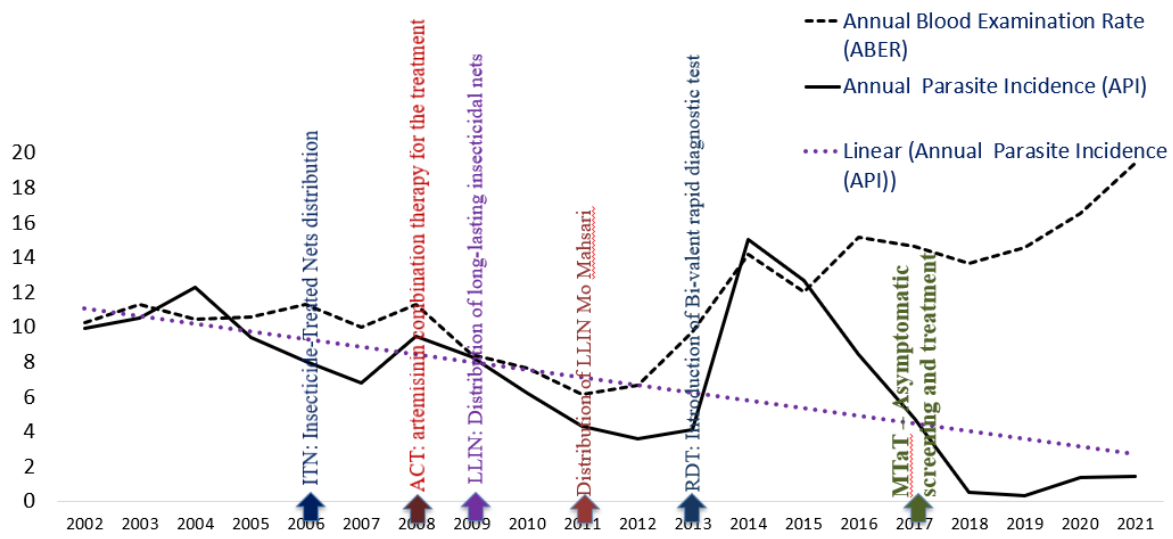


Figure 1: Major malaria control interventions

Responsibility for malaria control was divided between the central and the state governments of India. Technical and operational guidance was provided by the NVBDCP and the on-ground services and oversight were provided by the State Vector Borne Disease Control Division. The key elements of India's malaria control strategy include early case detection and complete treatment (EDCT), based on parasitological diagnosis of all suspected cases and complete treatment of all confirmed cases identified through active and passive case surveillance; along with vector control measures, information education and communication (IEC) strategies, and surveillance (Figure 2). The NVBDCP's commitment to end malaria aligns with rest of the world and responds to the commitment for malaria elimination by 2030 [11]. The National Strategic Plan for Malaria Control in India 2012–2017 was followed by the development of the National Framework for Malaria Elimination in India 2016–2030. The plan details every technical and operational element required for the nation to achieve malaria elimination by 2030.


Figure 2: Gaps in Malaria Elimination programme

## Mass Testing and Treatment (MTaT) of Malaria: Global Scenario

The pathogenesis of malaria is complex, and the clinical presentation of disease ranges from severe and complicated, to mild and uncomplicated, to asymptomatic malaria. Asymptomatic malaria remains a challenge for malaria control programs as it significantly influences the transmission dynamics [12]. A study conducted in Ethiopia showed the prevalence of asymptomatic malaria was about six percent; furthermore, it also revealed that larger family size and previous history of malaria had significantly associated with the burden of asymptomatic malaria [13]. Moreover, in sub-Saharan Africa, Zanzibar provided new evidence on sustainable malaria reduction by asymptomatic malaria screening in the high endemic regions [14]. According to Sturrock et al. both hotspots – geographically discrete households and hotpops – demographically discrete populations having high malaria rates are the main target region for asymptomatic malaria screening and treatment. Hence, scaling up the screening and treatment of asymptomatic malaria in endemic regions is one of the priority interventions for the elimination of malaria [14, 15]. MTaT is one of the various recommendations provided by the WHO for eliminating malaria. The recommendations are broadly divided into three categories: i) mass strategies applied to the entire population of a delimited-geographical area, whether it be a village, township or district; these strategies include mass drug administration, MTaT and mass relapse prevention (MRP); ii) targeted strategies applied to people at a greater risk of infection than the general population; and iii) reactive strategies triggered in response to individual cases that includes reactive case detection and treatment to reduce transmission of malaria and reactive IRS.

## Mass Testing and Treatment in Indian Context

It was observed from the operational research that the persistence of malaria transmission occurs in remote villages/hamlets where there are poor surveillance and the presence of asymptomatic malaria cases (no fever but they test positive for malaria). These asymptomatic cases act as silent reservoirs for malaria. Hence, the Government of Odisha state has initiated an innovative program in 2016-17, called "*Durgama Anchalare Malaria Nirakarana* (DAMaN); Malaria Control in Inaccessible Areas" to combat the asymptomatic reservoirs through mass screening and treatment of positive cases [16]. DAMaN is a type of MTaT activity with a focus on killing malarial parasites from the entire population in remote and inaccessible pockets, along-with addressing the equity concerns (Figure 3). It is done through mass testing with rapid diagnostic kit (RDK) for all age groups twice a year by organizing camps at the identified sites in villages. After mass testing, complete treatment is provided by the community health workers by following those tested positive. Additionally, information, education and communication activities are also done to increase the uptake of long lasting insecticidal treated nets (LLINs). The elimination interventions will require additional resources and regular monitoring to

sustain the momentum and stop the re-emergence of malaria. Hence, the Government needs support to identify the population at risk for asymptomatic malaria screening and its cost-effectiveness and budget impact analysis for the scaling-up of the program.

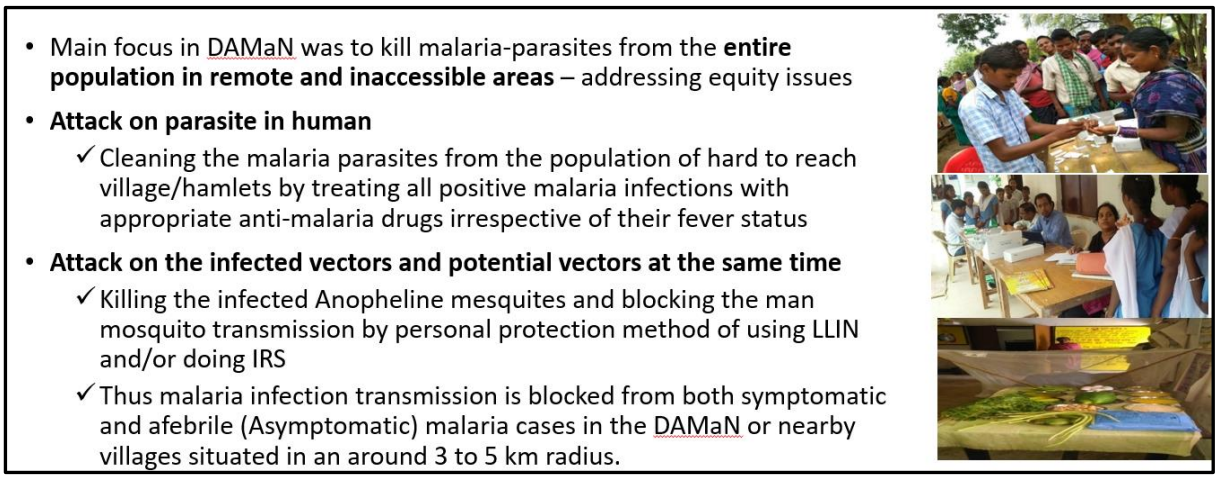


Figure 3: Overview of MTaT intervention

## Rationale of the project

Globally, malaria is considered as one of the severe public health issues, which causes immense morbidity as well as mortality [17]. It is a leading cause of death and disease particularly in low- and middle-income countries (LMIC) including India [17]. The elimination of malaria focusing on prevention and control of infection needs community access to the program as well as large scale coverage of effective interventions [18]. Furthermore, decisions on scale-up of the interventions require strong evidence on effectiveness, cost-effectiveness and equity of the interventions [19-23] along with acceptability of the program by the various stakeholders including community members, service providers, managers and decision-makers [24-27].

Globally, there is evidence that the detection and management of asymptomatic carriers have become an innovative strategy for malaria control programs as the treatment of asymptomatic cases have a potential impact on malaria reduction particularly in endemic regions [28]. A systematic review of the costs and cost-effectiveness of malaria interventions showed that most of the studies were undertaken in sub-Saharan Africa (78%) and limited studies were conducted in Asia (18%) as well as South America (4%) [23]. It was observed that the median cost of diagnosing a case of malaria was $4.32, however, the median financial cost of treating an episode of severe malaria was $30.26 [23]. The previous studies showed that MTaT is preferred than mass drug administration (MDA), as the latter involves massive over-use of drugs. MTaT incremental cost-effectiveness ratios (ICERs) were estimated in different sub-Saharan African settings revealed that at low transmission, MSTM probably is not worth considering. Instead, MTaT may be suitable at medium to high levels of transmission regions [22]. However, a cluster randomized control trial in Zambia estimated that population-wide

MDA was more cost-effective compared to MTaT for transmission reduction [21]. In low resource settings, the optimal use of limited financial resources perpetrates the cost and cost-effectiveness analyses of MTaT. Consequently, clear evidence on the costs and cost-effectiveness of malaria control interventions is crucial for resource allocation and the selection of ideal interventions by malaria control programs [18, 23].

Community-based intervention on the management of malaria was proven as an effective and promising strategy for the prevention and control of malaria [25, 26]. Moreover, it was worthwhile to break financial and geographical barriers in relation to access healthcare especially in rural, remote, and hilly areas, where a majority of the population are vulnerable to malaria parasite infections. Furthermore, several studies proposed MTaT is an effective strategy to reduce parasite load particularly in high malaria-endemic regions [14, 15]. However, refinement of the large-scale implementation of interventions requires evidence on operational feasibility, cost implications and sustainability before expanding/scale-up the program.

MTaT was evaluated as a potential tool for malaria control and prevention across the globe [25-27]. Although, it was well accepted by the various stakeholders' including community members; still, it is important to understand the operational feasibility of the interventions including contextual needs – acceptance, community mobilization, service delivery and timing [25]. The evidence suggests that community literacy and long-term approach to community-engagement are vital to avoid misconceptions and fear towards MTaT [24-25, 27]; which is crucial for successful implementation of the community-based intervention. Therefore, it is essential to understand all stakeholders' perceptive on asymptomatic screening of malaria along with operational feasibility and cost-effectiveness analysis.

The evidence showed that if timely interventions are not undertaken or the existing surveillance system is not strengthened then it may increase the societal cost in terms of higher out of pocket expenditure for the treatment of positive cases, along with increased mortality and reduced quality-adjusted life years [13, 15, 16, 18, 21, 28]. As per the strategic plan, identification of local hot spots, identification of risk population MTaT and surveillance are essential. Hence, it is crucial to identify the population at risk for asymptomatic malaria screening and its cost-effectiveness and operational feasibility for scaling-up the program along with the budget impact analysis.

The pathogenesis of malaria is complex, and the clinical presentation of disease ranges from severe and complicated, to mild and uncomplicated, to asymptomatic malaria. Asymptomatic malaria remains a challenge for malaria control programs as it significantly influences the transmission dynamics [12]. Odisha state has emerged as an innovative step in malaria reduction – reduced above

80% between 2017 and 2018 through MTaT in high endemic regions, which is projecting as a future model for malaria eradication in India [16, 29]. The reductions in the incidence of malaria in Odisha are mainly due to DAMaN (MTaT) intervention**.** The program includes MTaT of malaria along with supportive supervision and community literacy. Hence, it is prudent to address the equity in terms vulnerability mapping – identify the prevalence and map the risk population, which will be considered for MTaT. In India Odisha, Chhattisgarh, Madhya Pradesh, and Jharkhand states account for 74.1% of the total malaria cases reported in the country which requires a cost-effective intervention along with a Budget Impact Analysis, which could be useful for large scale implementation of interventions in other parts of the country where the malaria burden is high.

## Overall aim

To review the malaria trend between MTaT intervention and control settings before and after intervention; and to assess the cost-effectiveness of mass testing and treatment (MTaT) of malaria along with other routine NVBDCP programs.

Specific objectives

- To examine the trend of malaria in interventions and control blocks.
- To examine the cost-effectiveness of MTaT intervention along with routine malaria control program.

# Methods

## Population, Intervention, Comparator, and Outcomes (PICO)

**P: Population** – High-risk groups for malaria transmission (all age group including newborn children)

**I: Intervention** – Mass Testing and Treatment (MTaT) of malaria

**C: Comparator/Control** – Routine malaria control program by NVBDCP

**O: Outcome** – Incremental cost-effectiveness ratios (ICERs) for MTaT, averted cases (through API)

**T: Time Horizon** – Six-year time period

## Study settings

We chose six intervention sites from Odisha (MTaT implemented along with regular NVBDCP) and six control sites i.e. three each from Jharkhand and Chhattisgarh (only NVBDCP).

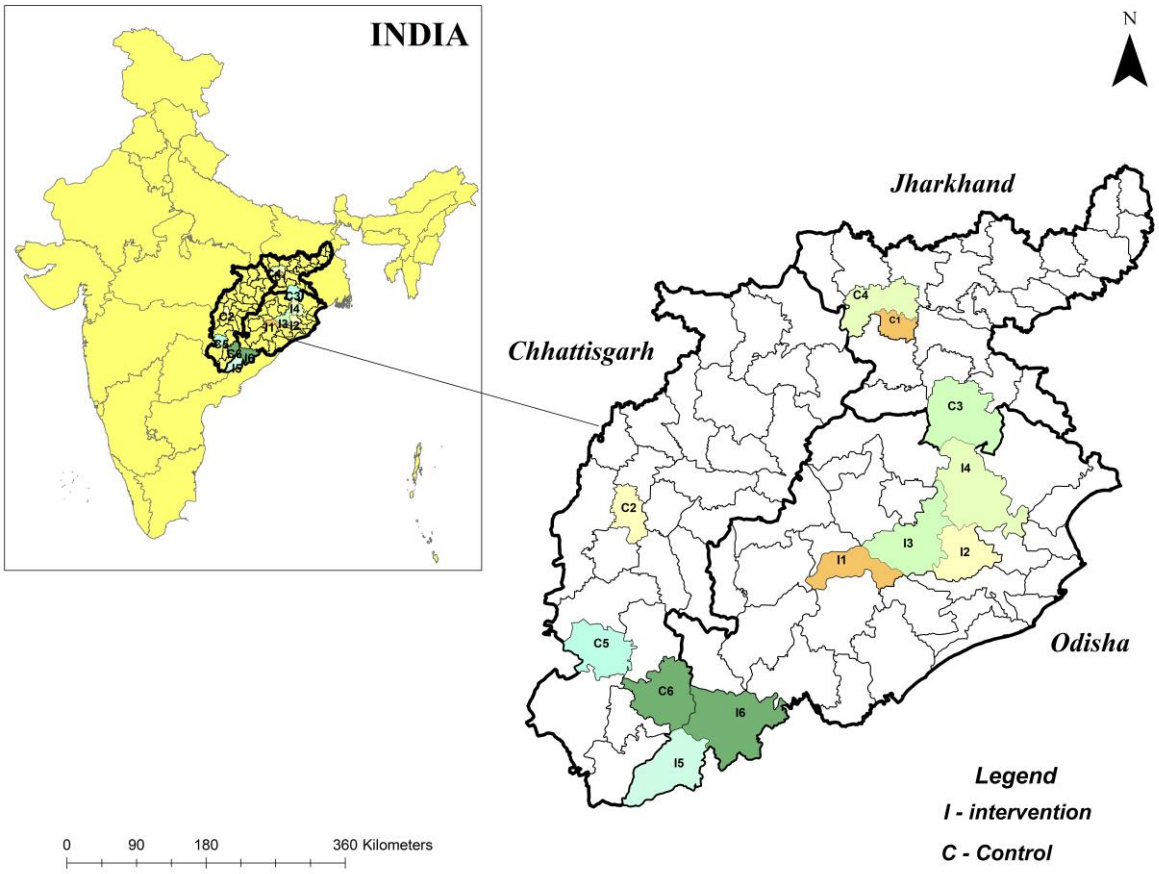


Figure 4: Map of intervention and control sites taken in the study

These intervention and control sites (Table 1) were matched for API in the year 2017 at the time of MTaT implementation (before intervention matched API). The detailed sites are shown in the figure 4. The detailed methods presented in Table 2.

Table 1. Settings and sampling strategy

| State | District | API (2017) | Block | Total population | % of Tribal Population | Literacy Rate | Total villages under CHC | Total no. of residential school | Total number of households | Total no of ASHA |
|---|---|---|---|---|---|---|---|---|---|---|
| Jharkhand (Control) | Latehar | 12.8 | Balumath | 206422 | 27 | 58 | 172 | 5 | 37848 | 273 |
| | West Singhbhum | 10.39 | Nowamundi | 120456 | 58 | 63 | 66 | 1 | 19675 | 114 |
| | Lohardaga | 2.29 | Kuru | 135868 | 48 | 67 | 76 | 2 | 23837 | 102 |
| Chhattisgarh (Control) | Narayanpur | 42.05 | Narayanpur | 122290 | 24 | 56 | 187 | 3250 | 22691 | 365 |
| | Bastar | 15.05 | Bastanar | 55992 | 92 | 23 | 46 | | 11726 | 317 |
| | Durg | 0.71 | Patan | 365289 | 8.6 | 68 | 146 | | | 497 |
| Odisha (Intervention) | Boudh | 4.76 | Harbhanga | 135797 | 18 | 74 | 368 | 8 | 32209 | 184 |
| | Dhenkanal | 1 | Hindol | 178899 | 9 | 73 | 167 | 3 | | 170 |
| | Anugul | 7.4 | Pallahara | 145245 | 48 | 67 | 218 | 13 | 35320 | 134 |
| | Keonjhar | 16.9 | Joda | 149185 | 40 | 67 | 215 | 6 | 29456 | 189 |
| | Malkangiri | 37.3 | Khairput | 47903 | 58 | 34 | 214 | 16 | 10881 | 85 |
| | Koraput | 26.4 | Boipariguda | 127632 | 58 | 38 | 650 | 24 | 29847 | 230 |

Table 2: Detailed Methods

| Specific Objectives | Design, Settings, and Participants | Analysis |
|---|---|---|
| Malaria Trend | ・ Desk review of programmatic data<br>・ Programmatic data of state National Vector Borne Diseases Control Programme (NVBDCP) | • Visual Representation |
| Cost-effectiveness of MTaT | ・ Health system cost<br>・ Prevalence of malaria (API)<br>・ Data collected from primary and secondary sources. | • Decision Tree |

## Conceptual framework for decision tree

The existing National Vector Borne Disease Control Program (NVBDCP) has been active against all vector-borne diseases in India for nearly two decades. However, this program has been mixed success in states with high malaria endemicity. To reduce the high malaria burden, the Government of Odisha started a unique initiative malaria control programme in 2017 in hard-to-reach-areas. Mass testing and treatment (MTaT) is the key strategy to control malaria transmission, along with the promotion of long-lasting-insecticidal nets (LLIN), insecticidal residual spray (IRS) and spreading awareness against malaria. A decision tree model with a six-year time horizon (three years each for pre and post MTaT implementation period) was used to evaluate the cost-effectiveness of the MTaT programme. We

defined effectiveness as the reduction in API of the year in interventions and control blocks. In this model, we assumed risk population for malaria infection are screened, diagnosed, treated, and prevented from malaria infection through the NVBDCP program with the MTaT scheme as intervention and routine program of NVBDCP as control group; as NVBDCP is the routine existing universal program implemented in India for malaria prevention and control. These programs identify the malaria-infected persons in high API as well as low API districts. Prevalence of malaria infection (through API) was seen for MTaT and NVBDCP separately in the intervention branch. The intervention and control branch has two branches with end nodes and their expected cost is determined as follows:

- Branch A|A': The cost of preventing and detecting of malaria infection, reflecting with Prevalence of malaria in NVBDCP + MTaT and routine program of NVBDCP implemented blocks of high API district, is included under this branch.
- Branch B|B': The cost of preventing and detecting of malaria infection, reflecting with prevalence of malaria in NVBDCP + MTaT and routine program of NVBDCP implemented blocks of low API district, is included under this branch.

The total costs of MTaT + NVBDCP and the Routine program of NVBDCP branches indicate the total cost of each program for the risk population. Our expected effectiveness for each program is calculated by multiplying the number of risk population entering the model by taking the prevalence of malaria (Figure 5).

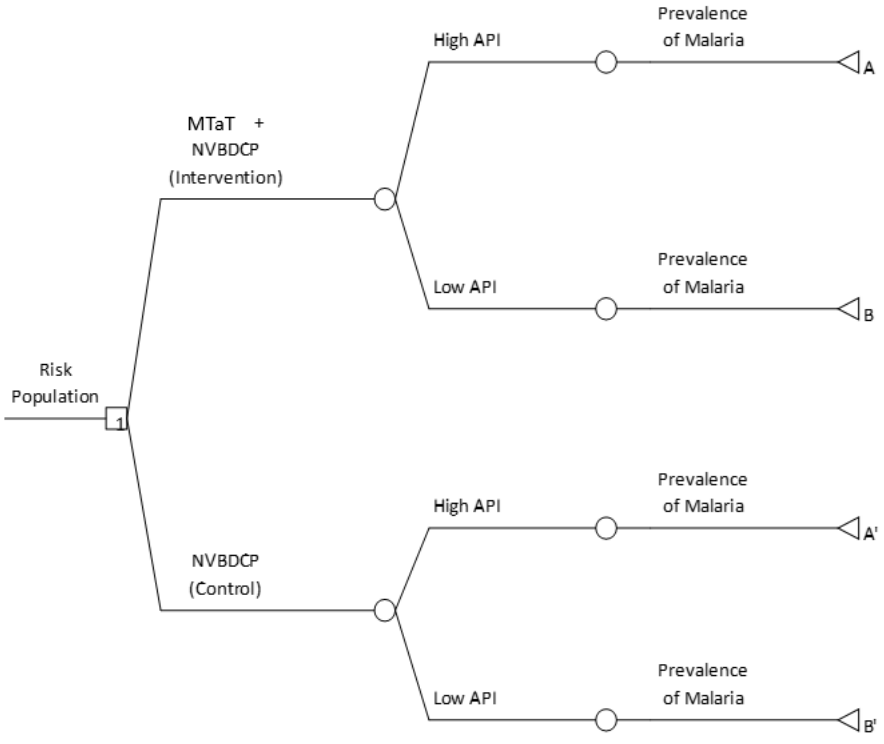


Figure 5: Conceptual Framework for Decision tree

The framework for costing was done in five stages: firstly, we collected preliminary data regarding budgetary allocation, programmatic data from NVBDCP and block programme management unit of Department of Health of the respective states. It was followed by segregation of data regarding basic unit costs of human resources, various consumables and non-consumables for the malaria control programs. The costs were then calculated based on services provided for malaria control such as mass screening and treatment. Human resource costing was done according to the time spent for malaria control for the respective programs. NVBDCP also works for diseases other than malaria whereas MTaT specifically works for malaria control so, all the costs were adjusted according to the time spent and prevalence of malaria cases in the region. The budget impact analysis estimates the annual total cost of each of the malaria program from the perspective of the health system for each block regarding screening, and treatment of malaria infection by MTaT. The total cost includes the unit cost per person screened, and treated multiplied by the number of persons at risk of malaria in the blocks.

## Ethical considerations

This study was approved by the Technical Appraisal Committee (TAC) of Health Technology Assessment in India, Department of Health Research (DHR), Ministry of Health and Family Welfare, Government of India. The ethical clearance was obtained from the Institutional Ethical Committee of ICMR-RMRC Bhubaneswar and State Research and Ethics Committee, Department of Health and Family Welfare,Govt. of Odisha. Permission was obtained from the concerned local authorities.

# Findings

## Comparison of Annual Parasite Index Trends in intervention and control sites

The implementation of MTaT encompasses universal screening for malaria has led to a reduction in the API of Odisha. However, there is lack of evidence that whether it is only in MTaT implemented other parts of the country have also experienced similar reductions in API. Hence, we compared the API of intervention (Odisha) and control (Jharkhand and Chhattisgarh) groups post MTaT implementation to garner evidence on the same. We collected data on the Annual Parasite Index (API) of the intervention district and its control from the year 2011 to 2021. Although, we intended to collect block-level data, but API at block were not available at many places especially of the past years due to which we had to resort to district level API. The MTaT intervention was started in the year 2017. The API matched (for 2017) intervention and control sites were compared for the trends in API post implementation of MTaT in Odisha with the regular NVBDCP implemented control sites. We used graphical representation to show the trends of each if the intervention-control groups (Figure 6).

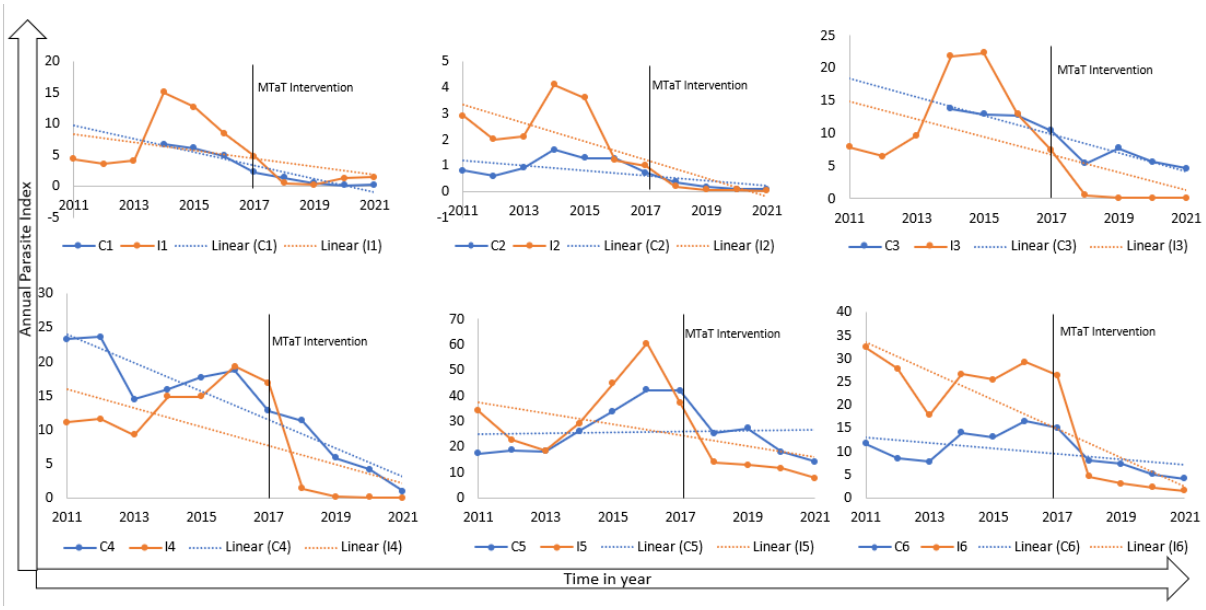


Figure 6: Trend of Annual Parasite Index (API) 2011-21 in MTaT Interventions and Control districts

We observed that there is a sharp decline in the API between 2011-2017 in the intervention district which kept declining more as compared with the control. However, it plateaued around 2020 (COVID-19/pandemic year). However, its decline continued till 2021. We saw a sharp and continuous decline in API between the second intervention and control pair districts during 2017-2021. We observed a very steep reduction in the API of intervention district post MTaT implementation which continued till 2021, although it plateaued around 2019-2021. We saw a significant reduction in the API of the intervention district during 2017-2018 which was levelled during 2019 but again an upsurge was

observed during 2019-2021. In the sixth district, a significant reduction in API was observed from 2017-2021. An overall significant reduction in the API was observed in intervention districts as compared to control districts post implementation of MTaT programme. Although, the pace of the slope or reduction plateaued around 2020 which could be due to disruptions caused by COVID-19 pandemic that led to halt in conduction of MTaT camps (social distancing restrictions).

## Costing of NVBDCP and MTaT in Intervention blocks

Table 3: Demographic and epidemiological parameters of each of the intervention blocks in 2021

| **MTaT (Round 1 + Round 2) Demographic and epidemiological parameters** | **I1** | **I2** | **I3** | **I4** | **I5** | **I6** |
|---|---|---|---|---|---|---|
| No. of target villages | 90 | 24 | 138 | 30 | 149 | 231 |
| Villages covered | 90 | 24 | 138 | 30 | 149 | 149 |
| Total target population | 10588 | 3512 | 41568 | 11329 | 27908 | 26964 |
| Population covered during camp | 4824 | 3236 | 21498 | 10097 | 26302 | 25010 |
| No. of camps (Target) | 52 | 14 | 132 | 30 | 140 | 55 |
| No. of camps (Conducted) | 52 | 14 | 132 | 30 | 140 | 55 |
| Total Screened | 4824 | 3236 | 21498 | 10097 | 26302 | 25010 |
| No. of asymptomatic malaria cases diagnosed | 98 | 0 | 29 | 3 | 225 | 157 |
| No. of asymptomatic malaria treated | 98 | 0 | 29 | 3 | 225 | 157 |

Table 4: Description of testing status in selected blocks

| **Site** | **State** | **Block** | **Year 2021** | | |
|---|---|---|---|---|---|
| | | | **RDK** | **Microscopy** | **Positive** |
| Control | Jharkhand | C1 | 1133 | 5639 | 21 |
| | | C3 | 8918 | 11764 | 517 |
| | | C4 | 20049 | 22422 | 277 |
| | Chhattisgarh | C2 | 15126 | 26771 | 13 |
| | | C5 | 20444 | 20176 | 1181 |
| | | C6 | 12813 | 752 | 1058 |
| Intervention | Odisha | I1 | 29846 | 3683 | 331 |
| | | I2 | 21422 | 3262 | 7 |
| | | I3 | 27844 | 4090 | 34 |
| | | I4 | 29639 | 0 | 18 |
| | | I5 | 24515 | 4772 | 632 |
| | | I6 | 24108 | 3259 | 176 |

*RDK: Rapid Diagnostic Kit

Table 5: Overall demographic and epidemiological parameters of all intervention blocks in 2021

| **Demographic and epidemiological parameters** | **N** |
|---|---|
| No. of target villages | 662 |
| Villages covered | 662 |
| Target population (Total population of the target villages) | 121869 |
| Population covered | 90967 |
| No. of camps (Target) | 423 |
| No. of camps (Conducted) | 423 |

| | |
|---|---|
| Total screened | 90967 |
| No. of asymptomatic malaria cases diagnosed | 512 |
| No. of patients asymptomatic received treatment | 512 |

Table 6: Coverage of MTaT through program data (Year 2021)

| Target population | Population Covered | Percentage of coverage |
|---|---|---|
| 121869 | 90967 | 74.64% |

Table 7: Break-up cost of village contact drive for MTaT

| Break-up cost of village contact drive for MTaT | Cost per camp (INR) |
|---|---|
| Advance intimation to community | 100 |
| Preparatory meeting | 300 |
| Printing and Use of IEC material | 700 |
| One wall painting | 1000 |
| School sensitization meeting | 200 |
| Drum beating | 200 |
| Documentation of MTaT activities | 100 |
| **Total** | 2600 |

Table 8: Cost of conducting MTaT in intervention blocks in the year 2021

| | COSTING | Unit Cost (INR) | Staff (N) | Days (N) | Camps/ Cases (N) | Total |
|---|---|---|---|---|---|---|
| **Human Resources** | Incentives for volunteers | 250 | 3 | 3 | 423 | 951750 |
| | TA & DA for health staffs (MPHS/MPW) | 100 | 2 | 3 | 423 | 253800 |
| **Total Human Resources cost (1)** | | | | | | **1205550** |
| **Transport to camp site (2)** | Mobility support to camp site | 950 | | 3 | 423 | **1205550** |
| **Training** | Training of field staff | 1200 | | | 423 | 507600 |
| **IEC/BCC** | Village contact drive | 2600 | | | 423 | 1099800 |
| | Contingency (IEC & BCC materials, refreshment) | 1000 | | | 423 | 423000 |
| **Meetings** | Orientation (District @4000/- & Block @1000/-) | 5000 | | | | 5000 |
| | Review meeting (District level @3000/-) | 3000 | | | | 3000 |
| **Total cost for training, IEC/BCC and meeting (3)** | | | | | | **2038400** |
| **Screening cost** (total target population*RDK cost) **(4)** | | 20 | | | 121869 | **2437380** |
| **Treatment cost** [Asymptomatic cases*(10 tabs cost@ 10 INR + ASHA incentive for treatment follow-up @Rs75 INR] **(5)** | | 85 | | | 512 | **43520** |
| **Total Cost (1+2+3+4+5)** | | | | | | **6930400** |
| MTaT cost per individual (Total MTaT cost/Total target population) | | | | | | **57** |

IEC/BCC: Information, Education and Communication/Behavioral Change Communication

## Costing of NVBDCP in intervention blocks

Table 9: Human Resources Cost for NVBDCP in intervention blocks (Year 2021)

| Human Resource | Monthly salary as per 7th CPC (INR) | No. of units | Total working hours/ month (48*30days) | % of hours dedicated to malaria | Hours dedicated for malaria (month) | Annual cost for malaria (INR) |
|---|---|---|---|---|---|---|
| Medical Officer | 65637 | 36 | 1440 | 20% | 288 | 5671037 |
| MPHS (M/F) | 9600 | 28 | 1440 | 30% | 432 | 967680 |
| MPWs | 9600 | 218 | 1440 | 30% | 432 | 7534080 |
| VBDC (Excluding PI i.e. 25% of Base Salary) | 50468 | 6 | 1440 | 70% | 1008 | 2543587 |
| VBDTS (Excluding PI i.e. 25% of base salary) | 20130 | 6 | 1440 | 70% | 1008 | 1014552 |
| Laboratory Technicians | 14568 | 16 | 1440 | 40% | 576 | 1118822 |
| Sentinel site malaria technician & Coordinator (Excluding PI i.e. 25% of Base Salary) | 20130 | 6 | 1440 | 100% | 1440 | 1449360 |
| Finance & Logistic Assistant (NVBDCP) (Excluding PI i.e. 25% of Base Salary) | 23192 | 6 | 1440 | 20% | 288 | 333965 |
| **Total (IA)** | **216825** | | | | | **20633083** |

Table 10: Incentive cost for NVBDCP in intervention blocks (Year 2021)

| Incentives | Incentive per case (INR) | Total Number Test | Total Incentives (INR) |
|---|---|---|---|
| ASHA Incentive for testing | 15 | No. of RDK Test Done: 135952 | 2039280 |
| ASHA Incentive for treatment per case | 75 | No. of cases: 1198 | 89850 |
| **Total (IB)** | | | **2129130** |

Table 11: Training cost for NVBDCP in intervention blocks (Year 2021)

| Training (District Level) | Unit Training Cost (INR) | No. of Units | Frequency of training/ Year | Training Cost (INR) |
|---|---|---|---|---|
| Medical Officer | 5400 | 36 | 1 | 194400 |
| ASHA/ CHWs | 1000 | 992 | 1 | 992000 |
| MPHS (M/F) Induction Training | 1000 | 28 | 1 | 28000 |
| MPWs Refresher Training | 1000 | 218 | 1 | 218000 |
| VBDC | 4500 | 6 | 1 | 27000 |
| VBDTS (Refresher training, IHIP), 2 days | 6000 | 6 | 1 | 36000 |
| LTs induction training, 10 days | 19000 | 16 | 1 | 304000 |
| LTs refresher training, 5 days | 8400 | 16 | 1 | 134400 |
| **Total (IC)** | **46300** | **1318** | | **1933800** |

Table 12: Cost of consumables for NVBDCP in intervention blocks (Year 2021)

| **Consumables (Testing kits and medicines)** | **Unit cost (INR)** | **No of tablets/ case** | **No of cases** | **% age share of cases** | **Total No. of cases** | **Total Cost** |
|---|---|---|---|---|---|---|
| Chloroquine phosphate tablets (per unit/tablet; 1 strip=10 tabs) | 1 | 10 | 1198 | 8% | 96 | 960 |
| Primaquine tablets (per unit/tablet) | 1 | 6 | 1198 | 92% | 1102 | 6612 |
| Testing kit (RDK) | 20 | 135952 | | | | 2719040 |
| Glass slides for microscopy | 2 | 19066 | | | | 38132 |
| Chemical and reagents | | | | | | 50000 |
| **Total (ID)** | | | | | | **2814744** |

Table 13: Indirect cost/Societal cost for visiting Primary Health Centers by suspected malaria patients in intervention blocks (Year 2021)

| **Indirect cost category** | **Unit Cost** | **Units (cases with microscopy test)** | **Total** |
|---|---|---|---|
| Travel to Primary Health Centres | 150 | 19066 | 2859900 |
| **Total (IE)** | | | **2859900** |

Table 14: Cost for various behavior change communication activities for NVBDCP in intervention blocks (Year 2021)

| **IEC/BCC Activities** | **Unit cost** | **Units** | **Total** |
|---|---|---|---|
| Advocacy at the district Level (World Malaria Day | 15000 | 6 | 90000 |
| GKS sensitization at the sub-centre level | 600 | 142 | 85200 |
| **Total (IF)** | | | **175200** |

Table 15: Per unit cost of NVBDCP for intervention block (Year 2021)

| **Total NVBDCP cost** (IA+IB+IC+ID+IE+IF) [for 155018 individuals] | **30545857** |
|---|---|
| NVBDCP cost (INR) per individual (Total NVBDCP cost/Total number of RDK and Microscopy test) | 197 |

Table 16: Total unit cost (per person) for NVBDCP+ MTaT

| | |
|---|---|
| MTaT (per unit cost) (INR) | 57 |
| NVBDCP (per unit cost) (INR) | 197 |
| **Total cost per person (NVBDCP+MTaT) in INR** | **254** |

## Costing of NVBDCP in control blocks

Table 17: Human Resources Cost for NVBDCP in control blocks (Year 2021)

| Human Resource | Monthly Salary as per 7th CPC (INR) | No. of units | Total working hours/ month (48*30days) | % of hours dedicated to malaria | Hours dedicated to malaria (month) | Annual towards Malaria (INR) |
|---|---|---|---|---|---|---|
| Medical Officer | 65637 | 58 | 1440 | 20% | 288 | 9136670 |
| MPHS (M/F) | 9600 | 22 | 1440 | 30% | 432 | 760320 |
| MPWs | 9600 | 154 | 1440 | 30% | 432 | 5322240 |
| VBDC (Excluding PI i.e. 25% of Base Salary) | 50468 | 6 | 1440 | 70% | 1008 | 2543587 |
| VBDTS (Excluding PI i.e. 25% of Base Salary) | 20130 | 10 | 1440 | 70% | 1008 | 1690920 |
| Laboratory Technicians | 14568 | 26 | 1440 | 40% | 576 | 1818086 |
| Sentinel site malaria technician and coordinator (Excluding PI i.e. 25% of base salary) | 20130 | 6 | 1440 | 100% | 1440 | 1449360 |
| Finance & Logistic Assistant (NVBDCP) (Excluding PI i.e. 25% of base salary) | 23192 | 6 | 1440 | 20% | 288 | 333965 |
| **Total (CA)** | | | | | | **21271824** |

Table 18: Incentive cost for NVBDCP in control blocks (Year 2021)

| Incentives | Incentive per case (INR) | Total Number | Total Incentives (INR) |
|---|---|---|---|
| ASHA Incentive for testing | 15 | No. of RDK Test Done: 78483 | 1177245 |
| ASHA Incentive for treatment per case | 75 | No. of cases: 3067 | 230025 |
| **Total (CB)** | | | **1407270** |

Table 19: Training cost for NVBDCP in control blocks (Year 2021)

| Health System Cost: Training (District Level) | Unit Training Cost (INR) | No. of Units | Frequency of training/ Year | Training Cost (INR) |
|---|---|---|---|---|
| Medical Officer | 5400 | 58 | 1 | 313200 |
| ASHA/CHWs | 1000 | 1667 | 1 | 1667000 |
| MPHS (M/F) Induction Training | 1000 | 22 | 1 | 22000 |
| MPWs Refresher Training | 1000 | 154 | 1 | 154000 |
| VBDC | 4500 | 6 | 1 | 27000 |
| VBDTS (Refresher training, IHIP), 2 days | 6000 | 10 | 1 | 60000 |
| LTs induction training, 10 days | 19000 | 26 | 1 | 494000 |
| LTs refresher training, 5 days | 8400 | 26 | 1 | 218400 |
| **Total (CC)** | **46300** | **1969** | | **2955600** |

Table 20: Cost of consumables for NVBDCP in control blocks (Year 2021)

| **Consumables** | | | | | | |
|---|---|---|---|---|---|---|
| **Drugs** | Cost (INR) | No of Tablets/case | No of cases | %age share of cases | Total No. of cases | **Total Cost** |
| Chloroquine phosphate tablets (Per unit/Tablet) (1 strip=10 tabs) | 1 | 10 | 3067 | 8% | 245 | 2450 |
| Primaquine tablets (per unit/tablet) | 1 | 6 | 3067 | 92% | 2822 | 16932 |
| Testing kit (RDK) | 20 | 78483 | | | | 1569660 |
| Glass slides for microscopy | 2 | 87524 | | | | 175048 |
| Chemical and Reagents | | | | | | 50000 |
| **Total (CD)** | | | | | | **1814090** |

Table 21: Indirect cost for visiting Primary Health Centres by suspected malaria patients in control blocks (Year 2021)

| **Indirect cost category** | **Unit Cost** | **Units (Cases with microscopy test)** | **Total cost** |
|---|---|---|---|
| Travel to Primary Health Centres | 150 | 87524 | 13128600 |
| **Total (CE)** | | | **13128600** |

Table 22: Cost for various behaviours change communication activities for NVBDCP in control blocks

| **IEC/BCC Activities** | **Unit cost** | **Units** | **Total** |
|---|---|---|---|
| Advocacy at the district Level (World Malaria Day | 15000 | 6 | 90000 |
| GKS Sensitization at sub-centre level | 600 | 171 | 102600 |
| **Total (CF)** | | | **192600** |

Table 23: Per unit cost of NVBDCP (in INR) in control blocks

| **Total NVBDCP cost** (IA+IB+IC+ID+IE+IF) [for 166007 individuals] | 40769984 |
|---|---|
| NVBDCP cost (INR) per individual (Total NVBDCP cost/Total number of RDK and Microscopy test) | **246** |

## Comparison of cost: NVBDCP+MTaT in intervention and NVBDCP in control blocks

Table 24: Comparison of cost for NVBDCP + MTaT in Intervention and NVBDCP in control blocks

| Costing Heading | Total NVBDCP Cost Interventions blocks (Year 2021), INR | Total NVBDCP Cost Control blocks (Year 2021), INR |
|---|---|---|
| Human Resource (A) | 2,06,33,083 | 2,12,71,824 |
| Incentives (B) | 21,29,130 | 14,07,270 |
| Training cost (C) | 19,33,800 | 29,55,600 |
| Cost of consumables – testing and treatment (D) | 28,14,744 | 18,14,090 |
| Indirect cost (Travel to PHCs) | 28,59,900 | 13128600 |
| IEC/BCC activities (E) | 1,75,200 | 1,92,600 |
| **Total NVBDCP cost** | **3,05,45,857** | **4,07,69,984** |
| Total individual tested (RDK + Microscopy) | 1,55,018 | 1,66,007 |
| **NVBDCP cost per individual** | **197** | **246** |
| Total cost for MTaT | 69,30,400 | NA |
| **MTaT (per unit cost)** | **57** | NA |
| **Total cost (NVBDCP+MTaT)** | **3,74,76,257** | NA |
| **Total unit cost (per person) (NVBDCP+MTaT)** | **254** | NA |

The per unit cost of implementing MTaT along with the routine NVBDCP programme is 254 INR as compared to 246 INR among control sites where only the NVBDCP programme is implemented. We observed that among intervention sites, there is an additional expenditure of Rs. 8.4 per individual on the malaria control programme as compared to that of the control site.

## Incremental Cost-Effectiveness Ratio (ICER)

$$ICER = \frac{Cost(A) - Cost(B)}{Benefit(A) - Benefit(B)}$$

ICER=37476257-40769984/2.5-3.3
ICER=-3293727/-0.8
ICER=4117159

## Sensitivity analysis for overestimating the total number of cases (RDK + Microscopy)

For calculating the total number of tests done, we used the sum of total RDK tests and total microscopy tests done in the population. However, there is always an overlap between the number of tests done by RDK and microscopy as few individuals would have got both tests done. Hence, we decided to do a sensitivity analysis by considering a reduction of 20% individuals from the total of RDK and microscopy tests.

## Costing of NVBDCP in intervention blocks

Table 25: Per unit cost of NVBDCP for intervention block (Year 2021)

| | |
|---|---|
| **Total NVBDCP cost** (IA+IB+IC+ID+IE+IF) [for 155018- (20% of 155018)= 124014 individuals] | **30545857** |
| NVBDCP cost (INR) per individual (Total NVBDCP cost/Total number of RDK and Microscopy test) | 246 |

Table 26: Total unit cost (per person) for NVBDCP+ MTaT

| | |
|---|---|
| MTaT (per unit cost) (INR) | 57 |
| NVBDCP (per unit cost) (INR) | 246 |
| **Total cost per person (NVBDCP+MTaT) in INR** | **303** |

## Costing of NVBDCP in control blocks

Table 27: Per unit cost of NVBDCP (in INR) in control blocks

| | |
|---|---|
| **Total NVBDCP cost** (IA+IB+IC+ID+IE+IF) [for 166007- (20% of 166007)= 132806 individuals] | 40769984 |
| NVBDCP cost (INR) per individual (Total NVBDCP cost/Total number of RDK and Microscopy test) | **307** |

## Comparison of cost: NVBDCP+MTaT in intervention and NVBDCP in control blocks

Table 28: Comparison of cost for NVBDCP + MTaT in Intervention and NVBDCP in control blocks

| Costing Heading | Total NVBDCP Cost Interventions blocks (Year 2021), INR | Total NVBDCP Cost Control blocks (Year 2021), INR |
|---|---|---|
| Human Resource (A) | 2,06,33,083 | 2,12,71,824 |
| Incentives (B) | 21,29,130 | 14,07,270 |
| Training cost (C) | 19,33,800 | 29,55,600 |
| Cost of consumables – testing and treatment (D) | 28,14,744 | 18,14,090 |
| Indirect cost (Travel to PHCs) | 28,59,900 | 13128600 |
| IEC/BCC activities (E) | 1,75,200 | 1,92,600 |
| **Total NVBDCP cost** | **3,05,45,857** | **4,07,69,984** |
| Total individual tested (RDK + Microscopy) | 1,24,014 | 1,32,805 |
| **NVBDCP cost per individual** | **246** | **307** |
| Total cost for MTaT | 69,30,400 | NA |
| **MTaT (per unit cost)** | **57** | NA |
| **Total cost (NVBDCP+MTaT)** | **3,74,76,257** | NA |
| **Total unit cost (per person) (NVBDCP+MTaT)** | **303** | NA |

## Conclusions and Policy Implications

Malaria is a major public health concern in India, with inaccessible terrain posing additional challenges that require special attention. Furthermore, asymptomatic malaria continues to pose a challenge to malaria control programmes because it has a significant impact on transmission dynamics. In India, Odisha, Chhattisgarh, Madhya Pradesh, and Jharkhand account for 74.1% of all malaria cases reported, indicating the need for a cost-effective malaria control intervention in accordance with the National Framework for Malaria Elimination in India 2016-2030.

We used API-matched similar settings in both the intervention and control groups to investigate malaria API trends before and after the intervention. We observed that the API trend is declining in both intervention and control sites; however, there is a significant decline in API in the intervention group, which is approaching zero. This demonstrates that MTaT combined with routine NVBDCP is more effective in controlling malaria burden.

In terms of cost, despite the similarity of the intervention and control settings, the intervention group spent less overall than the control sites. In 2021, the per-unit cost of implementing MTaT was 57 INR, while that of NVBDCP was 197 INR at six intervention sites. At intervention districts, the total cost per unit for NVBDCP and MTaT was 254 INR. We discovered that the per-unit cost of performing NVBDCP at six control sites was 246 INR. Thus, the intervention sites spent 8 INR per person more than the control sites. It should be noted that the MTaT intervention began in 2017 and has been followed by mass screening and treatment for the last five years, resulting in a significant reduction in asymptomatic parasite reservoirs and thus lower transmission. Furthermore, MTaT screens and treats everyone before and after the monsoon season, reducing transmission during the season and thus lowering the financial burden on the routine programme, i.e. NVBDCP, as fewer cases require diagnosis and treatment. This demonstrates that MTaT not only reduced the API but also the NVBDCP cost in the long run. Furthermore, similar settings (inaccessible areas) may use MTaT in conjunction with NVBDCP to reduce the API and financial burden on states.

The cost-effectiveness of implementing mass testing and treatment of malaria versus relying solely on routine fever testing and treatment to reduce the API is a crucial consideration in the fight against malaria. The effectiveness of these strategies varies depending on the specific context, prevalence of malaria, available resources, and the healthcare infrastructure of a given region. Mass testing and treatment initiatives can be highly effective in rapidly reducing the API, especially in areas with high malaria transmission rates. They provide a proactive approach to identifying and treating malaria

cases, thereby reducing the overall disease burden. However, they can be resource-intensive and may not be sustainable in the long term, particularly in resource-constrained settings. On the other hand, routine fever testing and treatment, while more cost-effective and sustainable, may not have the same immediate impact on reducing the API. This approach relies on passive case detection and may miss asymptomatic carriers, contributing to ongoing transmission.

The most effective strategy likely lies in a balanced approach that considers the specific needs and circumstances of each region. Mass testing and treatment can be employed as an initial intervention to rapidly reduce the API, followed by a shift towards routine fever testing and treatment for long-term sustainability. This combination allows for the identification and treatment of both symptomatic and asymptomatic cases while optimizing the allocation of limited resources. Moreover, ongoing research and investment in innovative malaria diagnostics, treatment options, and preventive measures are essential to enhance the cost-effectiveness of malaria control efforts. In the end, the goal remains the same: to reduce the API, save lives, and work towards the eventual elimination of malaria in a manner that is both economically viable and sustainable in the long run.

The global malaria strategy by the World Health Organization (WHO) emphasizes the need for all malaria-endemic countries to expedite their efforts toward achieving the elimination goal. The latest guidelines for the conclusive phase of elimination, as outlined in the WHO Guidelines for Malaria, present recommendations categorized into three types of interventions: "mass" strategies, "targeted" strategies, and "reactive" strategies. In instances where malaria transmission is widespread throughout the population in a specified geographical area, such as a district or village, comprehensive strategies may be essential to curtail transmission through Mass Testing and Treatment (MTaT). MTaT involves conducting malaria tests for the entire population within a defined geographic region and administering effective antimalarial treatment to all individuals who tested positive, typically within a synchronized timeframe.

MTaT is regarded as an integral component of the immediate response within the context of endemic control, aligning with various other malaria prevention and control initiatives outlined in the National Vector Borne Disease Control Program (NVBDCP). Given that malaria transmission tends to be localized and focal, the district emerges as the pivotal implementing unit. Consequently, program managers should function as the primary entities for both planning and executing these initiatives. States deemed at high risk for malaria transmission, including Odisha, Chhattisgarh, Jharkhand,

Madhya Pradesh, Maharashtra, Tripura, Meghalaya, and Mizoram, are identified for prompt MTaT implementations. According to the experts' opinion, the states are encouraged to classify their districts for MTaT interventions, with a particular emphasis on selecting districts with an Annual Parasite Incidence (API) of 2 and above per 1000 population. Furthermore, districts may subdivide their blocks based on API, and within each block identify the sub-centres based on API (more than 2 per 1000) for MTaT intervention. Moreover, the implementation of MTaT, in conjunction with the NVBDCP, is encouraged in villages that are geographically inaccessible due to factors such as dense forest areas, absence of road connectivity, seasonal cut-off, a shortage of community health workers (ASHA), and a high density of tribal population.

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