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Preface

In the last few decades, there has been a remarkable effort in the field of health as numerous initiatives have been taken to address individual and population health. Life expectancy has increased from 37 at the time of independence to 70 years at present. Malaria, one of the oldest and deadliest diseases has made unprecedented degree of success in India. In February 2016, the National Center for Vector Borne Disease Control (NCVBDC), Ministry of Health and Family Welfare (MoHFW) launched the National Framework for Malaria Elimination in India (NFME) 2016-2030, which articulates the vision, goals, objectives and strategies to achieve malaria elimination in phased manner by 2030. Align with NFME, five-year NSP 2017-2022 was developed and launched in 2017 with technical assistance by WHO Country Office, India according to WHO Global Technical Strategy (GTS) for Malaria 2016–2030.

India has made significant progress in malaria reduction in recent years which has been appreciated globally in subsequent WHO's World Malaria Reports (WMR) of 2018, 2019, 2020 and 2021. Overall, there has been a remarkable progress with 85.1% decline of malaria cases and 83.3% deaths in 2022 as compared to 2015. Whilst the progress in reducing the malaria burden in India is highly commendable, it is fragile, and the disease remains a public health concern particularly in hard-to-reach areas.

Numerous obstacles hinder the attainment of the malaria elimination goal within the country. Consequently, a comprehensive evaluation of the national malaria program took place between April 18th and 28th in 2022, spanning six states: Chhattisgarh (encompassing Bastar and Kanker districts), Tripura (comprising Dhalai and South Tripura districts), Gujarat (enveloping Panchmahal and Surat districts), Haryana (specifically Nuh district), Maharashtra (including Mumbai urban area), and Karnataka (covering Bangalore Mahanagara Palike, Bengaluru urban district, and Dakshina Kannada District).Three states, Assam, Punjab, and Odisha were covered through desk review, virtual discussions and based on reports and data of states. Eight thematic areas were identified covering all aspects of the malaria program.

This report derives its content from a combination of observations, progress assessments through desk reviews, on-site visits, engagements with healthcare personnel across hierarchies, consultations with academic institutions, researchers, non-governmental entities, as well as interactions with various sector-specific organizations and local communities. This provides strategic information, identify gaps and challenges and recommendations for development of the new NSP 2023-2027 to achieve the target for malaria elimination in the country by 2030.

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The commendable efforts of WHO Country Office for India, led by Dr Roderico H. Ofrin, WHO Representative to India, in accepting, coordinating, and organizing the review of the Malaria Programme in India, deserve recognition. Ms Payden, Deputy WHO Representative to India; Dr Po Lin Chan, Team Lead Communicable Diseases; Dr Roop Kumari, Technical Officer of Malaria and Vector-Borne Diseases; Ms Rina Sinha and Mr Anshu Shekhar Roy from the Communications Team of WHO India have made valuable contributions and are sincerely appreciated.

Dr Tanu Jain, Director of the National Center for Vector Disease Control (NCVBDC), and her team are acknowledged for their initiatives and dedicated efforts. They provided all the necessary documents, data, and contacts, facilitating the review process.

Dr Subhash Salunke, the chairperson of MPR, deserves praise for his continuous support and encouragement, which kept the entire team of around 60 people motivated. His skills and competence were crucial in successfully completing the work.

Special acknowledgments go to all partners and stakeholders for their technical support and human resources during MPR. The international experts, including those from SEARO and WHO Global Malaria Program, are thanked for their valuable inputs during the preparatory and implementation phases of MPR.

The subject experts, State Program Officers, Regional Directors of respective 9 states, consultants, and chairpersons of different thematic areas are also recognized for their tireless efforts and unbiased guidance to the programme. The team would like to extend gratitude to Dr Roop Kumari for her systematic planning and successfully conducting MPR in 9 states. Lastly, sincere gratitude is extended to the dedicated team members of MPR, specifically Dr K. Ravi Kumar, Dr P. K. Srivastava, Dr Suman Wattal, and Dr Shampa Nag, for their diligent efforts in collating and refining the MPR reports for India-2022.

Abbreviations

ABER	annual blood examination rate
ACT	artemisinin-based combination therapy
AHA	acute hemolytic anemia
AI	artificial intelligence
AL	artemether-lumefantrine
AMM	anti-malaria month
An.	Anopheles
ANM	Auxiliary Nurse Midwife
API	annual parasite incidence
APLMA	Asia Pacific Leaders Malaria Alliance
APMEN	Asia Pacific Malaria Elimination Network
AS&MD	Additional Secretary and Mission Director (MoHFW)
AS-SP	artesunate-sulfadoxine-pyrimethamine
ASHA	Accredited Social Health Activist
BBMP	Buhan Bangalore Mahanagara Palike
BCC	behaviour change communication
BMC	Bombay Municipal Corporation
BS	blood slide
BSF	border security force
Bti AS	bacillus thuringiensis israelensis aqueous suspension
Bti WP	bacillus thuringiensis israelensis wettable powder
C-SUM	cumulative sum
CAG	Comptroller And Auditor General of India
CBO	community based organization
CCMP	comprehensive case management programme
CDS	communicable diseases surveillance
CFV	control flow valve
CHAI	Clinton Health Access Initiative
CHC	Community Health Centre
CHO	Community Health Officer
CHV	community health volunteer
CME	continuing medical education
CMSS	Central Medical Services Society
COVID	coronavirus disease
CQ	chloroquine
CSO	civil society organization
CSR	corporate social responsibility
DAMaN	Durgama Anchalare Malaria Nirakarana
DBS	domestic budgetary support
DBT	Department of Biotechnology
DCGI	Drugs Controller General of India
DDT	dichloro-diphenyl-trichloroethane

Abbreviations

DEA	Department of Economic Affairs (Ministry of Finance)
DH	district hospital
DHFR	dihydrofolate reductase (enzyme)
DHM	district health mission
DHPS	dihydropteroate synthase (enzyme)
DMETF	District Malaria Elimination Task Force
DMO	District Malaria Officer
DM&HO	District Medical and Health Officer
DOT	directly observed treatment
DQA	data quality assurance
DSU	district surveillance unit
DVBDCO/DVBDO	District Vector Borne Disease Control Officer/District Vector Borne Disease Officer
EAC	externally aided component
ECA	external competency assessment
ECAMM	external competency and assessment of malaria microscopists
ECoP	environmental code of practice
EID	emerging infectious disease
EMBED	elimination of vector borne endemic diseases
EQAS	external quality assessment system
EDCT	early diagnosis and complete treatment
FBO	faith based organization
FDC AL	fixed dose combination artemether-lumefantrine
FDEC-India	Foundation for Disease Elimination and Control of India
G6PD	glucose-6-phosphate dehydrogenase
GeM	Government e-marketplace
GF	The Global Fund
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
GIS	Geographic Information System
GKS	Gramin Kalyan Samiti
GMP	Global Malaria Programme
GMSD	Government Medical Store Department
GoI	Government of India
GP	Gram Panchayat
GTS	global technical strategy
GVCR	global vector control response
HBHI	high burden to high impact
HC	hand compression (pump)
HMIS	Health Management Information System
HR	human resources
HRP2/HRP3	histidine-rich protein 2/histidine-rich protein 3
HQ	Headquarters

Abbreviations

ICMR	Indian Council of Medical Research
IDSP	Integrated Disease Surveillance Programme
IEC	information, education, communication
IHF	India Health Fund
IHIP	Integrated Health Information Platform
IIT	Indian Institute of Technology
IMA	Indian Medical Association
IMCP	intensified malaria control project
IMEP	intensified malaria elimination project
INR	Indian Rupee
IPC	inter-personal communication
IPHS	Indianpublic health standards
IR	insecticide resistance
IRM	insecticide resistance monitoring
IRS	indoor residual spraying
IVM	integrated vector management
JMM	joint monitoring mission
kdr	knock down resistance
KSMSCL	Karnataka State Medical Supplies Corporation Limited
LLIN	long lasting insecticidal net
LQAS	lot quality assurance sampling
LSM	larval source management
LT	laboratory technician
M&E	monitoring and evaluation
MBER	monthly blood examination rate
MC	medical college
MCGM	Municipal Corporation of Greater Mumbai
MEDP	malaria elimination demonstration project
MERA	Malaria Elimination Research Alliance
MFOs	mixed-function oxidases
MIS	malaria information system/management information system
MNM	malaria no more
MoHFW	Ministry of Health and Family Welfare
MO	Medical Officer
MPO	modified plan of operation
MPR	malaria programme review
MPW (M)	multipurpose health worker (male)
MSAT	mass screening and treatment
MSG	mission steering group
MTS	malaria technical supervisor
MVCR	mosquito control and vector response
NCAMM	National Competency and Assessment of Malaria Microscopists

Abbreviations

NCDC	National Centre for Disease Control
NCVBDC	National Center for Vector Borne Diseases Control
NE states	north-eastern states
NFCP	National Filaria Control Programme
NFME	National Framework for Malaria Elimination
NGO	non-government organization
NHM	National Health Mission
NIMR	National Institute of Malaria Research
NIRTH	National Institute of Research in Tribal Health
NMETF	National Malaria Elimination Task Force
NQMS	National Quality Management System
NRL	National Reference Laboratory
NTME	National Taskforce for Malaria Elimination
NSP	National Strategic Plan
NUHM	National Urban Health Mission
NYKS	Nehru YuvaKendra Sanghatan
PBO	Piperonyl Butoxide
Pf/*P. falciparum*	Plasmodium Falciparum
PfCP	*P. Falciparum* Containment Programme
PfCRT	Plasmodium Falciparum chloroquine resistance transporter
PHC	Primary Health Centre
PHIEC	Public Health Information and Epidemiological Cell
P. knowlesi	Plasmodium Knowlesi
PIP	programme/project implementation plan
P. malariae	Plasmodium Malariae
P. ovale	Plasmodium Ovale
POR	prevention of re-establishment
PPM	pooled procurement mechanism (with GFATM support)
PPP	public private partnership
PSCM/PSM	procurement and supply chain management/procurement and supply management
PSU	public sector undertaking
PQ	primaquine
PRI	Panchayati Raj Institution
Pv/*P. vivax*	Plasmodium Vivax
QA	quality assurance
QC	quality control
QM	quality management
RAC	Research Advisory Committee
RDT	rapid diagnostic test
RHO	rural health organizer
RKS	RogiKalyan Samiti

Abbreviations

RMRC	Regional Medical Research Centre
RMRIMS	Rajendra Memorial Research Institute of Medical Sciences
RNTCP	Revised National Tuberculosis Control Programme
RoHFW	Regional Office of Health & Family Welfare
ROP	record of proceedings
RRT	rapid response team
SAC	Scientific Advisory Committee
SBCC	social and behaviour change communication
SC	sub-centre
SD	standard deviation
SDGs	Sustainable Development Goals
SDH	sub-district hospital
SEA	South-East Asia
SEARO	South-East Asia Regional Office
SHG	self-help group
SHS	state health society
SHM	State Health Mission
SMC	Surat Municipal Corporation
SMETF	State Malaria Elimination Task Force
SOE	statement of expenditure
SOP	standard operating procedure
SP	synthetic pyrethroid
SP+PBO	synthetic pyrethroid with piperonylbutoxide
SPO	State Programme Officer
SPR	slide positivity rate
SRCMF	South-East Asia Regional Coordination Mechanism Forum
SSH	sentinel surveillance hospital
SSLR	sentinel surveillance site laboratory register
SSMR	sentinel surveillance site malaria register
SSU	state surveillance unit
SWOT	strengths, weaknesses, opportunities, threats
TAC	technical advisory committee
TCIF	Transport Corporation of India Limited (TCI) Foundation
TES	therapeutic efficacy study (of antimalarial medicine)
ToT	training of trainers
TPP	triphenyl phosphate
TWG	technical working group
UPHC	Urban Primary Health Centre
UMS	Urban Malaria Scheme
UN	United Nations
UPSC	Union Public Service Commission
USD	United States Dollar

Abbreviations

UT	Union Territory
VBD	vector borne disease
VBDCP	Vector Borne Diseases Control Programme
VBDTS	Vector Borne Disease Technical Supervisor
VCNA	vector control need assessment
VCRC	Vector Control Research Centre
VHSNC	Village Health Nutrition and Sanitation Committee
VHSND	Village Health Nutrition and Sanitation Day
WCO	WHO Country Office
WHO	World Health Organization
WHO HQ	WHO Headquarters
WHO SEARO	WHO South-East Asia Regional Office
WMD	World Malaria Day
WMR	World Malaria Report
WP	wettable powder
XM	xenomonitoring

Briefing meeting MPR - 18 April 2022

De-briefing meeting MPR - 28 April 2022

Executive summary

In November 2014, Asia Pacific Heads of Government ('Leaders') from 18 countries, including the Hon'ble Prime Minister of India, agreed to the goal of a region free of malaria by 2030; and a malaria elimination roadmap was endorsed in November 2015 in consonance with WHO GTS (2016-2030). Given these commitments, National Framework for Malaria Elimination (NFME) 2016-2030 was launched in February 2016, and the five-year National Strategic Plan (2017-2022) was launched in July 2017 by the Hon'ble Minister for Health & Family Welfare, with a vision to eliminate malaria from the country by 2030.

Malaria has been a significant public health problem in India for centuries. In 1947, the estimated malaria cases in the country were 75 million, with 0.8 million deaths annually;however, due to the remarkable success of reducing these cases to a mere 49151 cases and zero deaths in 1965, malaria eradication was envisaged as the next step. Instead, repeated setbacks on the technical, operational and administrative fronts resulted in a resurgence in the late 1960s. In 1976, 6.45 million cases were recorded, and a marked increase in malaria was seen in the urban areas. Policies and strategies were realigned to combat the challenge of malaria in different eco-types through the launch of the Urban Malaria Scheme (UMS) in 1971-1972, the Modified Plan of Operation (MPO) and *P. falciparum* Containment Programme (PfCP) in 1977. A number of newer problems emerged in the 1990s, like insecticide resistance among malaria vectors, change in vector behaviour, the resistance of *P.falciparum* to chloroquine, and the creation of newer vector breeding sites due to rapid urbanization, deforestation and developmental projects.

Intensification of malaria control was further enhanced in the high-endemic tribal districts in 17 states responsible for >90 % of the malaria burden, with funding support from external agencies like World Bank and GFATM. The consistent efforts have led to a gradual decline in overall malaria cases and deaths since 2000. The malaria cases were reduced from 2.03 million in the year 2000 to 1.10 million in 2014 (54%) and further to 0.15 million in 2021 (85.6%). The deaths were also reduced from 932 in 2000 to 562 (60%) in 2014. Further reduction from 2014 has been quite drastic, and in 2021 the malaria deaths decreased from 562 to 80 (85.8%).

The National Framework for Malaria Elimination (NFME) in India (2016-2030) was launched in February 2016. It envisages malaria elimination in a phased manner for which states have been stratified into four categories mainly based on the annual parasite incidence (API) of 2014, and milestones, targets, and goals have been clearly chalked out accordingly. The NSP (2017-2022) contains district-level stratification of the entire country into four categories and specifies the category-specific strategies.

The malaria situation in the country has changed significantly after the adoption of the NFME and the five-year NSP (2017-2022) by the states. The preparation of the next NSP (2023-2027) is also due. It is appropriate that learnings from the previous five years concerning the strengths, challenges, gaps and best practices are identified and appropriately dealt with in the next NSP. Therefore, the external review of the Malaria Programme was conducted to assess the progress, challenges and gaps, strengths and weaknesses and last but not least,record best

practices and lessons learnt after the adoption of the strategies laid down in the NFME (2016-2030) and NSP (2017-2022) by the States. The recommendations of the MPR are expected to inform the development of National Strategic Plan (NSP) for Malaria Elimination 2023-2027 and provide guidance to the Programme for appropriate actions to improve the management as well as the implementation of these strategies.

The MPR comprised the following phases:

i) Preparatory phase: 1 March to 17 April 2022
ii) Implementation phase :18-28 April 2022
iii) Reporting phase: May-June 2022

The review was conducted jointly by WHO Country Office for India (WCO India) and NCVBDC. Dr Tanu Jain led the formation of a technical working group (TWG), with Dr Po Lin Chan serving as the co-chair. Dr Roop Kumari was the nodal person for the preparation of the concept note, background paper, field tools and planning and organizing the MPR. Virtual support was provided by WHO,SEARO and GMP, WHO-HQ. Individual consultants were contracted by the WCO to support the TWG, besides the support team from the NCVBDC and WCO, India. The TWG,in addition to the overall guidance for malaria programme review (MPR) selected external experts and a chairperson, ensuring that the teams were constituted of multi-disciplinary experts, i.e., epidemiologists, entomologists/ vector control specialists/malariologists, public health specialists, health system specialists, social scientist, communication specialist, researchers and finance consultants and each team was led by either a senior public health specialist or a malariologist. Two independent international experts also joined the MPR team (virtually). Dr Subhash Salunke was designated as the MPR chairperson.WHO malaria technical staff from the WCO, SEARO and GMP,HQ were part of the MPR team. The officers/ Consultants from the Regional Offices of Health & Family Welfare (ROHFW) and NCVBDC accompanied the MPR teams to the States and districts and facilitated the review.

During the preparatory phase, that is, from 1 March to 17 April 2022, a concept note was prepared. The TWG supported the overall planning, coordination and execution of the malaria programme review(MPR), ensuringthe technical soundness of the review process and collation of relevant background materials. The background note and interview guide were shared with the MPR teams. Eight thematic areas were identified for MPR, namely, Programme Management and Governance; Epidemiology and Social Determinants; Surveillance, M&E, Epidemic Preparedness and Response; Case Management, Diagnosis and Treatment; Entomology and Vector Control; Advocacy, Partnership, Multi-sectoral and Cross-border Collaboration; Community Engagement, behaviour change communication; and Research and Development

A briefing meeting for the MPR team members was held on 18 April 2022, wherein the background paper, the interview guide, the National Strategic Plan 2017-2022, various Programme guidelines and documents were provided to the MPR experts before the field visit. During the implementation phase of MPR, the teams visited six States, Chhattisgarh (districts Bastar and Kanker), Tripura (districts Dhalai and South Tripura), Gujarat (districts Panchmahal and Surat), Haryana (Nuh district), Maharashtra (Mumbai urban), and Karnataka (Bangalore MahanagaraPalike, Bengaluru urban district and Dakshina Kannada District). Three States, Assam, Punjab and Odisha, were covered through desk review virtual discussions and based on reports and data of states and virtual discussions.Teams returned on the 23rd of April 2022

and prepared the reports on state-specific observations. Following this, the experts were grouped into eight teams with an identified team leader. The experts deliberated on the state-wise findings for respective thematic areas and prepared the report. The debriefing meeting was held on the 28th of April 2022, wherein the thematic area-wise findings were presented by each group. Both meetings were chaired by the Joint Secretary (NCVBDC) and co-chaired by WR, India and attended by the senior officers from WHO SEARO, WCO, India, NCVBDC and invited experts.

The MPR team endorses the remarkable decline in malaria burden after the launch of the National Strategic Plan (NSP) 2017-2022 and compliments India's remarkable achievements in successfully and significantly reducing malaria mortality and morbidity, especially in the high burden states. While acknowledging the extraordinary efforts and achievements of the Vector Borne Disease Control Programme, both at the central and state levels, the technical support of WHO country office is also appreciated. The MPR teams identified the strengths, weaknesses, gaps, and challenges and provided important recommendations with action points to address these gaps.The important recommendations suggested by the experts for each thematic area are summarized below:

Effective programme management and governance are the most critical component for achieving the elimination of malaria.It is important to ensure prioritized and sustained advocacy and coordination to keep malaria elimination as a key agenda at all levels of the health system, especially the political level. Ownership and effective leadership at the Central, State and District level are critical for consolidating the gains and moving progressively towards the elimination goals and targets.The availability of adequate human resources is critical for malaria elimination. Gaps in key positions existing from the central to peripheral level must be filled up. Recruitment of an adequate number of skilled cadres (doctors, nurses, entomologists, laboratory technicians, and community-level health workers) will be essential, failing which malaria elimination will remain a challenge. The capacity to implement the technical strategies considering local and focal situations is required to eliminate malaria in hard-to-reach areas, urban settings, tribal areas and other situations where general control strategies do not work for various reasons. Therefore,ensuring mechanisms of Programme ownership, clarity in roles and responsibilities, capacity building for effective implementation, accountability, systematic monitoring and supervision for immediate solutions and guidance is of utmost importance, and urgent steps are needed in this direction. Fully functional National Taskforce for Malaria Elimination (NTME) with multisectoral involvement, as well as the State Malaria Elimination Task Force and District Malaria Elimination Taskforce, are envisaged to play a guiding role in ensuring that the programme moves in the right direction as well as for ensuring inter and intra-sectoral co-ordination. All taskforces should ensure follow-up on recommended actions.

Capacity building at all levels is crucial for managers as well as implementers. Training needs assessment in the context of elimination is recommended for systematic and well-planned training to ensure that all levels of managers and implementers are adequately trained for malaria elimination as per their roles and responsibilities. Pooling of resources to cater to the huge capacity-building needs should be done. NCVBDC and States should carry out mapping of relevant institutions for strengthening capacities with the support of partners.Sensitization and involvement of the private sector in eliminating malaria and regular CME for them, along with other health staff with the participation of medical colleges, will be crucial.

Sub-national malaria elimination was envisaged to be achieved by 2022 in 15 low-endemic states, for which the process needs to be initiated immediately so that districts and states are adequately sensitized and the qualifying districts submit their proposal of having achieved sub-national malaria elimination. Strengthening micro-planning processes considering local and focal situations, micro-epidemiology, and sociological settings arerequired for incorporating it in the annual State PIPs so that financial allocations are sustained. Sufficient and sustained funding from domestic and external sources (e.g., the GF) to realize and sustain malaria elimination should be ensured. In addition, the malaria program should explore mobilizing resources for elimination from other sectors like the corporate sector. Full as well as rational utilization of available resources should be ensured with emphasis on equitable and universal coverage of interventions tailored to context,including HR, institutional strengthening and infrastructure. Strengthening procurement and supply chain management is required to ensure the availability of all essential commodities, including diagnostics and antimalarial medicines, at the right place and the right time, ensuring the minimum stocks at different levels of the health system.

Malaria elimination in urban areas has been and will remain challenging due to various factors. Therefore, it is important to strengthen malaria elimination strategies in the urban areas following the norms of the Programme, ensuring the required human resources and tools. The support under NUHM needs to be explored in this context.Further, there is a need for regular interaction with the state health departments and Housing and Urban Development departments. Elimination without community participation would not be possible. The Programme management should facilitate the participation of the community through committees at the community and Gram Panchayat level in Block, CHC and PHC.

Epidemiological analysis of malaria revealed that the malaria situation has improved over the years with a significant reduction in malaria morbidity and mortality, more so in the high-burden states. The annual parasite incidence (API) of India has come down from 2.09 per thousand population in 2000 to 0.14 per thousand population in 2020. The SPR has also shown a gradual decline from 2.34% in 2000 to 0.19% in 2020.The provisional figures for 2021 showed a further decline in API to 0.12 per thousand population and SPR to 0.14%, with zero indigenous cases in 109 districts. Though the overall malaria burden of the country has declined substantially, instancesof a significant increase in malaria burden have been seen in a few areas.

Considering 2015 as the base year for the implementation of NSP (2017-2022), the reported malaria cases have reduced from 1 169 261 to 161 753, that is, by 86.17%, and the reported malaria deaths have reduced from 384 to 90, that is, by 76.56% in the year 2021. Stratification to the sub-centre level is required for achieving further reduction by identifying foci of continued transmission and contributing factors to address them effectively. Innovative tools like GIS mapping are available in some states and are used effectively for stratification, identification of foci and microplanning. It is recommended that all states may use the GIS mapping tools for stratification, focus identification and response.

The correlation of social determinants with malaria prevalence has been a weak component. Therefore,in spite of achievements, critical challenges do exist that need to be addressed. Malaria in different eco-systems needs well-tailored strategies. Emphasis on a better understanding of the micro-epidemiology of malaria in different transmission settings is

required to support evidence-based interventions and accelerate progress. Strengthening the capacity to use epi-data at and by sub-national levels for local planning and actions is important. Analysis of disaggregated data related to age, gender and species for tailored planning and implementation is required. A detailed audit of deaths for parasitologically confirmed as well as parasitologically unconfirmed clinical malaria deaths is required for remedial measures. Special strategies and guidelines are required to address the problem of malaria in the mobile and migrant populations, native forest populations, and forest goers/ workers. This would require sensitization of these vulnerable populations as well as the general community along with the public and private health sectors. There is a critical gap in tracking, testing, treating and reporting malaria amongst mobile and migrant populations.

The MPR noted fourspecific eco-epidemiological types which require focused attention. These are 1) malaria in migrant /labour /mobile populations, 2) malaria in urban areas, 3) malaria in project areas, and 4) malaria in border areas.
This would require sensitization of these vulnerable populations as well as the general community along with the public and private health sectors. Screening has to be done of all incoming labour as well as their families coming from endemic malaria areas entering the project area for malaria using Rapid diagnostic Tests(RDTs) or taking blood smears. Prompt and effective treatment is to be given to all cases tested positive for malaria.

Rapid urbanization, construction and project-related malaria need a specific strategic approach for which clear guidelines are to be framed. Regulatory mechanisms are required forthe impact assessment of malariogenic potential for all upcoming projects within the jurisdiction of different states. The capacity of state health authorities needs strengthening to identify projects related tothe industry, irrigation, mines, power plants, construction etc., and make necessary recommendations on malaria control activities.

Surveillance is the core intervention for malaria elimination and monitoring and response are extremely important to ensure effective Programme implementation, identify gaps and address them on time. The Programme has an organized routine surveillance system for malaria.However, surveillance and reporting challenges exist in tribal, hard-to-reach, Jhum cultivation and urban areas, which need to be addressed. Malaria is a notifiable disease. But in most states, reporting is very low and unquantified. Enforcement is required for private sector notification of malaria, including PSUs and medical colleges. A‘Central Malaria Notification’ mechanismshould be explored,especially toincorporate data on confirmed cases from the private sector in the national data repository.

Clear guidance on active and passive surveillance reporting may be issued on priority by the Programme. Though most of the states categorised ASHAs dectection as passive surveillance ,some states considered it as active surveillance, against the national guidelines which indicates that ASHAs detection will be treated as passive surveillance A Uniform system needs to be followed in the country. Many states have undertaken Mass Screening and Treatment (MSAT) campaigns. However, clarity and guidelines on the technical issues and reporting mechanism for inclusion of malaria cases in the state and national data, as well as correct testingtools for such campaigns,are missing, so a clear advisory/guideline may be issued for carrying out such campaigns and including the positive cases inthe national data repository. However, it is recommended to have a technical consultation meeting to deliberate the issue of MSAT.

Case-based surveillance is implemented as per national guidelines in some states. However, proper guidance and strengthening for the rollout of this strategy in all low-endemic settings, ensuring focus identification, characterisation, classification, clearance, and follow-up, is required. The formats for case-based surveillance and foci investigation and response need to be reviewed and implemented uniformly across states. An effective supervision and monitoring mechanism is required for every case investigation in low-endemic settings.

Strengthening surveillance in urban areas should be taken up as a priority. Malaria elimination guidelines for urban bodies with the flexibility to adopt innovation by the state authority need to be developed. A review of annual blood examination rate(ABER)benchmarks based on different endemicity needs to be done.In areas closer to elimination, the approach may be on foci identification based on absolute numbers. There is provision for a rapid response team in each district so that State Program Officer should be ensured their presence in all districts to tackle any upsurge in malaria cases as well as outbreaks.
Based on the experience of the pilot project of IHIP-malaria modules, it should be rolled out at the earliest. This would prevent multiple data entries by health workers as well as help in real-time data reporting and response as well as improve the overall Programme management.
Guidelines for subnational elimination and validation are to be prepared, which are aligned with relevant WHO guidelines. These guidelines are to be circulated to states to facilitate the process of validation of zero indigenous cases and incentivization of states/districts having achieved the status of zero indigenous cases and deaths.

Regarding case management, universal coverage of malaria diagnosis and treatment is the cornerstone to achieving malaria elimination by 2030. For this, parasitological diagnosis of all suspected malaria cases under a strengthened surveillance system to detect, notify, investigate, classify, and respond to every case of malaria within 24 hours of the onset of fever and radical cure is important. Early Diagnosis and Complete Treatment (EDCT) are critical for the benefit of the individual as well as the community.

Access to diagnosis and treatment has improved considerably over the years with the introduction of rapid diagnostic tests (RDTs) and the involvement of Accredited Social Health Activists (ASHA) on an incentive basis for diagnosis and treatment. This has gone a long way in facilitating early diagnosis of malaria at the community level and close to the patient's doorstep, especially in the remote and hard-to-reach tribal areas of the high-burden states. Though most of the high-burden states have malaria microscopy services available at the health facilities up to the PHC level in varying degrees, some states like Odisha and Chhattisgarh have limited functional malaria microscopy services available up to the CHC level, and all PHCs have not provided with this facility yet.

The involvement of ASHA in diagnosis and treatment in low endemic states was found to be variable, ranging from no involvement to low involvement, and is largely entrusted to the MPW(M). Microscopy is the mainstay of diagnosis in low-endemic settings, and RDTs are used in specific situations only, though many states were found to use both methods simultaneously on the same patient. Treatment in some of these low endemic states is also available with the MPW(M) only. The health facilities are involved in passive case detection using microscopy up to the PHC level. In these states, the community has limited access to diagnosis and treatment due to the non-involvement of CHOs, ASHAs and sub-centres for passive surveillance, thereby defying the principle of universal access to diagnosis and treatment. A significant proportion

of the community is largely dependent on the private and informal health providers in these as well as the difficult-to-reach areas of high-burden states.

Pharmacovigilance of antimalarials was found to be insufficient in terms of capturing information on adverse events after administration of Primaquine in *P. vivax* patients and follow-up blood smears for parasite clearance.

The quality of malaria diagnosis has been strengthened over the years by the Programme, but major issues still exist with respect to the quality of diagnostics and services due to the varying capacity of the ASHAs, MPW and laboratory technicians. The laboratory technicians working currently in many of the PHCs in low-endemic areas may not have seen malaria parasites in the blood smears over the last few years, given the drastically reduced number of cases, thereby indicating the threat of loss of appropriate microscopy skills and capacity of laboratory technicians. The quality of slides and results is highly variable and unreliable in many instances due to a lack of quality training. There is an urgent need for organizing re-orientation training of laboratory technicianson a massive scale.

RDTs procured through decentralized procurement by states do not essentially conform to the technical specifications of NCVBDC, and deviations from procurement norms often result in the use of RDTs having low sensitivity and specificity as well deterioration due to extreme weather conditions due to unknown heat stability thresholds. Since malaria diagnosis and treatment have to be essentially quality assured, it is recommended that NCVBDC should operationalize and implement the revised National Quality Management System as envisaged under the National Strategic Plan (2017-2022) and ensure quality diagnosis by RDTs as well as microscopy at all levels.

Revision of the laboratory technician(LT)` training curriculum for induction, re-orientation and national refresher training as well as preparation of manuals and SOPs for these training has not been achieved as envisaged under the NQMS and needs urgent action. Advance yearly training calendar for all levels should be prepared for systematic cascade training at the State, Regional and National level as well as theExternal Competency Assessment andCertification (ECAMM) of Malaria Microscopists/Laboratory technicians to ensure the availability of well-trained and certified technicians in every state at all health facilities.

Ensuring the capacities of all medical officers, health workers and ASHAs for malaria diagnosis and treatment through regular and organized training, retraining and assessments are equally critical. Variable knowledge about and compliance with national drug policy was noted, especially in the private sector and urban health facilities.

Variable knowledge about and compliance with national drug policy was noted especially in private sector and urban health facilities. Revision of the national guidelines for the diagnosis and treatment of malaria is recommended to include the recent updates on case management as per WHO guidelines and based on efficacy studies of anti-malaria drugs. The programme should prepare clear and user-friendly SOPs for different levels to address the gaps existing in diagnosis and treatment.

Innovative approaches are required for the development, use and validation of newer and sensitive diagnostic tools to address the issues of existing diagnostic methods for the

detection of lesser reported malaria parasites like *P.malariae*, *P.ovale* and *P.knowelsi* as well as HRP-2 and HRP-3 deletions in *P.falciparum*.

Entomological surveillance and vector control are essential strategies for malaria elimination. Regular monitoring of entomological parameters to assess the impact, monitoring of resistance to insecticides, as well as formulation of new evidence-based strategies and guidelinesis recommended. Quality-controlled evidence-based interventions are possible only with the availability of trained entomologists/vector control specialists and support staff.

Though many consultants in entomology are available at the central level, their involvement in entomological surveillance and monitoring is lacking. Central laboratory facility for entomological monitoring and processing of field samples is lacking at all levels, viz., NCVBDC, regional offices and at most of the state and zonal levels across the country. The data generation on entomological surveillance is inconsistent and crucial parameters to guide interventions are lacking. At the State level, huge vacancies of entomologists (more than 50%) and insect collectors have resulted in the implementation of vector control interventions without monitoring through recommended entomological parameters.

To achieve malaria elimination, it is recommended to augment, boost and rejuvenate the entomological infrastructure at the Central, Regional, State and District level and to strengthen the entomological capability as per recommendations of the vector control need assessment (VCNA) carried out by WHO. Pooling existing resources from the research/ academic institutions, retirees from state and central services,IDSP etc., may be considered.

Expedited action is required to fill all human resource vacancies of entomologists and insect collectors at national, state, and district levels. Mandatory strengthening of state, zonal and district entomologists with two insect collectors per entomologist should be considered, and it should be supported through the National Health Mission(NHM) State Programme Implementation Plan (PIP) at least till 2030.

Focused monitoring of insecticide resistance (adults and larval) with priority to the areas lacking this information is of utmost importance. Insecticide resistance management should include the techniques of WHO tube tests and intensity bioassay, for which state and regional labs need to be strengthened in addition to research institutes.

Integrated Vector Management (IVM) is essential to optimize the existing resources, and its implementation in totality needs to be widely advocated to ensure that all professionals (public or private) are adequately sensitized. The recommendations of the VCNA done by WHO should be disseminated to all states, districts and even across urban local bodies

A comprehensive training plan for entomological skill and vector control is required with all teaching materials and empaneling the subject experts with an inbuilt evaluation mechanism for improvement in teaching quality.

Guidelines on vector control in different endemic settings and paradigms are urgently required so that vector control teams are aware of what to do when they approach different

elimination settings. Dissemination of SOPs and specific guidelines for entomological surveillance specifying mandatory and desired parameters should be done.

Newer efficient tools and technologies need to replace age-old equipment used under Programme, e.g., hand compression pumps with constant flow valves (CFV) should replace conventional Stirrup pumps. Similarly, cold fog should replace thermal fogging. The newer products may be expedited through the institutional mechanism of the country.

Research should be undertaken to assess if there are added benefits from sites where long lasting insecticidal nets (LLINs) have been rolled out in addition to Indoor Residual Spray (IRS).The use of LLIN and IRS with the same molecules should be deliberated in a technical working group. The outcome of operational research needs to be considered and absorbed into the Programme depending on its feasibility.

Advocacy and Partnership are important for accelerating the transition to malaria elimination and sustaining gains made so far to preclude any reversal.The Programme has strengthened the partnership with WHO, NCDC, ICMR, BMGF, CHAI, TATA trusts and some local NGOs for support on various technical activities and human resources as well as IEC/BCC. An action plan for regular advocacy activities of various stakeholdersand partners needs to be formulated, implemented and monitored to improve ground-level activities.

Reporting on Advocacy, Partnership, Multisectoral Collaboration, and Cross-border Collaboration need to be made a standard agenda item in the monthly meetings of state, district and block-level task forces.Actions may be initiated for persistent advocacy, harmonized partnership and multi-sector collaboration with clearly definedroles and responsibilities for contributing towards malaria elimination.

The advocacy may have a different approach in urban areas. Strengthened and sustained community actions in coordination with urban bodies are required for early diagnosis, treatment and prevention of mosquito breeding in neighbouring human habitations. The enactment of urban Byelaws is most important in urban areas, and all efforts should be made to ensure its implementation in all towns, municipalities and mega-corporations.

Assessment of malaria in border areas is recommendedto minimize the risk of importation and ensure timely, detection, treatment and liquidation of foci toprevent the re-establishment of transmission in malaria-free areas. Cross-notification of malaria information and synchronized response for malaria elimination is recommended. Inter-state and inter-district meetings within the country are to be revived for sharing. The inter-country meetings are also recommended at frequent intervals, and WHO support in this regard may be sought.

Community Engagement and Social behaviour change communication (SBCC) are the main supportive strategies for malaria elimination. Community engagement and BCC activities are incorporated in the national, state and district plans, which are most visible during specific events like World Malaria Day and Anti Malaria Month with the involvement of political leaders, various partners and stakeholders. Evidence-based community engagement and BCC remain highly variable and not always tailored to the local context. It is recommended that the Programme should move from BCC to SBCC to ensure effective community engagement and behaviour change outcomes. Developing a national SBCC strategy followed by state-specific

strategies and detailed implementation plans is recommended. In the plan, the focus may be emphasized on involving local key influencers at the community level, such as tribal leaders, active PRI members and teachers, and faith/traditional healers.

Research and development need to be a priority area. Research is essential for keeping track of Programme goals, monitoring the progress and recommending evidence-based course correction in strategies in a timely manner. Research support on various important aspects was either inadequate or totally lacking. Some of the important areas found lacking are inadequate therapeutic efficacy studies of anti-malarial drugs, lack of research on asymptomatic and sub-microscopic malaria, innovative diagnostic tools with high sensitivity and specificity and identification of all human malaria parasites. Similarly, innovative vector control agents and tools, vector bionomics, insecticide resistance, residual malaria, outdoor transmission, usage, durability and bio-efficacy of LLINs and innovative tools are some of the areas needing high priority.

Some significant challenges have been observed. There appears to be a lack of research regarding the development of new diagnostic tools as well as research related to basic entomological parameters in different eco-epidemiological situations. Inadequate research and evidence generation was also observed regarding drug resistance, newer drug combination trial, vector behaviour and changes due to climate change, insecticide resistance monitoring, outdoor transmission control measures and its feasibility studies, usage, durability and bio-efficacy of LLINs and innovative tools. Weak collaboration was also observed between Programme and other Institutions like DBT, IITs, and other technical institutions. ICMR institutions carry out research in the form of long-term research projects, and the outcome is known either after its publications or its clearance for sharing under their own institutional mechanism. Delay in sharing the results or evidence loses its significance for the Programme many times as actions required by Programme are no longer relevant. Although there is the involvement of the Programme in the Scientific Advisory Committee (SAC) and Research Advisory Committee (RAC) of ICMR, significant contributions to Programme related operational research is yet to be optimal.

MPR has identified priority areas for research which are mentioned in the relevant chapter of this report. On an ongoing basis, NCVBDC may organize a technical consultation involving expert malariologists/ entomologists, epidemiologists/public health specialists, IEC/SBCC and other relevant experts, partners and stakeholders to identify and prioritize research agenda relevant to malaria elimination for short-term, mid-term and long-term research. The programme should identify partners and stakeholders for collaborative research and ensure that research topics are distributed between these partners as relevant. At the same time, it is also important to harmonize research to address Programme needs across relevant research and academic institutions and partner agencies, with facilitation by Programme in collaboration with ICMR and other agencies, as appropriate, and draw on technical guidance of WHO. ICMR should ensure relevance of research to malaria programme needs as well asthe timely sharing of research findings and emphasize evidence-based policy/strategy. Adequate funding from different sources needs to be mobilized for priority research areas.

Chapter 1

Introduction

1.1 Background and rationale

The Government of India has made a strong commitment to achieving Sustainable Development Goals (SDGs), including SDG 3: "Good Health and Well-Being", with specific target 3.3 underscoring "end malaria" by 2030. In addition, the Government of India has committed to malaria elimination in the Asia-Pacific Region by 2030 by endorsing the World Health Organization (WHO) Global Technical Strategy (GTS) for Malaria 2016-2030 as well as the Asia Pacific Leaders Malaria Alliance (APLMA) Roadmap on Malaria Elimination in the Asia Pacific by 2030. India is also a signatory to the 2017 ministerial declaration on accelerating and sustaining malaria elimination in South-East Asia.

In February 2016, the National Center for Vector Borne Disease Control (NCVBDC), Ministry of Health and Family Welfare (MoHFW) launched the National Framework for Malaria Elimination in India (NFME) 2016-2030in close alignment with the 'Global Technical Strategy for Malaria 2016–2030', 'Action and Investment to defeat Malaria 2016–2030' and the 'Asia Pacific Leaders Malaria Alliance Malaria Elimination Roadmap'. The framework articulates the vision, goals, objectives, and strategies for malaria elimination in the country in a phased manner. By 2022, the NFME aimed to eliminate malaria in 26 states and union territories (UTs) with low to the moderate incidence of malaria. Thereafter, interruption of malaria transmission is targeted by 2027 in the country and maintaining malaria-free status up to 2030 and beyond.A five-year National Strategic Plan (NSP) 2017-2022 was launched in 2017. The NSP, along with an operational manual for malaria elimination in India(2016), serves as a guidance document for the States to implement malaria elimination strategies at the district level and beyond.

Country commitment, NFME, strong strategy, and progressive acceleration of malaria interventions by the NCVBDC have been vital for the success achieved so far by different states and Union Territories (UTs). Further, domestic investments by the Government of India and States, as well as external funding support by the Global Fund, previous support from the World Bank and continuing technical support by WHO have been extremely crucial in this journey, in addition to the support by various other partners, donors and stakeholders.

India has shown a remarkable decline in malaria mortality and morbidity after adopting the malaria elimination strategies as per the NFME(2016-2030) and NSP(2017-2022). India's substantial decline in malaria cases and deaths has been endorsed by the World Malaria Report (WMR) 2018, 2019, 2020, and 2021. According to WMR 2021, in WHO SEA Region, malaria is endemic in 9 of the 11 countries, accounting for 38% of the estimated burden of malaria outside WHO African Region. In 2020, the region had 5 million estimated cases and

8,900 estimated deaths (reductions of 80% and 77%, respectively, compared with 2010), representing the largest decline in any of WHO regions. All countries, including India, met the GTS 2020 target of more than a 40% reduction in case of incidence by 2020 compared with 2015, except Bhutan and Indonesia, where the case incidence was reduced by 39% and 35%, respectively. All countries, including India, also met the GTS 2020 target for a reduction in mortality rate by at least 40% in 2020 compared with 2015, except Indonesia, where the mortality rate was reduced by 24%. Within the SEA Region, three countries accounted for 99.7% of the estimated cases, India being the largest contributor (83%). India also accounted for about 82% of all malaria deaths in the region. Furthermore, the country has been impacted by the COVID-19 pandemic since early 2020. Several mitigation measures have been and continue to be taken to tackle the crisis, and a further improvement in malaria service delivery, surveillance, and M&E towards strengthening the pathway to malaria elimination is envisaged. However, whilst the progress in reducing the malaria burden in India is highly commendable, it is fragile, and the disease still remains a public health concern.

Given the fact that, the next NSP for (2023-2027) is to be formulated, and to provide strategic information,an independent review of India's Malaria Elimination Programme was undertaken; the MPR was conducted in April 2022 with support of WHO Country Office (WCO).

1.2 Objectives

Overall objective

To assess the progress, best practices and lessons learned since 2016 and to provide recommendations to inform the development of National Strategic Plan (NSP) for Malaria Elimination 2023-2027.

Specific objectives

i. To review progress, challenges, best practices, and lessons learned on malaria burden reduction and malaria elimination in India.
ii. To examine the epidemiological and contextual factors that impact malaria and the Programme and determine key areas for interventions and programmatic improvement.
iii. To review the policies, strategies and guidelines on malaria control and elimination and the status of implementation and provide recommendations to address identified gaps/challenges.
iv. To analyze the risks to malaria elimination, including but not limited to health system issues, knowledge gaps and programmatic bottlenecks at national and subnational levels, and recommend measures to mitigate those risks.
v. To identify potential enabling factors and opportunities within and outside the health sector that NCVBDC should consider to accelerate further and sustain the progress towards malaria elimination.
vi. To review the overall technical, administrative and financial management of the Programme and identify constraints and facilitating factors.
vii. To recommend strategic directions for National Strategic Plan for Malaria Elimination NSP 2023-2027.

1.3 Framework and methodology

The methodology comprised the following phases:

i. preparation and planning (preparatory phase)
ii. conduct of MPR (implementation phase)
iii. report writing, submission and dissemination (reporting phase)

Preparatory phase (1 March 2022-17 April 2022)

A concept note was prepared for conducting the Malaria Programme Review. A technical working group (TWG) was constituted by the NCVBDC and WHO Country Office (WCO) for the overall planning, coordination and execution of the MPR. The TWG focused on the scope of MPR thematic areas, key questions, review methodology, a listing of related documents needed, preparation of TORs, background notes and interview guide.The identification of key officials from health and other sectors to be met at different levels - central, state, and district during review; selection of states and districts to be visited; key partners to be involved; and financial resources were also finalized.The TWG comprised independent technical experts supported by WHO and partners. The officers and consultants from NCVBDC also supported the MPR. Dr Tanu Jain, Director NCVBDC and Dr Po Lin Chan, CDS Team Leader, WCO India, chaired and co-chaired the TWG, respectively. Dr Roop Kumari, WCO,was the nodal person for the MPR for planning, preparation of background papers and the interview guide and overall organizing MPR. Virtual support was provided by WHO, SEARO and WHO GMP/HQ. Dr Subhash Salunke chaired the MPR and led the whole review process. Dr Shampa Nag was designated as lead rapporteur.

Identification of thematic areas for MPR

Eight thematic areas for the review were identified by the TWG:

Thematic area 1: Programme management and governance
Thematic area 2: Epidemiology and social determinants
Thematic area 3: Surveillance, M&E and epidemic preparedness, and response
Thematic area 4: Case management, diagnosis and treatment
Thematic area 5: Entomology and vector control
Thematic area 6: Advocacy, partnership, Multi-sectoral Collaboration and Cross-border Collaboration
Thematic area 7: Community engagement and social behaviour change communication
Thematic area 8: Research and development

Development of tools and background paper for MPR

The background paper for the MPR team included the overall malaria situation and progress made in respective thematic areas. An interview guide containing detailed questionnaires was also prepared to facilitate the review. Several discussion sessions were held involving NCVBDC and experts during the finalization of the background paper and other documents. These documents, along with the NSP (2017-2022), various Programme guidelines and documents, were shared with each member of MPR as the reading material.

Constitution of MPR team

The MPR team was multi-disciplinary and comprised epidemiologists, malariologists, entomologists/vector control specialists, public health/health system specialists, Social

scientists, Communications specialists and Research scientists. Two international experts, Dr Kamini Mendis and Dr Jeffrey Hii, also joined the MPR team (virtually). WHO malaria Technical Staff from WHO Country Office, SEARO and GMP/HQ were part of the MPR team. The experts were grouped for visits to different states. The state-wise details of the MPR teams are indicated in Annex 2.

Implementation phase (18-28 April 2022)

Briefing meeting

The implementation phase commenced with a briefing meeting on 18 April 2022, chaired by the Joint Secretary (VBD), MoHFW, Govt. of India. The meeting was well attended by the Director NCVBDC, Deputy WHO Country Representative, officials of NCVBDC, Technical Officer from WHO Country Office, senior technical officials from WHO HQ, SEARO, subject experts (national and international), and representatives from partner organizations. The international experts, including officials from WHO HQ and SEARO, joined the meeting virtually. Overview of the malaria situation in the country and progress made were presented by the Director, NCVBDC and the Dy WR presented the background of the MPR. The details of MPR objectives, methodology, thematic areas, team composition, and expected outputs from field missions were presented by the Technical Officer,WHO Country Office.

Information shared by states

Each state identified for the field visit submitted the relevant data in the template shared with them for review by the MPR team. Several discussion sessions were held by the MPR team to gauge the progress made by states/districts in reducing the malaria burden and progressing towards elimination. The best practices, challenges and possible solutions were deliberated too.

Field mission

Six states and ten districts from low, medium and high malaria categories were selected for field visits with a focus on rural, tribal and urban areas. Bastar and Kanker districtsof Chhattisgarh state, Dhalai and South Tripura districts of Tripura, Panchmahal and Surat districts of Gujarat, Nuh district of Haryana, Mumbai urban area of Maharashtra, and Bangalore MahanagaraPalike, Bengaluru urban district and Dakshina Kannada District of Karnataka state were identified for field visits.

The teams started with the desk review of available resource materials, including but not limited to NSP 2017-2022, MPR background paper, data submitted by states, various guidelines, SOPs, and other relevant documents at central and state levels.

The MPR teams were accompanied by representatives from the NCVBDC and states as well as WHO. The field visits were exhaustive and covered review of Programme management as well as the implementation of interventions and malaria elimination strategies from the state to the sub-centre/village level. The methodology included key informant interviews with the heads and key officials at state/district/sub-district levels, various stakeholders including the community/beneficiaries, health workers, and village heads, as well as malaria-positive cases in addition to the health facilities for gaining specific insights about strengths, challenges and gaps related for each thematic area. Steps required to be planned/undertaken to further improve/strengthen Programme responses and prioritize key actions were also discussed.

The debriefing on salient observations was done with state officials on 22-23 April 2022 by the MPR teams before departing from the state.

At the national level, the field visit observations were further discussed involving all MPR experts, local experts and international experts (who participated virtually). The State reports were finalized between 24-27 April. Additionally, the teams were reconstituted as per the thematic areas for reviewing the findings of the state teams and preparing the thematic area reports with virtual participation by the international experts. The national programme was a part of all discussions. The team composition for each thematic area is given in Annex 2.

Debriefing meeting

The debriefing meeting was held on 28 April 2022. This meeting was co-chaired by the Director, NCVBDC and WHO Country Representative. The meeting was graced by the MPR Chairperson and Lead, MPR experts (national and international), the NCVBDC team, the malaria technical team from WHO Country Office and SEARO, and representatives from partner organizations and various stakeholders. The international experts and WHO HQ joined the meeting virtually. Amongst others, presentations on the detailed observations and recommendations were made by the teams for each thematic area. This was followed by an overall summary by the MPR Chairperson. The document on Vector Control Needs Assessment for India developed by WHO country office to support NCVBDC drawing on intensive review in four states and deliberations at national headquarter was also released during the meeting.

Review of additional states

Three additional states, viz., Assam, Odisha, and Punjab, were also covered under MPR through desk review only.

Brief methodology of desk review

The MPR tool/questionnaire and background information was shared with the states, and all relevant reports and data were requested for review. The desk review commenced with a briefing meeting with states, followed by the following steps :

i) Assembling of data from reports and documents, i.e., state reports and published documents
ii) An in-depth assessment of all available reports and data analysis, important published documents.
iii) Report writing covering the following thematic areas :
    a) Programme management components and Governance
    b) Epidemiology
    c) Surveillance, monitoring, evaluation and outbreak response
    d) Malaria Case management
    e) Entomology and vector control

The team composition for desk review is given in Annex 3

Reporting phase (May — June 2022)

A core group was constituted for finalizing the report and comprised of Dr Subhash Salunke, MPR Chairperson, Dr Roop Kumari, NPO, WCO (Nodal Officer) and independent experts Dr Suman Wattal, Dr K. Ravi Kumar, Dr P. K. Srivastava, and Dr Shampa Nag.

Chapter 2

Country profile

India has set the target of malaria elimination by 2030 and launched the NFME (2016-2030) in sync with the GTS of WHO. Historically, malaria has been a disease of great public health concern in India since antiquity. Organized and consistent efforts have been in place since the formation of a formal programme for malaria control in India in 1953. More than 90% of malaria cases and deaths are reported from the remote and hard-to-reach tribal areas of the country. India was able to achieve remarkable success by increasing access to malaria treatment in such areas and scaling up vector control interventions by introducing DDT for indoor residual spraying (IRS),resulting in spectacular results of reducing the malaria cases from 75 million and deaths from 0.8 million in 1947 to a mere 49151 cases and zero deaths in 1961, though the success was short-lived and there was a rebound due to various administrative, technical and operational reasons in the late sixties. Concerted efforts, support in terms of increased funding under the domestic and external budgetary support, as well as realignment of technical strategies from time to time and introduction of newer diagnostic, treatment and vector control strategies, have resulted in the gradual decline in the malaria burden in India over the years. The decline has been steady since 2000, with intermittent outbreaks and an upsurge in malaria cases and deaths in some high and low-endemic states. However, a drastic decline in the malaria burden has been recorded after adopting the revised strategies laid down in the NFME and the NSP (2017-2022). The highlights of these two documents are presented below:

2.1 National Framework for Malaria Elimination in India 2016-2030

The National Framework for Malaria Elimination (NFME) 2016-2030 outlines India's strategy for elimination of the disease by 2030 and clearly defines goals, objectives, strategies, targets and timelines and is expected to serve as a roadmap for advocating and planning malaria elimination in the country in a phased manner. The Framework provides necessary guidance for rolling out the strategies and related interventions in the States/UTs as per their epidemiological situation and timelines for attaining the sub-national and national malaria elimination status.

Vision
Eliminate malaria nationally and contribute to improved health, quality of life and alleviation of poverty.

Goals
1. Eliminate malaria (zero indigenous cases) throughout the entire country by 2030; and
2. Maintain malaria-free status in areas where malaria transmission has been interrupted and prevent malaria re-introducing.

Objectives

The framework has four objectives:

1. Eliminate malaria from all 26 low (Category 1) and moderate (Category 2) transmission states/union territories (UTs) by 2022;
2. Reduce the incidence of malaria to less than 1 case per 1000 population per year in all states and UTs and their districts by 2024;
3. Interrupt indigenous transmission of malaria throughout the entire country, including all high transmission states and union territories (UTs) (Category 3) by 2027; and
4. Prevent the re-establishment of local transmission of malaria in areas where it has been eliminated and maintain national malaria-free status by 2030 and beyond.

Strategic approaches

1. Programme phasing considering the varying malaria endemicity in the country
2. Classification of States/UTs based on API as the primary criterion
3. The district as the unit of planning and implementation
4. Focus on high endemic areas
5. Special strategy for *P. vivax* elimination.

Milestones and targets

Malaria elimination in India is envisaged in a phased manner for which the entire country has been stratified into the following four categories:

S.No.	Categories of states/UTs	Definition
1.	Category-0: prevention of re-establishment phase	States/UTs with zero indigenous cases of malaria
2.	Category-1: elimination phase	States/UTs(15), including their districts reporting an API of less than 1 per thousand population at risk
3.	Category-2: pre-elimination phase	States/UTs(11) with an API of less than 1 per thousand population at risk, but some of their districts are reporting an API of 1 case per 1000 population or above
4.	Category 3: intensified control phase	States/UTs(10) with an API of 1 per thousand population at risk or above

The malaria elimination target for states under these four categories varies as per their malaria endemicity, and accordingly, the milestones and targets have been set.

Milestones and targets set in the NFME 2016-2030 are given below:

By the end of 2016

- All states/UTs have included malaria elimination in their broader health policies and planning frameworks.

By 2020

1. Transmission of malaria was interrupted, and zero indigenous cases and deaths due to malaria were attained in all 15 states/UTs under Category 1 (elimination phase) in 2014 (base year).

2. All 11 states/UTs under Category 2 (pre-elimination phase) in 2014 enter into Category 1 (elimination phase).

3. Five states/UTs under Category 3 (intensified control phase) in 2014 enter into Category 2 (pre-elimination phase).

4. Five states/UTs under Category 3 (intensified control phase) in 2014 reduced malaria transmission but remained in Category 3.

5. An estimated reduction in the malaria of 15–20% at the national level compared with 2014.

6. Additionally, progressive states with strong health systems, such as Gujarat, Maharashtra and Karnataka, may implement accelerated malaria elimination programmes to achieve interruption of transmission and demonstrate early elimination followed by the sustenance of zero indigenous cases.

By 2022

1. Transmission of malaria was interrupted, and zero indigenous cases and deaths due to malaria were attained in all 26 states/UTs under Categories 1 and 2 in 2014.

2. Five states/UTs which were under Category 3 (intensified control phase) in 2014 entered intothe elimination phase.

3. Five states/UTs which were under Category 3 (intensified control phase) in 2014 entered intothe pre-elimination phase.

4. An estimated reduction in the malaria of 30–35% at the national level compared with 2014 by 2024

5. All states/UTs and their respective districts reduce API to less than 1 case per 1000 population at risk and sustain zero deaths due to malaria while maintaining fully functional malaria surveillance to track, investigate and respond to each case throughout the country.

6. Transmission of malaria was interrupted, and zero indigenous cases and deaths due to malaria were attained in all 31 states/UTs.

7. Five states/UTs which were under Category 3 (intensified control phase) in 2014 entered into the elimination phase.

By 2027

The indigenous transmission of malaria in India was interrupted.

By 2030

1. The re-establishment of local transmission is prevented in areas where malaria has been eliminated.

2. The malaria-free status maintained throughout the nation

2.2 National Strategic Plan for Malaria Elimination in India 2017-2022

The National Strategic Plan (NSP) for Malaria Elimination (2017-2022) has been developed based on the National Framework for Malaria Elimination (NFME) and focuses on the implementation of malaria at the district level. Districts across the country have accordingly been stratified and categorized into four categories as given below:

Vision: Aligning with the vision of NFME, the NSP 2017-2022 focuses on strategic policies to provide a universal intervention package, paving the way for malaria elimination by 2030.

Goals

1. Eliminate malaria (zero indigenous cases) by 2022 in all the districts of 26 States/UTs of existing category-1 and 2 and in districts having API <1 of Category-3 states.

2. All remaining districts are to be brought into the pre-elimination and elimination phase; and

3. Maintain malaria-free status in areas where malaria transmission has been interrupted and prevent re-introduction of malaria.

Specific objectives

1. Achieve universal coverage of case detection and treatment services at all levels in endemic districts by 2018 to ensure 100% parasitological diagnosis of all suspected malaria cases and complete treatment of all confirmed cases.

2. Strengthen the surveillance system to detect, notify, investigate, classify and respond to all cases and foci in all Districts on a real-time basis by 2018 to move towards malaria elimination.

3. Protect at least 90% of the population at risk of malaria with appropriate vector control interventions by 2018.

4. Achieve a universal package of knowledge, awareness and responsive behaviour regarding malaria elimination.

5. Provide effective Programme management and coordination at all levels by 2017 to efficiently deliver a combination of targeted interventions for malaria elimination.

Guiding principles determining the direction and pace of elimination in districts and states are:

1. Political commitment, leadership and ownership by states/districts.
2. Equitable access to services, especially for the most vulnerable and underserved geographical/populations at risk of malaria.
3. Quality healthcare service delivery.
4. Community mobilization and participation.
5. An inter-sectoral approach involving all stakeholders.
6. Promote innovative tools and newer approaches by having operational research.
7. Delegation of responsibility and fixing accountability.

Strategies for realizing the goal and objective of NSP aredivided into the following four components based on WHO-recommended principles and pillars:

1. Diagnosis and Case Management
2. Surveillance and Epidemic response
3. Prevention–Integrated Vector Management
4. Cross-cutting interventions- Advocacy, Communication and Community Mobilization, Programme management and coordination, Monitoring and Evaluation, Research and Development.

2.3 Progress towards malaria elimination

India's achievements in reducing malaria morbidity and mortality are remarkable, and the country has met the national as well as the global targets. Overall, malaria cases and deaths have been reducing gradually from 2000 onwards. As per Programme data, 2 031 790 malaria cases and 932 deaths were reported in 2000, which declined to 1 102 205 cases (54%) and 562 deaths (60%), respectively, in 2014, the base year for stratification of States as per NFME. The reduction in malaria cases and deaths from 2017 onwards has been quite drastic after the scaling up of interventions. Compared to 2014, in 2021, malaria cases and deaths decreased from 1 102 205 to 158 326 (85.6%) and from 562 to 80 (85.8%). The reported *P. falciparum* cases declined from 1 047 218 in 2000 to 722 546 cases in 2014 (31%).The *P. falciparum* cases also declined drastically to 99 239 (86%) in 2021 when compared to 2014.

So far during 2022, 158 326 cases and 80 deaths (provisional figures) have been reported in the country due to malaria. India's progress has been well appreciated globally in WHO World Malaria Reports (WMR) of 2018, 2019, 2020 and 2022. Out of the 11 High Burden to High Impact(HBHI) countries reported to contributed the highest malaria burden, India is the only country that has consistently reported decline in malaria cases and deaths.

Whilst the progress in reducing the malaria burden in India is highly commendable, it is fragile, and the disease still remains a public health concern. According to WMR 2021, in WHO SEA Region, malaria is endemic in nine of the 11 countries, accounting for 38% of the estimated burden of malaria outside WHO African Region. In 2020, the region had 5 million estimated cases and 8,900 estimated deaths (reductions of 80% and 77%, respectively, compared with 2010), representing the largest decline in any of WHO regions. All countries, including India, met the GTS 2020 target of more than a 40% reduction in case of incidence by 2020 compared with 2015, except Bhutan and Indonesia, where the case incidence was reduced by 39% and 35%, respectively. All countries, including India, also met the GTS 2020 target for the reduction

in mortality rate by at least 40% in 2020 compared with 2015, except Indonesia, where the mortality rate was reduced by 24%. Within the SEA Region, three countries accounted for 99.7% of the estimated cases, India being the largest contributor (83%). India also accounted for about 82% of all malaria deaths in the region.

The country has been impacted by the COVID-19 pandemic since early 2020. Several mitigation measures have been and continue to be taken to tackle the crisis, and a further improvement in malaria service delivery, surveillance, and M&E towards strengthening the pathway to malaria elimination is envisaged.

Within the country at the state level, the progress towards malaria elimination is noted in the shift and declining number of states under category III with an API of 1 case per 1000 population at risk or above

Table 2: Transitioning of states/UTs across categories (2015 versus 2021)

Categories	Status of states/UTs in 2015	Status in states/UTs in 2021
Category 1 States with API < 1 case/1000 population in all districts	Delhi, Goa, Himachal Pradesh, J&K, Kerala, Lakshadweep, Puducherry, Sikkim, Chandigarh, Daman & Diu, Haryana, Manipur, Punjab, Rajasthan, Uttarakhand **(15)**	Delhi, Goa, Himachal Pradesh, J & K, Kerala, Lakshadweep, Puducherry, Sikkim, Chandigarh, Daman & Diu, Haryana, Manipur, Punjab, Rajasthan, Uttarakhand, Andhra Pradesh, Nagaland, Tamil Nadu, Karnataka, Assam, Gujarat, Telangana, Bihar, Arunachal Pradesh, Dadra & Nagar Haveli, Ladakh, Uttar Pradesh, West Bengal, Andaman & Nicobar Island **(29)**
Category 2 States with API < 1 but some districts having API > 1	Andhra Pradesh, Bihar, Nagaland, Tamil Nadu, Telangana, West Bengal, Assam, Gujarat, Karnataka, Maharashtra, Uttar Pradesh **(11)**	Maharashtra, Chhattisgarh, Jharkhand, Odisha, Meghalaya, **(5)**
Category 3 States with API > 1 per 1000 population	A&N Islands, Arunachal Pradesh, Madhya Pradesh, Mizoram, Chhattisgarh, Dadra & Nagar Haveli, Jharkhand, Meghalaya, Odisha, Tripura **(10)**	Mizoram, Tripura **(2)**

Chapter 3

MPR observations and recommendations

3.1 Thematic area 1: Programme management and governance

3.1.1 Overview

Good governance and effective Programme management are critical to the performance of public health programmes. Effective Programme management for malaria elimination includes but is not limited to strong political commitment, resilient health system, effective leadership, strategic policy framework and guidelines, sufficient and sustained financial resources, monitoring and supervision, reliable data management, efficient procurement and supply chain management relevant incentivization, well-defined roles and responsibilities and accountability. Human resource and their capacity for effective implementation of the policies and guidelines is equally important. Often it has been seen that reduction in the malaria burden is easy to achieve but consolidating and sustaining the gains and moving towards elimination is the most challenging phase. Given these considerations and India's goals and targets for malaria elimination, the MPR teams reviewed these important aspects of Programme management and the implementation of the strategies on the ground level.

3.1.2 Observations

Policy and strategy

The NFME (2016-2030) and NSP (2017-2022) are the guiding technical documents for malaria elimination in India. The NSP 2017-2022 is being implemented nationwide. Some states have developed their own State Framework for Malaria Elimination/Strategic Plan, for example, Karnataka, Haryana, and Punjab. Political commitment prevailed in states to varying degrees. All nine states covered during the review have constituted the state and district-level taskforce/coordination committees. Odisha has additionally constituted block-level coordination committees also. In some states, specific campaigns have also been launched over the years to reduce the high malaria morbidity and/or mortality in specific areas, for example, DAMaN in high endemic pockets of 17 districts of Odisha, Malaria Bastar Abhiyan in 16 high-burden blocks of Bastar district of Chhattisgarh, "Malaria Mukt Mewat" campaign in Nuh district of Haryana.

The programme policies and guidelines are followed in principle with flexibility in implementation. This, however, has led to variability across states, with gaps in some instances. Programme ownership across States is also variable, and the mechanisms for ensuring such

standpoint and commitment at each implementation level are also insufficient. Though national policies and guidelines are broadly known to the State/District Programme officers, implementation variations have been noted across the visited States. Written guidelines and SOPs were not seen in most states at the district and sub-district levels. Guidelines and SOPs, particularly for entomological activities and laboratory procedures, were absent. Policy/ guidelines for the planning of interventions and procurement of supplies were generally known to all, but appropriate implementation was an issue in some states.

The role and involvement of medical colleges, research institutions, academia, private sector and civil society stakeholders in malaria elimination are very limited. In most states, malaria has been made notifiable, but still, reporting from private sectors is highly inadequate and unquantified. In urban areas, coordination between their health department and state VBDCPs is quite deficient, with the former having their system of Programme implementation, although broadly, they follow the national guidelines. Further, mechanisms to address malaria along the inter-district, inter-state and international border areas are not yet fully operational.

A series of newer interventions have been introduced by the Programme from time to time to keep up with the global advances and opportunities such as, artemisinin-based combination therapy (ACT) for *P. falciparum* malaria in the North Eastern States, HRP-2 antigen detecting rapid diagnostic tests (RDTs) for detection of *P. falciparum* malaria in 2009 and Pf/Pv detecting bivalent RDTs in 2012, Long Lasting Insecticidal Nets (LLINs) in 2009 , coverage of the entire eligible population living in endemic areas with LLINs in 2017 and their replenishment after three years, imposition of a country-wide ban on oral artemisinin monotherapy in 2009, revision of the National Drug Policy for malaria in 2013, improving quality of malaria diagnosis through introduction of the national refresher trainings followed by the external certification and assessment of malaria microscopists (ECAMM) by WHO ECAMM facilitators in 2016, revision of technical specifications for procurement of quality assured RDTs in 2017, and country-wide ban on manufacture, sale and use of antibody detecting RDTs for routine diagnosis of malaria in 2018. These interventions have been highly useful in improving Programme performance and reducing disease burden significantly.

Programme structure and function

Central level

he National Center for Vector Borne Diseases Control (NCVBDC) is the nodal agency of the Ministry of Health & Family Welfare, Government of India, for malaria elimination in the country.

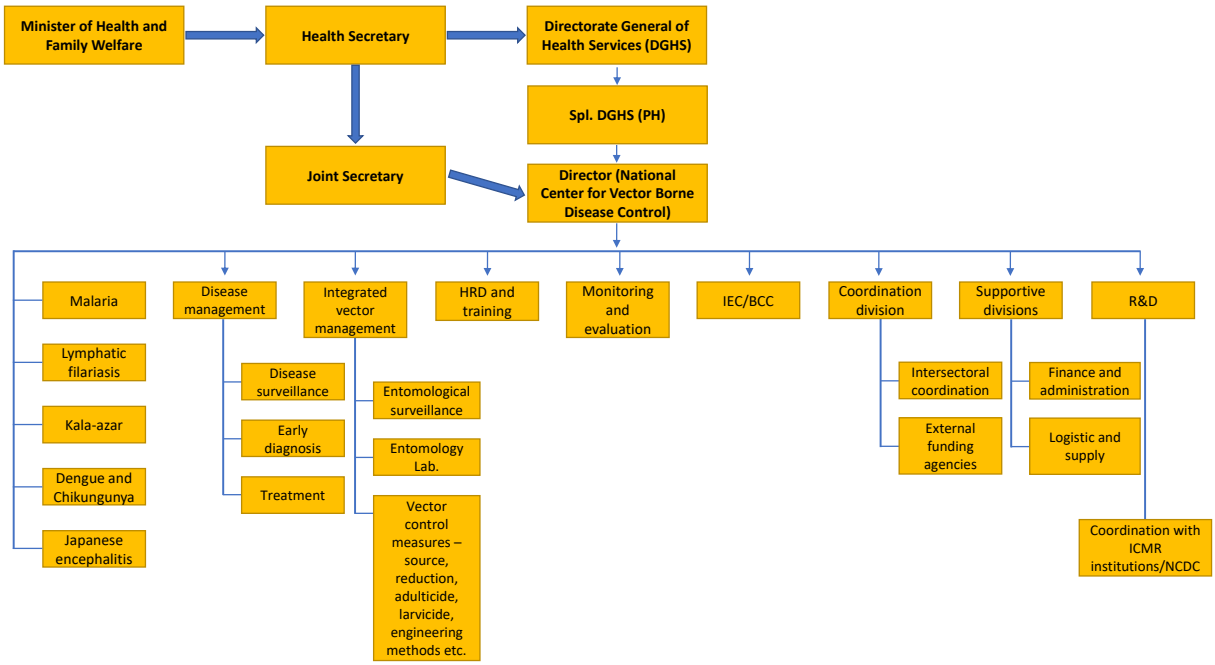
State level

The Department of Health and Family Welfare is responsible for the planning and implementation of malaria control/elimination activities. Every State has a designated State Programme Officer, a State Entomologist and supporting officers and staff for overseeing different components of Programme management and implementation in the districts.

District and sub-district level

District malaria officer (DMO)/district vector borne diseases Control Officer (DVBDCO) is mainly responsible officer at the district level for malaria elimination and works under the officer in

Organogram of National Center For Vector Borne Disease Control



charge of the district, like DM&HO/Civil surgeon etc., as per the hierarchy prevailing in the districts of different States.

India has districts, community health centres (CHCs), primary health centres (PHCs) and sub-centers for the implementation of health programmes for the health and wellness of its citizens in rural areas. In urban areas, urban PHCs cater to the health needs of the urban population. In addition, government hospitals and district and sub-district level hospitals are available for this purpose. Some states have a network of dispensaries also. This is supplemented by a large network of corporate and private hospitals, nursing homes and clinics.

As per norms, typically, CHC caters to 80 000-120 000 population, PHC to 20 000-30 000 population and Sub-center to 300-5000 population.

Village/community level

At the village level, a network of 10.33 lakh ASHAs across the country in rural and urban areas under the NHM act as a link between the community and the public health system. ASHAs are largely involved in malaria diagnosis, treatment and referral of severe cases for which incentive is paid @ INR 15/- for diagnosis of a suspected case, INR 75/- for treatment of malaria case and INR 300/- for referral and treatment, of a severe malaria case. The ASHAs play a very important role in malaria surveillance. In addition, the MPW (Male) and ANM are involved in malaria case diagnosis, treatment and surveillance in varying degrees across States, along with responsibilities of other disease control programmes. However, in many states, there is a significant shortage of male MPWs.

Health and wellness centres

A recent development over the last two years is the upgradation of sub-centres and PHCs into Health and Wellness Centres under the Ayushman Bharat platform. Of India's 146 000 sub-

centres and 26 000 primary health centres, about 20 000 has been so upgraded. This implies a much more comprehensive package of essential health services than were available earlier. They are expected to play an important role in the passive surveillance of malaria and health education activities.

The Community Health Centre and the sub-divisional/sub-district hospitals: This is the most peripheral level of hospital care that public services offer. There are close to 5000 hospitals at this level. The most standardized of these is the community health centres that cater to a population of 1 20 000 (80 000 in tribal and hilly areas) and are usually but not always located in the block headquarters, with no other PHC located there. Such a CHC is thus the nodal point for referral support to clinical care but also for leadership of the public health programs. But there are variations. In some states, the CHCs provide specialist clinical care and come under the Directorate of medical/hospital services and have limited or no public health supervisory duties. They generally provide hospitalization for malaria with complications and have testing for malaria- but do not have any preventive functions. In such states, the sub-centres and PHCs report instead to a block PHC, which reports to the Directorate in charge of health services/primary care, where all public health services, including the supervision of the malaria control program, would be located. The CHCs have a norm of 30 beds, with four basic specialists, three or more general duty medical officers and 11 or more nurses.

District hospital

The district hospital is the hub and, by norms, should have at least 100 to 200 beds, if not more. There are about 700 district hospitals. The Indian Public Health Standards (IPHS) spell out the different HR requirements for different staff strengths. The IPHS has been modified twice, both efforts reducing the human resources required, and continues to be under revision- but it still serves as a benchmark. The district hospital is meant to have 11 specialties and serve as a complete secondary care hospital. In some large districts, its capacity can be equivalent to medical college hospitals. In many districts, it functions at the capacity of a CHC. The district hospital is also required for clinical supervision of facilities below it, for provision of referral services, and for training and mentoring healthcare professionals of most categories. There is a move now to make most district hospitals into medical colleges. Most district hospitals in high malaria areas are the main centres for treating severe malaria and malaria with complications.

Urban areas

In urban areas, it is the municipality and corporations have a dedicated division that looks after the control of vector-borne diseases. However, the municipalities and some of the smaller corporations often hand over these functions to the state health department. The Urban health care scenario sees a dense presence of private providers and government hospitals. The government's primary healthcare scenario consists of health posts and dispensaries, which are far less than what is required and very skewed in distribution. It also has an insufficient network of urban primary health centres. These got a boost with the National Urban Health Mission.

Public tertiary medical care

This is provided by medical colleges and specialist hospitals etc. There are currently about 280 medical colleges and medical college hospitals in the public sector, and they generate close to 30 000 doctors each year. There are another 260 medical colleges and medical college

hospitals in the private sector. Other than the medical college hospitals, many public sector undertakings of the government like defense, railways, steel plants, mines, ports, power plants and other heavy industries have their own health care system with secondary and tertiary care hospitals- the largest of these being the defense and railway health care systems. The Employees Service Corporation also has a network of hospitals and dispensaries directly under it- though most of these are with the state government.

The private health sector

India has a large private health sector that accounts for nearly 60% of all hospitalizations and 80% of all ambulatory care. At the apex are corporate super-specialty hospitals and private medical colleges. Then there are a large number of 100 to 300-bed private hospitals and an even larger number of much smaller nursing homes and specialist consortiums. Besides, there are numerous general practitioners. Most of these formally registered and qualified private providers have little engagement with the malaria control program. There is a huge number of informal healthcare providers. They are dotted over all of rural India and much of urban India. In practice, they are often the first point of call for a patient with a fever. Malaria programmes try to engage with this part of the private sector to some extent, providing them with orientation and encouraging them to identify suspect cases and refer them early. However, this is not quantified.

Human resource

The success of the malaria elimination Programme depends on having a fully competent workforce. Regular staff are required for the continuity of the Programme, while contractual staff may be required to achieve specific objectives in time-bound projects within the Programme.

Vacancies of critical positions at central, state, and district levels remain a huge concern. It is seen across the states that there is a significant shortage of male and female MPWs, laboratory technicians, etc. Inadequately trained personnel at different levels also continue to be a major constraint for effective Programme implementation. State and District level Programme officers many of a times do not have adequate public health management background; they are often given multiple responsibilities. They do not possess adequate training for the management of public health programmes. A glaring example of the human resource crunch is evident from the fact that even though the resourceful state of Maharashtra has public health cadre structure, 24 of the 36 sanctioned posts of District Malaria Officers (DMOs) remain vacant. About 50% of the posts of Lab Technicians/ Microscopists in Maharashtra are also lying vacant.

The availability of entomologists and insect collectors to strengthen vector surveillance, appropriate evidence generation, and the need for control in both urban and rural settings is of utmost necessity from a Programme implementation point of view. The posts of entomologists are vacant in most states. Furthermore, there is a huge gap in the required and existing number of entomologists and insect collectors in many of the high and low endemic settings. Tripura, which is one of the highest endemic states in the northeastern part of the country, does not have a single entomologist and insect collector at any level. In Karnataka, besides vacancies for entomologists, there is an acute understaffing of insect collectors. In Gujarat also, all the entomologist posts are vacant in the Malaria Control Programme. Due acute scarcity of frontline workers in BMC (Bombay Municipal Corporation), and VBD officers

in the state of Maharashtra, it has become difficult to streamline the vector control activities effectively. Out of ten sanctioned posts of zonal entomologists, only three are filled up in the state of Maharashtra. All States have vacancies in varying numbers hampering the routine as well as specific entomological and vector control activities essential for malaria elimination.

There are vacancies at the level of Multipurpose Worker (Male) and Vector Borne Technical Supervisor (VBDTS) or Malaria Technical Supervisor (MTS) in most of the states, which is largely affected by the implementation of the Programme. Tripura has hilly terrain and hard-to-reach areas; out of 58 blocks, only 19 MTS are in position, and in most high endemic blocks, one MTS has been given the responsibility of two blocks.

Additional human resource has been provided for malaria elimination from State to the block level in varying degrees for 18 high endemic states (category-1 and 2) under the domestic budgetary support and GFATM. The low-endemic States are lacking in this respect, as additional contractual manpower support is generally lacking in these States. States like Punjab and Haryana reported the lack of trained contractual consultants impedes effective Programme implementation.

While the health infrastructure to achieve malaria elimination exists at a broader level, the capacity of this personnel is most often suboptimal. In some places, mostly the low endemic states like Haryana and Karnataka, there was a presence of HR from the periphery to the district, but an inadequate understanding of malaria case investigation guidelines at all levels from the State to the periphery was generally an issue, including the diagnostic capacity using RDTs and microscopy at the most peripheral level in some instances. Strong focus is needed on the development and implementation of structured training for all levels with robust pre and post-training assessments at all levels.

The malaria elimination programme is heavily dependent on Accredited Social Health Activists (ASHAs), which is the last institution at the front. The paradox exists in the role and responsibilities of the ASHAs in high and low-endemic areas. In high endemic areas, which are often accompanied by hard-to-reach areas, the ASHAs are overburdened with the malaria caseload due to difficult terrain in many states. She is not able to visit the distant hamlets at regular intervals. The problem gets amplified by inadequate training and low educational qualification of these foot soldiers. In a state like Tripura, this problem has been addressed, where community health volunteers have been identified and trained to ensure community mobilization and testing using rapid diagnostic tests (RDTs) in these hard-to-reach areas. In low-endemic areas, the problem is the low prioritization of malaria elimination services at the level of ASHAs. Due to a low number of cases in some areas, the ASHAs start forgetting key skills of using RDTs, giving correct antimalarial etc. A strong political and leadership commitment needs to be achieved through continuous advocacy to ensure the momentum to achieve the last mile of the malaria elimination drive.

Capacity building

Training is organized with in-built provision for knowledge and skills updates in the light of technical advances and Programme requirements from the malaria elimination point of view. The training generally follows a cascading model with three main tiers: regional levels - where the capacity for general public health functions including planning, training, supervision and monitoring is required; district level - where the emphasis is on specialist knowledge

on malaria and its control; and the service delivery level - where knowledge and skills for dealing with patients and managing small health care facilities are expected. For ASHAs, community health volunteers, MTS, VBD consultants/project officers, etc., at district and sub-district levels, who are new entrants, preference is given to their technical training related to their respective job duties. Further, training of concerned personnel at State and national levels for efficient planning and management, including supply chain management, as per new NCVBDC guidelines, are conducted. The National Programme has augmented support on training through partner organizations recently.

The levels of functionaries being trained have been quite low, especially of the State and district level functionaries, since 2015; however, the training has been encouraging below the district level. Special focus is given to improving the capacity to analyze, interpret, and use data for decision-making at all levels, including the field. Apart from regular hands-on orientation during supervision and monitoring visits, the review (regional and state level) and planning meetings emphasize dedicated sessions on building capacity to analyze and interpret data for decision-making in the agenda.

Capacity building of ASHAs/community health volunteers (CHVs) is a key activity of NCVBDC since it remains extremely important that the service delivery by ASHAs and CHVs (community workforce) in their own communities is optimized. The surveillance and early detection and complete treatment (EDCT) banks on these volunteers, especially in difficult-to-reach areas, to serve marginalized populations towards precluding suffering and severity as well as avert deaths and overcrowding of PHC/CHC. Their contribution also strengthens the pathway for overarching outcomes, e.g., maternal and child health, community organization and mobilization for ownership of health issues, etc.

Although the capacity building of ASHAs has been accelerated by NCVBDC with support from the State/District VBDCPs and others, the involvement of ASHAs is yet to be optimal in many areas. Presently, there is no defined system for benchmarking the capacity of ASHAs for malaria diagnosis and treatment. Specialized training and further sensitization are needed to improve surveillance and EDCT. The huge training gap in laboratory technician (LT) training on malaria microscopy is a challenge as well as a threat to malaria elimination. The plan for NQMS in the NSP (2017-2023) and introduction of the 10-day national refresher training followed by external competency assessment (ECA) and certification by WHO has been given a new direction and scope to microscopic examination in the States. The model for cascade training from the National, Regional and State levels, followed by certification at different levels, is commendable but needs full execution.

Training of private health care service providers on national guidelines and formats has been initiated towards ensuring rational treatment as well as piloting data reporting from them onto the NCVBDC MIS, but the gap is huge at present.

Supervision, monitoring, evaluation, review and planning

A comprehensive assessment of the VBD Programme's performance and impact requires that the basic health information systems are strengthened, and capacity is developed for collecting, analyzing, and timely disseminating data in real time for continuous monitoring and action. M&E is an ongoing process in the Programme. A web-based system of recording and reporting existed in the Programme, which was designed to capture information related

to malaria case detection, treatment and indoor residual spray (IRS) in specified formats.

The adoption of newer disease prevention and control instruments like RDT, ACT and LLIN and the recruitment of ASHAs made it necessary to restructure the Management Information System (MIS) for malaria. Malaria report is received from all the states every month in M4 format. This includes data for the month and up to the month as well as comparative data for the corresponding month of the previous year. With the change in the strategies, while shifting from control to elimination mode, the data collection and collation formats have been revisited to have a real-time reporting and monitoring system through the Integrated Health Information Platform (IHIP). Disease-specific malaria module has been designed and added to the portal to capture all important information. Annual, bi-annual and quarterly reviews are in place. The review process is stringent and quarterly in the GFATM-funded states due to donor requirements, while in other states, it is annual or bi-annual. Supervisory visits are also conducted by the National, Regional and State level officers in the high-risk areas to monitor the implementation of the malaria elimination Programme at the ground level. Annual plan meetings are held at the regional level for different categories of states for planning the next year's activities using pre-specified formats and guidelines.

States have guidelines and monitoring formats formulated, but there are too many formats & reporting tools that need standardization. There is a need for ownership and accountable personnel for monitoring and supervision at each level for each activity. Different information systems also exist that need to be integrated for monitoring real-time data. It is envisaged that roll out of IHIP malaria modules will address the prevailing issues in data quality, monitoring analysis and timely action.

Financing

The NCVBDC being the nodal agency under the overarching umbrella of the National Health Mission (NHM) for six vector-borne diseases, including malaria elimination, is responsible for planning, proposing and monitoring the budget requirements of the six diseases under its purview. The budget allocation is done under the disease control pool. The budget planned by the states as per the annual project implementation plan (PIP) is reviewed by the Programme divisions of NCVDC and discussed and finalized with the senior state level officials in the presence of the Programme division in a high-level meeting of the National Planning and Co-ordination Committee of the MoHFW under the chairmanship of AS&MD, NHM and approval are conveyed to states through the State specific record of proceedings ROP. In general, the financial resources seem to be adequate and released regularly as per the feedback of various review teams. In addition to the domestic budget, GFATM is supporting NCVBDC for 7 NE States. Additionally, a few high-burden states like Madhya Pradesh, Odisha and Chhattisgarh have also been covered for certain components like LLINs.

- Funds are released to the state through the treasury route by NHM Finance as per their norms and further to the different State Health Societies (SHS) Head-wise expenditure from states is uploaded on the NHM portal for DBS and EAC.
- The commodities supplied to states/UTs are booked through cost adjustment under commodity grants.
- The annual Budget allocation, releases and expenditure of NCVBDC is done for for all six VBDs, which includes malaria and establishment costs also,

As per details provided by NCVBDC, the total expenditure for all six vector borne diseases including malaria from 2015 to 2021 is given below :

Table 3: Total expenditure for all six vector-borne diseases including malaria (2015-2021)

(Figures in Crores)

Year	Expenditure
2015-2016	517.68
2016-2017	413.97
2017-2018	1628.24
2108-2019	817.54
2019-2020	929.23
2020-2021	1068.67
2021-2022*	495.05

*Provisional expenditure up to 31.03.2022

External aid from Global Fund:

1. Until 2018 Global Fund has funded 3 phases of Intensified Malaria Control Project (IMCP), and during 2018-2021 first phase of Intensified Malaria Elimination Project (IMEP) was implemented. Presently it is funding Intensified Malaria Elimination Project Phase II (IMEP-II) for the period of 3 years from April 2021-March 2024. IMEP had two Principal Recipients. The first principal recipient was the Department of Economic Affairs (DEA), Ministry of Finance, India and the Directorate of National Vector Borne Disease Control Programme implemented the projects.

2. Under IMEP – II total budget is 52.73 million USD for NCVBDC, out of which 35.03 million USD, approx. 66.43% has been provided for LLIN distribution.

3. Comptroller and Auditor General of India (CAG), which is an independent constitutional body responsible for conducting annual audits of central and state programmes, certifies the expenditure incurred on behalf of GFATM.

Internal control and financial monitoring systems of malaria programs/VBDs are based on the guidelines issued by the Government of India, Ministry of Health and Family Welfare and National Health Mission. The relevant guidelines for an externally aided project like Global Funds are followed.

States submit quarterly Statements of Expenditure (SOE) during each financial year to the NHM Finance Division under intimation to NCVBDC. The utilization certificate for the current year and audit report for the previous year is submitted by the States at the end of each financial year as per GFR norms.

Procurement and supply chain management

Procurement and Supply Chain Management is an integral part of Programme management. Though NCVBDC has decentralized most of the commodity over the years, still a few important items like RDTs, ACTs, Injection Artesunate, LLINs and DDT are procured and distributed centrally through CMSS and PPM (pooled procurement mechanism for GFATM). States are also provided cash grant assistance under the annual PIP to procure at least about 25% of the net annual requirement of the antimalarials and RDTs to ensure maintenance of a minimum buffer stock with the states till peripheral level, that is, PHCs, SCs, Health workers/ASHAs etc. The key Stakeholders of NCVBDC in Procurement and Supply Chain Management are State Programme Offices, the Central Medical Services Society, including its warehouses (Central procurement agency of MoHFW), GMSD warehouses, GF pooled procurement mechanism etc. The key personnel involved in the Procurement and Supply chain management are officials of national, state, and district VBD offices, PSCM consultants at national and state levels, district VBD consultants, a pharmacist at CHC/PHC Stores, VBDTs, ANM and ASHA. The NCVBDC shares the annual requirements request for procurement with CMSS along with standard technical specifications duly approved by the technical specification committee.

Microscopes, vehicles etc., are procured and supplied occasionally through external aid (GFATM). Anti-malarial drugs and diagnostics are a part of routine annual procurement, whereas commodities like LLINs, and other non-health products like Microscopes, Vehicles etc., are supplied as per the state requirement. The annual procurement process starts with a compilation of demand from States, its assessment, obtaining approvals, placing an indent to the designated procurement agency, namely CMSS, and commencing supplies takes around 6-9 months.

The GeM portal is used for procurement of all routine items like stationery items for office use, computers, microscopes, and vehicles. Items not available on GeM can be procured through customized tender.

In most states, the malaria supply chain is largely integrated with the regular essential medicines supply chain as far as the logistics at the district level and below are concerned. However, in some states, State Medical Supplies Corporation is the lead agency. An example from Karnataka is presented here. In this state, the districts receive malaria commodities from both the Karnataka State Medical Supplies Corporation Limited (KSMSCL) and the Central Medical Services Society (CMSS). CMSS typically procures LLINs, RDTs and antimalarials from the Govt of India (GOI) budgets. KSMSCL typically procures RDTs, IRS insecticides and some antimalarials from both the GOI as well as state health department budgets. KSMSCL suppliers directly deliver to the districts in most cases, with some buffer stock delivered at the state warehouse, while the CMSS suppliers deliver to the regional warehouse of CMSS in Bangalore. In general, the procurement and distribution from both KSMSCL and CMSS are smooth as long as they receive the requisitions on time, which often gets delayed, in turn, delaying the whole procurement process.

Quantification

Annual demand/indent is sent by states on request of NCVBDC, which is cross-checked and rationalized by the officers and consultants of program divisions at the national level as per available stocks and consumption during the previous year and the epidemiological data (at least the last three years), the latest available population data and health infrastructure

data are used to rationalize the indent/quantification. The quantity after finalization by the program division becomes a part of the Annual Procurement Action Plan.

As the malaria Programme moves towards elimination, the volume of malaria commodities, especially the anti-malarial drugs and, to a lesser extent, the diagnostics, has reduced. This is leading to a de-prioritization as malaria commodities become C-class items under the ABC classification. However, in case of unexpected episodes and outbreaks, this will become a major risk as malaria commodities are becoming increasingly difficult to procure through emergency procurements due to falling demand.

In Chhattisgarh, drug requirements, supply and consumptions are to be uniformly planned to avoid expiry in the field with proper monitoring mechanisms. In Gujarat, the supply chain may need to be streamlined to avert any potential stock-outs. There is evidence of re-distribution of stock between zones and rural health systems and no buffer stock. In Haryana, procurement is organized through Haryana State Medical Corporation Limited. RDTs are supplied by NCVBDC and also procured locally.

Supply, distribution and storage

The consignee list is provided by NCVBDC to CMSS for distribution to states/districts. Goods are supplied at CMSS warehouses by the supplier, where they are stored before further distribution to consignee locations in states as per requirement and release order from NCVBDC. The supplies of drugs are made to 20 CMSS warehouses situated at different locations catering to all States/UTs. The diversion of goods within and between the states is also made depending on the situation and demand raised by State/UTs. Microscopes and also some routine drugs are directly supplied at consignee locations at state to avoid delay. NCVBDC maintains the monthly state-wise stock position of the centrally supplied commodities.

Storage arrangement

States follow their state-specific supply chain mechanism and operationalize the supply chain mechanism through the district warehouses/stores and the CHC/PHC/SC level stores. LLINs are stored temporarily at identified warehouses at a different location in the states, which are then transported to Districts/CHC/SC for distribution. Efforts are made to minimize the storage time of LLIN.

Controls over assets (stocks) – the risk of counterfeit, theft etc.

All the stocks are stored in government facilities, and verification is done from time to time. The accountability is fixed with MPW, ASHA, ANM, and Stores-Pharmacists at various levels, which are continuously monitored and validated by State PSCM Consultants and other consultants during routine visits.

PSM recording and reporting

Stock registers are maintained at every stock point and monthly stock reports are shared via email through the reporting hierarchy in standardized formats. The reports are compiled, verified and analyzed at every level to analyze the situation for management of stocks/ supply chain.

PSM quality assurance

QA is an integral part of all procurement under NCVBDC. QA is done by empanelled

laboratories after the supply of goods at CMSS warehouses. For items being supplied directly to the consignee, pre-dispatch inspection is done, wherein a team of CMSS representatives, testing laboratory representatives and NCVBDC officials collect the sample as per protocol. The collected samples are sent for testing. At the same time, goods are dispatched upon undertaking from the supplier to replace them if they fail in QA at their own cost. Use in the field is done after the drugs/diagnostics pass in QA. During the procurement and supply chain, a few challenges are encountered, such as delays in submission of requirements from State/UTs, timely approvals for want of clarifications, insufficient response from bidders due to reducing quantity of commodities etc. Delay in supplies due to shortage of raw material, transportation and related issues were mainly observed during the COVID-19 period. Retendering due to various reasons of procurement like an escalation in the price of drug, technical disqualification etc.

Intersectoral coordination

Involvement of multi-stakeholders from different sectors beyond the health sector and with various organizations, platforms/networks is aimed through strategic dialogue and/ or collaborations at all levels until the village level, as appropriate, viz., with other disease control/ elimination Programme, other government ministries and regulatory agencies (relevant for malaria elimination), research and academic institutions, civil society organization/NGOs/ Faith-based organizations (FBOs), and community networks, and self-help groups, local self-government (PRIs, Municipalities) as well as the private sector, professional bodies, WHO, other UN agencies and other international organizations/platforms. Dialogue and coordination with the Ministry of Defense, Armed and paramilitary forces have been initiated too.

In Tripura, active inter-sectoral collaboration is being done with BSF. In Gujarat, collaboration and utilization of tribal funds through the tribal welfare department are being done. Indian Council of Medical Research (ICMR), with its regional presence in several states, also helps in the generation of technical evidence to support the Malaria Programme. Along with ICMR, there is a need for the engagement of medical colleges and academic institutions in research towards malaria elimination.

Further consolidation is being pursued with a special focus on the harmonization of resources and efforts and precluding fragmentation and duplication. The country emphasizes one National Strategic Plan, one nodal organization (NCVBDC) to oversee, coordinate and harmonize the implementation of strategies at all levels and across stakeholders and partners, and one M&E framework. Evidence has shown that a large number of people access private sector providers, both formal and informal sectors. Efforts have been made to collaborate with the Indian Medical Association Head Quarters and its State branches to sensitize private doctors (formal) for treatment and reporting according to national guidelines. Similar endeavors were undertaken in selected states from time to time. However, further assessment and systematic strengthening are needed.

Malaria data reporting

Malaria data reporting is presently paper-based. For near real-time reporting and monitoring of the progress of states, IHIP is being piloted in Odisha and Himachal Pradesh for real-time data entry and monitoring through specialized malaria modules. The malaria modules added to the IHIP are envisaged to be rolled out in the entire country in the near future, which

should be able to solve all issues related to the presently used manual system of data entry, reporting and management.

Incentivization of states/districts for sub-national malaria elimination

Incentivization of States and Districts for sub-national malaria elimination: Govt. of India has instituted and approved the award of certificates and cash prizes to the districts/States. The proposal for incentivization of well-performing States/districts which achieve 'Zero Indigenous Malaria Status' and maintain it for three consecutive years to get certified for sub-national elimination was approved by the 6th Mission Steering Group (MSG) of NHM in February 2019. This is envisaged to create healthy competition among the districts and States to accelerate malaria elimination activities and achieve the targets in a timely manner.

3.1.3 Strengths

1. Strong political commitment at central and state level has ensured adequate domestic and external funding which has facilitated improved performance resulting in decline of malaria incidence.

2. Provision of incentivization of the well-performing districts/States for achieving zero indigenous case status and maintaining it to achieve sub-national malaria elimination. Development of state-specific elimination framework/strategic plans by some states in line with the NFME 2016-2030 and NSP 2017-2022.

3. Motivated VBD teams at different levels in many states towards realizing elimination goals.

4. NMETF has been constituted at the national Level.

5. Proactive planning and special campaigns are in place in many states to reduce the malaria burden; for example, Odisha and Chhattisgarh.

6. Effective participation by grassroots-level health workers and ASHAs in most high-burden states.

7. Some states have motivated WHO-certified LTs at the central/state Malaria Laboratory, for example, Haryana and Karnataka.

8. Important commodities (for example, LLINs, diagnostics, and antimalarials) are mostly available at key service delivery points.

9. Partnership with stakeholders and NGOs is in place, and Programme management and coordination is progressively improving.

10. Motivated and trained contractual consultants are available for support in Programme management in the high burden states.

11. Capacity building/strengthening of states on malaria elimination, especially in high-burden states, has been prioritized.

12. Healthcare staff/grassroots cadres are provided with training periodically.

13. Overall, health infrastructure at all levels is tuned to malaria elimination.

14. The availability of funds through NHM is satisfactory.

15. Significant domestic and external funding is available for malaria elimination.

3.1.4 Challenges and gaps

1. Lack of experienced and expert malariologists for effective Programme management as well as regular officers of the entomological cadre at the Central (NCVBDC) level. The vacant positions were created over the years due to the retirement of officers of this cadre; the last recruitment was done in 1997 by the UPSC.

2. Diminishing strength of entomological cadre in States as well as other partner institutions like NCDC and ICMR institutes.

3. Medical officers, Entomologists, LTs, MPWs, and insect collectors are also available in low numbers in States.

4. Dedicated HR for malaria at the block/district/state level is insufficient. Under-utilization of available HR or non-involvement of CHOs of Health and Wellness Centres in malaria elimination.

5. Availability of work allocation orders for different cadres in the States and mechanisms for accountability was variable, with examples of being totally lacking in a few visited districts/states
6. Ownership and involvement of MO of PHC and CHC are low in most places.

7. Training on the malaria elimination Programme for all levels is not yet a priority. In some states, SPOs and DMOs have not been formally oriented to the NSP/malaria elimination programme.

8. CME for health staff and private practitioners is inadequate.

9. Variable M&E. M&E plan is lacking in most states and/or not developed in most states in line with national M&E plan.

10. A review of supervision and monitoring mechanisms is needed. A formal mechanism for State or district and sub-district level supervision, monitoring and review of technical activities is yet to be optimal. There is a low priority for monitoring and follow-up actions at all levels.

11. Service delivery at the community level remains challenging in hard-to-reach rural, tribal areas along border areas especially pertaining to key and vulnerable populations, namely, forest workers/goers, Jhum cultivators, and mobile and migrant populations.

12. The NMETF meetings and oversight role are yet to be fully functional. State and district malaria elimination task forces are yet to be effectively functional in most states/ districts. The institutional mechanism for multi-sector coordination is not yet optimal.

13. The involvement of medical colleges was observed to be lacking in reporting as well as training, operational research as well as supportive supervision.

14. Weak coordination between state health services and municipal corporations.

15. Staff strength in municipalities and corporations was as per the norms of population and area of the 1970s. In Haryana, the population catered by the health facilities is almost double the existing NHM norms.

16. Relatively poor infrastructure in municipalities is seen. Overall, the entomological setup is very weak. No biologist is available in most of the urban malaria schemes.

17. Clear policy and guidelines on interstate/district border/international border malaria issues are required.

18. Infrastructure, especially storage space for LLIN and other commodities in States/ districts.

19. There have been definite instances of stock outs, which though addressed, need to be reviewed regularly to ensure uninterrupted supply.

20. There is under-utilization of available funding in some states. Absorption capacities of funding for certain components are variable due to the non-performance of planned activities as per the annual action plan (PIP).

In Chhattisgarh, drug requirements, supply and consumptions are to be uniformly planned to avoid expiry in the field with proper monitoring mechanisms. In Gujarat, the supply chain may need to be streamlined to avert any potential stock-outs. In Haryana, stock out of malaria stains for several months was reported at the PHC level. In Haryana and Punjab, access to diagnosis and treatment has to be ensured up to the peripheral level by ensuring drugs, diagnostics and services for malaria at the sub-centre and community level. There is evidence of re-distribution of stock between zones and rural health systems and no buffer stock. In Haryana, procurement is organized through Haryana State Medical Corporation Limited. RDTs are supplied by NCVBDC and also procured locally. Information on whether specifications are in line with National guidelines could not be established through the review

1. Lack of effective IEC for improving community awareness on malaria elimination, treatment seeking, pro-active participation in the implementation and acceptance of vector control strategies like IRS and use of LLINs.

2. Malaria control and its management in urban areas are foreseen as a major challenge for malaria elimination during this review.

3.1.5 Recommendations

1. Prioritize sustained advocacy and coordination to keep malaria elimination as a key agenda at all levels of the health system, especially the political level. Ownership and Effective leadership at all state and district levels are critical to malaria elimination at this juncture for consolidating the gains and reducing the burden of malaria further for achieving elimination.

2. Ensure effective Programme implementation and accountability through written work allocation and supervision orders for all levels in States up to the peripheral level. Ensure fully functional NMETF with multisectoral involvement as per the constitution, and ensure functional SMETF and DMETF were not yet done. A functional task force at the district and state levels should ensure follow-up on recommended actions.

3. Ensure filling all critical HR positions from central to state, district and sub-district, and community levels (dedicated and full-time officers and supporting staff), as essential elements in the journey to malaria elimination. Recruitment of an adequate number of skilled cadres (doctors, nurses, LTs, entomologists, laboratory technicians, and community-level health workers) should be addressed. In the context of manpower shortage, specific jobs may be outsourced.

4. Strengthen technical and strategic leadership at the central, state and district level and hold regular meetings involving technical/malaria experts to monitor progress and review challenges.

5. Carry out a comprehensive review of existing HR, and gaps should be identified in relation to changing requirements for elimination. According to the review findings, HR development plans at all levels should include the necessary skilled HR for elimination and prevention of re-establishment.

6. Carry out a training needs assessment in the context of elimination. All levels should be trained in malaria elimination. Coverage and quality of training for different levels and on-the-job capacity assessments should be considered.

7. Carry out mapping of institutions/organizations related to malaria elimination so as to exchange learning and capacities.

8. Seek/consider technical support from WHO regarding building/strengthening capacities for malaria elimination.

9. CME for health staff and private practitioners involving medical colleges and hospitals.

10. Develop a strategy for integrated responses in elimination settings and in malaria-free areas and initiate/pilot strategy implementation. Selected states and districts should be enabled to initiate planning and coordination accordingly.

11. Strengthen annual PIP and micro-planning processes with the involvement of all key cadres and sectors. More emphasis should be placed on local-level evidence-based

planning and what has worked and/or not worked. Prioritize bottoms-up approaches.

12. Block CHC/PHC level Programme management should facilitate the community level committees/GP committees- there has to be a mechanism to build up ownership at the local level.

13. Consider the provision of social audit to infuse findings into micro-planning.

14. Strengthen procurement and supply chain management to ensure the availability of commodities and antimalarials at the right place at the right time. Forecasting especially involving the local level, should be strengthened based on caseload and trend analysis, and accordingly and deployment should be considered. Expected lead times for procurement and lessons learned from the past should inform the process.

15. Ensure sufficiently and sustained funding from domestic and external sources (for example, the GF), especially to realize and sustain malaria elimination. In addition, the NCVBDC should explore mobilizing resources for elimination from various sectors (viz., corporate sector/others).

16. Ensure full as well as a rational utilization of available resources with emphasis on equitable and universal coverage by interventions tailored to context as well necessary, HR, institutions strengthening/infrastructure.

17. Emphasize strengthening of urban malaria with necessary manpower as per current population and area in Municipalities.

18. NUHM has given additional support to contractual male MPWs, link workers, and breeding checkers. Their services must be used appropriately.

19. There is a need for closer interaction with the state health departments and Housing and Urban Development departments.

20. Ensure consonance of malaria control/elimination strategy in Municipal Corporations with national strategy. Formulation of an elimination-focused strategy aligned with the National Strategic Plan is required.

3.1.6 Key action points

1. Strengthen the NCVBDC malaria elimination cell with dedicated senior officers, supporting officers and staff with a tenure of at least three years.

2. Ensure retention of dedicated Programme officer with public health background for at least three years both at the state and district level.

3. Ensure the appointment of entomologists and insect collectors in the required number for dedicated work in entomological and vector control.

4. Ensure the positioning of at least one VBDTS in high endemic blocks for adequate

monitoring and supervision.

5. Consider specific mechanisms for capacity building in NE states.

6. Establish institutional mechanisms to address inter-district, inter-state, and international border malaria problems.

7. Constitute a core technical team at all levels to help and guide the programme officers at the state, district and block levels.

8. Develop special guidelines for urban bodies in coordination with the state VBD office; emphasise adequate diagnosis and treatment facilities in urban public health systems; capture data from private sectors and entomological setups; provisioning funds for identified/specific interventions, logistics and monitoring and review mechanisms.

9. Enforce case notification from all sectors/institutions. Malaria is a notifiable disease. This should be widely disseminated.

Table 4: Guidance on key action points and timelines

S. No.	Issue	Action	Responsibility	Timeline
1.	Sustained advocacy	Sensitization of top leadership at the central as well as state levels.	NCVBDC, State	Short-term (3-6 months)
2.	NMETF, SMETF, DMETF	Regular meetings and support through NMETF, SMETF, and DMETF, including follow-up on recommended actions	NCVBDC, State, District	Periodical
3.	Programme management	Strengthen the malaria elimination cell with dedicated senior officers, supporting officers, expert consultants and staff. Dedicated Programme officer with public health background for at least three years both at the state and district level	NCVBDC, State	Mid-term (6-12 months)
4.	Ownership and accountability	Clarity in roles and responsibilities, capacity to perform, well-defined monitoring mechanisms and documentation	NCVBDC, State, District	Short-term (6-12 months)
5.	Human resource	Situation analysis for HR gaps and filling all critical HR positions from central to state, district and sub-district.	MOHFW, NCVBDC and States	Long-term (12 months and above)
6.	Strategic leadership and technical support	Ensure leadership and technical capacity at central, state and district levels; involvement of technical/ malaria experts for technical support, monitoring progress and reviewing challenges.	MOHFW, NCVBDC and State	Short-term (6-12 months)
7.	Capacity building	Training needs assessment in the context of elimination and systematic capacity building	NCVBDC and State	Mid-term (6-12 months)

8.	Ownership at the local level and evidence-based micro-planning, community engagement	• Bottoms-up approach for all malaria elimination activities, including annual action plans and PIPs. • Community level committees/GP committees; Social audits to infuse findings into micro-planning amongst other locally feasible plans.	NCVBDC and State	Mid-term (6-12 months)
9.	Cross-border malaria issues	Establish institutional mechanisms to address inter-district, inter-state, and international border malaria problems.	WHO, NCVBDC and State	Mid-term (6-12 months)
10.	Urban malaria management	Special guidelines in coordination with state VBD office; Diagnosis, treatment and entomological setups; provisioning of funds for identified/specific interventions, logistics and monitoring and review mechanisms	NCVBDC, NUHM and State	Mid-term (6-12 months)
11.	Case notification	Central notification, legislative measures for compliance.	NCVBDC and State	Short-term (3-6 months)

3.2 Thematic area 2: Epidemiology and social determinants of malaria

3.2.1 Overview

The malaria situation in India is diverse across different States and geographical areas, and based on this variation across states, malaria endemicity varies considerably. The parasite distribution, seasonality of malaria transmission, presence of vectors as well as socio-economic status and human behaviour being varied across different States as well as within the states, strategies and their implementation in these areas varies to a large extent. In spite of all issues and existing challenges, India has achieved significant progress in reducing malaria cases and deaths over the last decade and is poised to interrupt local transmission in the country in a phased manner and achieve the goal of malaria elimination by 2030. Based on these parameters, various malaria indicators, mainly the annual parasite incidence in the entire country, have been stratified into four categories.

3.2.2 Observations

Malaria situation

The reported malaria cases and deaths have been declining steadily but progressively since 2000, with an upsurge in 2009, 2010, 2014 and 2015 due to outbreaks in a few States. The decline after 2016 is remarkably drastic after the launch of NFME and the adoption of revised strategies as per NSP (2017-2022). Compared to 2015, the number of reported cases declined from 1 169 261 to 158 326, that is, by 86.5% and the reported malaria deaths from 562 to 80, that is, by 87% in the year 2021. The caseload, though steady at around 2 million cases annually in the late nineties, has shown a declining trend since 2002. The reported *P. falciparum* (Pf) cases declined from 1.04 million in 2000 to 0.11 million cases in 2020. Confirmed deaths due to malaria have been fluctuating during this period until 2010; however, in the last five years, there has been a significant decline in reported deaths due to malaria, with around 93 deaths in 2020. The declining trend in malaria cases and deaths in 2021, as indicated by provisional figures. In 2021, 158 326 cases and 80 deaths were reported in the country due to malaria.

The epidemiological situation of malaria in India from 2000-2021 is given in Annex 4

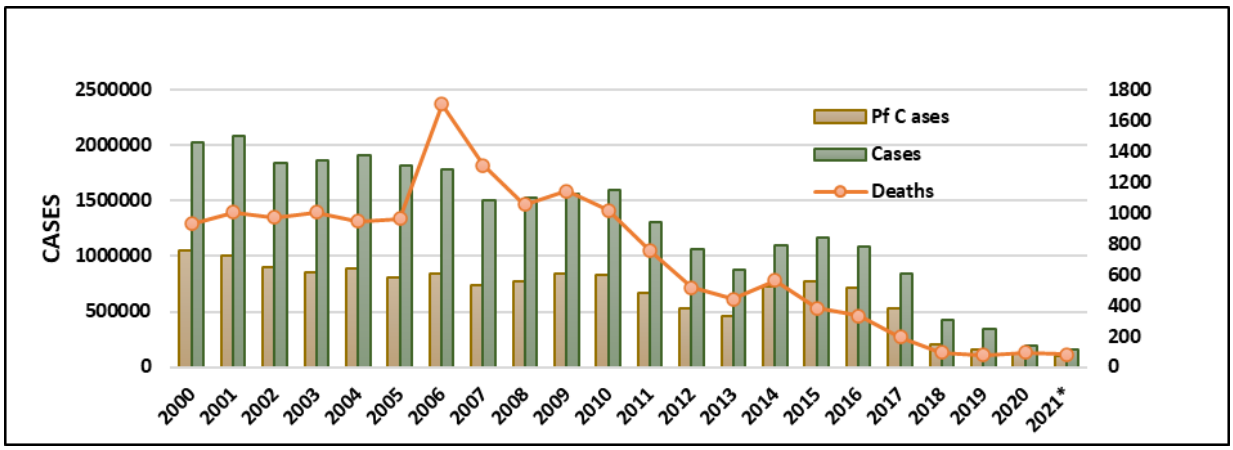


Fig. 1. Trend of malaria cases and deaths (2000-2021)

The annual parasite incidence (API) has come down from 2.09 per thousand population in 2000 to 0.14 per thousand population in 2020. The SPR has also shown a gradual decline from 2.34% in 2000 to 0.19% in 2020 (Annex-4, Fig. 1). The provisional figures for 2021 showed a further decline in API (0.12 per thousand population) and SPR (0.14%). However, the annual blood examination rate (ABER) has remained within the range of around 10%. During the years 2020 and 2021, however, ABER dropped due to various restrictions related to the COVID-19 pandemic in the country.

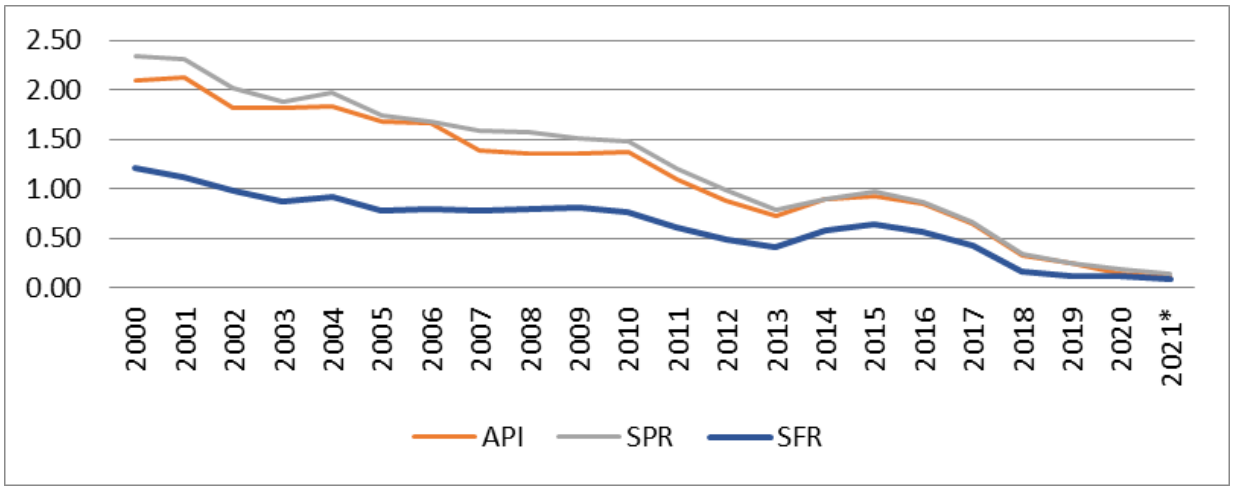


Fig. 2. Malaria indices [2000 — 2021]

The NCVBDC figures mostly do not include data from the private sector at present, even though an attempt is being made to initiate reporting by this sector. The reported malaria statistics provide a robust measure of progress yet may not fully reflect the true burden of the disease. Data from the Mass Screening and Treatment Campaigns under special State initiatives, for example, DAMaN and similar other initiatives and interventions of Odisha state, is not added to the data reported to the NCVBDC.

State-wise distribution of malaria

Reviewing malaria morbidity over the years in the States, the highest contributors have been Odisha, Chhattisgarh, Jharkhand, Madhya Pradesh and the Northeastern States. In 2014, 90% contribution was by 11 States, namely Odisha (35.8%), Chhattisgarh (11.7%), Jharkhand (9.4%), Madhya Pradesh (8.8%), Maharashtra (4.8%), Tripura (4.6%), Uttar Pradesh (3.8%), Gujarat (3.8%), Meghalaya (3.6%), West Bengal (2.4%) and Mizoram (2.1%). The same situation continued till 2017, with some additional states contributing to the 90% morbidity. In 2018, the 10 States which contributed to >90% of cases included Uttar Pradesh (20.1%), Chhattisgarh (18.3%), Orissa (15.4%), Jharkhand (13.3%), West Bengal (6.2%), Madhya Pradesh (5.2%), Gujarat (5.1%), Tripura (3.0%), Maharashtra (2.5%), Meghalaya (1.5%). States like Uttar Pradesh, West Bengal and Gujarat case loads showed significant upward changes while Odisha's caseload reduced drastically. In 2019, nine States contributed to >90% of cases, namely, Uttar Pradesh (20.1%), Chhattisgarh (18.3%), Odisha (15.4%), Jharkhand (13.3%), West Bengal (6.2%), Madhya Pradesh (5.2%), Gujarat (5.1%), Tripura (3.0%), Maharashtra (2.5%) with Odisha as well as the Northeastern States recording continuous reduction. In 2020, Chhattisgarh and Uttar Pradesh became the biggest contributor, followed by Jharkhand. There has been a reduction in malaria endemicity in most states/UTs, to the extent that no state had API more than 1 in 2021 except Chhattisgarh and Mizoram.

District-wise distribution of malaria

Over the years, malaria cases have reduced and are limited to some districts only at present, as per the available data. In 2014, there were 60 districts in the country, which accounted for 70% of malaria. The number of such districts started declining gradually, and in 2019, there were only 11 districts contributing to nearly 50% of malaria in the country.

Seasonality of malaria

Malaria in India generally peaks during the post-monsoon period, viz., during the months of July to September. A second small peak was noted in November-December, extending to January in some years. The seasonal peaks have been successfully managed in recent years (Fig. 3). However, perennial transmission is also noted in some high-endemic areas.

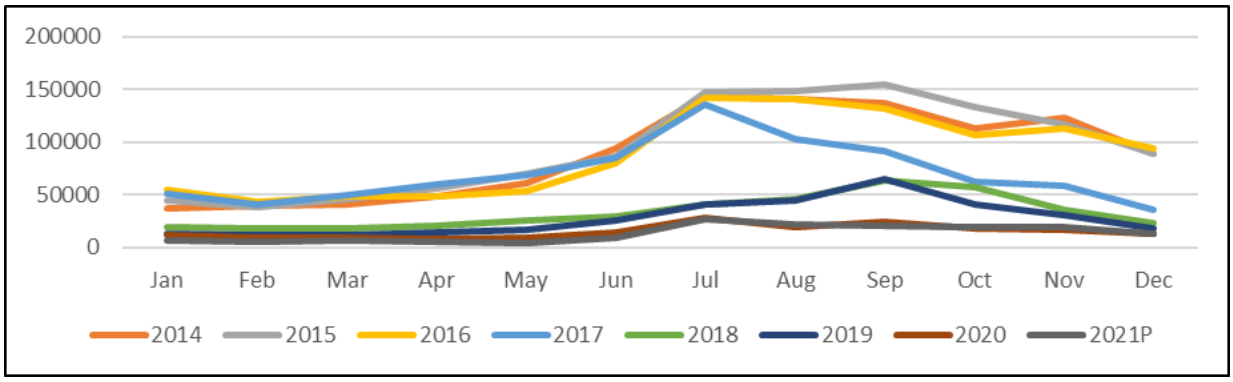


Fig. 3. Month-wise seasonality of malaria (2015-2021)

Age and gender distribution of malaria

The age- and gender distribution of malaria cases showed that in 2021, the majority of malaria cases were found in the age group 15+ years (62%) and among males (57%). The gender-wise distribution in the same year was 57% male and 43% female.

Age distribution:

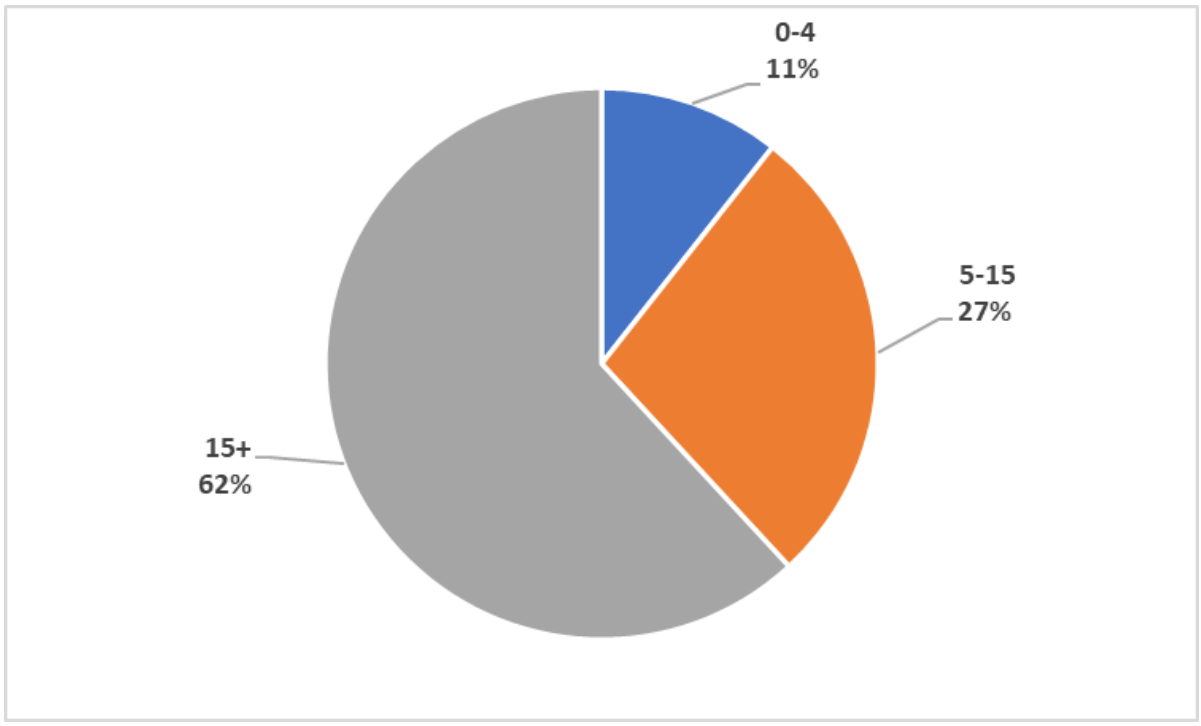


Fig. 4. Age-wise distribution of malaria cases

Male: female distribution

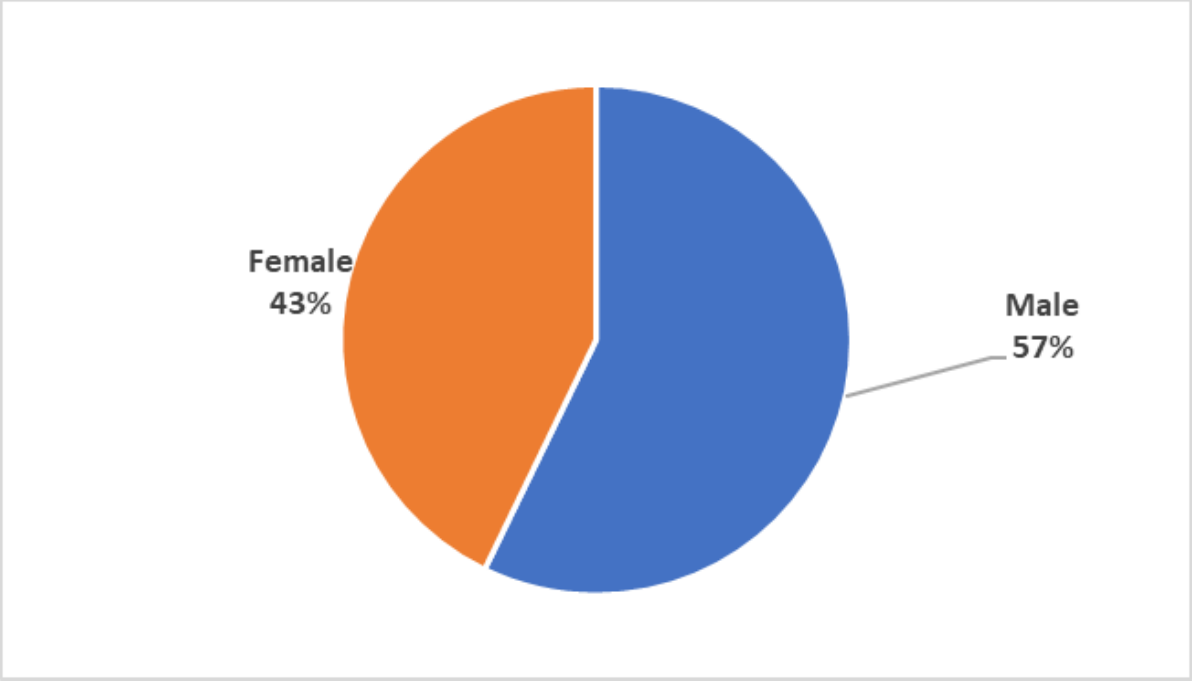


Fig.5. Gender-wise distribution of malaria cases

Epidemiological types, populations at risk

It is well known that the epidemiology of malaria in India is complex and varies across state/district/sub-district levels, various populations, and individuals, requiring strategies/ approaches tailored to specific contexts and risk groups, vector behaviour, as well as available infrastructure including health system coverage. Over the years, malaria transmission has become local and focal in hilly, forested and forest fringe areas, inter-state, international border areas, mostly amongst indigenous/tribal and mobile and migrant population groups, Jhum (shifting) cultivators, forest workers/goers, Jhum cultivators, labour in tea gardens/ plantations, socio-economically disadvantaged groups. A few urban areas are also reporting relatively high malaria caseloads, viz., in Mumbai and Surat, amongst others. The intensity of malaria transmission in any given area is prone to change as a result of changing ecologies, population movements, various social determinants, etc.

Further, certain epidemiological types of the disease, as mentioned below, pose particular challenges in malaria control and malaria elimination. The geo-ecological as well as social determinants, amongst others, need to be understood to address malaria in these settings.

- Malaria among migrants/labour (mobile and migrant populations)
- Malaria in urban areas
- Malaria in tribal and forest ecosystems
- Malaria in rural plain areas
- Malaria in project areas
- Malaria in border areas

Malaria among migrants/labour

It is recognized that population movement is an important element with implications on malaria incidence throughout the phases of migration - before departure, during travel and transit, at the destination and upon return. Migrant and mobile populations face obstacles in accessing equitable essential health care services due to socio-economic factors such as living and working conditions, education level, gender, migration status, language and cultural barriers, anti-migrant sentiments, and lack of migrant-inclusive health policies/strategy, amongst others. Thus, migration is considered one of the social determinants of health for migrants and other marginalized and vulnerable groups. When populations move from low malaria transmission areas to high transmission areas, they are more susceptible than the resident population. Migration from the high transmission areas to the low transmission area can expose malaria-free inhabitants previously to the disease. This cycle of reintroduction threatens progress towards malaria elimination. It was observed that surveillance among migrant and mobile populations, especially in urban settings, is inadequate in all the states visited, even though a significant number of malaria cases occur among the migrants. For example, in Mangalore city, 22,192 labour were screened, and among them, 296 positive cases were detected in 2021. Of the 637 cases in Mangalore city, 296 (46%) were reported among migrants. Interventions tailored for mobile and migrant populations are needed to:

1. Ensure universal access to preventive measures and prevention of transmission of malaria parasites by mosquito control, personal protection and environmental manipulation. IRS of labour sheds should be done with appropriate periodicity. LLINs should be distributed, and regular and appropriate usage should be followed up.

2. Ensure universal access to early diagnosis and effective treatment services with an emphasis on the detection of all malaria cases and clearance of *P. falciparum* gametocytes and dormant liver stage of *P. vivax*.

3. Ensure universal community awareness and behaviour change through comprehensive behaviour change communication (BCC), community mobilization, and advocacy activities.

4. Halt drug pressure for the selection of artemisinin-resistant malaria parasites by improving access to appropriate treatment and prevention use of monotherapies by both public and private sectors.

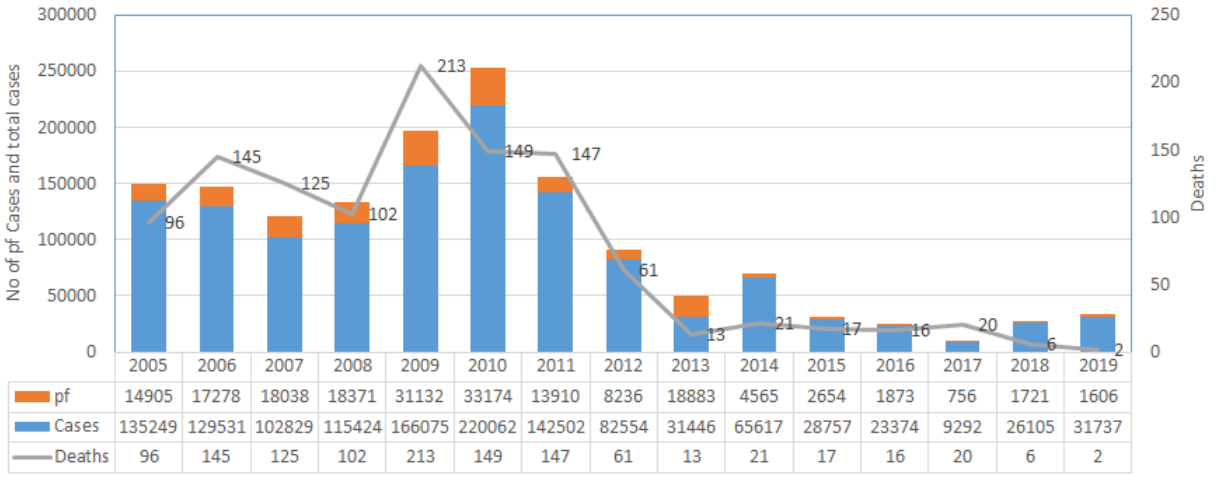
5. Provide effective management (including information systems and surveillance) and coordination to enable rapid and high-quality implementation of elimination strategy.

6. Map and keep track of mobile and migrant populations in collaboration with Labour and other departments, contractors etc. Information exchange between states where migrants/labour originate and where they move is necessary.

7. Screen mobile and migrant populations at the earliest point of entry for malaria. Surveillance should be strengthened at the weekly interval to detect any malaria cases at the earliest. Night shelters should be given special attention.

Malaria in urban areas

Malaria in urban areas is contributed by large-scale rural-urban migration triggered by urban "push" (for earning a livelihood and urban "pull" (for availing both medicare/education opportunities). Demographic and societal changes, unplanned urbanization, development projects without appropriate health impact assessment and incorporation of non-eco-friendly technologies increasing vector breeding potential pose immense complexities. Urban Malaria Scheme (UMS) of the NCVBDC, approved in 1971, envisaged that 131 towns with more than 2 API and>50,000 population would be covered for interventions in a phased manner. However, the implementation of the UMS is yet to be optimal. In view of the changing scenarios, any comprehensive assessment to revisit, re-strategize and re-align with the elimination goal also has yet to be carried out. The malaria cases and deaths reported under UMS over the years are depicted in Fig. 4. In 2017, a decline in malaria cases in UMS towns/cities was observed, although thereafter, a reverse trend was noted.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
pf	14905	17278	18038	18371	31132	33174	13910	8236	18883	4565	2654	1873	756	1721	1606
Cases	135249	129531	102829	115424	166075	220062	142502	82554	31446	65617	28757	23374	9292	26105	31737
Deaths	96	145	125	102	213	149	147	61	13	21	17	16	20	6	2

Fig. 6. Trend of malaria cases and deaths in urban areas [2005-2019]

In towns and cities under the UMS, the following interventions are applied:

- **Parasite control:** Diagnosis and treatment are based on passive agencies, viz. hospitals and dispensaries in the public sector, besides both private sector facilities and individual private practitioners. In megacities, malaria clinics have been established by Municipal corporations, Railways, and Defence services.

- **Vector control:** Source reduction, use of larvicides, use of larvivorous fish, space spray and legislative measures are recommended. [The same is applicable in the 206 towns covered under National Filaria Control Programme (NFCP) under NCVBDC].

Observations related to urban malaria in selected cities, viz., Mumbai, Surat, Mangalore and Bangalore, are presented below:

Mumbai (Maharashtra)

Between 2017 and 2019, Maharashtra achieved a 49% reduction in malaria cases through a combination of surveillance, case management, vector control and cross-cutting interventions. However, malaria cases increased by 119% between 2019 and 2021, reversing the gains. In 2021, Maharashtra contributed 19 430 malaria cases, sharing about 12.3% of the total reported burden of malaria in India. Over 60% of the total reported cases in the state

were due to Pf infection, comparable to the Pf proportion reported nationally. Malaria deaths reported by the state have also increased in the past two years, paralleling the rise in malaria cases. However, in 2022 no death due to malaria has been reported. Malaria endemicity is very high in Mumbai suburban/Mumbai City and Gadchiroli district and very low in the remaining parts of the state. Gadchiroli district reported API >1 in 2021.

Mumbai city was categorized into six segments to deliver tailored interventions: 1) MCGM properties, 2) Government and Semi-government properties, 3) slums, 4) building construction sites, 5) sick mills, and 6) private properties. Two strategic interventions are applied: 1) elimination of breeding sites through engineering methods and 2) adult and larval treatment for vector control.

In the MCGM properties, mosquito-proofing of water tanks, disposal of unused tanks, odd article removal, disposal of scrap, and proper stacking of pipes and bends are carried out. In the government and semi-government properties, the Mosquito Abatement Committee facilitates the demolition of dilapidated structures and sick mills and various cross-sectoral actions, such as the rearrangement of wheels in railway yards, removal of odd articles, etc. In slum areas, interventions include weekly Temephos treatment, IRS and indoor fogging, odd articles removal, and scaling up the use of mosquito nets. In building construction sites, developers are entrusted with site correction and labour welfare measures, including the distribution of health cards, mandatory appointment of medical practitioners, and bed nets to workers. MCGM conducts a regular inspection, regular workshop of site engineering and safety officers, IRS at construction workers' huts, periodic baseline survey, and issuing of stop-work notices to non-compliers. In the sick mills, the activities include the removal of odd articles, treatment of inaccessible roof gutters, and converting mill ponds into hatcheries. In private properties, mosquito-proofing of tanks, health education in societies, odd article removal drives, and legal action against non-compliers are undertaken.

The current 5-point programme strategy followed by BMC is control focused, and there is limited awareness regarding National Strategic Plan for Malaria elimination. The state PIP does not include MCGM's demand in demand submitted to the NCVBDC; hence MCGM does not get any assistance from the state. Acute scarcity of frontline workers in the corporation and microscopists and VBD officers in the state. 50% of the sanctioned posts are vacant. There is an acute shortage of RDTs to be used during the emergency period when malaria microscopy facilities are not available. There is a shortage of antimalarial drugs (ACT-SP, PQ 2.5 and 7.5 mg tabs). Entomology staff (Assistant insecticide officer/entomologist/ overseer/ pest control officer) and paramedical staff have limited capacity.

The same phenomenon was also observed in a post-pandemic situation in Mumbai in 2020 and 2021. There is an increasing burden of *P. falciparum* malaria (approx. 30%) in Mumbai that started in 2021 and has been continuing in 2022. The local teams attributed this change to high parasite mobility due to in-migration, but otherwise, the problem is not as well characterized. The overcrowded slums having close proximity to markets and high-rise buildings profoundly increase the risk of malaria transmission. Despite the intensive antilarval measures taken by the MCGM, the breeding continues in old and dilapidated structures (cotton mills), which cannot be demolished due to legal complexities and pending judgements.

Mangalore (Karnataka)

Mangalore city, with 637 cases alone, has contributed to 71% of the malaria burden in Karnataka state. From 2015 onwards, the number of deaths due to malaria till last year was nil. There were two malaria deaths in the year 2021. One each happened in Hassan and Dharwad districts. Epidemiological investigation of both cases showed that the infection was probably acquired in Mangalore city. The disease in Mangalore is persistent throughout the year due to high rainfall during monsoon and post-monsoon season, high humidity, the influence of Anopheles stephensi and Anopheles culicifacies, increase in construction activities and rapid urbanization attracting aggregation of migrant labourers from other endemic areas.

Special Factors for Perennial Transmission in Mangalore City: Temperature and humidity favorable for the vector Anopheles stephensi breeding, Intermittent rainfall, Breeding Sources (In Bunder - scrap shops with uncovered scraps where rainwater gets collected during rainy season, Port area – unused boats in the shore near Dakke and Bengre, boats with open barrels and tires tied at the side to avoid friction, Anopheles breeding in wells, open syntax and barrels without lids, Terraces and shades of the buildings with water stagnation during rainy season which increase the vector density, Construction sites with uncontrollable sources during rainy reason, Migrant labour staying in the cheaper lodges near bunder, central market, port area without proper protection against mosquito bites, Homeless people who are sleeping outdoors near central market and Nehru maidan areas, Difficulty in tracing, verification of radical treatment and follow – up smear collection due to improper or no specific address of the migrant positive cases),

Seasonal trend of malaria in Mangalore city

Malaria cases are reported throughout the year. However, its peak is observed from July to September. Mangalore city has been given additional inputs for malaria control. 45 contractual staff have been provided. Four of them are laboratory technicians. Three are manning the 24/7 mobile units. Two are involved in doing focal spray. Ten conduct domestic visits for epidemiological investigation of positive cases and control measures. The rest of them visit the construction sites for surveillance of labour and antilarval measures. Migrant population surveillance is happening well.

In the year 2021, about 22 192 have been screened. 227 vivax, 57 Pf cases and 12 mixed positives were detected. The private sector is actively involved in malaria surveillance in line with the notification requirements. As of now, 140 laboratories and 40 hospitals do real-time reporting. Active surveillance is to be done weekly in large construction complexes with labour habitation and fortnightly in other areas. It was found that out of 145 private health facilities, about one-third are reporting on a real-time basis. Proper supervision and cross-checks of surveillance and data reporting are necessary at all levels. All fever cases must be screened for malaria as per national guidelines across all health facilities. It was observed that clinicians of a reputed medical college are not screening all fever cases for malaria.

Bangalore (Karnataka)

The surveillance activities in Bruhan Bangalore Mahanagara Palike (BBMP) are very weak. Most urban PHCs do not screen fever cases for malaria by taking a blood smear. Occasional RDT is done. Whatever surveillance is taking place in Bangalore is by the private sector. They also mainly do RDTs. About 10 % of private health facilities report in the online PHIEC software. In BBMP, 48553 patients were screened for malaria in 2021, and the same was 50 459 in 2020.

Of this, all the cases were screened by RDT/microscopy. Of the total 48 553 screened, 45 814 were tested in private hospitals and 2 739 in BBMP UPHCs. Though there are ANMs and male MPWs in each UPHC, hardly any active surveillance is going on. ASHAs are also contributing little. Most UPHCs do not have a stock of antimalarials.

Surat (Gujarat)

Surat Municipal Corporation (SMC) is one of the oldest in India, having an area of 462 sq. Km, Population 4 645 384 (Census 2011), whereas district Surat as a whole has a population of 60.80 Lakhs (Census 2011). In Surat Municipal corporation, in 2015, there were 7513 cases, which have reduced to 651 (99%) in 2021. API has reduced from 1.43 in 2017 to 0.09 in 2021. SMC contributes about 13% to 15% to the total positive cases in the state. SMC follows antilarval measures for urban vector control, which includes peri-domestic intervention intra-domestic interventions by using Temephos, Diflubenzuron and Guppy Fishes. Focal anti-adult measures are also taken, but not for malaria specifically. However, space spray is done in the places of positive malaria cases. IRS is done with two rounds in a high-risk area.

From 2017 to 2021, SMC shows a declining trend of malaria cases. For 2017, 2018 and 2019, SMC public health reporting system shows a typical seasonal trend (peak during monsoon) except for 2020 and 2021 (most probably due to the disturbance in surveillance because of the covid pandemic). SMC also has a robust mechanism to collect and compile laboratory-confirmed Malaria cases from the private sector (though, as per the VBD officer: to date, around 10-15% of private hospitals/labs/private practitioners are only enrolled for reporting). Overall, like the public sector, data collected from the private sector also shows a declining trend of malaria cases over the period. But in comparison to the public sector, the private sector reports around five folds high malaria cases. In SMC, if we consider malaria-reported cases from the public sector, then all units show API less than 1. But if we include cases reporting from the private sector into it, then there may be a few units which may show API>1.

Illustrating the prevalence of malaria within tribal and forest ecosystems, specific instances are highlighted through the malaria scenario in Chhattisgarh and Tripura as outlined below:

Chhattisgarh

There has been a decline in malaria in the last five years as cases dropped from 130 721 in 2017 to 29 733 in 2021. Malaria (93%) remains concentrated in the tribal areas in Bastar Division which consists of 7 districts, namely Bastar, Kanker, Narayanpur, Kondagaon, Dantewada, Sukma and Bijapur (Fig. 7 and 8). API distribution maps in Fig. 7, clearly show the drastic declines of malaria in all districts but malaria concentration in the Bastar Division. The state has analyzed the malaria situation based on API on a yearly basis which clearly shows the decline in the number of districts, blocks, sub-centres and villages. This decline in API is remarkable and shows that malaria remains concentrated in certain areas which are remote, inaccessible and have cultural practices which hamper the adoption of malaria control interventions.

The state continues to report deaths due to malaria. In 2021, 38 deaths due to malaria were reported. Almost all deaths are in the Bastar division.

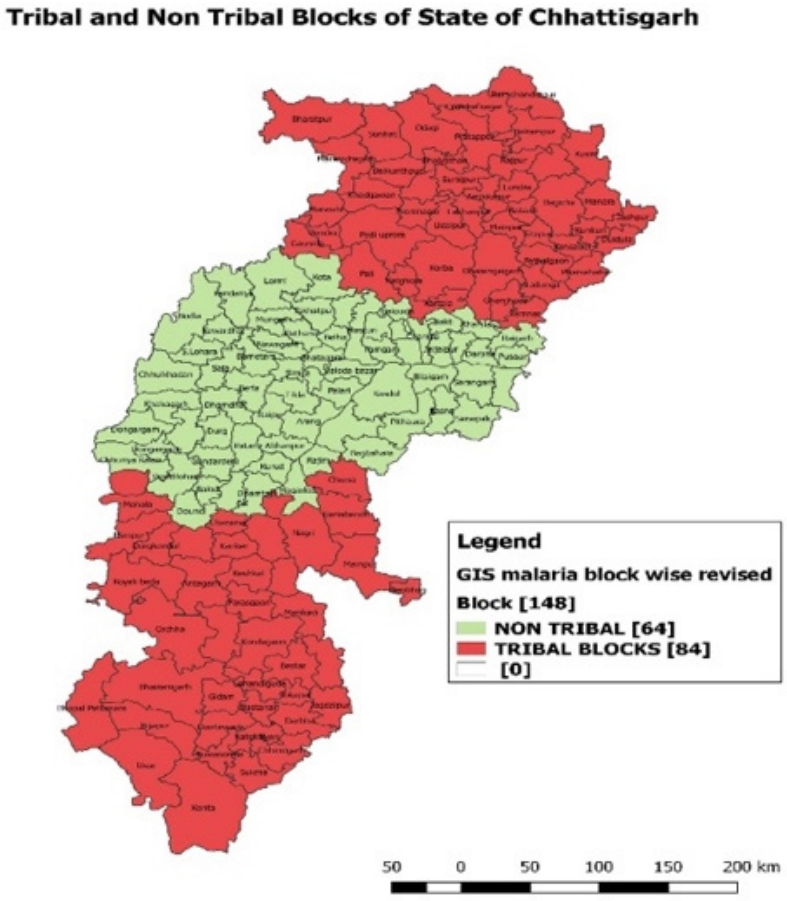


Fig. 7. Malaria in tribal blocks in Chhattisgarh

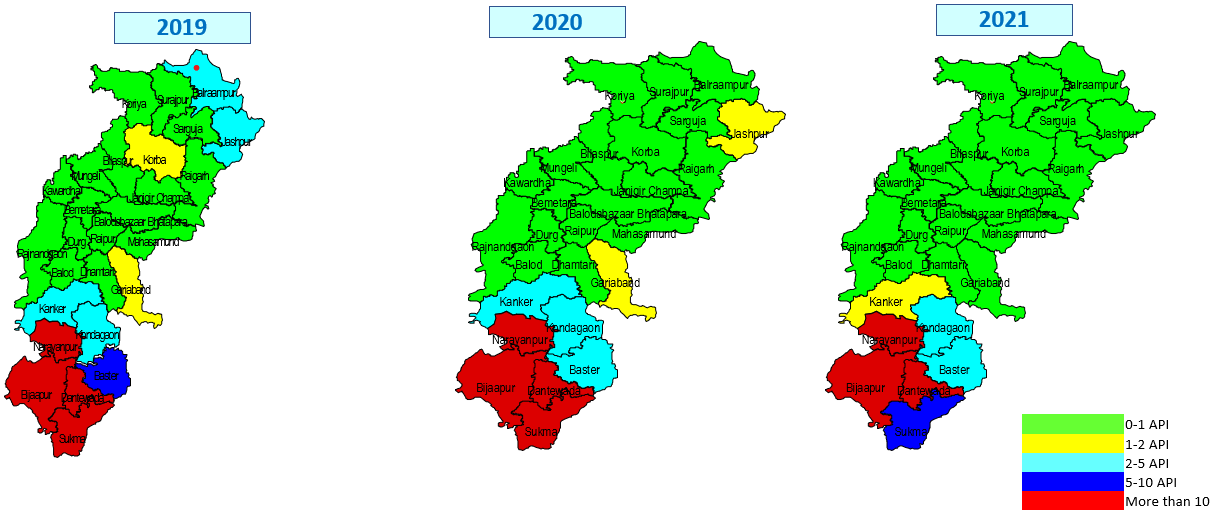


Fig. 8. API distribution in Chhattisgarh (2015-2021)

Tripura

There are eight districts in Tripura, of which all are endemic (API ranging from 0.99 to 17.9). The highest endemicity has been reported from Dhalai, Khowai, and South Tripura, with sizeable tribal populations. The state has witnessed outbreaks of malaria, and the last outbreak was in 2014, wherein 51 240 cases and 96 deaths occurred. In 2021, there were 10 136 cases (API 2.58) against 32 525 in 2017. Pf species dominate in all the districts ranging from 74 to 97%. Dhalai district is the most endemic. In 2015, API was 25.03, which came down to 7.54 in 2019 but again, there was a rebound in 2021 with an API of 17.93. On the other hand, in the South Tripura district, there were appreciable gains in the reduction of malaria cases, that is, 9 102 cases in 2015 versus 476 cases in 2021. (19.25 API in 2015 Vs 1.01 API in 2021). The state reported 04 deaths in 2021.

Malaria situation in Gujarat

Malaria shows a reducing trend in Gujarat from 2015 (4166 cases and seven deaths) to 2021 (4921 cases and no deaths); malaria has reduced to 88% in the state, and deaths are restricted (Fig. 9). There are 33 districts and eight municipal corporations. The urban population constitutes 42.6% while 57.4% is rural (tribal population is 14.75%). The state reported an 88% reduction in malaria. In 2015, there were 41566 cases and seven deaths, while in 2021, there were only 4921 cases. The malaria problem is mostly restricted to municipal corporation areas and districts from Saurashtra (Kutch desert). The transmission is almost perennial, with a peak in the months of August to November, related to rainfall. In the Panchamahal district, a gradual reduction of malaria has been reported. In 2016, there were 1825 cases were there, while in 2021, only 51 cases were recorded. P vivax is the predominant (87%) parasite. Cases start appearing from April onward and peak till October, and cases are minimum during January and February each year. This suggests that ten months are favourable for malaria transmission in the state. In 2021, the malaria problem was mostly restricted to municipal corporation areas and districts from Saurashtra (Kutch desert).

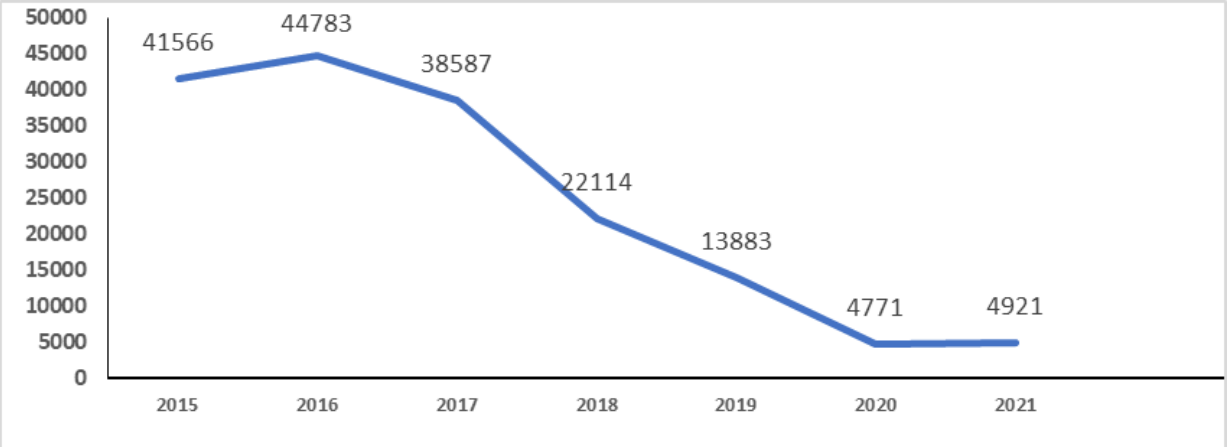


Fig. 9. Malaria trend in Gujarat (2015-2021)

Panchamahal district is one of the important tribal districts of **Gujarat state.** It is a border district in the eastern part of Gujarat and is situated between 22 030' and 23 030' latitudes and 73 015' and 74 030' longitudes. Panchamahal district comes under heavy rainfall areas in Gujarat, having a sub-tropical climate with moderately low humidity. Panchamahal district has a population of around 1 884 196, of which 40 % are tribal. Districts have seven blocks with 4 Nagarpalikas and 657 villages. The population depends upon district hospitals (1), CHC

(12), PHC (56), SC (300), malaria clinics (71) and private hospitals (24) for health services. The administrative headquarter is Godhra for the Panchamahal district. The majority of the tribes migrate to the nearby district within the state for work.

Panchamahal district was analyzed for the cases of malaria it was observed that cases follow some reducing trend as the Gujarat state among the malaria Pv dominates (87%) of total cases. During 2015 about five villages with API >5, 85 villages >2, 105 villages >1 API and 126 villages <1 API and 262 villages were free from malaria. Whereas in the year 2021, this has reduced to only four villages >1 API and 33 villages <1 API and 576 villages free from malaria cases. Malaria cases follow a seasonal pattern; however, it is interesting to note that cases appear every month; there is no non-transmission period, unlike the whole Gujarat state (Fig. 5). LLINs were distributed in 2017 to the PHCs having villages with more than 1 API. IRS activity is also being carried out in the villages having API more than since 2015(59 villages to 2021(8 villages). In the Panchamahal district, the tribal population has a practice of collecting Tadi in earthen pots of small size, which are left over during and post-monsoon and are available for mosquito breeding. The community needs to be oriented for this. Community participation is required for the distribution of Guppy fish in the wells.

Malaria in rural plain areas

As examples of malaria in rural plain areas, the malaria situation in Haryana is presented.

Malaria situation in Haryana

There are 22 districts and four corporation areas. The rural population is 9.65 lakhs, while the urban is only 1.24 lakhs. A drastic reduction in malaria has been recorded. In 2015 there were 9308 cases, and in 2021, there were only 54 cases in the whole state of Haryana (Fig. 10).

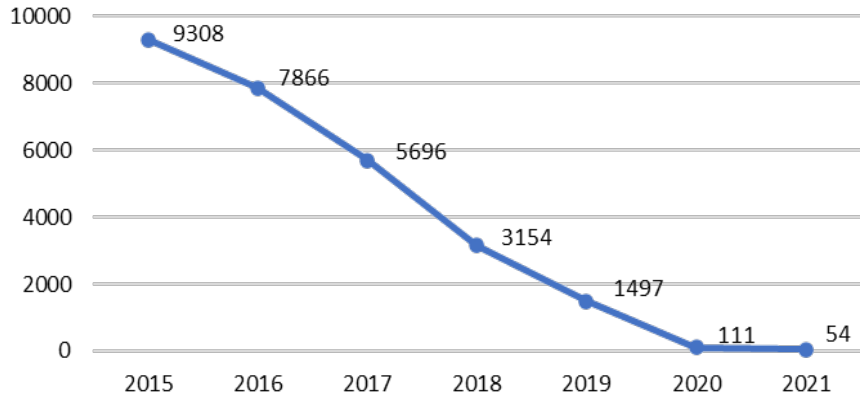


Fig. 10. Malaria trend in Haryana (2015-2021)

In 2015, 3 deaths were reported. Thereafter no deaths have been recorded. The Nuh district, which is one of the most underdeveloped districts, recorded a drastic reduction in cases, although its contribution to the state total remained relatively high. In 2015, there were 6380 cases, while in 2021, only four cases were recorded. *P. vivax* is the predominant parasite (98% in 2021), warranting a focus on compliance with treatment. Village-wise micro-stratification is required to identify, characterize and clear foci of continued transmission. Eight districts have reported zero indigenous malaria cases. However, the State has missed the target of sub-national elimination by 2022.

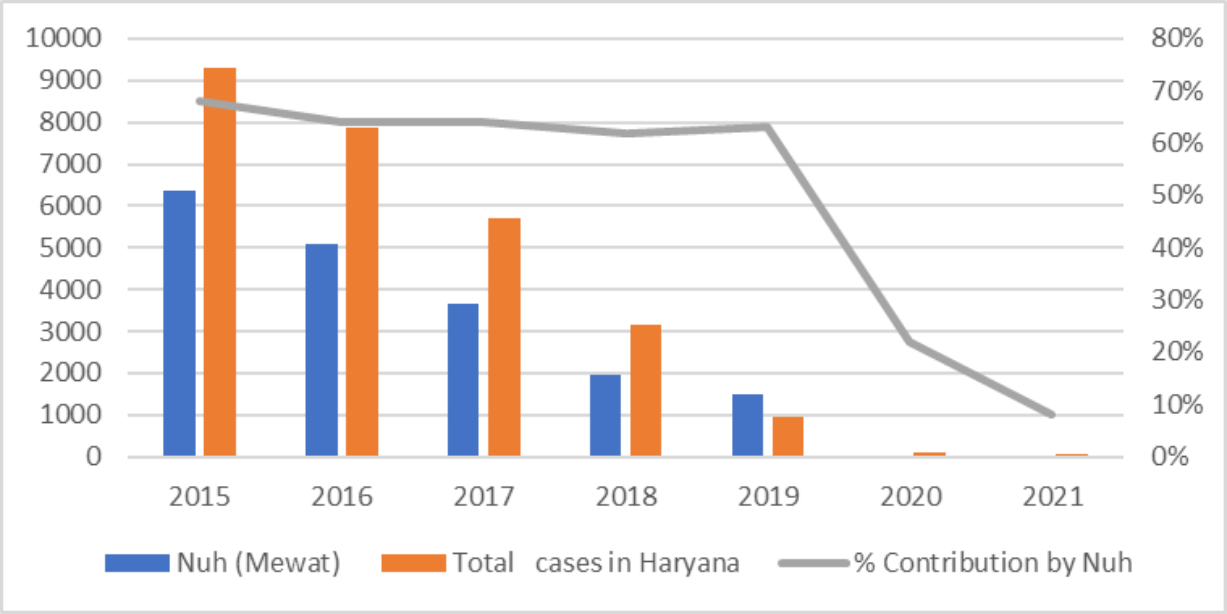


Fig. 11. Malaria situation in Nuh (Mewat) and contribution (%) to total malaria cases in Haryana (2015-2021)

Socio-economic determinants of malaria in Nuh, Haryana

The backwardness of the area, water storage practices due to the non-availability of piped drinking water, extreme poverty, large family size, outdoor sleeping habits with partial clothes and treatment-seeking behaviour are some important factors responsible for malaria in Nuh, Haryana.

Malaria situation in Assam

Assam State has been successful in reducing malaria annual parasite incidence across its various districts and successfully achieved a 99% decline in malaria cases compared to 2015, and has transitioned from Category-2 to Category-1. State API has reduced from 0.46 in 2015 to 0.005 per thousand population in 2021, with no deaths. Six districts have been reporting zero indigenous malaria for three years (Lakhimpur, Dibrugarh, Sivasagar, Golaghat, Darrang, and Nalbari). Preparation for validation has been initiated.

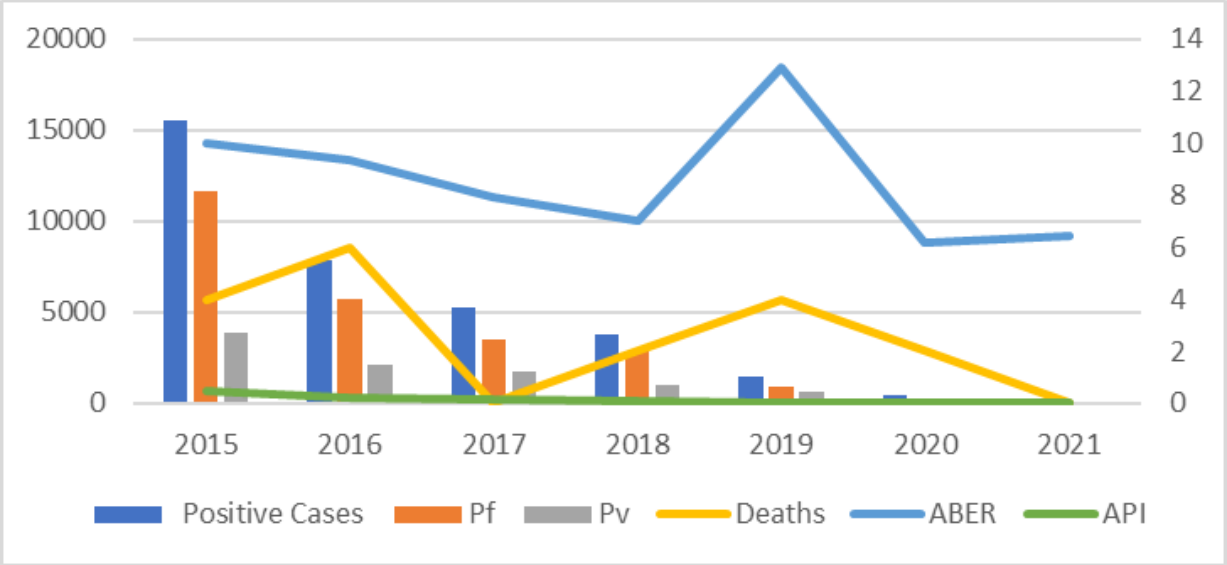
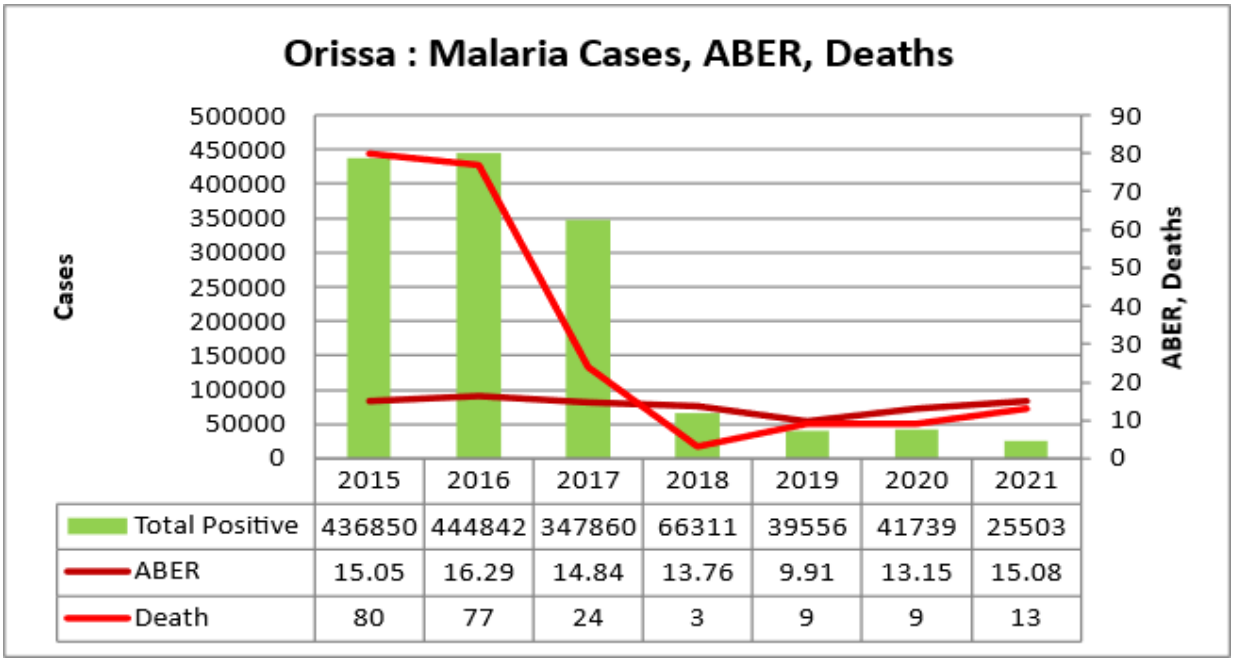


Fig.12. Malaria cases, Pf and PV cases, deaths, ABER and API in Assam (2015-2021)

Malaria situation in Odisha

Odisha has a perennial transmission, and a number of vectors are involved in transmission. Malaria control in remote areas, forests and forest fringes is still a challenge. All districts except the eight coastal districts have high receptivity and vulnerability. Odisha has been one of the top malaria contributors to the country. However, malaria cases, as well as deaths, have shown a declining trend from 2016 onwards, with a drastic decline since 2018 (Fig. 13). In 2017, the State ensured complete saturation and universal coverage of all 17 high endemic districts with LLINs from village to district level and saturation up to sub-centre level for the remaining districts. In addition, MSAT was done twice a year to address the long-standing issue of surveillance in these areas under the DAMaN initiative. However, the data of positive cases captured under this project and other similar state initiatives are not reflected in the State data reported to the central level as well as in the figure presented here. Despite these interventions, the top five malaria-contributing districts have been consistent, except Ganjam, which featured as one of the top five districts only in 2018 and 2019. On averaging the malaria cases during the last three years, i.e., 2019-2021, the contribution of the top 5 districts again remained consistent, i.e., Malkangiri (20.5%), Kalahandi (20.4%), Rayagada (13.1%), Kandhamal (10.3%) and Koraput (10%).



	2015	2016	2017	2018	2019	2020	2021
Total Positive	436850	444842	347860	66311	39556	41739	25503
ABER	15.05	16.29	14.84	13.76	9.91	13.15	15.08
Death	80	77	24	3	9	9	13

Fig. 13. Trends in malaria cases, deaths, and ABER in Odisha (2015-2021)

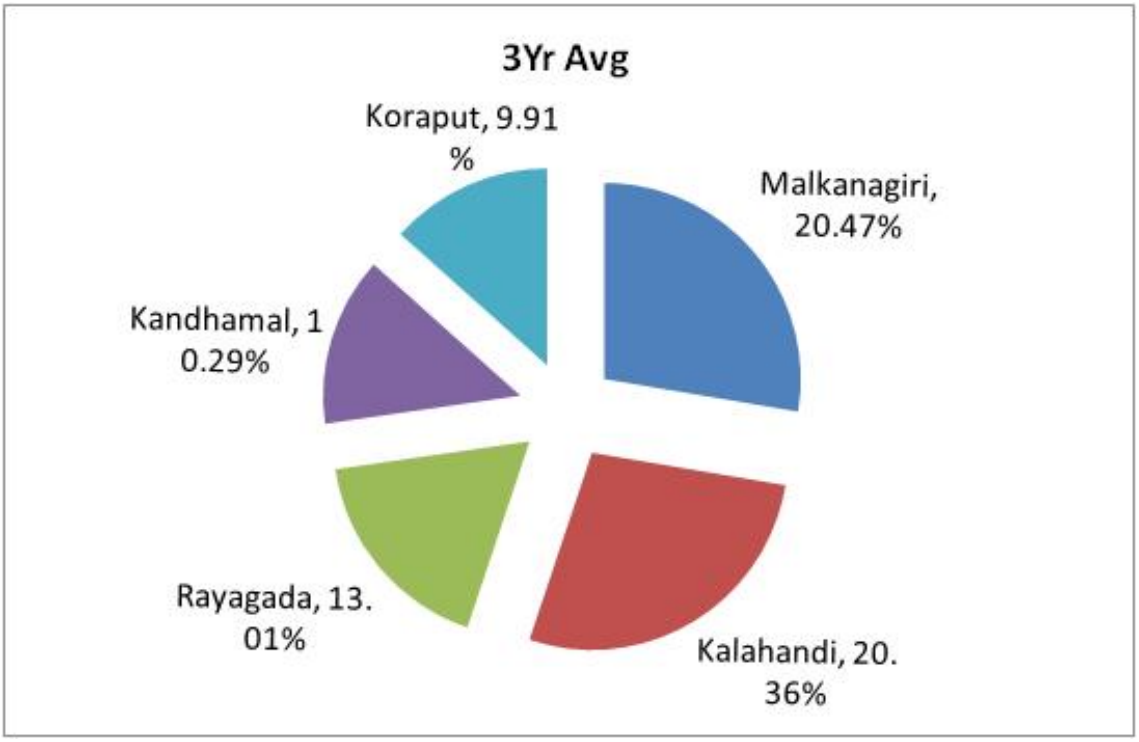


Fig. 14. Pie-chart showing the top 5 high burden contributing districts (average of 2019-2021)

In a comparison of the malaria cases in Odisha with the previous year, an increase of 1.83% was seen in 2016, a 21.8% decrease in 2017, an 81% decrease in 2018, a 40.3% decrease in 2019, 5.25% decrease in 2020 and 38.9% decrease in 2021. Malaria deaths increased from 9 in 2020 to 13 in 2021. Comparing the malaria cases and deaths between 2015 and 2017, there was a decline of 20.4% and 70%, respectively, while on comparing the decline between 2017 and 2021, the cases declined by 92.7% and deaths by 45.8%. The state has categorized districts based on API in 2021. Twenty districts fall under category 1 (Districts with API <1 and all CHCs/PHCs have API<1), four districts fall under category 2 (Districts with API< 1, but some of the CHCs/ PHCs are reporting API of 1 and above), seven districts fall under Category-3 (Districts with API of 1 and above).

Pf proportion continues to remain high, about 90%. Private sector data reporting is also low. Tracking and treating of migrant and mobile populations are still low, though initiated in the districts with coal mines like Angul to some extent.

Ecological factors and social determinants of malaria in Odisha

The ecological conditions, hilly, forested areas, preponderance of vector breeding sites, and favourable climatic conditions are congenial for perennial malaria transmission. Most of the malarious areas are hard to reach and inaccessible, and about 80% population is dependent on the agriculture sector for their livelihood. The high predominance of tribal population in most of the districts and their frequent visits to forest areas, outdoor sleeping habits without the use of LLINs and their treatment-seeking behaviour from local informal healers – Disari, Guniya and Quacks, is a major cause of high malaria morbidity and mortality in Odisha.

Malaria situation in Punjab

Malaria has been a public health problem in Punjab historically, and a high incidence of

malaria has been reported up to 2000. However, with the constant efforts for malaria control coupled with the high use of pesticides in the agricultural fields, there has been a remarkable decline since 2000, with no deaths due to malaria since 2012. The decline in malaria cases over the years can be seen in Fig. 15.

Fig. 15. Trend of malaria cases in Punjab

Being a category-1 State, Punjab was envisaged to be the first state that would achieve sub-national malaria elimination. As per the State's micro-strategic (2018), out of a total of 13208 villages, 26 villages consistently reported one or more Malaria cases during the last three years (2015-2017). These were Atla Kalan, Ballianwali, Parolbhatthe, Bhadson, Bhaini Bhagha, Bir Talab, Boha, Burj Hari, Bhai Desa, Guram, Guduwala, Jhakkarwala, Khiala Kalan, Khiala Malakpur, Kilaraipur, Kotra, Mehta, Mour Mandi, Nangle Kalan, Sarhali, Ubha, Boothgarh, Gopalpur, Manakpur Sarff+ Bhatte, Toffapur, Uddat. The total malaria cases in these villages ranged from 72-76 during the said years. However, in 2019, 424 villages reported malaria cases which decreased to 59 and 43 cases subsequently in 2020 and 2021. At the same time, ABER also decreased to almost half during these years because of compromised surveillance due to the COVID-19 pandemic. The State has identified 144 villages, which had API>1 in 2019 for LLIN distribution covering a population of 191685 individuals. Number of reported malaria cases in these 144 villages was 41 317 and 3 during 2015, 2016, and 2017.

In 2019, cases increased by ~ 60% as compared to the previous year, clearly indicating that the State witnessed an outbreak which was reported as an outcome of increased surveillance among migrant population resulting in an increased number of positive cases. This interpretation of the State for the upsurge does not stand good since data analysis showed that 70% of the positive cases were indigenous. The state is tracking the migratory population as per the line listing; the proportion of indigenous malaria-positive cases has declined over the years from 91% in 2015 to 57% in 2021, though in 2019, it was 70%. Considering the average number of cases from 2015-2017 and comparing it with those of 2019-2021, it is observed that Mansa, S.A.S. Nagar, Bhatinda, Hoshiarpur, and Ludhiana have maintained the status of the top five districts. Notably, the contribution of all five districts to the total malaria cases of the State has increased over time.

These facts suggest weak surveillance and case-based investigation resulting in the spread of malaria to newer areas in the State since as many villages which did not report malaria cases previously during 2015-2017 have reported the same during 2019-2021. Punjab being a Category-1 State, has missed the target of achieving zero indigenous case status by 2020 in all districts.

Apparently, malaria cases are under-reported due to a lack of surveillance. Data quality issues were also seen as the data consolidated at various levels did not match during some years.

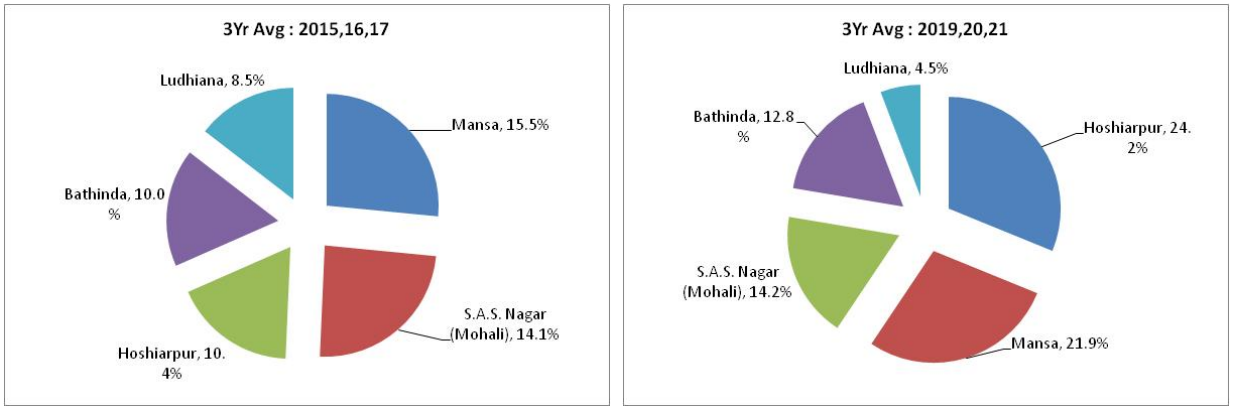


Fig. 16. Top five malaria-contributing districts in Punjab (average of 2015-2017 compared with an average of 2019-2021)

Ecological factors and social determinants of malaria in Punjab

Farming and agriculture are the main occupation of people in Punjab. in addition to that, a huge number of brick kilns are also seen. Irrigation of the farmlands is through permanent irrigation canals, which contain water throughout the year. This attracts a large number of labour who seek employment in farms and brick kilns. The high receptivity and vulnerability, along with favourable climatic conditions, contribute to malaria in Punjab.

Malaria in project areas

Areas where infrastructure/development projects have been/are being undertaken were noted as foci of malaria incidence. Outbreaks have also been seen in project areas. There is a need to: have Impact Assessment Survey for any project coming up in any area. The District Malaria Officer should identify projects, namely, industry, irrigation, mines, power plants, construction etc., as well as those which have separate townships and make necessary recommendations on malaria control activities. For major projects, it is necessary that a special project malaria organization be established. In addition, screening all incoming labour as well as their families coming from endemic malaria areas entering the project area for malaria by performing RDT and taking blood smears is needed.

Prompt and effective treatment should be given to all cases tested positive for malaria. These areas should have adequate surveillance to detect any potential outbreak. Geographical reconnaissance should be conducted in the project area and surrounding areas covering each location every week for detecting mosquito breeding sites. Environmental measures for water management like drainage, filling and levelling of water bodies should be undertaken wherever possible. Weekly anti-larval measures with chemical larvicides or biocides will be done where applicable. Based on the advice from the District Malaria Officer, the residual insecticidal spray will be carried out with appropriate insecticide in all buildings and hutments to cover the entire transmission season.

Malaria in border areas

Malaria in border areas is recognized as an important issue. Border areas are difficult, hard-to-reach terrain, forested and remote. Detailed information about local epidemiology needs

to be updated regarding changing malaria landscape. Variable settings (often an area in the elimination phase bordering with a high burden area in the control phase). Diverse socio-cultural, economic, political, and legal backdrop (tribes/ethnic groups, 'Jhum' cultivators, forest goers/workers, mobile and migrant populations and groups without documentation). Variable health systems, intervention coverage, surveillance and Monitoring and Evaluation, as well as health-seeking behaviour, rights and gender-related barriers and inequities. Security/conflict concerns. Absence of inter-state and inter-district meetings on malaria in border areas (within the country) for information sharing regarding malaria cases. Further details are presented under thematic area – 6 later in this report.

Climate change and malaria

The effect of climate change on malaria also is an important epidemiological aspect. A few points to consider are: The relationship between climate and malaria has been very well studied. In many outbreak-prone areas in the country like Rajasthan, Gujarat, Haryana, Punjab, parts of Karnataka and Brahmaputra valley, rainfall may be used as an indicator for early warning of outbreaks. In view of a gradual reduction in malaria incidence, it becomes imperative piloting of tools for the early detection of outbreaks. Studies undertaken in India on the impact of climate change on malaria have revealed that new foci of malaria transmission are emerging/likely to emerge in the Himalayan region of India by the 2030s, and in existing foci, the windows of transmission are set to extend. Therefore, periodic surveillance in fringe areas of transmission in Himalayan states and health education about preventive measures for malaria should be undertaken before the problem emerges.

3.2.3 Strengths

1. Significant reduction in malaria morbidity and mortality over the years.
2. Zero indigenous malaria cases in 109 districts.

3.2.4 Challenges and gaps

1. State-specific malaria elimination guidelines aligned with national strategy and operational guidelines not yet developed and/or operationalized in most states/UTs.

2. A perceptible gap in the mapping of the migrant and mobile populations as well as a tailored strategy for prevention and case management.

3. Analyses related to economic-epidemiological types are not attempted in most settings.

4. The malaria epidemiological analysis requires the understanding of components viz., vectors, pathogen, endemicity of disease and transmission cycle. In addition, the knowledge about the local environment and natural features along with human behaviour (anthropological factors) are crucial and need to be assessed. It is important to consider these determinants and their interactions to understand the reasons for disease occurrence and appropriate control measures. Entomological analysis facilitates the identification of local determinants of the transmission and prevalence of VBDs.

5. There is a knowledge gap about this issue among the zonal and district entomologists, so the appropriate strengthening of this area will be of immense help to strengthen

malaria elimination activities. The above-mentioned information needs to be collected through local surveys, interviews, and participatory exercises.

6. Capacity and capability on vector characteristics, parasites, and disease transmission need to be strengthened for existing HR available even at the national level along with state and district levels.

7. Therapeutic efficacy studies were carried out by ICMR-National Institute of Malaria Research and National Institute of Research in Tribal Health (NIRTH); however, the data is not available with the programme. Data is mostly not disseminated to states.

8. Drastic malaria reduction seems to have set in certain complacency, and lessened capacity may occur.

3.2.5 Recommendations

1. Emphasize a better understanding of the micro-epidemiology of malaria in different transmission settings to support evidence-based targeting and accelerating progress. A specific sub-plan should be developed with ingenuity and tailored and innovative approaches to handle malaria in different eco-epidemiological types.

2. Build/strengthen capacities to ensure the use of epi-data at and by sub-national levels for local planning and actions.

3. Formulate specific strategies/guidelines for mobile and migrant populations, native forest population, and forest goers/workers, followed by sensitization of the public sector and the local authorities as well as those key and vulnerable populations and the general community at large.

4. Explore and initiate mechanisms for receipt of early information about new economic activities as well as population movements as well as occurrences of fever outbreaks, which require immediate reporting and investigation.

5. Emphasize Impact Assessment for malariogenic potentials for any project coming up in any area. The State health authorities should be capacitated to identify projects, namely, industry, irrigation, mines, power plants, construction etc., as well as those which have separate townships and make necessary recommendations on malaria control activities. For major projects it is necessary that a special project malaria organization be established.

6. Ensure analysis of disaggregated data related to age, gender and species for tailored planning and implementation.

7. A detailed audit of deaths is required for remedial measures.

8. Data quality audits are required. A near real-time data recording and reporting system are highly recommended.

9. Initiate a study related to the link between malaria and meteorological data (rainfall, temperature) to use the same for early warning of outbreaks since the relationship between climate and malaria is well-noted. Since malaria transmission matches with the rainy season, the use of rainfall as an early warning tool for the detection of outbreaks should be attempted.

10. Ensure study of the likely impact of Covid-19 on case detection. This calls for further verification.

3.2.6 Key action points

1. Develop a strategy for malaria elimination with updated milestones and targets and with approaches and interventions relevant to context and populations at risk (in different eco-epidemiological types) subsequent to comprehensive epi-analysis. Develop a strategy for the prevention of re-establishment for malaria-free areas.

2. Following the development of a new strategy for malaria elimination and prevention of re-establishment, all guidelines, SOPs, training plan, M&E plans, PSM plans, etc., should be revisited, and updated versions should be made available at all levels.

3. Reinforce the investigation of every malaria death by a designated death audit committee to ascertain the reasons so as to prevent deaths.

4. Screen all incoming labour as well as their families coming from endemic malaria areas entering the project area for malaria by performing RDT and taking blood smears. Prompt and effective treatment is to be given to all cases tested positive for malaria.

5. Ensure data quality at all levels, and conduct data quality audits.

6. Operationalize and roll out IHIP in the entire state expeditiously.

Table 5: Guidance on key action points and timelines

Sl. No.	Issues	Action points	Responsibility	Timeline
1	Mobile population	Migrant/ Mobile population policy/ strategy is to be drawn up for study/ surveillance.	NCVBDC	Short-term (3-6 months)
		Cross-border surveillance at international border sites is to be strengthened.	NCVBDC/States	Mid-term (6-12 months)
		Mapping to keep track of mobile and migrant populations in collaboration with Labour and other departments, contractors etc.	States	Mid-term (6-12 months)
		Comprehensive surveillance of mobile population as they enter any area, during their stay in the area and at their next destination.	NCVBDC/States	Mid-term (6-12 months)
2	Project areas	Impact assessment survey for malariogenic potential of any project coming up in any area.	States	Short-term (3-6 months)
		Comprehensive surveillance of the labour population and local population	States	
		Environmental measures for water management like drainage, filling and levelling of water bodies are to be intensified.	NCVBDC/States	
3	A specific plan for tribal and forest ecosystem	A detailed audit of deaths is required for remedial measures. There is a need to synchronize IRS operations with peaks of malaria. Therapeutic efficacy studies are needed. Behaviour change communication to reach and motivate population groups reluctant to use public health services	NCVBDC/States	Mid-term (6-12 months)
4.	Data quality	Data audits should be done till a real-time reporting system (IHIP) is rolled out.	States	Short-term (3-6 months)

3.3 Thematic area 3: Surveillance, monitoring and evaluation and epidemic preparedness and response

3.3.1 Overview

Surveillance is one of the core interventions for malaria control and elimination. India has a long history of capturing malaria data right from the community level and facility-based institutions, both from rural areas as well as selected urban areas. The robust routine surveillance system monitors the disease trend and analyzes the epidemiological information according to the NCVBDC Operational Manual (2016).

3.3.2 Observations

Surveillance is carried out at different levels of the health care system (for example, health facility-based, community-based), and using different detection systems (for example, active, passive) and through sentinel sites in line with the technical guidance from the NCVBDC and WHO. In low endemic states, case-based surveillance has been initiated to some extent, but in states like Haryana and Punjab, there is a partial implementation of the case-based surveillance guidelines. A strong surveillance mechanism is apparently lacking in these states, due to which the state has not been able to achieve the status of sub-national elimination by 2022.

While high endemic states like Odisha and Chhattisgarh have initiated regular MSAT in the high endemic remote to reach pockets of selected districts, a low endemic state like Haryana has also done MSAT twice alongside LLIN distribution. The timing and technicality of these surveys need an in-depth evaluation by experts. Data from these surveys are not reported by the states to NCVBDC and are also not included in the national data repository. MSAT has also been initiated in a few low-endemic states but needs guidance and streamlining. Technical consultation with experts is suggested to streamline all surveillance-related issues and prepare guidelines accordingly. The dataset is further disaggregated into the type of parasitological examination, malaria species, type of antimalarials and treatment outcome. Age and gender disaggregation are carried out in specific situations, as needed.

In elimination settings, surveillance activities require focused attention in project areas and construction sites and among migrant populations and slum populations. In these areas, malaria is a notifiable disease (although many other states in the above-mentioned phases have also made such promulgation). The monthly blood examination rate (MBER) should be sustained at a minimum of 1% during transmission months. The ABER should be sustained at a minimum of 7% in perennial transmission areas and a minimum of 5% in seasonal transmission areas. In this phase, if a fever case is found to be positive for malaria, it is to immediately be notified to DVBDCO, SPO, RoHFW and NCVBDC for the following actions (which will be initiated during the upcoming NSP period):

i) Initiation of treatment within 24 hours of detection and ensuring complete treatment.

ii) Detailed case investigation in the prescribed format is to be carried out by vector borne disease Technical Supervisor (VBDTS)/MPHW, and the case is to be classified as imported or indigenous. Case investigation is to be completed within three days of detection.

iii) Contact survey is to be carried out by blood smear collection for microscopy in the surrounding 50 households by a team comprising ASHA and MPHW/VBDTS.

iv) If additional cases are found on the contact survey, the survey area is to be expanded, and an appropriate response is to be initiated within seven days.

In malaria-free areas, the emphasis is on the prevention of the re-establishment of indigenous malaria transmission. In areas under this phase, malaria has to be notifiable. Any fever case reported to a health care provider/facility (including private and other sectors) is to be ascertained whether it meets the definition of a suspected malaria case. If the fever case meets the definition of suspected malaria, the case is to be investigated using microscopy. If the case is found to be positive for malaria, treatment is to be initiated within 24 hours of detection, and complete treatment is to be ensured. The information is to be immediately notified to the DVBDCO, SPO, RoHFW and NCVBDC, and the following actions should also be taken:

i) Initiation of treatment within 24 hours of detection and ensuring complete treatment (as in areas under the above-mentioned elimination phase).

ii) Detailed case investigation in the prescribed format is to be carried out by vector borne disease technical supervisor (VBDTS)/MPHW/RRT, and the case is to be classified as imported or indigenous. Case investigation is to be completed within three days of detection.

iii) Contact survey is to be carried out by blood smear collection for microscopy in the surrounding 50 households by a team comprising ASHA and MPHW/VBDTS.

iv) If additional cases are found on the contact survey, the survey area is to be expanded, and an appropriate response is to be initiated and completed within seven days.

v) In malaria-free areas, screening at points of entry at international and interstate borders is to be established for the purpose of cross-reporting, enumeration of cases and public health action.

A routine surveillance system collects nationwide malaria data through electronic and paper-based modes using standardized forms. Routine paper-based data is collected and collated at the community level (until the SC level). From the SC level, the paper-based forms are submitted to the respective PHCs mostly within set timelines. With the advent of technology and the availability of hardware, the data is entered into excel sheets and transmitted from PHCs/CHCs to the district to state to central level (NCVBDC). The excel sheet comprises aggregated data rather than individual malaria case data, which is available at PHC/CHC and SC. Concerned staff are trained to collate and analyze surveillance data and carry out appropriate responses to a large extent.

Malaria data repository

The NCVBDC has created a data repository since 1995. Subsequently, ten years of data have been analyzed using software with the assistance of a partner agency - India Health Fund (IHF), with the objective of enhancing and strengthening the surveillance system for malaria

elimination in India by supporting an end-to-end digital solution to monitor, report, appraise program performance and support timely decision making. NCVBDC has developed a retrospective dashboard for the last decade, that is, 2010 to 2019. A similar data repository also has been created by NCVBDC in collaboration with NIMR to understand and validate the results and outcome analysis for the malaria dashboard. These give monthly and yearly trends on all parameters for malaria. Both the dashboards provide extensive analysis of all malaria data and GIS linked for visual analysis. This will be available online with a security password at NCVBDC. Malaria data exists till block and village levels, and a malaria repository should be compiled.

The NCVBDC has a robust routine surveillance system to monitor the disease trend and analyze the epidemiological information for Programme planning and implementation according to the Operational Manual (2016). The routine surveillance system collects nationwide malaria data through electronic and paper-based modes. The dataset is further disaggregated into the type of parasitological examination, malaria species, type of antimalarials and treatment outcome. Age and gender disaggregation are carried out, as needed, in a specific situation.

Prospective data for malaria surveillance

NCVBDC has initiated redesigning of all reporting formats to meet the requirements of malaria elimination with technical support of WHO in the Integrated Health Information Platform (IHIP). This is software wherein login ID and password can be generated for entering real-time data. IHIP will provide all details of information as envisaged in the Operational Manual for Malaria Elimination. The IHIP has designed input Formats to take into consideration all data requirements for malaria elimination which majorly include Facility Information, Patient details, Type of surveillance, and Clinical details, including the type of surveillance, tests performed, treatment follow-up, etc. This is based on the IDSP platform but has a different login for NCVBDC.

This gives the advantage of analyzing and correlating with other parameters like fevers, other diseases, hospital admissions, climatic factors, and geospatial mapping. Advantages include the Creation of geospatial maps, Correlation with climatic factors, Seeing and linking with diseases as per IDSP, and Mechanisms of feedback. Vector Control formats are also being developed. The output formats will give all information that is required for documenting malaria elimination, including current M4 format details. Pilots are ongoing in Odisha, and Himachal Pradesh, with WHO technical support and expansion in other parts of the country envisaged. NCVBDC plans to fully utilize the Global Fund support for software/hardware and expansion. The issue of integrated surveillance with other data sets like HMIS, IDSP and others needs to be reviewed.

Epidemic preparedness and response

The NCVBDC works in close association with the state surveillance units (SSU) and district surveillance units (DSU) of the Integrated Disease Surveillance Programme (IDSP). The IDSP collects data from subcenters, PHCs, CHCs, and hospitals, including government and private sector hospitals and medical colleges. The weekly data is re-analyzed by DSUs for disease trends, and whenever there is a rising trend, it is investigated by the RRTs to diagnose and control the outbreak. This section provides criteria that could be used to determine if an epidemic has started. The expected level of malaria should be calculated from historical data, excluding the past epidemic years. Four methods for calculating the weekly/monthly epidemic threshold level are described below.

i) Weekly/monthly mean for the past five years plus two standard deviations (SDs).

ii) Value of the second-highest quartile for the month/week over the past five years.

iii) C-SUM, which is the mean of previous, current and following month/weeks date for the past five years.

iv) C-SUM was refined by adding a 95% confidence interval (1.96.SD).

Each area should plot on a graph all four methods to see which one would be most suitable for them, considering sensitivity, specificity and predictive value.

i) Monthly/weekly mean of past five years plus two SDs -The alert threshold for each month/week is determined as the mean plus 2 SD as this should capture 95% of cases in normally distributed data.

ii) Upper third quartile - This method involves placing the values of the particular month/week for the past five years in a series – minimum value; second lowest; median value; second highest (upper third quartile); and highest value. If the current month/week's cases exceed the second-highest value of the past five years, it indicates that the epidemic threshold has been crossed.

Epidemic response mechanism

The districts should have their malaria epidemic plans in place and be fully prepared to respond rapidly to epidemics/outbreaks. The following are components of an effective response mechanism. Rapid response teams (RRTs) should work in collaboration with IDSP, with the aim of undertaking urgent epidemiological investigations and providing on-the-spot technical guidance and logistic support. The RRT at the district level will comprise an epidemiologist and entomologist from IDSP, laboratory technicians and other support staff. At CHC/PHC level, RRTs may comprise the MO, health supervisor, laboratory technician, IRS squad, insect collector/field workers etc.

Surveillance and M&E, epidemic preparedness and response in rural and urban areas: Salient highlights and issues regarding surveillance and M&E from rural and urban areas are described below. Surveillance guidelines with special emphasis on case-based surveillance in elimination settings within states/districts are required to be disseminated until the lowest reporting level following customization for malaria elimination. Capacities need strengthening with regard to surveillance, M&E, epidemic preparedness and response.

Rural areas

Many states/districts conduct stratification exercises at the sub-district level (block level and below) to identify areas with ongoing malaria transmission as well as areas with low endemicity and areas not reporting malaria cases. Drawing on such analysis of the trend of malaria cases over the years, micro-planning and targeting interventions tailored to context

are carried out. An example of a shrinking map of malaria and block-level stratification in the S. Tripura district is given in Fig. 17.

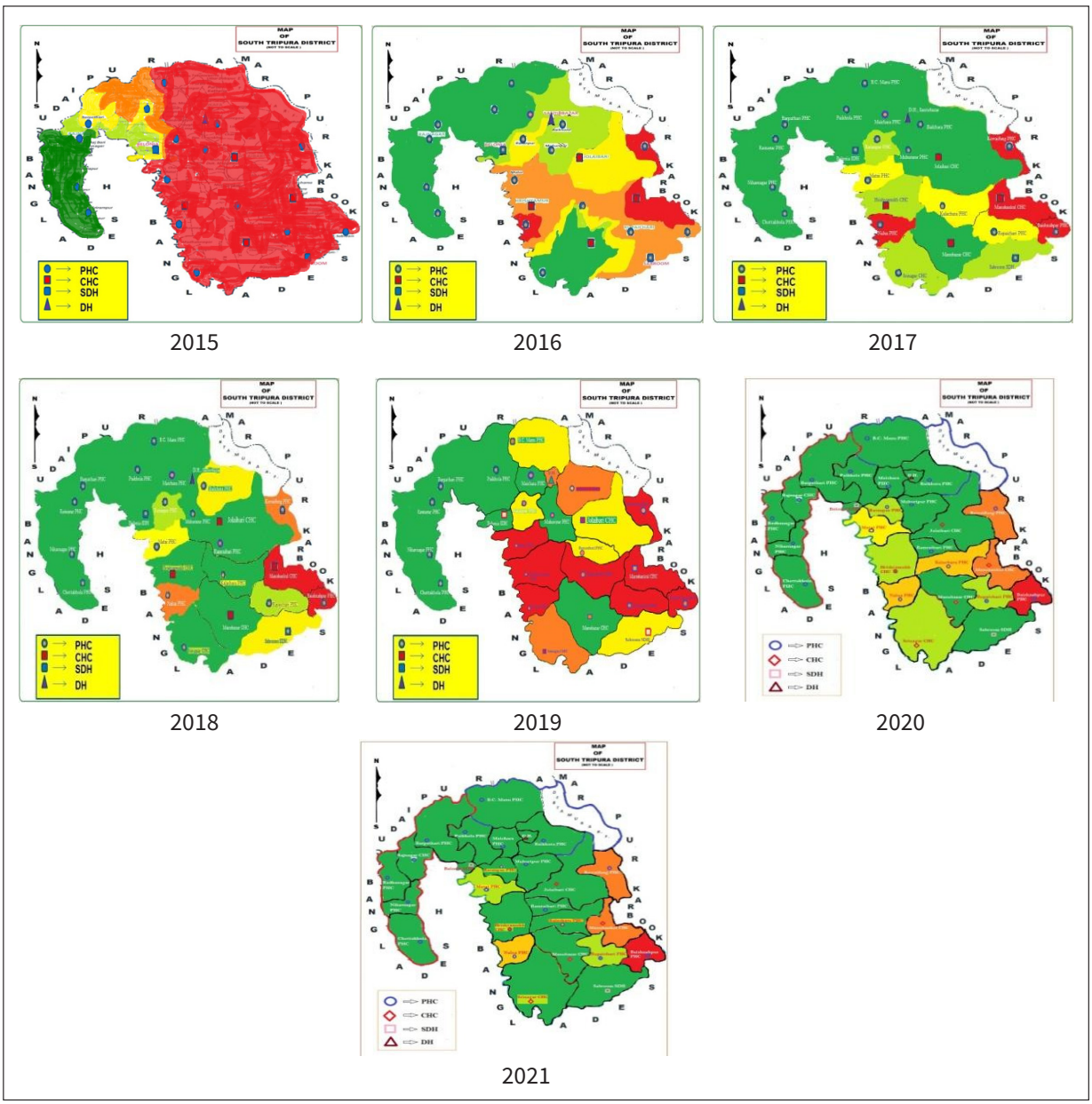


Fig. 17. Shrinking map of malaria and API-wise stratification at block level in S. Tripura district

In Chhattisgarh, malaria surveillance data has been available district/block and village-wise for the last ten years. State analyses data up to block, village level for targeted interventions. Stratification is based on malaria cases, and API is estimated up to the village level. Figure 18, 20, 21 and 22- show that endemicity continues in the southern blocks of Chhattisgarh.

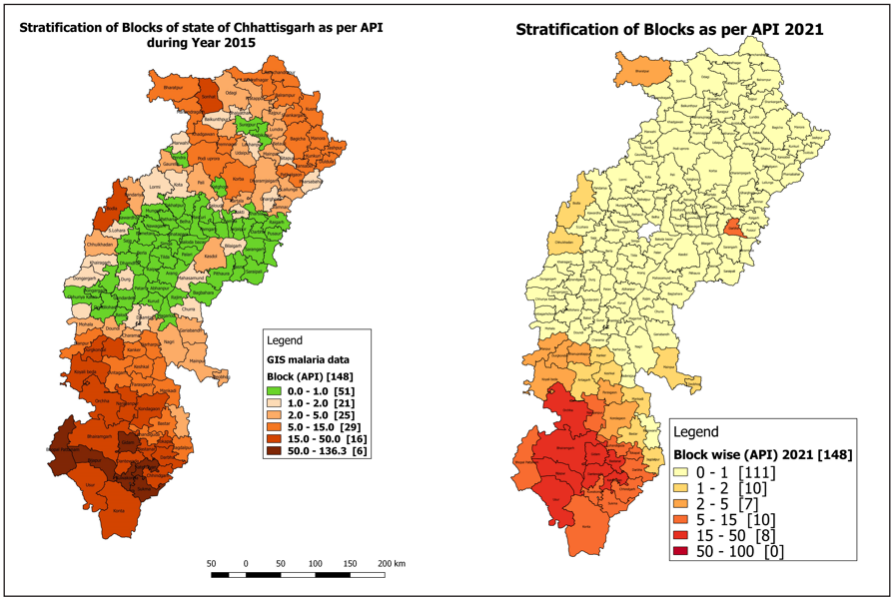


Fig. 18. Block stratification in Chhattisgarh (2015, 2021)

The state of Chhattisgarh has been carrying out "Malaria Mukt Abhiyan", where mass screening was initiated in 16 blocks for five rounds. In each round, more blocks were added. Analysis of 16 blocks which underwent five rounds of mass screening is given graphically in GIS maps in Fig. 19. It is clear that there has been an increase in certain blocks in the year 2021, and this is also the case in the hotspot maps in routine reporting shown in the lowermost map (hotspots are marked yellow).

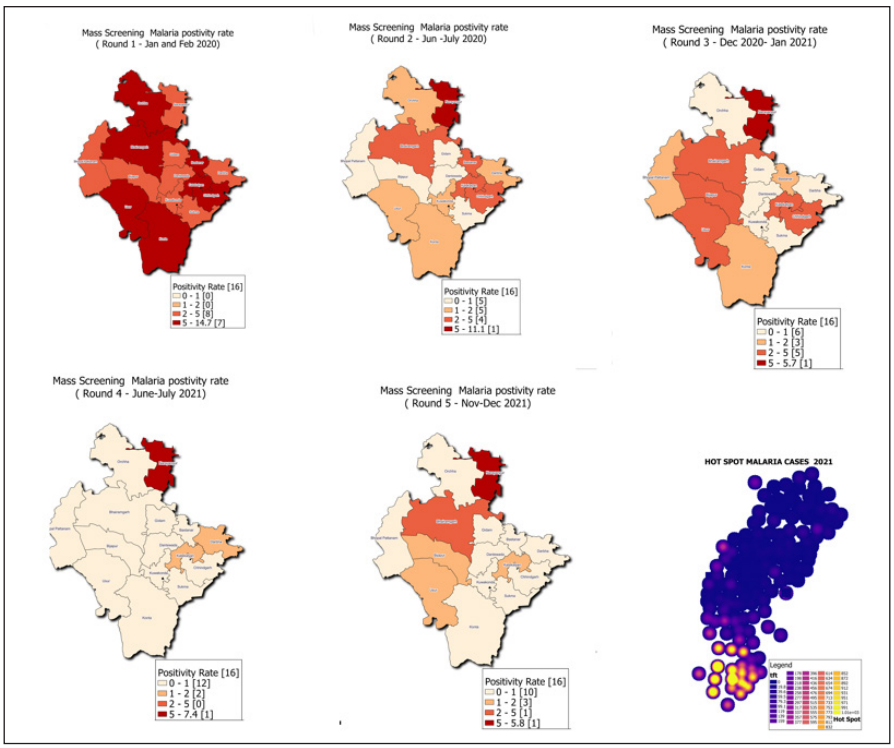


Fig. 19. Results of mass screening in block-wise GIS map

The State has the capacity to do such GIS mapping and analysis right up to the village level (Fig. 20, Fig. 21, Fig. 22), which helps in identifying areas showing an increase and in mitigating any outbreak. This stratification and data triangulation is important for planning and targeting interventions appropriate for the context. The surveillance system needs to include such analytic aspects, which will help in detecting villages reporting higher malaria cases and taking appropriate measures.

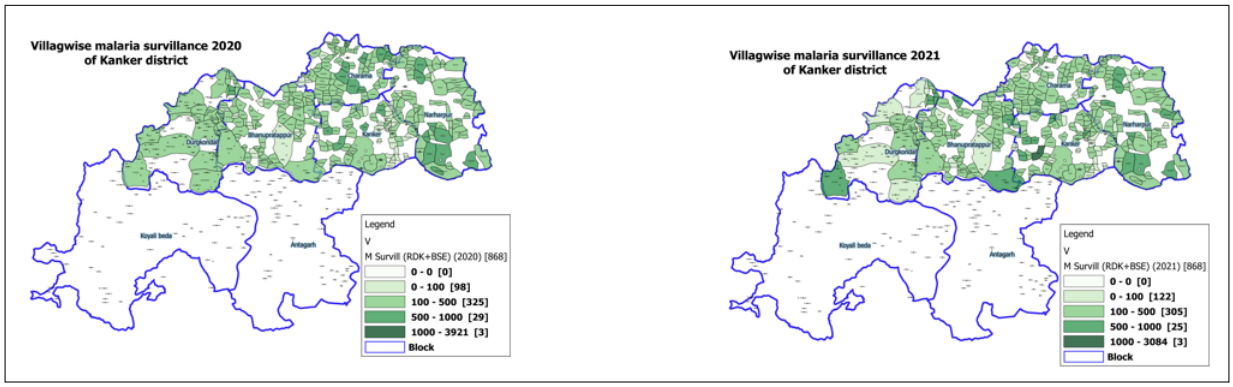


Fig. 20. Village-wise surveillance in Kanker district, Chhattisgarh

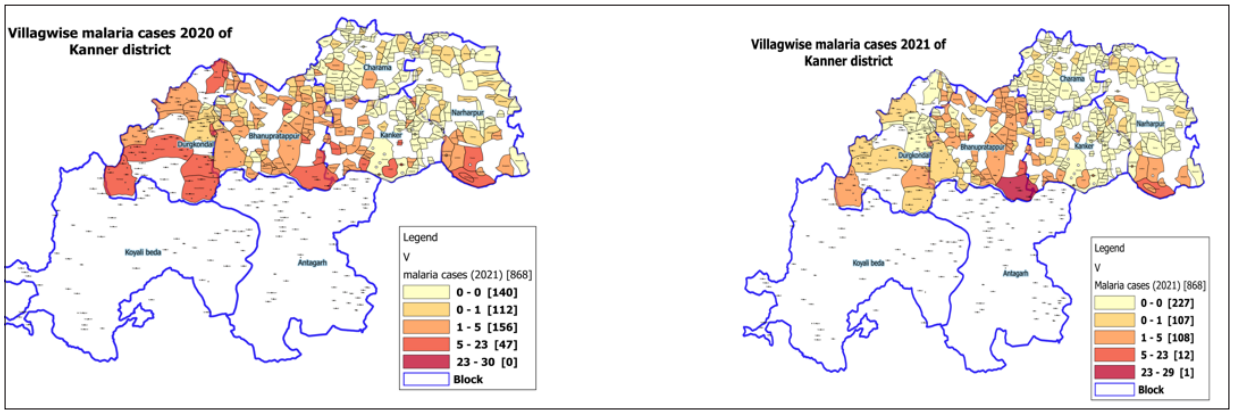


Fig. 21. Village-wise surveillance in Kanker district, Chhattisgarh, with zero reporting

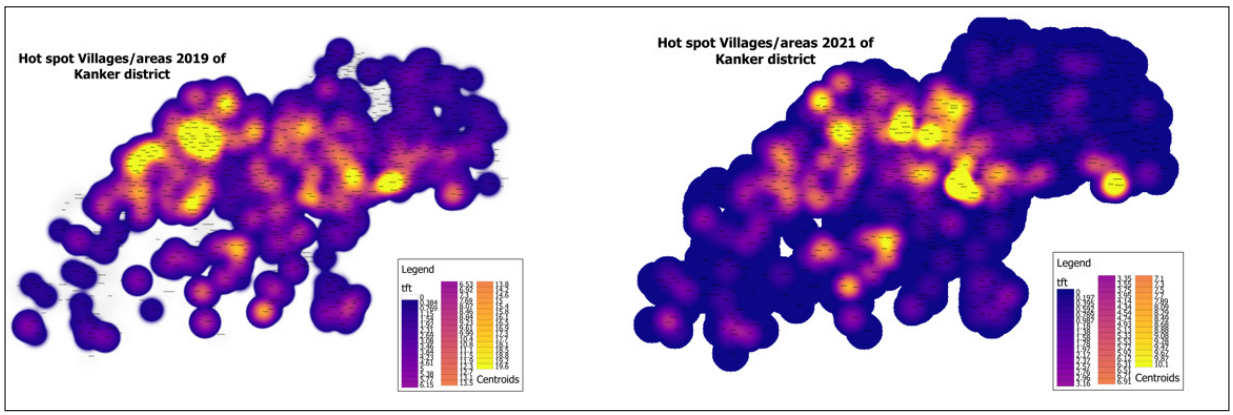


Fig. 22. Village-wise surveillance in Kanker district, Chhattisgarh showing hot spots

However, systems for case detection, recording, reporting, notification, analysis, feedback and action in Chhattisgarh need to be strengthened. A data quality assurance system needs to be emphasized. A suspected case of malaria is any fever that can be malaria, so tested by Mitanin, RHO, at PHC/CHC/SDH/DHH using RDT or by blood slide and entered in the M1 register. M1 registers are kept with Mitanin, RHO. However, it could not be reviewed due to non-availability. The M3 register is not found in the lab at CHC and PHC. There is a huge gap in total tested and positive cases reported in HMIS and M4 in Bastar, indicating an inadequate DQA system. HMIS validation is not being done with reported malaria surveillance and positive cases. In Jagadalpur medical college, there were different figures for malaria deaths reported. By medical college, sentinel site, and reported by district and state in M4. Triangulation of data generated by M4 should be validated with IDSP, and HMIS but not happening. There should be stringent death analysis of clinical malaria death so that parasitologically positive malaria death can be reported.

Active surveillance contribution is noted as 74%, whilst the RHO contribution at the SC level is 32%, which needs to be looked for duplication as this is being done by microscopy. The RHO is doing surveillance by both RDT and BS. Mitanin (ASHA) surveillance is included under active surveillance, which may be looked at by the state. Blood slide, if positive by RDT treatment, is being given while slides are sent to the nearest microscopy centre. Turnaround time for getting this slide examined is 15-30 days, and it has poor slide quality, both thin and thick smears. A separate analysis of sentinel site data needs to be carried out regularly and backtracked all positive cases to the village level. SSMR and SSLR were not available in the visited sentinel site at Jagadalpur MC and in CHC.

Urban areas: Overall, guidelines are required for surveillance, including a standardized information system aligned with state/national reporting formats and data flow so as to incorporate quality data from all sectors in urban areas within the state/district information system. Private sector engagement for malaria reporting needs to be strengthened.

Chhattisgarh has four municipal areas, but there is no separate malaria data with regard to urban areas. The urban area authority (Municipal corporation) is aware of malaria. The focus is on the fogging for all vector-borne diseases. Fever clinics in the wards test suspected cases with RDT and follow up with treatment.

In Gujarat, malaria cases are detected and treated under the aegis of Municipal Corporations. There is a real-time information system for daily reporting, which has been strengthened during the COVID-19 pandemic. Different information systems also exist, viz., separate real-time notification systems for private sector hospitals and laboratories. Guidelines on integration are required from NCVBDC. Presently, the data from the private sector is not being incorporated into the state data. Overall, the exchange of data needs streamlining between IDSP, NCVBDC and the private sector. Data utilization for decision-making and planning needs improvement. There are several formats and reporting tools which need improvement with attributes critical for elimination. Case investigation forms are available but need further expansion to ensure appropriate case classification. Training focusing on elimination is needed.

In Karnataka, considering the decline in malaria cases in urban areas, extra intelligence on epidemiological and entomological surveillance will be required, and currently, it seems to

be a great challenge. UPHCs in Bangalore do hardly any blood smear examinations. MPWs do not conduct required active surveillance.

In Mumbai, active surveillance is conducted by Municipal Corporation in slums. Every frontline worker is mandated to conduct active surveillance in at least 250 houses per day. Special drives for active surveillance are conducted in construction sites to test and treat malaria cases. Passive surveillance was conducted by the dispensary, peripheral hospitals, and medical colleges in the past. To strengthen passive surveillance, Health Posts have been linked to dispensaries, and community health volunteers have been engaged for fever case detection and radical treatment compliance. Decentralized malaria microscopy provision with microscopic facilities available at the primary care level (Dispensary-Health Post), and the city has a zero-backlog policy under which an outsourcing facility is also available for blood slide examination. In addition to the routine measures, Arogya Abhiyaan camps are organized at the community level through an integrated approach engaging medical colleges, representatives, and public health departments. Private medical practitioners are sensitized and trained for improved service delivery, especially to slum populations. By-laws implementation in all Municipal Corporations areas is a must. Mumbai and Mangalore have such byelaws. However, enforcement is an issue.

In the low endemic States of Punjab and Haryana, surveillance is entrusted to the MPW(M) mainly. ASHA involvement is negligible in Haryana, and in the case of Punjab, ASHAs are used for surveillance and blood slide collection resulting in compromised quality of slides not fit for microscopic examination. Passive surveillance at the health facilities is mostly operational at the CHCs and PHCs, while the Sub-centres and community-level surveillance are poor or lacking. These states need to put in place routine activities as well as passive surveillance to ensure that malaria cases are captured early and treated promptly as well.

Odisha and Assam have actively involved the ASHA network for routine passive surveillance, but facility-based surveillance in these States needs strengthening. Odisha's heavy dependence on RDTs has resulted in EDCT, but at the same time, the PHC-level microscopy facility has not been augmented. Passive surveillance at the CHC level is also not optimal. Odisha captures about 80% of the malaria cases through passive surveillance by ASHAs and health facilities.

Haryana does not have the facility of GIS mapping and stratification yet, and Punjab to needs strengthening in this regard. Odisha has been successfully using GIS-based stratification to some extent.

3.3.3 Strengths

1. NCVBDC has an effective routine surveillance system.

2. Passive surveillance is being done across the country and involves both public and private sectors, though reporting from the private sector is highly inadequate. Active surveillance is being done periodically and in special situations.

3. Guidelines for surveillance M&E and epidemic preparedness and response are disseminated.

4. Data reporting from public sector health facilities are regular through paper-based/ electronic systems.

5. An excellent data repository of 10 years of malaria data exists. Few states have their own data repository system.

6. Most states/UTs have made malaria a notifiable disease.

7. The process to track progress and do course correction is done through periodic reviews at the State and District level on an annual basis.

8. Near real-time data entry through IHIP was piloted in Odisha and Himachal Pradesh with technical support from WHO and subsequent to success, which will be eventually rolled out in other states.

9. Few urban areas have real-time information systems and mechanisms for collating private sector data as well; for example, municipal corporations in Mumbai, Bangalore and Surat have their own system of disease surveillance mechanisms.

3.3.4 Challenges and gaps

1. Surveillance, as per national guidance, needs further strengthening across the sectors throughout the country. Routine surveillance and reporting constraints in tribal areas, hard-to-reach areas, and Jhum cultivation areas (for example, Tripura and Chhattisgarh).

2. Case-based surveillance, as per national guidance yet to be rolled out in most elimination settings.

3. Reporting from Medical Colleges (public) and the private sector remains incomplete and episodic, even though malaria is a notifiable disease.

4. Absence of visible coordination between urban bodies and the VBD Programme in most states. Unless there is well set-performance public health surveillance system equipped with diagnostic facilities (Microscopy and RDT) and reporting mechanisms, timely malaria detection, treatment and prevention will not be possible as per nationally recommended drug policy and guidelines.

5. Routine surveillance and reporting mechanism exist in all the states; however, a real-time online reporting system is still awaited.

6. Coordination with IDSP is poor in most instances.

7. Urbanization is increasing year by year in almost all the states leading to a large number of slums with the inflow of population from malaria-endemic areas to urban areas. Municipal corporations and Municipalities have no dedicated Programme management system to prevent malaria importation. Due to the increasing population, the drainage and sanitation problem increases which favour the breeding of vector population. Thus, there is always a potential threat of continued malaria transmission and outbreaks.

8. Surveillance and M&E guidelines for urban areas in line with national and international guidelines are mostly not available.

9. A wide gap between state VBDCP and municipal health departments. Many issues regarding sharing of data as well as reporting of shared data.

10. Malaria data from the private sector is either yet to be collected or not incorporated within the state malaria information system.

11. Inadequate manpower to respond to the outbreak.

12. LQAS as a tool for M&E is not being used uniformly and appropriately in the high-burden states.

13. ABER benchmarks for different settings need to be set/revisited.

3.3.5 Recommendations

1. Ensure that the surveillance system is tailored to the context, and accordingly, a national surveillance guideline for malaria elimination should be developed. Provide clear guidance on active and passive surveillance, its proportion and its reporting, including mass surveillance.

2. Develop and disseminate SOPs following the development of national surveillance guidelines for malaria elimination.

3. Strengthen routine surveillance systems nationwide, including capacities at all levels.

4. Strengthen passive case detection to capture all suspected cases as well as subject them to a confirmatory laboratory test. Develop SOPs to suit different levels of detection and reporting.
5. Roll out and strengthen case-based surveillance with case and focus characterisation, classification, follow-up and appropriate response in states/districts aiming at interrupting local/indigenous transmission and realizing elimination, with standardized forms/registers followed by appropriate responses. The formats currently used for case investigation and focus investigation need to be reviewed and revised for effective case classification and focus classification.

6. Strengthen capacities at all levels in states/districts on surveillance and response and M&E through continual training/re-trainings and supportive supervision.

7. Ensure capacity building at all levels for data analysis, interpretation, and use, as well as for giving timely feedback for micro-planning and response. Elimination-focused training on surveillance and M&E is to be given emphasis.

8. Update the monitoring and evaluation framework with a focus on impact and outcome, as well as evaluate the effectiveness of current interventions for malaria control and elimination.

9. Update SOPs and formats for supervision and monitoring.

10. Explore the possibility of missed cases among patients attending healthcare institutions through revised customized formats.

11. Ensure the availability of processed surveillance information to end users in a more timely and transparent manner.

12. Ensure data repository at the central as well as state level. States need to compile such a repository up to the village level to help in analysing/referring to future trends and identify changes, which is also an essential component of malaria elimination.

13. Consider IHIP as the primary data reporting platform and for real-time malaria monitoring, which should be expanded quickly.

14. Develop a malaria dashboard for ready reference in planning, decision-making, and course correction. Emphasise data analytics for performance review.

15. Ensure zero reporting up to the Sub-centre level from rural and urban areas.

16. Develop guidelines for subnational elimination validation and initiate the processes followed by recognition/awards for states/districts. Ensure alignment with WHO guidelines towards preparedness for nationwide elimination verification and certification.

17. Initiate compilation required documents/information for subnational elimination validation.

18. Carry out independent evaluation among the villages reporting zero cases in the last three years to be carried out.

19. Enforce private sector notification of malaria, including PSUs and medical colleges, formal and informal private sector, especially in 33 States/UTs where malaria has been made notifiable through regular sensitization, advocacy, supervision and follow-up. Explore a Central Malaria Notification mechanism. Incorporate surveillance data on confirmed cases from the private sector into the national case surveillance data.

20. Roll out regular fever surveillance in areas which have done mass screening.

21. Review and disseminate learning from Odisha and Chhattisgarh's experience of mass fever surveys. Incorporate guidance on MSAT and other relevant approaches within national surveillance guidelines aligned with WHO guidelines. Timing of mass fever surveys to be based /informed by epidemiology.

22. Explore the use of innovative tools to track surveillance, like GIS, as few states have shown capacity.

23. Provide/reinforce clear guidelines regarding the usage of RDT and microscopy.

24. Decide ABER benchmarks based on different endemicity. In areas closer to elimination, the approach needs to place emphasis on focus classification and response based on absolute numbers.

25. Consider the use of threshold charting or IDSP case definition of malaria outbreak/ epidemic based on the present malaria situation in the states.

26. Develop mechanisms of real-time reporting for early detection of malaria outbreaks. Till then, the transmission of each malaria case detected in the community may be transmitted using social media platforms or tablets, which are being used in NHM in some states, where malaria cases have reduced drastically.

27. Study link between malaria and rainfall to use the same for early warning of outbreaks

28. Explore/pilot tools for early detection of outbreaks in view of a gradual reduction in malaria incidence.

29. Develop malaria elimination guidelines for urban bodies with the flexibility to adopt innovation by the state authority. NUHM health staff should be well-trained to understand urban malaria dynamics and address malaria prevention.

30. Strengthen surveillance and response in urban areas. Emphasize a dedicated system in urban health offices to oversee/manage surveillance of malaria and other VBDs.

31. Urban programmes should be overseen/coordinated by the State VBDCP. Urban bodies should be supported with logistics, and capacity building, as needed.

32. Ensure guidance and oversight on surveillance and M&E by the National/State Task Forces for Malaria Elimination as an integral part of the follow-up on progress towards malaria elimination.

3.3.6 Key action points

1. Strengthen and switch surveillance from control to elimination mode in a phased manner with updated guidelines, SOPs with standardized data collection tools, reporting formats and training and ensure coverage at all levels in rural and urban areas.

2. Ensure clear case definitions for different settings.

3. Ensure updated strategy on surveillance and M&E to achieve malaria elimination in the upcoming NSP 2023-2027 and related operational plan. Update national guidelines, SOPs, and formats on surveillance and M&E accordingly.

4. Update the national M&E plan and develop state-specific M&E plans in line with the national M&E plan with an emphasis on data quality assurance.

5. Set up malaria elimination data repository at central and state levels. Address data quality issues ensuring data triangulation between different reporting systems.

6. Ensure guidelines on sub-national elimination validation are in sync with WHO certification guidelines and ensure appropriate dissemination and sensitization/ orientation at all levels.

7. Initiate sensitization of all levels (from NCVBDC to district) on the compilation of documents towards preparedness for subnational elimination validation as well as for nationwide elimination certification.

S. No	Issues	Action points	Responsibility	Timeline
1	Surveillance system tailored to the context of elimination	National surveillance guidelines for malaria elimination should be developed.	NCVBDC	Short-term (3-6 months)
		Develop guidelines for subnational elimination validation and initiate preparation of required documents/information for subnational elimination validation. Plan for peer reviews at the district level.	NCVBDC/ States	Short-term (3-6 months)
		Develop and disseminate SOPs following the development of national surveillance guidelines for malaria elimination, including epidemic preparedness.	States	Short-term (3-6 months)
		Guidance and oversight on surveillance and M&E by the National/State Task Forces for Malaria Elimination	NCVBDC/ States	Mid-term (6-12 months)
	Case-based surveillance	Strengthen case-based surveillance with case and focus characterisation, classification, follow-up and appropriate response. Standardized forms/registers	NCVBDC/ States	Mid-term (6-12 months)

2	Maintaining high-quality surveillance for the prevention of the re-introduction of malaria	Strengthen routine surveillance systems nationwide. Roll out the IHIP malaria modules in all states and UTS for real-time malaria monitoring. Strengthen case-based surveillance with case and focus characterisation, classification, follow-up and appropriate response. Standardized forms/registers	NCVBDC/ States/ Partners	Mid-term (6-12 months)
		Ensure data repository up to the sub-district level to help in analysing/forecasting /referring	States	Mid-term (6-12 months)
		Decide ABER benchmarks based on different endemicity levels.	NCVBDC / States	Short-term (3-6 months)
		Strengthen capacities at all levels in states/districts on surveillance and response and M&E through continual training/re-trainings and supportive supervision.		Mid-term (6-12 months)
3	A specific plan for urban malaria surveil-lance	Update malaria elimination guidelines for urban bodies with the flexibility to adopt innovation by the state authority. Strengthen surveillance and response in urban areas. Emphasize a dedicated system in urban health centres to oversee/ manage surveillance of malaria and other VBDs.	NCVBDC/ States	Mid-term
	The road map for IHIP malaria modules should be expanded	IHIP malaria modules for real-time malaria monitoring, which should be expanded quickly	NCVBDC/ States/WHO	Mid-term (6-12 months)

3.4 Thematic area 4: Case management, diagnosis and treatment

3.4.1 Overview

Case management includes diagnosis, treatment, clinical care, counselling, and follow-up of all malaria infections. Universal coverage of malaria diagnosis and treatment is one of the important objectives laid down in the NSP (2017-2022) and the cornerstone to achieving malaria elimination by 2030. This includes parasitological diagnosis of all suspected malaria cases and a strengthened surveillance system to detect, notify, investigate, classify, and respond to every case of malaria within 24 hours of the onset of fever and radical cure. Early diagnosis and complete treatment (EDCT) are critical for the benefit of the individual as well as the community.

Malaria diagnosis in India is based on microscopic examination of stained thick and thin blood smears or quality assured bivalent (Pf/Pv) antigen rapid diagnostic tests (RDTs). Although microscopy continues to be the gold standard for malaria diagnosis, quality-assured RDTs are equally good in terms of sensitivity and specificity for the detection of a symptomatic malaria case. Microscopy is recommended at the PHC/ CHC/ Institutional level, while RDTs at the community level or in case of emergency at the institutional level if microscopy is not available or the quality is doubtful. This is backed by a quality assurance system under the NQMS. Technical specifications for the procurement of RDTs based on the limit of parasite detection, heat stability etc., have been defined in line with WHO product evaluation criteria. The revised National Quality Management System (NQMS) for malaria microscopy includes creating a pool of master trainers for cascade training as well as benchmarking the skills of laboratory technicians through external assessment and certification. These trainers are supposed to take part in panel preparation, State, Regional and National assessment and certifications to fast-track quality microscopic diagnosis up to the PHC level.

Given the assumption that under a strengthened surveillance system, ~60-70% of cases will be detected and treated at the community level through ASHAs/Health workers and active case search, and ~ 30-40 % of cases will be diagnosed and treated at the health facility level, use of RDTs is expected to be about 70% in the high endemic areas while as microscopy is the gold standard is considered as the mainstay of diagnosis under elimination settings.

Presumptive treatment is not recommended unless there is strong clinical suspicion of malaria and parasitological confirmation is not possible due to unavoidable reasons. *P. falciparum* malaria is the predominant species in high-burden states and can rapidly progress to severe illness or death, thereby necessitating urgent initiation of appropriate antimalarial treatment as per the national drug policy.

Fixed dose combination therapy with artemether-lumefantrine is only recommended in the North-Eastern region, and co-blistered artesunate-sulfadoxine-pyrimethamine (AS-SP) for the rest of the country *P. vivax* malaria is the predominant specifies states at elimination / pre-elimination. Chloroquine is the drug of choice for the blood-stage infection, and primaquine for the liver stage. Complete primaquine radical treatment is crucial for relapse prevention. Patients with severe malaria are expected to be referred immediately to an appropriate hospital for treatment with Injectable Artesunate or Quinine, followed by a complete oral

course of ACTs. Quinine remains the treatment of choice for pregnant mothers during the first trimester of pregnancy.

In high endemic areas with perennial malaria transmission, asymptomatic cases continue to fuel malaria transmission. The NSP (2017-22) endorses the strategy of mass screening and treatment (MSAT) in active foci with large asymptomatic parasite carriers to interrupt malaria transmission/eliminate the huge reservoir of infection (considering local situations, in consultation with technical partners and WHO guidance). This strategy was pioneered in the comprehensive case management programme (CCMP), Odisha and subsequently scaled up in the high endemic, difficult-to-reach high-risk villages in 17 districts of the state through the DAMaN campaign, along with the introduction of LLINs.

In order to monitor the therapeutic efficacy of anti-malarial drugs used under the Programme, NCVBDC has been conducting therapeutic efficacy studies (TES) every year in collaboration with research partners like ICMR.

3.4.2 Observations

Diagnosis

RDT, as well as microscopy, is being used by states in varying degrees. The high endemic states (e.g., Tripura, Odisha, and Chhattisgarh) have effectively leveraged the extensive network of ASHAs / workers to bring diagnosis and treatment close to communities using RDTs. This has gone a long way in early diagnosis and prompt treatment resulting in reduced malaria morbidity and mortality, especially in remote and hard-to-reach areas. The high endemic states are heavily dependent on RDTs for diagnosis, and microscopy is limited to health facilities with variations between states.

In Tripura, microscopy is available at the PHC level, while in Chhattisgarh and Odisha, the microscopy facilities are available up to the CHC level mostly and at the PHC level to a limited extent. Low-endemic states such as Karnataka, Haryana and Punjab rely primarily on microscopy. At the facility level, microscopy is the mainstay of diagnosis, while at the community level, RDTs, as well as slide preparation, are practiced by ASHAs in varying degrees in Punjab and Karnataka, while in Haryana ASHA involvement for diagnosis is almost negligible and only RDTs are used by them. In Haryana and Punjab, malaria diagnosis is made mainly by MPW(M) at the community level and by the lab. Technicians at the facility level. ASHA involvement is generally limited to areas where MPW(M) are not available. ASHA skills for slide preparation are highly variable and mostly compromised in Punjab. Diagnostic services being quasi-vertical, through only MPW(M), and not available with all the PHCs, Sub-centres and ASHAs, this limits the access to diagnosis in Punjab and Haryana. (Diagnosis by RDTs is ~ 10%. in Haryana and ~ 20% in Punjab.). Dual testing using both microscopy and RDT was observed in some States (for example, Haryana, Tripura, Chhattisgarh, urban areas of Gujarat and Mumbai). There were also instances where variations existed in the testing of fever cases for malaria, for example, in some instances, fever patients were tested immediately, while in others, they were sent home with paracetamol and asked to return if the symptoms persisted, for example, in Haryana. This happened since most diagnosis and treatment facilities at the sub-centre and community level are not available, and only 4-5 ASHA workers are trained to do so.

Microscopy is available down to the primary care level (dispensary/health post) in Mumbai with the involvement of community health volunteers in case detection. Mumbai has a zero-backlog policy, and outsourcing blood-slide examination is done. However, the labs do not function all day. There is over-reliance on passive diagnosis, and several quality issues were reported in microscopy, for example, the use of improperly washed and reused slides in health posts and ready-made long, kept poor-quality stains.

The migrant population are screened for malaria, and 30-40% of private sector real-time reporting has been achieved. In Gujarat, the private sector treats five times the cases seen in the public sector. The figure is likely to be higher as only 10-15% of private practitioners report to the State. In Haryana, this figure was reported as 40%, though evidence of this effect could not be established.

There was no systematic testing of pregnant women during ante-natal clinics in the visited states. Though the availability of RDTs was generally found to be adequate, insufficient quantity and stock-outs at certain levels were observed for RDTs as well as stains. Access to timely diagnosis remains challenging in many settings, including hard-to-reach areas, tribal areas, mobile and migrant populations, areas with no to low involvement of ASHAs, and many urban settings.

Quality assurance

RDTs are supplied centrally to States, complemented by decentralized procurement at the state and district level. The provision of procurement of highly sensitive and specific RDTs by following recommended technical specifications exists at the central level, along with a lot of testing facilities at ICMR-NIMR. The quality of RDTs procured through decentralized procurement follows a State-specific method of quality assurance, and some RDT kits used in the field were not found to be procured as per the national guidelines.

The Covid-19 pandemic has disrupted the systematic lot testing of RDTs at WHO-certified facilities at the National Institute of Malaria Research (NIMR). WHO accreditation of NIMR lot testing facilities has not been renewed, and the pre-dispatch lot testing of the centrally procured and supplied; RDTs is not being done for more than two years.

The program initiated a revised National Quality Management System (NQMS) in 2016, and so far, 27 WHO-certified Level 1 and Level 2 Microscopists/LTs are available, two at the national level and the rest in State and Regional Offices. In addition to this, about 12 LTs from ICMR-NIMR have been certified by WHO to provide support for therapeutic efficacy studies, quality assurance, slide panel preparation and establishment of a slide bank.

WHO-certified LTs available with the Programme have been highly useful in training LTs in their States as well as at the National and Regional Level and are envisaged to strengthen the malaria microscopy services further with appropriate guidance and support from the State and central level. However, quality control of diagnostic services is still extremely inadequate due to the huge training load and gaps in the training of laboratory technicians, the absence of a National Reference Laboratory (NRL) and slide bank as well as limited slots available for WHO's External Quality Assurance Programme for microscopists. Although many trainings have been conducted after the introduction of the External Competency Assessment for Malaria Microscopy (ECAMM), important milestones have not been achieved, including

standardization of training across states, the plan for cascade training, availability of well-characterized slide panels with all parasite species for training, establishment of a slide bank and implementation of the State, Regional and National level certifications.

Many LTs, especially the contractual LTs, have not received induction training and only received on-the-job training. Although certified LTs are envisaged in all States in line with the national policy, this is not the case, and still, many trainings within the states are conducted by non-certified LTs.

Quality of microscopy was highly variable, often inadequate, with issues in the quality of slide preparation (quality of smear and staining) and examination (only thick smears stained and examined; only parasite species and not stages and count reported). Though in low endemic States like Karnataka and Haryana, certified LTs have been highly useful in the improvement of slide quality at the facility level, slide preparation at the community level remains poor and inadequate in most settings, especially in States like Karnataka and Punjab wherever ASHAs prepare the slides. In Mumbai and Category 3 states, blood slides were being reused without proper washing, whereas poor staining and delays in microscopy results were flagged in Chhattisgarh and Tripura.

The cross-checking mechanism of examination of 5% slides by the State, and Regional level cross-checking labs on a sharing basis is largely functional. The discrepancy rates in States like Punjab and Haryana are reported to be nil and minimal in Karnataka, which is questionable in view of the reported quality issues. However, it is much higher in high endemic states like Chhattisgarh, Maharashtra, and Tripura, Odisha. Both certified as well as non-certified LTs are involved in cross-checking slides. Therefore, the reliability of the cross-checking and discrepancy results is doubtful and may not be of much consequence for ensuring the quality of microscopy, more so in view of the revised and upgraded quality assurance system of malaria microscopy. The capacity of cross-checkers and their certification through external or national competency assessments has not been achieved as envisaged. This needs serious consideration and review in view of the proposed upgradation for EQAS as per NSP (2017-22).

SOPs and guidelines were not available in many health facilities visited.

The involvement of private labs as a part of the NQMS was not there under the program.

Treatment

National Treatment Guidelines

The national guidelines for the diagnosis and treatment of malaria in India date back to 2014. Newer updates in the malaria treatment and recommendations from the National Strategic Plan 2017-2022 (for example, use of fixed-dose combination ACT AL for Pf for the entire country, guidance for specific settings) are not reflected in the national guidelines.

***P. falciparum* malaria**

P. falciparum malaria is the predominant species in Category 3 stages, having the highest malaria burden and API. Fixed dose combination artemether-lumefantrine (FDC AL) is limited to the North-East, and AS-SP is used in the rest of the country. The first line ACT used in most of the country, except the Northeast, is AS-SP which is not a fixed-dose combination but only

available as a single-agent formulation. Patients may only take one of the two drugs, leading to de-facto monotherapy. This is a highly volatile situation and could lead to treatment failures at the critical stage of malaria elimination. WHO recommends the use of fixed-dose combinations rather than co-blistered, single-agent formulations.

In some low endemic settings also, non-utilization of the entire health system in malaria diagnosis and treatment and dual testing policy with Microscopy and RDT has been found to limit access to treatment (e.g., In Haryana and Punjab, antimalarials are kept with the MPWs and not at PHCs/SCs/ASHAs. The radical cure is only initiated after slide confirmation of RDT-positive diagnosis, though CQ is provided immediately). In such areas, the community is still largely dependent on informal health providers for treatment.

Injectable Artesunate (monotherapy) is frequently used in the private sector for complicated malaria in Gujarat and in the public sector in Chhattisgarh. Issues related to improper Artesunate reconstitution were reported from Tripura, particularly in health facilities having low case burden.

P. vivax malaria

P. vivax malaria is predominant specifies in Category 1 and 2 states and is the key obstacle to elimination owing to the liver stage of the parasite. States with very low caseloads, such as Haryana, Karnataka, and Punjab, provide 14-day primaquine treatment as directly observed treatment (DOT) for the first dose and further follow-up through the MPW(M) or ASHAs. However, in other states, particularly in urban areas, compliance with 14-day radical cure treatment is not monitored or supervised, rendering it ineffective. Compliance was also reported to be poor. States that follow the policy of slide examination of RDT positive tests before administrating primaquine result in delayed treatment, e.g., Punjab and Haryana. Follow-up blood slides for parasitological confirmation of all cases are done between Day 3-7 in Karnataka, while in Punjab, it is done after a month. This practice could not be established in other states.

There is poor awareness of primaquine-induced acute hemolytic anaemia (AHA) in G6PD deficient patients. Although the risk is clearly mentioned in the National Treatment Guidelines, the majority of health workers/ASHAs do not check whether patients have signs of hemolysis.

Access to treatment and quality

Though access to timely treatment has improved considerably over the years and reached the most peripheral areas due to the involvement of ASHA volunteers in the high endemic areas, it continues to remain limited and challenging in some hard-to-reach tribal and forested areas and forest fringes. Access to timely treatment could be an issue in view of the number of malaria deaths as there is a huge gap in clinical and parasitological confirmed malaria deaths, for example, in Chhattisgarh.

Though malaria cases were generally treated only after parasitological confirmation, presumptive treatment with CQ was seen to prevail in urban settings of some Category 2 states (especially in Mumbai). This is particularly alarming as 30% of reported cases are *P. falciparum*.

Inadequate stocks of ACT-AL, resulting in inadequate treatment, were reported in Tripura.

Reconstitution of Injectable Artesunate was not appropriately done at district hospitals or PHCs with low malaria burden in Tripura.

In some low endemic settings also, non-utilization of the entire health system in malaria diagnosis and treatment and dual testing policy with Microscopy and RDT has been found to limit access to treatment (e.g., In Haryana antimalarials are kept with the MPWs and not at PHCs/SCs/ASHAs. The radical cure is only initiated after slide confirmation of RDT-positive diagnosis, though CQ is provided immediately). In such areas, the community is still largely dependent on informal health providers for treatment.

MSAT campaigns have been initiated by some states to extend access to diagnosis and treatment in hard-to-reach areas and asymptomatic screen cases. A large number of symptomatic as well as asymptomatic malaria positives have been detected under these campaigns in the high-burden states of Odisha, Chhattisgarh and Tripura. Some low endemic states (e.g., Haryana) have also initiated the MSAT approach and detected asymptomatic carriers. The timing of these campaigns is not always based on epidemiological criteria, limiting the validity of the conclusions drawn. Also, continued and timely access to malaria diagnosis and treatment has not been ensured following MSAT.

No clear mechanisms for monitoring case management were found during the review. The absence of monitoring has led to the deterioration of case management services in certain areas. Practices such as presumptive treatment with CQ and PQ in Mumbai slums through the municipal corporation are flagrant examples.

The supply chain of diagnostics and drugs

The supply chain mechanism is largely manual and managed by the malaria teams, with a high scope of delays in the supply due to the dependence on staff. Mostly the drugs and diagnostics in the states/districts visited were available, but stock out/ non-availability of pediatric doses of AS-SP was a common problem across all states. The inadequate stock of ACT-AL was also reported in Tripura, and a shortage of antimalarial drugs (ACT-SP, PQ 2.5 and 7.5mg tabs) was reported from Chhattisgarh.

Stock out of stains for microscopy was reported in Haryana. Timely supply of logistics and its maintenance was reported as an issue in Chhattisgarh, along with an acute shortage of RDTs during the emergency period when malaria microscopy facilities were not available. An acute shortage of RDTs and microscopic diagnostic services were reported in Mumbai.

Non-availability and stock out of age-specific packs, especially the pediatric dose, have been a major challenge in areas using AS-SP. Health workers (especially ASHAs) find combining different age packs complicated due to the different tablet strengths, resulting in patients receiving inappropriate dosages. This is less of an issue with AL as the tablet strength is identical across all age bands; only the number of tablets given varies and thus simplifies treatment provision in the event of stock-outs. Inadequate stocks of AL resulted in inadequate treatment in Tripura.

Therapeutic efficacy studies

Therapeutic efficacy studies (TES) with CQ and ACTs have been in place under the Programme for a long through collaboration with ROHFW. Collaborative studies with NIMR were initiated

in 2009 under the World Bank support project. This collaboration was continued under GFATM support after 2013 across 10-15 study sites each year. WHO also supported ICMR institutes for TES, including studies on molecular markers, but very few studies have been conducted in the last 3-4 years. The efficacy of existing ACTs in falciparum malaria has been good and over 95% to date. However, almost 100% of samples have shown pfcrt mutations, high proportion showed DHFR double and triple mutations as well as DHPS mutations, though no Kelch 13 mutations have been reported for artemisinin resistance. This indicates that although ACTs are effective and there is no evidence of artemisinin resistance so far, the efficacy of partner drug SP used in AS-SP combination is already compromised. Further, continued use of AS+SP may t amount to creating drug pressure on artemisinin. The number of TES studies being conducted is not adequate for the large country, and the Covid-19 pandemic has further interrupted the continuation of TES.

Pharmacovigilance

Pharmacovigilance of antimalarials was found to be insufficient in terms of capturing information on adverse events and follow-up blood smears.

Case notification and private sector reporting

The formal and informal private sector plays a crucial role in providing malaria services in all settings. Case management practices in both formal and informal private sectors are often highly inappropriate/dangerous. Practices of treating malaria based on a clinical diagnosis without confirmation and treatment with injectable medicines are widespread throughout the country.

- In some areas, such as Surat (Gujarat), although only 10-15% of practitioners share surveillance data, they treat five times the cases in the public sector. Although malaria is a notifiable disease, especially in states at the elimination stage, implementation is very limited, and mapping of the private sector is either incomplete or not available. Lack of standardized training of lab technicians on malaria microscopy and QA/QC, including job aids seen in Gujarat. ROHFW uses RDTs instead of microscopy.

Most practitioners in the private sector, even at the highest levels of medical schools and teaching hospitals, are unaware or unfamiliar with national case management guidelines and follow their own treatment protocol.

3.4.3 Strengths

1. Access to diagnosis and treatment up to the peripheral level through the ASHAs in most parts of the high endemic states to ensure diagnosis and treatment at the community level nearest to the doorstep of the patients.

2. Central supply of quality-assured RDTs. Availability of a WHO-certified lot testing laboratory in the country at ICMR-NIMR.

3. Policy for implementation of a revised national quality management system for quality assurance of microscopy and RDTs as per WHO guidelines which ensures quality and sensitivity, and specificity at the thresh hold levels of parasitaemia, thereby ensuring quality diagnosis and EDCT.

4. Availability of highly motivated WHO-certified LTs working at national, regional, and state level and their involvement in training as master trainers and continuation of minimum essential training during the COVID-19 pandemic also

5. The E-learning platform for malaria microscopy is being validated in partnership with WHO.

3.4.4 Challenges and gaps

1. There is a huge training load of about 25000 LTs across states/UTs, and capacity building and benchmarking of the LTs for malaria microscopy is not optimal yet.

2. The establishment/functionality of well-equipped state/regional level malaria training labs has not been ensured by all states. Six ROHFWs were supplied with high-quality binocular light microscopes and multi-headed training microscopes, but utilization is very low due to diminishing or uncertified staff in some of them.

3. Capacities of ASHAs/Health workers for diagnosis and treatment remain variable.

4. Capacity building and lack of a policy for benchmarking the skills of ASHAs/ Health workers for diagnosis and treatment of malaria.

5. Access to timely treatment in the difficult-to-reach areas of the high burden States like Chhattisgarh in view of the malaria deaths and a huge gap existing in the clinically and parasitologically confirmed malaria deaths. Limited access to treatment due to availability and control of antimalarial drugs with only MPW(M) and Health Inspectors in some low endemic areas (Haryana, Punjab) with limited involvement of ASHAs and use of RDTs

6. Non-involvement of a large number of CHOs in malaria diagnosis and treatment at the sub-centre level.

7. Sub-optimal utilization of WHO-certified LTs for cascade training and state, regional and national level certification. Lack of adequate and well-defined budgetary support for their frequent visits within and across States.

8. Diagnosis and treatment in urban settings and continued presumptive treatment in urban areas like Mumbai.

9. Positive cases detected through MSAT are not included in the annual reports, necessitating clear program policy and guidelines on such issues.

10. RDT procurement by States through decentralized procurements does not always follow the programme's technical specifications and suggested quality assurance mechanisms.

11. The certification of WHO lot testing laboratory at ICMR-NIMR has not been done lately due to the COVID pandemic.

12. Limitation of the recommended bivalent RDTs for diagnosis of lesser prevalent species-*P. malariae*, *P. ovale* and P.knowelsi and lack of capacity of LTs to identify these parasites during routine slide examination due to lack of training on the identification of these parasites.

13. Case notification and reporting by the private sector (registered/unregistered) remains a major challenge in all states, though partial reporting has been achieved by a few States.

14. Variable knowledge about and compliance with national drug policy, especially the private sector and urban local bodies (for example, presumptive treatment was noted in Mumbai).

15. Manual supply chain systems lead to issues in supply chain and distribution within States and non-availability of antimalarials and RDTs at some levels of the health system leading to poor access to diagnosis and treatment.

3.4.5 Recommendations

Diagnosis and quality assurance

1. Prioritize and ensure timely access to quality diagnosis, treatment and services up to the peripheral level of the health system in all settings (Category 0,1,2,3) as well as urban, difficult-to-reach areas, forest and forest fringes etc.

2. Reduce turnaround time for diagnosis and treatment of malaria cases in high microscopy performing areas by rationalization of LTs. The use of RDT and microscopy is also to be rationalized as per facility-wise caseload for ensuring EDCT.

3. Implementation of NQMS as envisaged in the NSP and strengthening of microscopy services at all levels.

4. Ensure availability of certified LTs across all States for further cascade training and certification of LTs through NCAMM. All laboratory technicians should be trained through cascade training in collaboration with identified institutions and ROHFW having the necessary training infrastructure and capacity.

5. Preparation of training calendar ahead of time for at least one year to plan for ECAMM, NCAMM and refresher training listing the level of trainers and the slides to be used for training.

6. Expedite leveraging the platform of virtual training and expedite on priority shortlisting of the LTs for certification.

7. Ensure the functionality of the National Training and Certification facility at NCVBDC, NRL, SLIDE Bank and RDT Lot testing lab.

8. Revision of malaria microscopy manuals and SOPs in line with WHO standards.

9. Standardized training curriculum and slide panels for induction, refresher and national-level refresher training.

10. Ensure adherence to NCVBDC technical standards for decentralized procurement of RDTs by States and systematic lot testing and quality control

11. Develop evidence-based policy/guidelines for MSAT campaigns, ensuring regular surveillance for diagnosis and treatment following such campaigns.

Treatment

1. Ensure access to timely treatment (within 24 hours of case detection) from Sub-center to tertiary level hospitals of the health services, including the private sector, in all settings to achieve and sustain early diagnosis and complete treatment (EDCT) for achieving zero indigenous cases.

2. Review and update national treatment guidelines in line with findings from the TES, recent recommendations and updates by WHO.

3. Ensure effective case management and treatment compliance by developing clear case management guidelines and SOPs for control and elimination settings; putting in place effective monitoring and evaluation mechanisms.

4. Ensure effective case management and treatment compliance by developing clear case management guidelines and SOPs for control and elimination settings; putting in place effective monitoring and evaluation mechanisms.

5. Address specific challenges of *P. vivax* radical cure for compliance and risk of hemolysis in G6PD deficient patients. While updating/revisiting national drug policy, the introduction of new strategies and tools for *P. vivax*, including WHO recommendations on shorter radical cure regimens and point-of-care G6PD tests, should be deliberated for their use under the Programme appropriate to context to accelerate the elimination of *P. vivax*.

6. Operationalize therapeutic efficacy surveillance network and TES studies for both As-AL and AS+SP. Include more sites to cover all States. Sentinel sites should be considered for the expansion of monitoring of drug resistance.

    a. Therapeutic efficacy studies-related data should be shared with the NCVBDC by ICMR institutions.

    b. Develop capacities of states and districts for assessing drug resistance

7. Collaborate with the DCGI to implement pharmacovigilance for antimalarials.

8. Ensure minimum strategic stock of antimalarials at all levels through an effective supply chain management system.

9. Capacity building of all health care providers, including medical officers, to ensure

correct and effective case management as per national guidelines

10. Ensure dissemination of national drug policy and its compliance across all sectors, including the private sector. Ensure inclusion of national drug policy in CME in the public/private sector. Involve IMA and other professional bodies for dissemination and compliance.

11. Develop effective partnerships with the private sector and medical schools; explore innovative approaches used by other programs like RNTCP to ensure case notification.

12. High burden of asymptomatic malaria in high endemic states (Tripura).

3.4.6 Key action points

1. Strengthen technical and strategic leadership at the central, state and district level and hold regular meetings involving technical/malaria experts to monitor progress and review challenges.

2. Operationalize and implement the revised National Quality Management System as envisaged under the NSP (2017-22) and ensure quality diagnosis by RDTs as well as microscopy at all levels.

3. Revise the national guidelines for the diagnosis and treatment of malaria to ensure regulation of all extreme practices outside the national diagnosis and treatment guidelines. Prepare clear and user-friendly SOPs for different levels to address the gaps existing in diagnosis and treatment.

4. Ensure the capacities of all medical officers, health workers and ASHAs for malaria diagnosis and treatment.

5. Ensure mechanisms and legislative measures for case notification and reporting from all sectors -private, informal, and other Govt. sectors.

6. Ensure evidence-based policy guidelines for MSAT and special strategies for remote and difficult-to-reach areas in consultation with technical partners, experts and WHO.

7. Revise the national treatment guidelines for malaria diagnosis and treatment.

8. Revise the LT training curriculum for induction, re-orientation and national refresher training and manuals and SOPs for these training as well as malaria microscopy and ensure dissemination up to peripheral level.

Table 7: Guidance on key action points and timelines

S. No.	Issue	Action point	Responsibility	Timeline
1	Access to timely diagnosis, treatment and services up to the peripheral level.	Strengthen technical and strategic leadership at the central, state and district level and hold regular meetings involving technical/malaria experts to monitor progress and review challenges. Ensure diagnosis and treatment at all levels in all epidemiological settings	NCVBDC, ROHFW, States/ Districts	Short-term (3-6 months)
2	Quality assurance of RDTs and malaria microscopy	• Procurement and use of quality-assured RDTs as per NCVBDC recommended technical specifications • Operationalize NQMS. • The functionality of NRL, Slide Bank and RDT Lot testing facility. • Cascade training and certification of LTS	NCVBDC, ROHFW States/Districts, NRL, ICMR-NIMR, WHO	Short-term (3-6 months)
4	Monitoring of drug resistance.	• Operationalize therapeutic efficacy studies (TES) • Update diagnosis and treatment guidelines to include newer updates.	ICMR Institutes, NCVBDC, in collaboration with ROHFW and States with the support of WHO	Short-term (3-6 months)
5	Capacity building of service providers	Ensure the capacities of all medical officers, health workers and ASHAs for malaria diagnosis and treatment	Systematic, standardized training for each level followed by assessment	Mid-term (6-12 months)
6	Case notification from all sectors	Ensure central notification as well as mechanisms for enforcement	NCVBDC, States	Mid-term (6-12 months)
7	Policy for MSAT	Ensure evidence-based policy guidelines for MSAT in consultation with technical experts	NCVBDC	Short-term (3-6 months)
8.	Revision of malaria diagnosis and treatment guidelines, manuals and SOPs	Revise existing guidelines, manuals and SOPs to include newer updates. Manuals and guidelines for diagnosis, capacity building and quality assurance should be in sync with revised guidelines.	NCVBDC	Mid-term (6-12 months)

3.5 Thematic area 5: Entomology and vector control

3.5.1 Overview

Entomology and vector control is one of the core strategies for malaria elimination. Achieving effective coverage of entomological surveillance and vector control measures in malaria-endemic areas is a crucial part of the strategy. This includes using long-lasting insecticidal nets (LLINs), indoor residual spray (IRS), larval source management (LSM) and environmental management or modification appropriately depending on the epidemiological situation. Though the IRS and the use of LLINs are the core strategy to interrupt malaria transmission, the choice of intervention in eligible areas is still focused on IRS as per guidelines of NCVBDC indicated below:

- For areas having perennial transmission (more than five months in a year): Two rounds of IRS with DDT/ synthetic pyrethroid or three rounds with malathion, depending on vector susceptibility and priority distribution of LLINs as per the guidelines.
- For areas having seasonal transmission (less than five months in a year): One round of IRS before the start of transmission, focal spray whenever and wherever needed; priority distribution of LLINs as per the guidelines.

Malaria transmission in India is under the influence of 9 vectors (six primary and three secondary vectors). The areas under the influence of the six primary vectors of malaria in India have been depicted in the map.

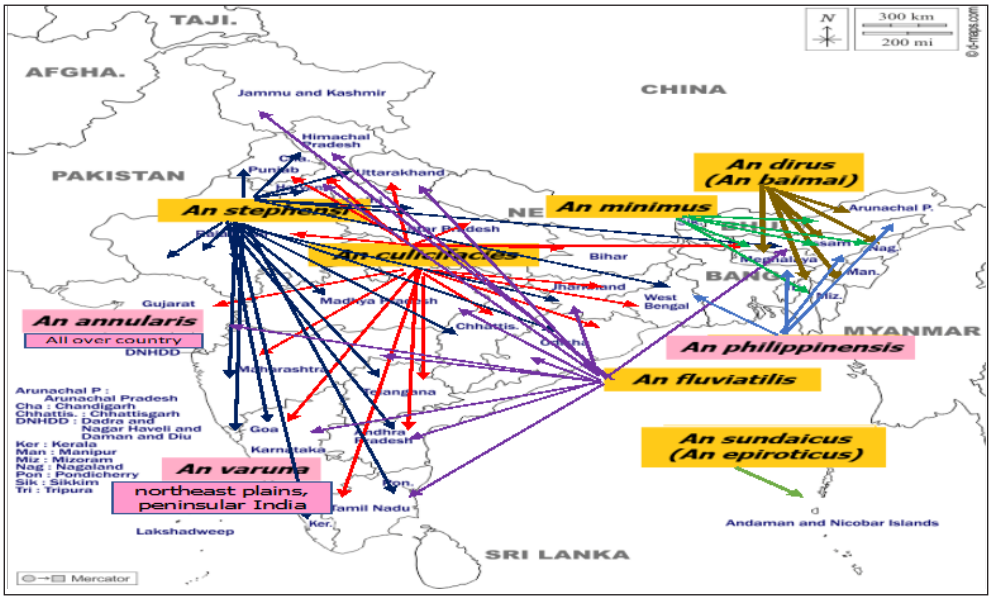


Fig. 23. Areas under influence of vectors in India

According to national guidelines (Compendium on Entomological Surveillance and vector Control), the entomological surveillance is to be carried out in sentinel and random sites selected through 72 (currently 89) entomological zones (Fig. 24). During deliberation at the national level, it was revealed that the guidelines for carrying out entomological work are circulated to states and zones from NCVBDC, Delhi. A basic structure for entomological monitoring is entomological zones covering 4-5 districts, which were established in 1977

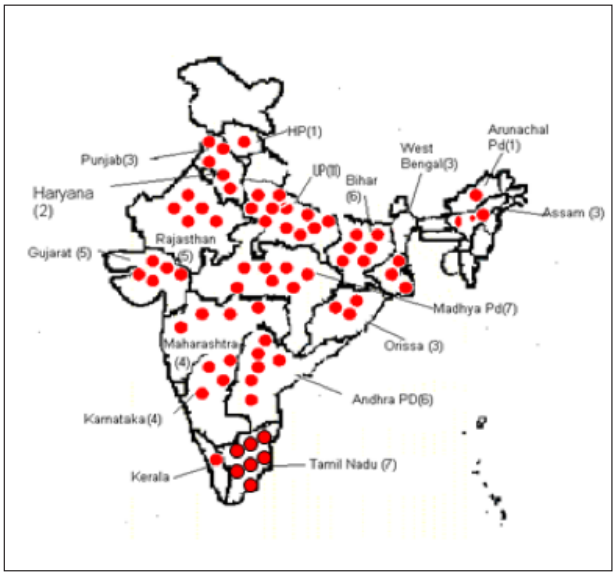


Fig. 24. Entomological Zones in India

with a strength of entomologists, insect collectors and support staff. The expenditure on this infrastructure is met by the States from state resources. To strengthen the entomological monitoring, the number of zones has now been increased to 89 by sanctioning the posts of entomologists. The functional zones, however, are only 50%, and support for other zones is taken from ICMR institutes and NCDC branches to generate data. The districts under the entomological zones need to be visited by a zonal team at regular intervals throughout the year. In addition, 16 Regional Offices for Health & FW, Government of India out of 19 were also equipped with entomologists for carrying out entomological activities besides other public health activities. However, only one ROHFW has a regular entomologist, and few have consultants. The data generated in districts are transmitted to state and Central HQ, which are mainly on vectors and density and also generally not consistent except for a few states.

The NSP 2017-2022 endorses Integrated Vector Management (IVM), in which a combination of interventions was recommended. These strategies mainly aim to reduce vector density (adult and larval) and human-vector contact or the duration of vector survival. The NFME 2016-2030 has been translated into a national plan of action by establishing category-specific interventions, which have been detailed in the 'Operational Manual for Malaria Elimination, 2016' to serve as a practical guide for the implementation of the Framework. Given that the malaria vectors, transmission potential and endemicity vary from area to area, the intervention measures are tailored and implemented broadly according to the API of the area. IVM activities are implemented at the subcenter and village levels. Category-specific guidelines: The Operational Manual for malaria elimination in India (2016) and NSP 2017-2022 provided category-wise vector control measures, as shown below.

Category 0 (no case) and one state (Elimination)

- Mapping of potential vector breeding sites
- Regular adult vector monitoring (prevalence and density)
    - Environmental management and modification in rural areas through Village Health Nutrition and Sanitation Committee (VHSNC) and in Urban areas by de-silting, de-weeding, channelizing, and larviciding.
    - Biological control - larvivorous fish
    - Foci-based adult vector control interventions - in and around 50 houses of a positive case. Space spray followed by IRS.

Category 2/3 (Pre-elimination / control)

- Universal coverage of all sub-centres with API> 1 with LLINs
- In sub-centres with API>1, if not covered with LLIN< two regular rounds of supervised IRS (sub-centre as a unit)
- In LLIN covered sub-centre, if there is no upsurge of cases, efforts to be made to increase

the compliance rate of LLIN usage;
- In outbreak situations - an additional round of IRS
- Anti-larval measures in urban areas with the main focus on slum clusters. In an outbreak situation, slum clusters can also be covered by IRS.
- Larval control through source reduction and biological and environmental measures.

The Insecticide policy under Programme is indicated in the Operational manual for malaria elimination 2016. As per the policy, the decision to change insecticide for IRS is taken by technical advisory committee (TAC) based on resistance status among vector mosquitoes and epidemiological data. The environmental code of practices (ECoP), which is unique, comprises six parts describing safety precautions for the use and handling of insecticides.

In addition, the supervisory checklist and advisories are regularly disseminated before the vector control operations start every year. The Programme also has a common evaluation protocol for new Public Health products and standard operating procedure (SoP) for the producers interested in getting their products included under the public health Programme. These guidelines have been prepared in collaboration with the ICMR and the NCDC and are also hosted on the program website. The comprehensive guidelines on Mosquito Control and Vector Response (MVCR) aligning with the Global Vector Control Response (GVCR) of WHO released in the year 2020 have emphasized both challenges to Entomological surveillance, it's strengthening, and the vector control operations in a judicious manner.

3.5.2 Observations

During the review, it was revealed that the Programme has switched over from a control to an elimination strategy and accordingly, the emphasis has been laid on strengthening vector management strategies with the objective of reducing the transmission of disease. The 'Compendium on entomological surveillance and vector control- India' dates to 2016. Recommendations from the National Strategic Plan 2017-2022 on focus investigations are not being implemented in totality. The NCVBDC guidelines distinctly outline essential entomological metrics for various disease vectors. These encompass parameters such as indoor and outdoor density, vector prevalence, vector incrimination, vector susceptibility, and cone bioassay for malaria vectors. However, the suboptimal performance of entomological surveillance has been observed in almost all the nine states reviewed during MPR and the existing human resource lack adequate understanding of national guidelines and SOPs in general. The salient observations are given below:

Infrastructure-capacity of human resources and capability of the system to deliver services

1. The programme has switched over from control to an elimination strategy, and the emphasis is on strengthening vector management. The guidelines have clearly defined important entomological parameters.

2. Lack of uniformity in the training curriculum and training materials available across all states for the training of entomologists as without adequate training on mosquito bionomics, vector identification using pictorial keys, components and functioning of tools and monitoring of proper dosage of insecticides against vectors, the performance will be suboptimal.

3. Proper entomological laboratories at the central, state and district levels were not evidenced, which is a prerequisite for desired entomological surveillance and processing of the field material in the laboratory.

4. Planning of interventions and quality of entomological surveillance is not generally ensured due to a lack of entomological capacity for vector surveillance, limited awareness of national guidelines for vector control, and unfilled HR vacancies for entomologists and insect collectors at the state, zonal and district levels. Even at the Regional Office for Health & FW (ROHFW), GoI, a minimum of one entomologist is not ensured. A similar situation is noted at Central HQ, where no regular entomologist is working.

5. The consultants engaged at the central level are not conducting any entomological surveillance though their numbers are good. A central cross-checking organization is also available at the central level. Their involvement in malaria vector surveillance is also insignificant. Sub-optimal utilization of entomologists for monitoring, planning and supervision resulting in suboptimal entomological surveillance

6. Logistics for Entomological Surveillance, especially entomological kits, larval and adult susceptibility/bioassay kits, insecticide-impregnated papers and other tools like light traps, exit and entry window traps, were not available, along with proper mobility and contingency support. Items found in stores do not reconcile with stock registers (for example, Haryana), and the practice of incorrect storage of IRS insecticides and LLINs were reported in Karnataka.

7. A functional state-of-art molecular laboratory in Surat with facilities for real-time PCR has been established, which could potentially be strengthened for xenomonitoring (XM) of vector-borne diseases in addition to a routine entomological technique for sporozoite infection in mosquitoes.

8. Entomological surveillance is significantly hampered by low to weak capacity, capability, and zonal infrastructure (i.e., inadequate human resources and logistics to support surveillance in 4-5 districts under each zone) in nearly all states.

Training

The capacity and capability at the national, state and district level are compromised, which may be attributed to inadequate awareness of strategic framework and logistics shortfalls, including limitations in human resources, well-trained entomologists, mobility support and financial constraints.

Data collection, analysis and management

1. Lack of recent data on vector prevalence, distribution, bionomics and breeding sites and inconsistent reporting.

2. In urban areas, mostly no systematic monitoring is undertaken besides a few reports of breeding sites in peri-urban areas. Municipal Corporation of Greater Mumbai (MCGM) has effectively mapped case clusters and geo-coded Anopheles breeding sites for the micro-planning of vector control operations. The other States have not progressed well. For

example, in Haryana and Punjab, the lack of plans for vector surveillance or monitoring of vector control activities contributed to a lack of regular and planned longitudinal vector surveillance and monitoring activities, including the poor functioning of entomological zones that are staffed with entomologists and insect collectors. Similarly, other deficiencies were a lack of recent data on vector prevalence, distribution, bionomics and breeding sites by the state of Tripura and Chhattisgarh.

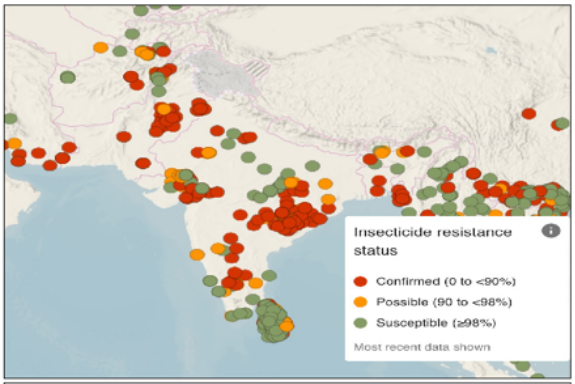
3. The MPR team observed suboptimal entomological surveillance in Gujarat and inconsistent reporting in Karnataka. The reporting from Haryana and Punjab was also not consistent with NCVBDC guidelines which may be attributed to a combination of human resource deficit, unfilled zonal posts, lack of training, lack of SOP or procurement-supply chain issues.

4. Apart from reports of breeding sites of An. stephensi and An. culicifacies in peri-urban and low-lying areas in Mumbai, there was no systematic monitoring from low or high-endemic States. The lack of monitoring breeding habitats was also noticed in Tripura.

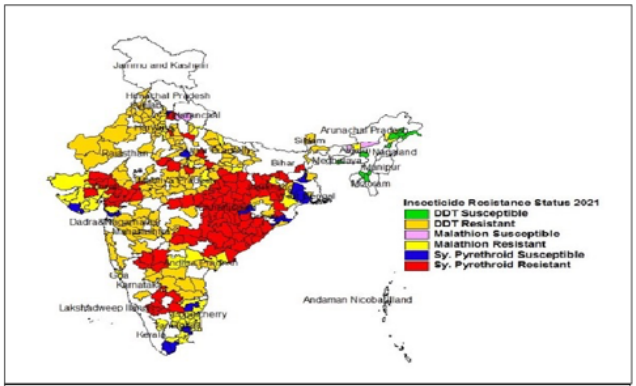
5. Insecticide resistance monitoring (IRM) is mostly conducted in rural areas. However, this activity was not systematically planned or implemented in all districts due to a lack of insecticide-impregnated papers, of which supply is dependent on WHO.

6. Larval susceptibility tests were not done due to the non-availability of larval susceptibility test kits. The kits were received and supplied to states recently. The MPR teams also noted that skill development of human resources at the State and zonal level (for example, Chhattisgarh, Punjab and Haryana) and non-availability of larval susceptibility test kits (for example, Mumbai, Punjab and Haryana) were the main issues for not conducting the adult and larval susceptibility tests.

7. The available data on resistance in Chhattisgarh through NIMR reports revealed multiple resistance among malaria vector species to DDT, malathion and synthetic pyrethroids. Karnataka state has also reported An. culicifacies resistance to 4% DDT, 5% malathion, 0.05% lambdacyhalothrin and 0.05% alpha-cypermethrin. An. culicifacies is resistant to at least one insecticide in 101 districts of 16 states, and triple insecticide resistance, that is, to DDT, malathion and deltamethrin, was reported from 31 districts. Also, An.



Map showing insecticide resistance of malaria vectors as reported to WHO. Source: **WHO Malaria Threats Map**). Many sites showed mortalities <90% (red circles). Accessed on 10 May 2022. https://www.who.int/teams/global-malaria-programme/surveillance/malaria-threats-map



Map showing insecticide resistance of major malaria vector- *An culicifacies based on 5-year data (2015–2020).* Source: **NCVBDC-MPR Background paper.** Main rural malaria vector *Anopheles culicifacies* has developed resistance in many places. The high burden malarious area which are under the umbrella of IRS and LLIN has shown triple resistance i.e., against DDT, Malathion and Synthetic Pyrethroid.

Fig. 25. Map showing insecticide resistance of malaria vectors reported to WHO

fluviatilis, a vector prevalent in hilly forested and foothill regions, was reported resistant to DDT in 17 districts and to malathion in one district (MVCR 2020).1 Confirmed resistance is defined as <90% mortality after 24 hours.

8. WHO guidelines 2016 for measuring phenotypic resistance frequency via discriminating concentration, resistance intensity via intensity concentration bioassays, and resistance mechanisms via synergist-insecticide bioassays, molecular and biochemical assays are not in practice by zonal entomologists as perfection in techniques and logistics will be required. However, different research institutions are generating data in this regard. Data available for alphacypermethrin intensity concentration (10x) bioassays conducted in 2015-2016 from India representing the South-East Asia region (WHO 2018)2 show moderate to high resistance levels.

9. The resistance is quite widespread in India as many sites demonstrated mortalities of about 70-80%, which falls in the moderate (permethrin, deltamethrin, alphacypermethrin, etofenprox, bendiocarb, malathion) to high (for example, DDT) category. WHO Global report on insecticide resistance in malaria vectors: 2010–2016 included many reports of the high frequency of DDT resistance. The updated map (2015-2020) by NCVBDC (Fig. 25) clearly indicates the spread of insecticide resistance in the main malaria vector of India.

10. Insecticide Resistance Management: States are using a similar class of insecticides (that is, pyrethroids) for IRS/Focal spray and LLIN as observed in field visits to Chhattisgarh, Haryana, Gujarat, Karnataka and during desk review of Punjab, which will accelerate the development of resistance. Synergistic bioassays with PBO and TPP showed the association of metabolic resistance with esterases (12 tests) and monooxygenase (11 tests) in An. culicifacies during 2014 and 2015 after the distribution of PermaNet 2.0 LLINs in Kondagaon district, Chhattisgarh state. (WHO Threats Map; https://www.who.int/teams/global-malaria-programme/surveillance/malaria-threats-map). Decrease in deltamethrin susceptibility of the multiple insecticide-resistant An. culicifacies was due to the use of large numbers of deltamethrin-impregnated Permanent 2.0 nets, agriculture, and e involvement of knockdown resistance (kdr) genotype in addition to mixed-function oxidases (MFOs) and esterases as a major mechanism in An. culicifacies, including expression of the genes (CYP6Z1 and GSTe2) conferring metabolic resistance and mutations L101F, L10104S and V10101L in An. culicifacies populations in central India.

11. Focus investigations in areas reaching to elimination phase: Focus investigations during elimination or in response to outbreaks are not correctly implemented across all states. “Random or spot checks study” was conducted in response to malaria-positive areas/outbreak area/vulnerable areas comprising a dawn and dusk adult mosquito collection, cone bioassay, larval survey and dissections for parasite infections and physiological age status (for example, 29 studies were conducted in 2018 at Karnataka). However, the findings were not linked with focus classification and response, i.e., active, residual (non-active) and cleared, as stated in NSP 2017-2022.

12. Malaria vector control:

    a) National vector control guidelines: Action plans for IRS, distribution and use of LLIN, and larvivorous fish are generally available in states.

b) Integrated vector management (IVM), in most settings, was partially implemented. Despite the adoption of IVM policy and strategy, its implementation is uneven and probably unsatisfactory in Haryana partly due to the "unclear role of zonal entomologists in planning and execution of field investigation and response", lack of supervision and lack of plans for vector surveillance and monitoring of control operations. No clear mechanisms for IVM implementation were found during the JMM in Tripura.

c) The absence of a state entomologist and supporting staff has led to the deterioration of entomological activities. Despite the lack of entomological support, two rounds of IRS with DDT 50 WP were conducted in South Tripura (population coverage of 82.9-88.9%; protected: 260 000) and Dhalai district (population coverage of 72.75-75.3%, protected: 541,136).

d) Mass campaigns of Duranet and Permanent 2.0 LLINs (n=423,629) from 2015 to 2020 covered a total population of 942 020 (2.2 persons per net) in 3 sub-divisions of the south Tripura district. This level of coverage is not consistent with the threshold (1.8 persons/net) as prescribed in the national IVM operational manual (Operational Manual for IVM, Directorate of NVBDCP, 2016).

e) Quality of vector control services is inadequate due to gaps in training, intersectoral collaboration with NCDC, NIMR, RoHFW, Vector Control Research Centre (VCRC), and experts (for example, Chhattisgarh and Haryana), lack of multisectoral engagement with urban development, water supply, sanitation and drainage, education, public health engineering, women and social welfare and transport (for example, Chhattisgarh).

f) LLIN distribution in a few places is arbitrary (not population-based), and documentation is inconsistent with national guidelines; its use is not being monitored, and many unused LLINs are kept in plastic wrapping (e.g., Haryana and Punjab). Lack of universal coverage was noted in the LLIN distribution plan for endemic sub-centres, which is inconsistent with national guidelines (for example, Tripura). Gujarat state was unclear about the category-wise LLIN distribution policy stated in the NSP

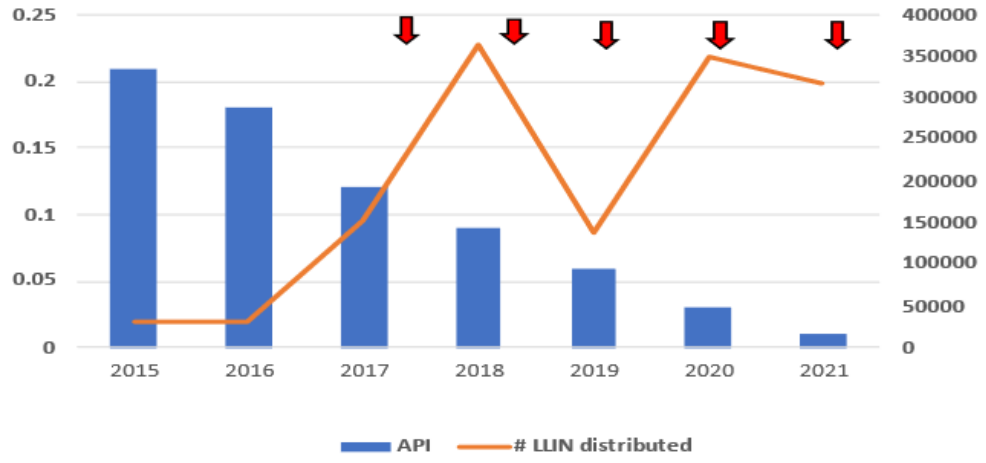


Fig. 26. Annual parasite incidence and vector control (LLIN and IRS)

2017-2022, which resulted in partial distribution at Panchmahal district as PHCs with API<1 qualified for LLIN distribution in 2015.

g) The MPR team reported new LLINs shrunk in height after washing, thus creating a gap when hung over the bed in the Tripura district.

h) Vector control in focus districts of Chhattisgarh with a high tribal population was found to be riddled with challenges due to non-conformity with national guidelines for the selection of sub-centre for IRS operations, particularly matching the timing and duration of spraying with bordering districts, use of the same insecticide class for IRS and LLINs, incorrect record keeping of spray pumps and insecticides, inadequate spray coverage, lack of supervision and monitoring, and inappropriate maintenance of Gambusia fish at CHC level.

i) However, Mass campaigns in Chhattisgarh distributed a total of 9 795 609 LLINs covering a population of 17 107 326 @1.75 people per net, which is consistent with the national guidelines. IRS population (target: 1 384 509) and room (target: 1 374 660) coverage were 95.7% and 88.7% respectively and consistent with the threshold as per national guidelines. Though HC pumps have been advocated in Programme guidelines since the beginning for difficult and hilly areas, during IRS, mainly stirrup pumps are used.

j) After ten years of LLIN mass campaigns, States are challenged with the disposal of expired nets. National guidelines on these aspects were not available in states.

k) In Karnataka states, a good correlation was observed between IVM activities and malaria incidence where vector control operations were systematically guided by entomological surveillance, an integrated approach comprising a combination of LLIN, routine IRS (at relatively high coverage in 13 endemic districts), larval control (1689 Liters of temephos, 437 Liters of BTI AS, 634.4 kg BTI WP), 203 Liters of pyrethrum 2% for fogging applied per year during 2017-2021, larvivorous fish (applied to an average of 32,646 water bodies per year, 2017-2021), environmental engineering in 30 districts at 60.7% (19950/32838) coverage of total breeding sources enumerated (range: 209.6-475.8 breeding sources covered per year during 2017-2021), supported by inter-department coordination meetings, community mobilization, public awareness and exhibition, advocacy activities via media in Karnataka.

l) Focal spraying: Usually, the States respond quickly to tackle malaria outbreaks. The MPR team observed that the states had executed a mix of vector control measures focal IRS, LLIN and larvivorous fish (Karnataka achieved focal IRS coverage between 68-97% in 8 districts). However, the linking of such response with types of malaria foci, viz., active, residual (non-active) and cleared, was not noticed, as stated in NSP 2017-2022. Refusal to IRS was reported presumably among mobile tandas (lambani tandas) in short-term settlements along the canals of an irrigation setting (for example, Upper Krishna Project area, Karnataka). In contrast, the focal IRS and anti-larval measures were not conducted in Haryana for 50 houses around the index case of a malaria patient.

m) Space spraying: Space spraying is often deployed in response to outbreaks of all vector-borne diseases in urban areas (as revealed in Chhattisgarh); in malaria and dengue-affected areas, and on demand by people who reported nuisance mosquitoes (for example, Haryana) and in places of malaria-positive cases (for example, Surat Municipality Corporation). Space spraying guidelines were misaligned with NSP 2017-2022 (for example, Mumbai). Due to the high visibility of this intervention, the decision to use this approach is usually made to demonstrate that the local authorities act in response to the outbreak.

n) Vector control for Urban malaria: Malaria transmission by An. stephensi is well written in Programme guidelines emphasizing larval source management and intersectoral coordination. The implementation of control activities, however, is far from satisfactory. The observations in metro cities like Mumbai and Bengaluru indicated that some of the components of Programme guidelines are followed, but few decisions on the use of insecticides not recommended under the Programme are taken locally. The intra-sectoral coordination between the health, pest control and departments of MCGM and the Mosquito Abatement Committee was integral in urban vector control operations in Mumbai city corporation. The vector control activities consist of source reduction activities in various properties owned by MCGM (for example, mosquito-proofing water tanks, disposal and removal of water containers and scraps); government and semi-government agencies (for example, demolition of dilapidated structures and cross-sectoral actions at railway yards, airport, etc.); slum areas (for example, weekly larviciding, IRS and indoor fogging, source reduction, mosquito net distribution); building construction sites (for example, work site corrections and labour welfare measures supported by MCGM interventions); sick mills (for example, source reduction and environmental modification); and private properties (for example, community-based source reduction and container removal, health education, legal action). The observation revealed injudicious use of larvicides, especially in respect of dose compliance of insecticides in Bengaluru as well as in Mangalore. The other group of townships is bigger municipal corporations like Surat Municipal Corporation (SMC), having a structured infrastructure and implement a mix of peri-domestic and intra-domestic vector control such as larviciding with temephos and diflubenzuron, use of guppy fish, space spray in malaria-positive houses and two rounds of IRS in high-risk areas. ASHAs in urbanized rural areas are remunerated for antilarval activities in domestic water containers. The MPR team noted that smaller townships and municipalities have fragmented and unplanned approaches towards vector control activities for want of technical knowledge, human resource and structured Programme governance. Performance of vector control operations in 131 towns covered under the Urban Malaria Scheme (UMS) and in 206 towns covered under the National Filaria Control Programme (NFCP) are suboptimal as in many places, the post of the biologist is vacant, and the field workers are engaged in other sanitary works.

o) BMGC (Mumbai) used drones (unmanned aerial vehicles) for the application of anti-larval oil in inaccessible areas such as dilapidated mills for the control of malaria and dengue. It is not clear if any entomological evaluation was conducted to estimate the success of breeding site reduction, the treatment effort and cost.

3.5.3 Strengths

1. Resource pool with research/academic institutions retired from central and state services with the collaborative approach is the strength towards building human resource and skill development. There are experienced entomologists in different parts of the country with subject experts who can contribute to support the entomological surveillance and strengthen the entomological infrastructure, which requires a boost for malaria elimination and sustained thereafter. The IDSP system is another strength which, in many places are, supporting the Programme through state entomologists.

2. For vector control, a large workforce with different disciplines working for the general health care system and research institutions is the real strength for mobilizing and improving the capability of the system to deliver the services under the Programme.

3. The network of ICMR institutions across the country is important because, in India, there are various paradigms, viz., forest, forest fringe areas, desert, foothills, riverine, coastal, urban, and suburban areas, hot and humid climate areas etc. Their scientific studies on vector bionomics and outdoor transmissions in relation to social determinants will be of much help to the Programme in deciding appropriate strategic planning.

4. Various national, state and regional training centres engaged in capacity building are the support Programme where entomologists and vector control professionals working in different eco-geographical areas are trained to tackle the problems in different situations.

3.5.4 Challenges and gaps

Entomological monitoring depends on HR, Infrastructure facility and Skill development:

1. Huge vacancies (more than 50%) of entomologists and insect collectors at the state and almost 100% at the national level with no regular staff.

2. Central Lab facility, especially for entomological monitoring and processing of field samples, is lacking at central headquarter, Regional offices and at most of the state and zonal level across the country.

3. The data generation on entomological surveillance is inconsistent and crucial parameters to guide Programme activities are often not captured in a systematic manner (maintaining seasonality and area-specific), and its monitoring or feedback from the Centre and states are broadly missing.

4. The capacity of human resources, especially available entomologists and insect collectors with proper mobility and logistic support, to undertake vector surveillance in the different time periods (morning, evening, night) is mostly suboptimal in terms of updated knowledge about vector bionomics, information on latest insecticide resistance, generating entomological evidence to support malaria elimination claims in elimination settings etc.

5. Though broad guidelines have been disseminated, the availability of comprehensive and specific training material for all entomologists and VBD consultants are lacking.

SoPs, formulation of micro-plans, process and impact monitoring of implementation activities are to be made available from the central level.

6. Special training on achieving malaria elimination in outdoor transmission areas and developing a comprehensive plan to tackle Urban malaria transmitted mainly by An stephensi is not done except for mapping of breeding sites in some areas.

Vector control

1. Inadequate skill in preparing the ready-to-use formulation of insecticides and its use to ensure that the correct dose is applied

2. Suboptimal awareness among spray workers about the impact of the use of higher doses or injudicious applications of insecticides/larvicides.

3. Clarity among supervisors regarding the use of appropriate and recommended vector control tools like indoor residual spray, LLIN and anti-larval application is mostly lacking. It is very important because unless this knowledge is ensured among the implementers or the supervisors, it would be very difficult to ensure that proper recommended doses are used. There can be some items where flexibility can be considered, but some items should be non-negotiable where no compromise can be given, for example:

    - Dose applications and their recommended procedures should be non-negotiable under the public health Programme and Commodities, which have been recommended for the public health Programme by the regulatory authority and included under Programme.

    - There are certain things like the distribution of LLINs to high-risk areas, but it can be flexible for its distribution to be used in residential schools, hostels, slum dwellers or construction workers etc., if its use is feasible. Flexibility in the field situation, especially for the big corporations in urban areas like industrial setups, is the challenge to avoid misuse.

4. Mobilizing and retaining the trained workforce on vector control; otherwise, the investments made on them will be without any output, and a new team will have to be developed, which takes time and reinvestment.

5. Training and reorientation of different categories engaged in the delivery of different vector control services, for example, IRS squads, anti-larval workers, fogging machine operators, distribution of LLINs and introduction of larvivorous fish as these require specific training along with the art of interpersonal communication and community involvement.

6. Most of the people are tuned and have been practicing the conventional pumps (stirrup pumps) for IRS because they were equipped with that, but with the new technology, the hand compression pumps fitted with control flow volume value are being recommended so the capacity building across the country will be a major challenge.

7. Next-generation insecticides for indoor residual spraying are one of the challenges, especially in the context of DDT being phased out and widespread resistance against available and recommended insecticides under Programme (malathion and synthetic pyrethroids). To bring such a product in fast-track mode is a challenge.

3.5.5 Recommendations

1. Augment entomological surveillance and strengthen the entomological infrastructure, which requires a boost for malaria elimination and sustained thereafter. The resource pool with research/ academic institutions, retired from state and central services with the collaborative approach, is the strength towards building human resource and skill development. The IDSP system is another strength which, in many places, is supporting the Programme through state entomologists.

2. Strengthening of entomological surveillance is based on the following
   - Strengthened capacity of available human resources
   - Identifying a few centres and equipping them with newer technology
   - Training of staff of such centres
   - Experiences during MPR revealed that few states have the capacity in different urban areas like Surat, where such facilities are functional and can be quickly strengthened.
   - In addition, there are sentinel surveillance hospitals (SSH) used mainly for dengue and other arboviral infections, which can be equipped with such technology.
   - ICMR institutions can be roped in for skill development in certain areas and setting up the labs.

3. Capacity building
   - Filling up vacant position of sanctioned posts in entomology/ biologists/DVBDOs/ insect collectors/vector control consultants.

   - Ensure that entomologists are backed up with supporting staff, that is, insect collectors with appropriate qualifications.

   - Develop a training plan focusing on skills development for entomologists and insect collectors, including a separate plan for routine training and new technology. Strengthening Insect collectors in states in terms of matching numbers for entomologists (minimum 2 per entomologist) under NHM through PIP may be considered.

   - Conduct capacity-building activities of all existing and newcomer Entomologists/ Biologists/DVBDOs/Vector Control consultants and other relevant staff on a regular basis focusing on integrated approaches for all vector-borne diseases.

4. The concept of zonal entomological set-up existing in India caters for the Entomology girl surveillance in longitudinal studies, short-term studies and random studies for 3 to 4 districts. These upgraded centres may be a mix of state authority, district authority, research institutions and regional offices for Health and Family Welfare (ROH&FW) GOI. In a few states, the infrastructure is below the desired level in Chhattisgarh, Haryana, Punjab and Maharashtra etc. However, in certain states, the infrastructure is extremely well, and the results are also used for analysis and taking decisions on vector control, like in Tamil Nadu and Karnataka.

5. Possible suggestions for HR for field work: The option may be:
    - Pooling of resources (Entomologist and VBD Consultants) working in the districts and under a zone so that a minimum of 3 to 4 entomologists are pooled together who can be assigned to visit one high endemic district for longitudinal study and remaining lower endemic areas or the areas reporting zero cases can be taken for short-term studies means visiting once in a quarter depending on their mobility support and other infrastructural support.

    - To process the material collected from the field, there must be a district or zonal entomology laboratory to be established at zonal level minimum and state level reference laboratory.

    - Certain districts which have performed well can be upgraded and make a reference centre like:
        - Certain states have concepts of a division comprising seven or eight districts
        - Certain states have regions or zones comprising 4-5 districts, so such zonal/ regional headquarters can be considered for setting up the entomological monitoring cell with the established laboratory for which the support is to be provided in terms of:
        - human resource
        - financial resources.
        - Areas reporting zero cases can be used for short-term studies, and the quarterly field visits will depend on the mobility and infrastructure support available. The pooling of resources available in states, zones, districts (state's resources) and 19 regional offices for Health &FW, ICMR Institutions, especially NIMR, VCRC, RMRCs at Gorakhpur, Bhubaneswar, Dibrugarh, NIRTH Jabalpur, RMRIMS, Patna and NCDC along with its field units and IDSP entomologists may be considered. In such pooled resources, all may be oriented on the requirement of the Programme so that uniformity in data generation and management is maintained.

6. Evidence-based decision-making
    - States that have the sub-optimal infrastructure for vector surveillance and control (for example, Chhattisgarh, Haryana, Punjab, Maharashtra) could benefit from the expertise and technical support from other states. They need to be advised to seek expertise and technical support from other states on generating evidence and establish laboratories with diagnostic tools and quality assurance systems for which necessary provisions may be made in PIP.

7. Programme guidelines and ownership for such initiatives will facilitate the policy decision, which will be mandatory for institutional mechanism and support under NHM.
    - Operationalizing entomological surveillance and lab network would need to be carefully managed to maintain rigorous systems and quality standards for malaria elimination and vector control across a large range of services and to get buy-in from national Programme managers and other laboratories. Irrespective of the control methods planned, ensure that surveillance activities conform to appropriate quality management (QM) criteria.

- Specific national guidelines and SoP: Entomologists can play an active role in foci classification by collaborating with the epidemiological and surveillance teams during the elimination phase.

- Entomological surveillance in urban areas is limited to checking the breeding sites only. This need to be guided separately involving urban areas with the involvement of the Directorate of Municipal administrations and local bodies.

8. Insecticide resistance monitoring More efforts are needed to expand resistance monitoring across the country with a comprehensive IRM plan, including rural and urban areas. Prior to the implementation of the IRM plan, all stakeholders and partners may be brought to one platform on methodology, site selection, reporting in standard formats and data sharing in a time-bound manner.

9. Reporting formats for data generated and its inclusion under Programme aligning IHIP portal will have to be framed and disseminated without comprising the required parameters in existing formats. This will also make the data rolling out new technology and its practical feasibility. The jurisdiction or catchment area of such a lab needs to be decided.

10. Vector infection using new technology Given the availability of XM expertise and resources for the lymphatic filariasis Programme (Manual for IVM, 2016), it is time to assess the local vector/pathogen. An XM system designed for disease elimination could have different constraints than one for detecting emerging infectious diseases (EIDs).

11. Clear guidelines on the disposal of LLINs and their packing materials need to be framed and disseminated.

12. Quality assurance processes on tools, insecticide and LLINs need to be strictly ensured and also be circulated to states and districts to make them aware and follow the procedures in case of any reports on the substandard commodity.

13. Advisory need to be circulated from the centre to use hand compression pumps with CFV to ensure required pressure during IRS instead of conventional stirrup pumps.

3.5.6 Key action points

1. Fill all HR vacancies of entomologists and insect collectors at the national, state, and district levels

2. Human resource at Regional Offices for Health & FW for entomological monitoring needs to be ensured, and entomologists at ROHFWs should be involved in data analysis and its management. As these are directly under the Government of India, quick action may be initiated for already sanctioned posts (regular or contractual).

3. Infrastructure strengthening of state, zonal and district entomologists should be considered mandatory with required support staff (Insect collectors @2 per entomologist). These should be considered and supported through PIP at least till 2030.

Pooling of available resources (entomologists and VBD consultants) may be a short-term measure to initiate the monitoring immediately.

4. Disseminate SOP and specific guidelines for entomological surveillance with mandatory and desired parameters.

5. Establish a central entomological laboratory at NCVBDC, Delhi. This is to be equipped with experienced entomologists to do process monitoring and analyze data using entomological intelligence received from various parts of the country and provide feedback.

6. Focused monitoring on Insecticide Resistance (adults and larval) with priority to the areas with no information.

7. IRM should include both the techniques of WHO tube tests and intensity bioassay for which state and regional labs need to be strengthened in addition to research institutes.

8. IVM implementation in totality needs to be widely advocated, and professionals (public or private) should be adequately sensitized.

9. VCNA should be done in all the states. The recommendations of the VCNA done by WHO should be disseminated in all states, districts and even across urban local bodies.

10. A comprehensive training plan for entomological skill and vector control will be required with all teaching materials and empaneling the subject experts with an inbuilt evaluation mechanism for improvement in teaching quality.

11. Guidelines on vector control in different settings and situations will be urgently required so that vector control teams are aware of what to do when they approach elimination settings covering various paradigms.

12. Newer tools and technologies need to be included in Programme. For example, Hand compression pumps with CFV should replace conventional Stirrup pumps. Similarly, cold fog should replace thermal fogging. The newer products may be expedited through the institutional mechanism of the country.

13. Research should be undertaken to assess if there are added benefits from sites where IRS has been rolled out or where LLINs are being used. The outcome of operational research needs to be considered and absorbed into the Programme depending on its feasibility.

Table 8: Guidance on key action points with timelines

Sl No	Issues	Action points	Responsibility	Timeline
	Human resource Permanent	Fill all vacancies of entomologists, insect collectors and Biologists at national, ROHFWs, state, district and Zonal levels	NCVBDC and States	Long Term (1-2 years)
	Human resource contractual	• Human resource at Regional Offices for Health & FW for entomological monitoring needs to be ensured, and entomologists at ROHFWs	NCVBDC State through PIP under NHM	Mid-term (6-12 months)
		should be involved in data analysis and its management. As these are directly under the Government of India, quick action may be initiated for already sanctioned posts (contractual). • Infrastructure strengthening of state, zonal and district entomologists should be considered mandatory with required support staff (Insect collectors @2 per entomologist). These should be considered and supported through PIP at least till 2030.		
	Human resource pooling/reallocation	Pooling of available resources (entomologists and VBD consultants) may be a short-term measure to initiate the monitoring immediately.	State through PIP under NHM	Mid-term (6-12 months)
	Infrastructure	• Establish a central entomological laboratory at NCVBDC, Delhi. This is to be equipped with experienced entomologists monitoring and analysing data using entomological intelligence. • Establish a State entomological laboratory at State HQ/Zonal Laboratory at the Zonal or District HQ	NVBDC/WHO/Partner's support States based on the advisory of NCVBDC	Long-term (12 months and above) Mid-term (6-12 months)
	Capacity building	Teaching materials and empanelling the subject experts with an inbuilt evaluation mechanism for a comprehensive training plan for entomological skill and vector control	NCVBDC/States/ Partners	(12 months and up to 24 months above)

	Capacity building	Guidelines on entomological surveillance, monitoring, vector control, supervision, analysis and Data compilation reporting in different settings and situations so that vector control teams are aware of what to do and when especially during elimination and post-elimination settings.	NCVBDC/WHO/ Partners	Mid-term (6-12 months)
	Capacity building	Disseminate SOP and specific guidelines for entomological surveillance with mandatory and desired parameters.	NCVBDC/WHO support	Mid-term (6-12 months)
	Capacity building	Newer tools and technologies need to be included under Programme by expediting institutional mechanisms. Example: • Hand compression pumps with CFV in place of conventional Stirrup pumps. • Cold fog should replace thermal fogging.	NVVBDC/State/ Municipal Corporations/Districts and Local Bodies	Long-term (12 months and above up to 3 years)
	Capacity building	Disseminate SOP and specific guidelines for entomological surveillance with mandatory and desired parameters.	NCVBDC/WHO support	Mid-term (6-12 months)
	Entomological surveillance	Routine monitoring of vector's bionomics with priority to the areas of case investigation/foci investigation	State/Zones/ Districts/Corporations/ICMR/ NCDC/ROHFWs	Mid-term (6-12 months) to Long- term (1 year)
	Entomological surveillance	Focused monitoring on Insecticide Resistance (adults and larval) with priority to the areas with no information.	State/Zones/ Districts/Corporations/ICMR/ NCDC/ROHFWs	Mid-term (6-12 months)
	Entomological surveillance	IRM should include both the techniques of WHO tube tests and intensity bioassay for which state and regional labs need to be strengthened in addition to research institutes.	Tools and Training by NCVBDC/ WHO Implementation by States	Long-term (12 months and above)
	Vector Control Implementation and Publicity	IVM implementation in totality to be implemented and should be widely advocated. Professionals (public or private) should be adequately sensitized.	• Implementation by State/Districts • Monitoring by ROHFW • Advisory by NCVBDC	Long-term (12 months and above-up to 2 years)

	VCNA	• The recommendations of the VCNA done by WHO should be disseminated in all states, districts and even across urban local bodies. • VCNA should be done in all the states/districts.	NCVBDC/State Zones and Districts guidance by WHO/NCVBDC	Mid-term (6-12 months)
	Operational research	Research should be undertaken to assess if there are added benefits from sites where IRS has been rolled out or where LLINs are being used. The outcome of operational research needs to be considered and absorbed into the Programme depending on its feasibility.	NCVBDC/ICMR/ NCDC	Mid-term (6-12 months)

3.6 Thematic Area 6: Advocacy, partnership, multisectoral collaboration and cross-border collaboration

3.6.1 Overview

India, in its pathway to malaria elimination, has been fostering and continues to foster efforts for advocacy and multi-sectoral partnerships. The prime objectives are to strengthen political and donor commitments, enable the environment, and garner sufficient and sustained resources besides seeking complementary support for implementation, as relevant and needed, amongst others. Technical and resource support by various international and national partners and donors, as well as partnerships with some non-government organizations for the development of strategy, policy, implementation of interventions and research, have been ongoing.

3.6.2 Observations

Advocacy, partnership, and multisectoral collaboration

Advocacy is an important tool for accelerating the transition to malaria elimination and sustaining gains made so far. Advocacy activities and campaigns also aim at political and stakeholder ownership of malaria elimination and position this agenda as part of the SDGs. Malaria elimination requires continued advocacy and partnership from the highest level to the most peripheral or community level, and it is of utmost importance that the entire country is sensitized towards the goals and targets of malaria elimination. Malaria is widespread across the country in varied ecotypes, active participation of the community is critical, and they are key players in malaria elimination.

At the national level, a Mission Steering Group (MSG) of NHM, under the chairpersonship of the Union Health Minister, Government of India, whilst at subnational levels, various multi-stakeholder bodies are leveraged for advocacy activities. At the subnational level, such bodies include the State Health Mission (SHM) under the chairpersonship of the State Health Minister at the state level, district health mission (DHM) under the chairpersonship of Zila

Parishad exist for multi-stakeholder involvement in disease programmes including malaria elimination Programme. At the sub-district level, there is Rogi Kalyan Samitis (RKS) at the block level under the chairpersonship of Block Pramukh and Village Health Sanitation and Nutrition Committee (VHSNC)/Gramin Kalyan Samiti (GKS) at village level chaired by village Pradhan.

In addition to the above-mentioned multi-stakeholder bodies, the NCVBDC has constituted a National Malaria Elimination Task Force (NMETF) under the chairpersonship of the Union Secretary of Health & Family Welfare to strengthen the enabling environment and garner and consolidate support for malaria elimination.

Technical support by WHO has played and continues to play a vital role in the development of policy, National Strategic Plan and guidelines, as well as quality assurance, TES and drug resistance, capacity building, reviews, assessments, and research. Development and launch of the NFME 2016-2030, Operational Guidelines for Malaria Elimination, and National Strategic Plan 2017-2022 have been carried out with WHO support. A malaria information system, viz., IHIP malaria modules to enable near real-time reporting and monitoring of data to guide better programme implementation, has been developed by WHO, India and piloted in Odisha and Himachal Pradesh. WHO provides support in quality assurance of malaria microscopy by arranging and funding the facilitators for the External Competency Assessment of Malaria Microscopists (ECAMM), arrangement of slide panels from the Philippines and providing e-learning courses for Lab technicians for the programme for validation. WHO support is also provided for the development of guidelines for validation of zero cases collaboratively with Programme; ToT on subnational malaria elimination for Programme officers of low endemic states; and strengthening of drug resistance and insecticide resistance monitoring; virtual training/webinars on malaria elimination and VBDs for staff at different levels; besides provisioning consultant support as well as convening international and national experts.

The webinar on “Integrated Vector Control Management” was organized in sync with Global Vector Control Response. World Malaria Day is also jointly organized with NCVBDC on 25 April every year, followed by a technical session for advocacy and sensitizing stakeholders about malaria elimination. In 2022, a high-level advocacy meeting was organized with a keynote address by the Hon’ble Union Minister and Hon’ble Minister of State, Health & Family Welfare, Government of India, with participation by the National Programme, stakeholders and partner agencies. A vector control needs assessment (VCNA) was carried out in the country, and the technical document was released in 2022. WHO has also provided technical support for the launch of a High Burden High Impact (HBHI) strategy starting with situation analysis in identified high burden states of Jharkhand, Chhattisgarh, Madhya Pradesh, Odisha and West Bengal including the development of district operational plans. Technical support was provided for the development of and implementation of a micro-strategic plan and capacity building for district and sub-district personnel on malaria elimination in Punjab.

The external resource support by the Global Fund (GF) from 2005 has also been crucial in accelerating malaria control/malaria elimination. Besides the domestic investments, the financial assistance from the GF focuses on the implementation of key interventions, strengthening Programme capacities, health and community systems strengthening, and M&E, amongst others. The investments have immensely contributed to the remarkable progress in the reduction of malaria morbidity and mortality in the 7 North Eastern States. The GF has

also supported and continues to support dual-track financing for providing complementary support by civil society/non-government in accelerating Programme implementation, capacity building, and M&E. Currently, under the Intensified Malaria Elimination Project (IMEP), few NGOs are providing implementation support as SRs in selected high endemic areas of Meghalaya and Mizoram besides Chhattisgarh.

Besides WHO and the GF, cooperation and collaboration are being progressively strengthened with various other agencies, viz. RBM Partnership to End Malaria, APLMA-APMEN, South-East Asia Regional Coordination Mechanism Forum (SRCMF), international NGOs/Foundations like CHAI, TCIS, etc.

Collaboration with ICMR institutions (NIMR, VCRC, RMRC, NIRTH, and others) is continuing for operational research. The National Centre for Disease Control (NCDC) and NCVBDC also have years of collaborative work for building/strengthening capacities. In addition, the IDSP includes malaria modules for weekly reports that provide information on early signs/warning for potential outbreaks.
Furthermore, there is a number of organizations/institutions/medical colleges that collaborate with the NCVBDC. These include ICMR headquarters and its allied institutions like the NIMR, VCRC, NIRTH and RMRCs located in various states. Their contribution to research to address Programme needs related to malaria elimination, are vital, and RMRCs are located in various states. A Malaria Elimination Research Alliance (MERA) has been constituted by ICMR to identify, articulate, prioritize and respond to the research activities of institutes under ICMR in a coordinated and combinatorial way. Likewise, collaboration with National Centre for Disease Control (NCDC) for specialized training on epidemiology, entomology, surveillance and M&E is also imperative.

NGO and Public Private Partnership (PPP) is also strong at the National and State level. The India Health Fund (IHF), which is an initiative of the Tata Trusts, has assisted NCVBDC in creating an electronic repository. The MEDP, which is a public-private-partnership (PPP) between the ICMR, the Government of Madhya Pradesh and the Foundation for Disease Elimination and Control of India (FDEC-India), has been established by Sun Pharmaceutical Industries Ltd. as a not-for-profit entity. This project aimed to demonstrate the elimination of malaria in the Mandla district of Madhya Pradesh. The Elimination of Vector Borne Endemic Diseases (EMBED) project, supported by the Godrej Consumer Products Limited under their Corporate Social Responsibility (CSR) in partnership with select states and other partners Malaria No More (MNM), is partnering with Odisha State for malaria elimination in identified districts.

Furthermore, a major advocacy event in commemoration of World Malaria Day (WMD) on 25th April every year with a specific theme with support by WHO and involving various stakeholders. On this day, messages from the political leadership at the central level reinforce the commitment to malaria elimination and extols the states to continue/accelerate efforts in that direction. Technical symposiums, seminars, community a civil society meetings, and engagement of political leaders, PRI, private sector partners, and various other stakeholders are carried out across the country. At the sub-national level, the day is observed from the village to block, to district and state levels for mobilizing masses and civil society in addition to sensitizing the political and administrative leadership and various partners, including the corporate sector.

Anti-malaria month is observed in the month of June every year. Month-long campaigns are organized for stakeholder advocacy and participation, including the community, through locally relevant SBCC activities, including IPC, to sensitize the community and other stakeholders towards ownership of the malaria elimination agenda. Guidelines and SOPs for carrying out AMM are circulated to all states. Orientation of field-level workers is carried out to enhance knowledge about malaria and dos and don'ts, so that correct and clear messages are spread at the grassroots. Strengthening of health systems and ASHAs, as well as community systems, are focus areas in such processes.

From the MPR field assessments, it was noted that planned advocacy directed towards various stakeholder groups (international donor agencies, corporate sector, media, elected representatives at all levels, youth groups and key influencers at the community level) are either missing in many states or are limited to episodic campaigns. Advocacy efforts with certain stakeholder groups have been reported by states such as Karnataka and Gujarat. Chhattisgarh saw a high level of political commitment in the implementation of Malaria Mukt Bastar/Chhattisgarh Abhiyan, resulting in advocacy with various stakeholder groups. Whilst Gujarat and Karnataka have progressed in multi-sector collaboration; many other states need to strengthen multi-sectoral collaboration and partnerships planned, regular and active involvement of different non-health government departments such as Women and Child Development, Education, Panchayati Raj, Rural Development, Urban Development, Agriculture, Tribal Affairs and other bodies such as Municipal Corporation was not found in most of the states. Gujarat seems to have a good inter-sectoral mechanism in place. Specific partnership efforts with the Indian Medical Association (IMA), Indian Academy of Pediatricians and other such bodies and the corporate sector have not been reported by many of the states.

Cross-border collaboration

It is well-recognized that continued malaria transmission in border areas needs to be tackled urgently since few neighbouring countries are aiming to interrupt local transmission soon, and imported cases are posing a challenge. The same is true for some inter-state and inter-district border settings, too (often an area in the elimination phase bordering with a high burden area in the control phase).

India has been participating in consultations (organized mostly by WHO) for initiating cross-border collaboration has been continually expressed. In 2017, India signed Ministerial Declaration on Accelerating and Sustaining Malaria Elimination in South-East Asia, thereby committing to cross-border-border related strategic areas (amongst others): universal access to quality-assured prompt diagnosis and treatment, effective prevention to all vulnerable and at-risk populations (including the disadvantaged communities, communities in border and conflict areas, and refugees and undocumented migrants); provision of adequate quality-assured supplies for malaria diagnosis, treatment (and vector control) through effective procurement and supply management; and criticality of effective cross-border collaboration and complementary responses.

The Programme envisages initiating and strengthening cross-border collaboration to prevent and/or reduce transmission and disease burden, with special emphasis on minimizing the risk of importation of malaria cases; prevent, and/or rapidly responding to and controlling malaria upsurges, and preventing the re-introduction of indigenous malaria transmission in malaria-free areas, and prevent antimalarial resistance. Consultations within the country and

sub-regional/regional stakeholders and mechanisms have already started, viz., with technical support from WHO and facilitation by the APLMA-APMEN, SRCMF, and relevant others. Bilateral and multi-country meetings on initiating/strengthening cross-border collaboration have been ongoing. In 2019, a roadmap for cross-border collaboration between India and Bhutan in districts having international borders was discussed. In recent years, cross-border meetings with Bangladesh, Nepal and Bhutan were coordinated and facilitated by the SRCMF to discuss strengthening collaboration across borders.

An indicative list of stakeholders and partners for advocacy and multi-sector partnership and collaboration.

For advocacy

1. International donors, corporate sector and other national level partners for resource support for the development of strategy, policy, implementation of interventions and research

2. National level, from the Prime Minister's Office, Ministry of Health and Family Welfare, and National Health Mission – for adequate resource allocation, monitoring, accountability, and keeping malaria elimination high on the national health agenda as part of the Sustainable Development Goals (SDGs)

3. State level: state leadership, both political and administrative, state Health and Family Welfare, State Institute of Health and Family Welfare

4. People's representatives: parliamentarians, legislators, corporators, ward members, Panchayati Raj Institute members
5. Media: electronic, print and social media

6. Youth groups: such as Nehru Yuva Kendra Sanghatan (NYKS), National Social Services, National Cadet Corps and Bharat Scouts and Guides

7. Community groups and panchayat committees: Self Help Groups, Village Health Sanitation and Nutrition Committee (VHSNC), active Community-Based Organizations

8. Key influencers at the community level – tribal leaders, religious leaders, village elders, including PRI members

For partnership

(Non-government partners)

1. Technical support agencies
2. Donor agencies
3. International/national non-government organizations
4. Corporate Sector Research foundations
5. Civil society organizations and community based organizations
6. IMA, Indian Academy of Pediatrics, Indian Public Health Association, and other professional bodies

For multi-sector collaboration

(Government ministries and departments)

1. Women and Child Development
2. Panchayati Raj and Rural Development
3. Education
4. Agriculture
5. Tribal Affairs
6. Information and Public Relations
7. Water Resources
8. Urban Development
9. Defence (border security force, Indo-Tibetan border police, central reserve police force, etc.)

For collaboration within the health sector

1. Medical Colleges
2. Integrated Disease Surveillance Program
3. Indian Council of Medical Research

Cross-border collaboration

1. Develop a roadmap for border malaria with roles and responsibilities in line with WHO technical guidance subsequent to comprehensive situation analysis.

2. Roll out the implementation of activities along international border areas drawing on the roadmap especially prioritizing actions, coordination and collaboration at subnational and local levels for sharing of malaria information and joint responses (as per consensus).

3. Harmonized actions by partner organizations for cross-border collaboration across countries should be deliberated.

4. Revive inter-state and inter-district border meetings within the country for sharing malaria information and appropriate responses.

3.6.3 Strengths

1. High-level commitment to malaria elimination.

2. NMETF is constituted with multi-sector representation.

3. Some states have initiated partnerships and collaborations.

4. Cross-border deliberations, especially with the involvement of subnational/local levels, revived with facilitation by WHO and others.

5. HBHI approach has already been initiated in four high-burden states, including Chhattisgarh (and West Bengal and Jharkhand, and Madhya Pradesh) in coordination with WHO, wherein a coordinated malaria response is emphasized.

3.6.4 Challenges and gaps

1. High-level committees/task forces at the state and district levels are yet to be either constituted or are not fully functional.

2. Partnerships and collaborations (with the health/non-health sector, private/corporate sector) have been initiated in a few areas, but such efforts are mostly episodic.

3.6.5 Recommendations

Advocacy, partnership, and multisectoral collaboration

1. An action plan for regular advocacy activities for engaging various stakeholder groups/ partners needs to be developed, implemented and monitored at state, district and block levels.

2. Reporting on Advocacy, Partnership, Multisectoral Collaboration, and Cross-border Collaboration must be made a standard agenda item in the monthly meetings of state, district and block-level task forces.

3. Strengthen and sustain community actions in urban areas in coordination with urban bodies with special emphasis on EDCT and prevention of breeding in containers and around households. In addition, the urban byelaws should be widely communicated to communities, contractors, and other stakeholders.

    - A committee needs to be formed where not done yet (for example, under the aegis of MCGM) to drive action to expedite decisions related to dilapidated structures, and immediate legal support should be sought to initiate antilarval measures in inaccessible structures.

Cross-border collaboration

1. Situation analysis for border malaria and assessment of partner landscape to be carried out.

2. Roadmap for addressing border malaria with timelines to be developed in line with WHO technical guidance and with emphasis on the following:

    - prevention and/or reduction of transmission and disease burden and minimizing the risk of importation of malaria cases,
    - prevention, and/or rapidly responding to and controlling malaria epidemics; and
    - prevent the re-establishment of transmission in malaria-free areas.

3. Roadmap to prioritize and articulate equitable access to interventions and strengthened surveillance and M&E within national boundaries, cross-border collaboration, roles and responsibilities, M&E indicators, and resource needs.

4. Inter-state and inter-district meetings within the country are to be taken up regularly for sharing of malaria information and harmonization/synchronization of responses.

5. Bilateral meetings/multi-country meetings with facilitation by WHO and others, especially with participation by local levels, to be continued for:

    - Micro-plan for harmonization/synchronization of interventions tailored to context.

    - Sharing appropriate malaria information [viz. Fever cases tested, malaria cases diagnosed and treated, deaths, any local upsurges, LLINs distributed, the population covered by IRS in targeted areas, and in elimination settings, cases and foci fully investigated and classified and responses applied].

3.6.6 Key action points

Advocacy, partnership, and multisectoral collaboration

1. Develop an action plan with clear roles and responsibilities of every concerned department stated, and ownership and implementation of the plan by each department guided by the highest administrative leadership at the state level.

2. Leveraging the platform of NTFME, take concrete steps to identify roles and responsibilities of different departments in control of malaria vectors as well as the implementation of other malaria elimination strategies in specific situations like urban settings, remote areas, tribal areas, forests and forest fringes.

3. Ensure advocacy at the highest for harnessing timely support and participation of all relevant departments.

Table 9 : Guidance on key action points with timelines

S. No.	Issue	Recommendation	Responsibility	Timeline
1.	Advocacy, partnership, multisectoral collaboration	Develop an action plan with clear roles and responsibilities of every concerned department stated, Ownership and implementation of the plan by each department guided by the highest administrative leadership at the state level (as per the indicative list of stakeholders).	NCVBDC, in collaboration with responsible agencies/departments	Mid-term (6-12 months)
2.	Cross-border collaboration	Roadmap for addressing border malaria with timelines to be developed in line with technical guidance	NCVBDC, WHO, States/districts and countries	Mid-term (6-12 months)

3.7 Thematic Area 7: Community engagement and social behavior change communication

3.7.1 Overview

Community engagement and mobilization are vital elements for acceptance of services provided by public health programmes, and this holds true in the malaria elimination Programme. Inter-personal communication (IPC) and community meetings with the involvement of local grass root workers like ASHAs are built components of the Programme for improving community engagement; Resource materials are also distributed in local languages/dialects. The awareness generation has changed the perception in the community, and therefore, all activities of awareness generation are targeted at social behaviour change communication (SBCC) to achieve malaria elimination and sustain the gains.

3.7.2 Observations

The NCVBDC has been carrying out IEC/BCC activities/campaigns through the development of IEC/BCC annual plans that are part of the Programme Implementation Plans (PIPs) for the States. The activities of different types and intensities are reported from all the states. Channel-mix is used, viz., mass media like TV, Radio and print, while the states have been focusing more on message dissemination using mid-media, outdoor publicity like traditional/folk media (drama/song/skits, puppetry etc.), wall paintings, billboards/hoardings, stickers, leaflets, posters, etc. as well as interpersonal communication (IPC), especially at the grassroots. Such channels have been effective and often are supported by miking (public announcements). School-based initiatives are critical in creating change agents in short- to long term; various programmes are initiated particularly to foster knowledge and awareness, and responsive behaviour among peer groups and families. Such activities are emphasized before transmission season, especially during 'anti-malaria month' in June every year and 'World Malaria Day on 25 April. The interactive/participatory activities include but are not

limited to competitions, debates, presentations, classroom sessions, games, quizzes, rallies, etc., devised in consultation with school principals/teachers.

As part of NHM and Universal Health Coverage, the integration of malaria messaging has also been taken up. A few partners/stakeholders (NGOs, CBOs, corporate sector, and Municipal Corporations) are also supporting community engagement and IEC/SBCC activities.

Progressively, the focus will need to be directed towards SBCC rather than only improving dissemination as well as access to information. National and state-specific Social and Behavior Change SBCC strategies, customized SBCC materials and implementation plans are not available in most states. An example of an SBCC package was noted in Chhattisgarh and developed as part of the Malaria Mukt Bastar Abhiyan with messages in Hindi, Gondi and Halbi (local dialects). However, its continued implementation and M&E for any course correction were not evidenced. There is a lack of dedicated and well-trained human resources at the state, district, block and village levels for conducting SBCC activities. Capacity building for SBCC, especially for local and frontline health functionaries, is also required to be conducted regularly.

3.7.3 Strengths

1. Community engagement and behaviour change communication are incorporated into the national, state, and district plans.

2. Emphasis is given during specific events like World Malaria Day and Anti Malaria Month with the involvement of political leadership, various partners and stakeholders.

3.7.4 Challenges and gaps

1. Evidence-based community engagement and BCC remain highly variable and not always tailored to the local context as well as to the key and vulnerable populations, which is diverse.

2. Malaria messaging is focused more on routine activities, but the benefits of malaria elimination and ownership are yet to be aggressively promoted besides the appropriate uptake of interventions.

3. SBCC is not seen as an important Programme component.

4. Insufficient fund allocation for the SBCC component.

5. Lack of dedicated staff at state and block levels for regular planning, implementation, handholding and reporting of SBCC activities.

6. Specific capacity building for SBCC for malaria elimination is missing at almost all levels.

7. M&E of BCC almost always focused on process and outputs rather than outcomes.

3.7.5 Recommendations

1. The programme should move from IEC and BCC to SBCC to ensure effective community engagement and behaviour change outcomes.

2. The programme should develop a 'National SBCC strategy' followed by state-specific strategies and detailed implementation plans.

3. Adequate resources need to be ensured for dedicated HR and SBCC capacity building for the effective implementation of SBCC activities. IPC and group communication activities supported by mid-media, mass-media and social media efforts may be emphasized to build an enabling environment for SBCC.

4. Local key influencers at the community level, such as tribal leaders, active PRI members and teachers, and faith/traditional healers, should be involved.

5. Use of all available community-level platforms, and influencers for enhancing community engagement towards empowerment, responsive behaviour and ownership may be promoted.

6. Strengthening capacities for optimized SBCC efforts need to be undertaken on a regular basis.

7. Regular monitoring and handholding of frontline functionaries will have to be emphasized to ensure quality SBCC activities.

3.7.6 Key action points

1. Conduct communication needs assessment for malaria elimination.

2. Develop national SBCC strategy with implementation and M&E plan followed by state-specific strategies and detailed implementation plans

3. Develop SBCC packages customized to audience profile – pictorial and audio-visual tools with simple messages and calls to action

4. Development of SBCC capacities at all levels across key stakeholders.

5. Ensure use of all available community platforms PRI members (VHSNC), active SHGs, CBOs, community leaders, faith-based groups and leaders, and other key influencers such as village elders, teachers (through VHSND, Gram Sabha, other group meetings in community areas/haat-bazaars with high footfall, amongst such others). In addition, women's groups, adolescent girls' groups and mother's groups for ensuring the active participation of women and girls should be considered.

Table 10: Guidance on key action points with timelines

S. No.	Issue	Action points	Timeline
1.	Effective community participation	Conduct communication needs assessment for malaria elimination	Mid-term (6-12 months)
2.	Shift from IEC to SBCC	Develop national SBCC strategy with implementation and M&E plan followed by state-specific strategies and detailed implementation plans HR and SBCC capacity building	Mid-term (6-12 months)
3.	Customized SBCC packages	Develop SBCC packages customized to audience profile	Mid-term (6-12 months)
4.	Ensure the use of all available community platforms	Involve PRI members (VHSNC), active SHGs, CBOs, community leaders, faith-based groups and leaders, and key influencers like village elders and teachers. Involve women's groups, adolescent girls' groups and mother's groups to ensure the active participation of women and girls	Mid-term (6-12 months)

3.8 Thematic area 8: Research and development

3.8.1 Overview

Research and development play a pivotal role in achieving the desired goal of the concept, which is true in achieving control or elimination of malaria and other vector-borne diseases through prioritized operational and implementation research. Basic and applied research aims toward providing new tools which can be tested in limited settings before deployment. Research also helps in keeping track of programme goals, monitoring the progress and recommending course correction, if needed. The epidemiology of malaria is complex in India due to the multiplicity of vectors, parasites, conducive environmental conditions, divergent socio-economic conditions, ethnocultural practices, and population mobility. Insecticide and drug resistance also pose significant challenges. Malaria elimination is a time-bound and targeted approach; concurrent adoption of the enabling strategies will help meet the set milestones and targets.

3.8.2 Observations

The NCVBDC takes cognizance of research support primarily directed at developing tools, strategies and interventions for malaria control and malaria elimination. Three categories of research are needed for effective malaria elimination:

1. Research for new anti-malaria interventions, including drugs, diagnostics, vaccines and vector control tools which facilitate interruption of transmission and those which address asymptomatic infections;

2. Research to facilitate policy decisions on interventions best suited for elimination;

3. Operational and implementation research to understand the use and effectiveness of interventions in the field and improve the delivery, quality, equity and effectiveness of malaria prevention and treatment.

The NCDC, with its branches in different states and ICMR, with its institutions, especially NIMR, VCRC, NIRTH, RMRCs support the Programme for operational research. These institutions also undertake studies on vector bionomics and insecticide resistance monitoring.

3.8.3 Strengths

1. Basic and Operational Research is carried out regularly as an in-built mandate of ICMR and NCDC institutions. The need-based support to the programme is offered either within their resources or as a sponsored research project.

2. ICMR and NCDC are part and parcel of the evaluation of any new public health product for inclusion under the Programme.

3. The routine data generated by NCDC or ICMR on entomological studies are also utilized by the Programme once it is shared.

3.8.4 Challenges and gaps

1. Lack of research regarding the development of new diagnostic tools.

2. Lack of research related to basic entomological parameters in different eco-epidemiological situations.

3. Inadequate research and evidence generation regarding the following topics:
   a) Drug resistance
   b) Newer drug combination trial
   c) Vector behaviour and changes due to climate change
   d) Insecticide resistance monitoring
   e) Outdoor transmission control measures and its feasibility studies
   f) Usage, durability and bio-efficacy of LLINs and innovative tools
   g) Effective coordination within the health sector and between health and non-health sectors, various local governance bodies
   h) Collaboration between Programme and other Institutions like DBT, IITs, and Engineering colleges due to differences in priorities

4. ICMR institutions carry out research in the form of long-term research projects, and the outcome is known either after its publications or its clearance for sharing under their own institutional mechanism. Delay in sharing the results or evidence loses its significance for the Programme many times as actions required by Programme are no longer relevant.

5. Although there is the involvement of the Programme in the Scientific Advisory Committee (SAC) and Research Advisory Committee (RAC) of ICMR, significant contributions to Programme related operational research is yet to be optimal.

3.8.5 Recommendations

1. Consider research needs related to different aspects of malaria and Programme implementation. A list of research needs related to various thematic areas is listed in the following table. The research may be relevant to other states and even to the whole of India.

Table 11: Research and development needs

States	Surveillance	Drug / resistance/ compliance/ G6PD	Diagnosis/ treatment	Vector biology/ control	Community engagement
Haryana	The burden of *P. vivax* cases and relapses	Drug/ insecticide resistance monitoring G6PD studies PQ compliance studies	Feasibility of using single-dose radical cure (Tafenoquine) Feasibility of using point-of-care molecular diagnostic tests Pharmaco-vigilance of 14-day primaquine Efficacy study of shortening of PQ regime to 7 days (0.5mg/kg/day)	Vector bionomics studies Update of VC tools	Effective strategies for most optimum community involvement
Maharashtra	modalities of inclusion of the private sector in reporting Early warning system	Therapeutic Efficacy Studies (TES) to monitor drug resistance		Monitoring vector resistance, especially to larvicides	Health-seeking behaviour of the community New tools for public sensitization

Gujarat	The burden of low-density infections	TES Drug resistance studies Drug compliance	Use of molecular tools for detection of low parasitemia	Bionomics Climate change Insecticide resistance LLIN usage	NIL
Chhattis-garh	The burden of symptomatic and asymptomatic cases	-		Bionomics Insecticide resistance LLIN usage IRS coverage studies	Inter-state/ district border population movement studies
Tripura	High burden areas assessment New surveillance strategies at border areas	TES Antimalarial drug resistance markers	Quality microscopy and tools to improve microscopy (AI-based, smart digital tools)	Bionomics Insecticide resistance LLIN usage	Mitigation strategies of cross-border malaria at the community level
Karnataka	Modalities of inclusion of the private sector in reporting Studies on relapses burden Near real-time reporting and monitoring systems Migrant malaria surveillance	Efficacy studies of shortening of PQ regime to 7 days @ 0.5mg/kg/day	Diagnostic tools for all five parasite species Single-dose anti-relapse treatment for *P. vivax*	Bionomics Insecticide resistance LLIN usage IRS coverage studies	Modalities to track migrants and malaria mitigation strategies

In addition to the state-wise priorities flagged by the teams, other research needs for malaria elimination include the following agenda:

Surveillance

As the elimination goal is zero indigenous malaria cases, it is imperative that the malaria case number be captured very well through a robust surveillance system. Not only do the overt malaria cases need to be identified in a timely manner and treated, but the submerged covert cases (Pv malaria, non-Pf/Pv species, and low-density infections) also need to be diagnosed and treated. Some of the aspects of surveillance can be strengthened with the following tools, which may require development, validation, and field testing for deployment.

i) Digital tools for near real-time surveillance

ii) GIS-based dashboard for data visualization and analysis

iii) Tools/ mechanisms for tracking of mobile populations/migrants/labor

iv) Tracking cross-border malaria (humans and vectors) at national and international

borders

v) Monitoring of HRP 2/3 deletions in the parasites.

vi) Role of non-Pf/Pv parasites in overall burden and continued transmission.

vii) Role of low-density parasitemia, sub-microscopic infections and asymptomatic carriers in low and high malaria endemic areas.

viii) Role of MSAT in clearing sub-microscopic and asymptomatic vivax infections.

ix) Drug resistance studies in high-burden areas/persistent malaria
x) Insecticide resistance (IR) studies across the country suggest management of IR

xi) Vector prevalence and vector behaviour after universal coverage of LLINs and in areas covered with IRS

xii) Feasibility of Drones for delivery of drugs, vector control products in inaccessible areas and its evaluation to ensure proper dose at the end point.

Research needs for diagnosis and treatment, vector biology and control, as well as other relevant elimination topics, are mentioned below.

Diagnosis
Sensitive diagnostic tools are the mainstay of surveillance and form the basis of mitigation of malaria cases. The challenge will increase as we progress towards malaria elimination and there is a reduction in the malaria burden (in terms of absolute numbers and load of parasitemia). The following needs were identified in this domain:

a) Diagnostic markers to identify relapse cases/hypnozoites/disease severity and drug compliance.

b) Next-generation RDTs can detect all five plasmodium parasites.

c) A rapid diagnostic test is non-HRP2 dependent.

d) Digital tools for microscopy (AI + Machine learning).

e) Sensitive, field-friendly, economic diagnostic tools for detecting asymptomatic/low-density infections.

Treatment
Although effective drugs are available for malaria compliance, especially for a 14-day drug regime of primaquine is a significant concern leading to the risk of relapses (which has not been quantified systematically). The following areas of research would strengthen the treatment arm of the national Programme:

a) Safety and efficacy studies to shorten the regimen of primaquine from 14 days (PQ dose - 0.25

mg/kg/day) to 7-day regimen (PQ dose - 0.5 mg/kg/day) against relapses of P vivax malaria.

b) Understanding the compliance levels in real-life settings.

c) Strategies to improve compliance with treatment (PQ) in different settings.

d) Studies (Phase III/feasibility studies) to assist the rollout of new and effective drugs like Tafenoquine, which offers single-day radical treatment of *P. vivax* malaria.

e) Effective vaccines like RTS, and S in high and moderate transmission settings can be piloted in appropriate areas.

f) Preparedness for trials of the newer R21 vaccine can be explored.

g) Once known, the G6PD status information should be available to the communities, and this can be easily done by tagging the status on ID cards like the Aadhar card for easy record keeping and future use. Other modalities can be explored for this too.

h) Regular and periodic therapeutic efficacy studies are needed to monitor the efficacy of ACT-AS+SP and AL. In case of indications of AS-SP treatment failures, switch over to AL to be considered by the national Programme.

Vector biology and control

a) Quantification of the actual contribution of outdoor transmission to the overall malaria burden needs to be carried out systematically

b) Insecticide resistance profiling and management (including larvicides)

c) LLINs usage profiles, safe disposal and replenishment guidelines

d) Next-generation LLINs (SP+ newly approved classes) e.g., SP+ PBO, SP+ Pyriproxyfen etc.

e) Tools for mobile populations: effective personal protective measures, attractive toxic sugar baits, and spatial repellents (volatile pyrethroids, terpenoids)

f) Endectocides like ivermectin can be pilot tested in cattle first. The target of the approach is for the drug to kill mosquitoes that feed on ivermectin-treated livestock (cattle and pigs), thereby limiting the transmission of malaria

g) Insecticide paints are one of the options which have a long-term residual activity and could be used in urban and rural areas as compared to IRS. These can be explored after due regulatory considerations.

Others

1. Different elimination models for islands, isolated tribal areas and other regions

2. Costing studies that address the economic aspects of malaria elimination

3. Social benefits/impact of malaria elimination

4. Climate change studies to understand the emergence of new foci and/or the resurgence of malaria in a well-controlled/elimination-achieved area (studies undertaken in India on the impact of climate change on malaria have revealed that new foci of malaria transmission are emerging/likely to emerge in the Himalayan region of India by 2030s and in existing foci, the windows of transmission are set to extend. Therefore, periodic surveillance in fringe areas of transmission in Himalayan states and health education about preventive measures for malaria should be undertaken before the problem emerges)

5. Public-private partnership models for malaria control (building on MEDP/DAMaN)

6. Prioritizing private sector participation in all facets of malaria elimination

7. Coordinate and collaborate with MERA-India, which has been launched to address the research needs of the malaria elimination program in India in order to streamline the activities of ICMR and ensure meaningful research outcomes.

3.8.6 Key action points

1. Set research agenda for short-, medium- and long-term drawing on MPR recommendations; the country needs following technical consultation involving expert malariologists/entomologists and epidemiologists/public health specialists and partners and stakeholders.

2. Ensure timely sharing of research findings and emphasize evidence-based policy/ strategy.

3. Identify partners and stakeholders for collaborative research and ensure that research topics are distributed between these partners as relevant. Involve other Institutions in addition to ICMR in operational research.

4. Harmonize research to address Programme needs across relevant research and academic institutions, and partner agencies, with facilitation by Programme in collaboration with ICMR/MERA India and or other agencies, as appropriate, and draw on technical guidance from WHO.

5. Mobilize funding for research in coordination with Programme Offices of the NCVBDC, involving States and medical colleges, universities, NGOs, etc.

Table 12: Guidance on key action points with timelines

S. No	Issue	Action points	Responsibility	Timeline
1	Set research priorities for the programme	Technical consultation with subject experts, scientists, partners and stakeholders.	NCVBDC, ICMR and NCDC	Short-term (3-6 months)
2	Surveillance	Conceptualization, protocol submission and execution	ICMR	Long-term
3	New diagnostics	Seeking Partner's support	ICMR	(12 months and above)
4	Newer treatment	Evidence generation	ICMR/NCVBDC	Long-term (12 months and above)
5	Drug resistance	Capacity building of multiple partners like ROFWs, NCDC, States, and Medical Colleges and mapping of drug resistance	ICMR/NCVBDC	Long-term (12 months and above)
6	Vector surveillance	Planning to cover the entire country and update the information	ICMR, NCDC, NCVBDC and States	Long-term (12 months and above)
7	Insecticide resistance	Mapping of all the states	NCVBDC, ICMR, NCDC, and States	Long-term (12 months and above)
8	Vector bionomics	Planning area allocation mobilization of resources	ICMR NCVBDC NCVBDC/WHO	Long-term (12 months and above)

Annexures

Annexure-1: MPR core group

- Dr Tanu Jain, Director,NCVBDC
- Dr Subhash Salunke, Chairperson,MPR
- Dr Roop Kumari, NPO, Malaria & VBDs, WHO Country Office,India
- Dr Shampa Nag, Independent Expert, MPR
- Dr Suman Wattal, Independent Expert, MPR
- Dr K Ravi Kumar, Independent Expert, MPR
- Dr PK Srivastava, Independent Expert, MPR
- Dr Rinku Sharma, Joint Director & Head of Malaria Division, NCVBDC

Annexure 2: Contributors for preparation of background paper and interview guide

- Dr Neeraj Dhingra, Ex–Director, NCVBDC
- Dr Tanu Jain, Director, NCVBDC
- Dr Roop Kumari, NPO, Malaria & VBDs, WHO
- Dr Naresh Gill, Deputy Director, NCVBDC
- Dr Rinku Sharma, Joint Director & Head of Malaria Division, NCVBDC
- Dr Vinod Choudhary, Malaria Officer, NCVBDC
- Dr Jyoti Nagarkoti, Assistant Director, NCVBDC
- Dr Jayanti, Independent Expert
- Dr PK Srivastava, Ex-Joint Director, NCVBDC
- Mr Pritam Dutta, Finance Consultant

Annexure-3: State-wise MPR field visit teams
Chairperson, MPR-Dr Subhash Salunke
Nodal officer WHO to conduct MPR-Dr Roop Kumari

State	District	MPR field visit teams		Facilitators		
-	-	Independent experts	WHO country office, SEARO, HQ	NCVBDC	Sr.R.D/ R.D	State programme officers
Chhattisgarh	Kanker	Dr Neeraj Dhingra (TL)	Dr Sarosh Jamil	Dr Tarique Aziz	Dr Chaitanya Nigam	Dr Jitendra Kumar
		Dr S N Sharma				
	Bastar	Dr S V Gitte	Dr Anju Viswan K			
		Dr Nilam Somalkar				
		Dr Nirmal Verma				
		Ms Vidhya Raghavan				
		Ms Vartika Singhal				
Gujarat	Surat	Dr P P Doke (TL)			Dr Amol Patil	Dr Piyush Patel
		Dr Himmat Singh	Dr Risintha Premaratne			
	Panchmahal	Dr Shampa Nag				
		Dr Amol Patil (BMGF)				
Tripura	Dhalai	Dr P. K. Sen (TL)	Dr Pritam Roy	Dr Kalpana Baruah	Dr TK Bhattacharya	Dr Abhijeet
		Dr M M Pradhan				
	South Tripura	Dr Neelima Mishra		Dr Sweta Bhan		
		Dr Raghavan Gopakumar (MNM)				

Karnataka	Uttar Dakshina	Dr Ashwani Kumar (TL)		Ms Jyoti Nagarkotti		Dr Ramesh Kaulgud
		Dr K Ravikumar				
	Bangalore Urban	Dr Sachin Jagtap				
		Dr Harsh Rajvanshi (APLMA)				
Maharastra	Mumbai	Dr Subhash Salunke (Chairperson and TL)	Dr Roop Kumari	Dr Vinod Choudhary	Dr Gokak	Dr Swapnil Lale
		Dr R S Sharma		Dr Paulamee Kashyap		
			Dr Rajendra Kumar Singh			
		Dr Ashok Rawat				
		Dr Meghna Desai				
Haryana	Mewat	Dr A. C. Dhariwal(TL)		Mr Anil Kumar	Dr Amarjeet Kaur	Dr Rakesh
		Dr Suman Lata Wattal (TL)*	Dr Neena Valecha			
		Dr Penny (APLMA)				

**: Due to the limited availability and participation of Dr Dhariwal, Dr Suman Wattal was designated as TL for the field visit and subsequent responsibilities.*

Annexure-4 Team composition (independent experts) for thematic area reports

Thematic areas	Experts
1.Programme management and governance	Dr PK Sen-TL Dr Raghavan Gopakumar Dr Ashok Rawat Dr Sachin Jagtap Dr MM Pradhan Dr Harsh Rajvanshi
2. Malaria epidemiology and social determinants of malaria	Dr P L Joshi-TL Dr Leonard Ortega(virtual) Dr Ravi Kumar. K Dr RC Dhiman Dr Kaushik Sarkar Dr Meghna Desai
3. Malaria surveillance, M & E and epidemic preparedness, and response	Dr Neeraj Dhingra-TL Dr Roop Kumari Dr Neelam Somalkar Dr Kayla Dr Risintha
4. Case management, diagnosis and treatment	Dr Kamini Mendes-TL (virtual) Dr Neena Valecha Dr Suman Wattal Dr Penny Grewal Daumerie Dr Neelima Mishra
5. Malaria entomology	Dr AP Dash-TL Dr Jefry TL (Virtual) Dr R S Sharma Dr P K Srivastava Dr SN Sharma Dr Kalpana Dr Arun Chauhan Dr Anju Viswan K
6. Advocacy, partnership, multi-sectoral collaboration and cross-border collaboration community engagement, behaviour change communications	Dr PP Doke-TL Dr Shampa Nag Mrs Vidya Raghavan Dr Amol Patil
7. Research and development	Dr Ashwani Kumar Dr Amit Sharma-TL Dr Manju Rahi Dr Himmat Singh Dr Aditi Sajwan

Annexure-5: State-wise desk review team composition:

State	Review team
Odisha	1. Dr Suman Lata Wattal, Independent Expert and Coordinator 2. Dr Roop Kumari, NPO, WCO- MPR Nodal Officer** 3. Dr Neelam Somalkar, RD, Bhubaneshwar, Expert 4. Dr Jeffery Hii, International Expert (Entomology) 5 . SPO Odisha/Dr Sahil, Public Health Spl. Facilitator
Punjab	1. Dr Suman Lata Wattal*, Independent Expert and Coordinator 2. Dr Amarjeet Kaur, Expert 3. Dr Jeffery Hii, International Expert (Entomology) 4. Dr P. Risintha, Technical Officer, SEARO, WHO Nodal Officer*** 5. SPO Odisha/Dr Anup Kumar, Consultant, Facilitator
Assam	1. Dr Pradeep K Srivastava, Independent Expert and Coordinator 2. Dr L. S. Singh, Sr. RD, Guwahati and Shillong, Expert 3. Dr K Ravi Kumar, Sr.R.D. Bangalore, Expert 4. Dr Jeffery Hii, International Expert (Entomology) 5. Dr Neena Valecha, RA, Malaria, SEARO, WHO Nodal Officer*** 6. Dr Ruplal, SPO /Dr Barman, Consultant, Facilitator

**: Overall Coordinator and Independent Expert*
***: WHO Nodal officer and Coordinator*
****: Participated in discussion with States during the briefing (virtual) meetings only*

Annexure-6: Epidemiological situation of malaria in India(2000-2021)

Year	BSE	Cases	Pf cases	Pf%	ABER	API	SPR	AFI	SFR	Deaths
2000	86 790 375	2 031 790	1 047 218	51.54	8.94	2.09	2.34	1.08	1.21	932
2001	90 389 019	2 085 484	1 005 236	48.20	9.18	2.12	2.31	1.02	1.11	1 005
2002	91 617 725	1 841 229	897 446	48.74	9.04	1.82	2.01	0.89	0.98	973
2003	99 136 143	1 869 403	857 101	45.85	9.65	1.82	1.89	0.83	0.87	1 006
2004	97 111 526	1 915 363	890 152	46.47	9.33	1.84	1.97	0.86	0.92	949
2005	104 143 806	1 816 569	805 077	44.32	9.62	1.68	1.74	0.74	0.77	963
2006	106 725 851	1 785 129	840 360	47.08	9.95	1.66	1.67	0.78	0.79	1 707
2007	94 928 090	1 508 927	741 076	49.11	8.73	1.39	1.59	0.68	0.78	1 311
2008	97 316 158	1 526 210	775 523	50.81	8.69	1.36	1.57	0.69	0.80	1 055
2009	103 396 076	1 563 574	839 877	53.72	8.99	1.36	1.51	0.73	0.81	1 144
2010	108 679 429	1 599 986	834 364	52.15	9.31	1.37	1.47	0.72	0.77	1 018
2011	108 969 660	1 310 656	665 004	50.74	9.12	1.10	1.20	0.56	0.61	754
2012	109 044 798	1 067 824	533 695	49.98	9.00	0.88	0.98	0.44	0.49	519
2013	113 109 094	881 730	463 846	52.61	9.26	0.72	0.78	0.38	0.41	440
2014	124 066 331	1 102 205	722 546	65.55	10.05	0.89	0.89	0.59	0.58	562
2015	121 141 970	1 169 261	778 821	66.61	9.58	0.92	0.97	0.62	0.64	384
2016	124 933 348	1 087 285	711 502	65.44	9.74	0.85	0.87	0.55	0.57	331
2017	125 977 799	844 558	529 530	62.70	9.58	0.64	0.67	0.40	0.42	194
2018	124 475 724	429 928	207 198	48.19	9.31	0.32	0.35	0.16	0.17	96
2019	134 230 349	338 494	156 940	46.36	9.95	0.25	0.25	0.12	0.12	77
2020	97 177 024	186 532	119 088	63.84	7.08	0.14	0.19	0.09	0.12	93
2021*	110 192 062	158 326	99 239	62.68	8.03	0.12	0.14	0.07	0.09	80

**: Provisional data*







Notes

The malaria programme review has been conducted to assess the progress of malaria elimination in the country, and to provide strategic information and recommendations for development of the new NSP 2023 to achieve the target of malaria elimination in the country.