SOVE Indian Region

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Mission

To forge linkages between scientists, academia, programme managers, industry, regulatory bodies and policymakers for effective management of vectors and vector-borne diseases.

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Editorial

The Final Mile in India's Decades-Long War on Malaria

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For generations, malaria loomed over India as an intractable public health shadow. At the time of independence, the nation grappled with an estimated 75 million cases annually. Today, that shadow has dramatically receded. As India targets an ambitious 2030 deadline for complete elimination—with an interim goal to interrupt indigenous transmission by 2027—the final mile of this journey, however, will be the hardest to walk.

India's recent progress is a testament to what systematic anti-malaria interventions can achieve with the launch of the National Framework for Malaria Elimination (2016–2030). A relentless, multi-pronged push – leveraging rapid diagnostic tests, artemisinin-based combination therapies, and the mass distribution of pyrethroid long-lasting insecticidal nets – reduced malaria burden by ~80% in the last 10 years. Consequently, India exited the global High Burden High Impact group—a monumental shift from a high-transmission country to an elimination-phase leader.

Today, 34 States and Union Territories have successfully driven their Annual Parasite Incidence down to <1/1000 people, while many districts have reported zero indigenous cases for three consecutive years. Yet, India still accounts for >70% of the malaria burden in the WHO South-East Asia Region. The transmission has shifted from a generalised nationwide threat to a highly concentrated problem, primarily lingering in tribal, forested regions of states like Tripura and Mizoram, alongside distinct urban micro-pockets.

Eliminating the final vestiges of malaria introduces uniquely complex roadblocks:

- **The *Plasmodium vivax* Paradox:** Unlike the more lethal *P. falciparum*, *P. vivax* accounts for nearly two-thirds of cases, causing relapses months later. Defeating it requires a strict adherence to a 14-day radical cure.
- **Urbanisation and Migration:** Mobile migrant workforces linked to urban development threaten to reintroduce the parasite to areas already declared malaria-free.
- **Insecticide Resistance:** Emerging vector resistance to pyrethroids and drug-resistant parasites threatens to blunt our sharpest intervention tools.

To achieve zero indigenous cases, the healthcare apparatus must evolve from standard control to precision surveillance. India must strictly comply with the "Test, Treat, and Track" strategy.

First, real-time data integration via platforms like the Integrated Health Information Platform (IHIP) must become flawless, mandating participation from the heavily under-reported private healthcare sector. Second, cross-border surveillance with neighbouring nations must be institutionalised to freeze migratory transmission chains. To outpace biological resistance, next-generation tools (e.g. non-pyrethroid nets; newer non-artemisinin drug combinations) must be introduced by simplifying regulatory procedures.

Eliminating malaria is no longer a question of medical capability; it is a test of political will, logistical precision, and community-level discipline. India has successfully broken the back of the long-endemic malaria burden. In this last-mile phase, it must summon the sustained energy and resources to finish the job and secure a malaria-free future.

From Top-Down to Ground-Up: Why Community Ownership is the New Frontier in Global Vector Control.

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Vector-Borne Diseases: The Global Challenge

The global challenge posed by vector-borne diseases (VBDs) has reached a critical inflection point that transcends traditional medical intervention. We are no longer dealing with isolated outbreaks but with a systemic public health crisis that threatens global economic stability and disproportionately impacts the most vulnerable populations. While VBDs are fundamentally preventable, their persistence highlights a profound strategic failure: the reliance on reactive, centralised models in an era of rapid urbanisation and environmental shifts. To reverse this trend, the public health community must transition from viewing vector control as an external government service to a model of community-integrated resilience.

The data provided by the World Health Organization (WHO) and the United Nations International Children's Emergency Fund (UNICEF) illustrate the staggering human cost of our current trajectory. VBDs account for more than 17% of all infectious diseases globally, resulting in over 700,000 deaths annually. Malaria remains a primary driver of this burden, with 249 million cases in 2022, leading to 608,000 deaths—the majority of which were children under the age of five in Africa. Simultaneously, dengue fever, transmitted by *Aedes aegypti* and *Ae. albopictus*, now places nearly half the world's population at risk, with 96 million symptomatic cases reported annually across 129 countries. These figures represent more than just health statistics; they are a clear indictment of traditional "vertical" programs that have failed to keep pace with the scale of the threat. The "So What?" factor is undeniable: if we continue to rely solely on top-down spraying and professional-led surveillance, we will remain in a permanent state of catch-up.

The Decline of the Top-Down Model

Understanding why traditional models failed is the first step toward a more resilient strategy. Between 1940 and 1970, the "Vertical Control Program" was the gold standard. These programs utilised large, centrally organised government teams to deploy mass insecticide applications. While they achieved notable temporary successes in reducing malaria and yellow fever in parts of Latin America, the model was ultimately too rigid to survive. The decline was fuelled by a combination of escalating labour and insecticide costs, the emergence of vector resistance to chemicals, and a "disease du jour" funding cycle. This reactive funding often mirrored a lack of sustained political will, making these programs fragile and vulnerable to budget cuts the moment a crisis appeared to recede.

Beyond technical and financial hurdles, the vertical model suffered from a deep-seated disconnect from the communities it served. By centralising all responsibility within the state, these programs fostered public apathy and a sense that vector control was a government duty in which the citizen had no role. This led to a catastrophic breakdown in community perception; residents often refused to allow government workers into their homes for indoor residual spraying (IRS) or ignored breeding sites in their own backyards. Logistically, these efforts were further hampered by jurisdictional fragmentation. Because mosquitoes do not respect political or administrative boundaries, the lack of coordination between neighbouring programs—each with different protocols and resources—created gaps in coverage that vectors easily exploited. The transition to a decentralised, participatory approach is not merely an alternative; it is the only sustainable path forward.

Community-Based Methods: Tapping into Local Knowledge

Community-Based Methods (CBMs) represent a strategic pivot toward decentralisation and social mobilisation. Unlike traditional models that rely on a small cadre of specialists, CBMs mobilise the "untapped wealth" of the community. In this framework, "community members" include a diverse range of stakeholders—youth, farmers, military service members, and faith leaders—who are trained to perform interventions traditionally reserved for professionals. In India, for instance, frontline health workers such as Accredited Social Health Activists (ASHAs) and Auxiliary Nurse Midwives (ANMs) have become the primary pillars of active surveillance, bridging the gap between formal health systems and the private spaces where vectors breed.

The strategic value of CBMs lies in their ability to democratise healthcare and expand workforce capacity at a fraction of the cost. Utilising residents ensures that interventions are culturally appropriate and geographically comprehensive, particularly in "informal" urban areas that government teams often struggle to reach. By training those without prior specialised skills in surveillance and reporting, we transform the community from a passive recipient of aid into an active co-producer of health. This localised effort is the engine that drives the broader framework of Integrated Vector Management (IVM).

IVM: A Unified Strategic Framework

Integrated Vector Management (IVM) is a rational, data-driven decision-making approach that moves beyond single-method dependency. It is an adaptive strategy designed to optimise resources by tailoring interventions to specific ecological and social contexts. The pillars of IVM include method integration (combining chemical and non-chemical tools), intersectoral collaboration (working with public works and transport departments), community engagement, and evidence-based decision-making. IVM is not a replacement for scientific rigour; it is the extension of that rigour into the lived environment.

The impact of IVM on sustainability is evaluated through three lenses: social, economic, and environmental. Social sustainability is achieved through capacity building that empowers residents to manage their own environments. Economic sustainability is found in resource optimisation—for example, combining the strategic use of long-lasting insecticidal bed nets with targeted community-led spraying. Environmental sustainability is perhaps the most critical in the long term; by targeting interventions more precisely, we reduce our reliance on chemical products, thereby slowing the development of vector resistance. This multi-layered defence is more resilient than any single-method approach used in isolation.

Evidence of Impact: From India to Ethiopia

Empirical evidence is crucial for securing the political buy-in necessary for community-led strategies. In Jodhpur, India, a targeted health education campaign revealed a significant "awareness versus understanding" gap. While 90% of the population had "heard" of dengue, only 51.4% initially knew that fever was a symptom. Post-intervention, knowledge of symptoms rose dramatically: fever recognition reached 85.7%, knowledge of vomiting as a symptom jumped from 14.3% to 31.4%, and awareness of body aches increased from 8.6% to 25.7%. Crucially, this knowledge translated into protective behaviour, with the practice of wearing full-sleeved clothing rising from 60% to 81.4%.

Similarly, in Ethiopia, community-based Indoor Residual Spraying (IRS) and Larval Source Management (LSM) proved that residents could perform these complex tasks with a level of efficiency and quality equal to, or exceeding, district-based professional teams. These case studies highlight a fundamental reality: the "eyes" of the community are required to identify prolific breeding sites like cement tanks and water coolers. In many regions, the failure of municipal water systems leads to intermittent supply, compelling residents to store water in multiple containers for long periods. This is an intersection of infrastructure failure and public health; no central agency can monitor these millions of household-level containers. Only direct community involvement can address these localised risks before they escalate.

The Future of Surveillance: Technology and Empowerment

Modernising surveillance through digital tools is the next frontier in vector control. "Citizen Science" (CS) initiatives are currently revolutionising how we track vector density. By utilising smartphones for photo submission and GPS tagging, community members can provide real-time data that bypasses the geographic and time limitations of conventional active surveillance. These platforms create larger, more diverse entomological datasets that are more epidemiologically relevant and economically viable.

This digital shift is about more than just data collection; it is about the democratisation of science. Technology acts as a bridge, moving the resident from a "passive recipient" to a "co-producer of knowledge." When a farmer in a remote district can submit a photo of a vector via a smartphone app and receive immediate feedback, the health system becomes a dynamic, two-way conversation rather than a one-way government mandate.

A Strategic Roadmap for the Future

To secure a sustainable future, the global health system must bridge the disconnect between disease control programs and the communities they serve. Vector control can no longer be viewed as a periodic government intervention; it must become a shared civic responsibility. For policymakers and strategists, the following roadmap is essential:

- **Establish Sentinel Surveillance Systems:** Implement community-led monitoring that provides continuous, rather than episodic, data on vector density and infection rates.
- **Strengthen Regular Entomological Surveys:** Use community-based teams to conduct routine monitoring of Aedes aegypti and Anopheles breeding, ensuring that interventions are proactive.
- **Prioritise Capacity Building:** Invest in the training of non-professionals, particularly youth and women's collectives, to foster long-term local ownership.
- **Incentivise Intersectoral Collaboration:** Ensure that health outcomes are a shared metric for departments of public works, transport, and urban planning.

The fight against vector-borne diseases in the 21st century will not be won through chemicals alone, but through the empowerment of the people living on the front lines. By transforming vector control into a shared, sustainable responsibility, we can move beyond the spray and toward a future of collective resilience.

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Molecular Xenomonitoring for Surveillance of Pathogens of Vector-Borne Disease

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In recent times, there has been immense interest in validating molecular xenomonitoring (MX) as a surveillance tool to detect pathogens in insect vectors such as mosquitoes, ticks, sand flies, and blackflies for the presence of the genetic material of the disease-causing organisms.

To literally translate, "xeno" means "foreign" and monitoring means "watching/checking regularly." Adding "molecular" indicates looking for the disease-causing organism's genetic material (DNA/RNA) using molecular laboratory tests like Polymerase Chain Reactions (PRC), Real-time PCR/qPCR, Reverse transcription-PCR for RNA of viruses, Loop-mediated isothermal amplification (LAMP), etc. So, MX aims to find evidence of pathogen infection in vectors using molecular laboratory tests.

When vectors feed on humans or animals, they pick up the disease-causing organisms. If an adequate number of vectors are tested and the pathogen is detected, it indicates the presence of transmission or the circulation of the pathogen in the area of interest. Instead of testing humans, MX is useful because many vector-borne diseases become difficult to detect in humans when infection levels are very low and clinical symptoms of the disease are not present. Further, human surveys require testing of blood samples, which are invasive and also costly. Thus, MX offers an alternative, early warning signal to identify areas where pathogen infections may still be present.

The main steps in MX include selecting the target area and the appropriate vector species of interest, collecting an adequate number of vectors using appropriate collection methods, identifying vector species, grouping them into pools, extracting DNA or RNA, and testing the samples using methods such as PCR or real-time PCR. Pools of vectors are small groups of test insects to reduce cost and laboratory workload. If a pool is positive, it means that at least one vector in that group contained the disease-causing organism's genetic material.

Over the past few decades, research has shown that MX can be used as a surveillance tool for many vector-borne diseases, including lymphatic filariasis, malaria, dengue, chikungunya, Zika, Japanese encephalitis, leishmaniasis, onchocerciasis, and tick-borne diseases. In lymphatic filariasis elimination programmes, MX is especially useful after mass drug administration to check whether transmission has been interrupted or whether residual infection remains in some areas.

The main advantages of MX are that it is a non-invasive, sensitive, and cost-effective method for detecting low-level pathogen transmission and for identifying hotspots. The public health programmes can use it for surveillance and undertaking targeted vector control activities. However, the results must be interpreted carefully. While a positive result (a pool being positive) shows that the disease-causing organism's genetic material is present, it may not always prove the active transmission. Likewise, a negative result does not always mean the disease is completely absent, especially if too few vectors were collected or sampling was done in the wrong season. Thus, the method needs to be validated for its operational use.

In conclusion, MX should be used along with human infection data, vector density information, treatment coverage, and local epidemiological knowledge. When properly planned and conducted, MX could prove to be a powerful surveillance tool that may help programmes monitor and move towards the elimination of vector-borne diseases.

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Migration-Associated Malaria in India: Public Health Challenges and Regional Dynamics

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Introduction and Epidemiological Context

Migration is a complex phenomenon driven by a multi-faceted interplay of economic, social, political, and environmental factors that profoundly shape population distribution and dynamics. At its core, human mobility represents an adaptive strategy in response to shifting ecological, economic, and sociopolitical pressures. Both international and domestic migration significantly influence public health outcomes, particularly regarding vector-borne diseases such as malaria. India stands among the top ten countries in the Southeast Asian region for international migrant volume, yet internal migration plays an equally critical role in regional disease dynamics. The broader incidence and transmission patterns of malaria are heavily intertwined with these demographic shifts. Consequently, migration-associated malaria is increasingly emerging in historically non-endemic areas, driven by the steady influx of individuals from highly endemic regions.

In India, domestic population movements are primarily spurred by rapid urbanisation and labour opportunities in sectors such as agriculture, construction, mining, industrial manufacturing, and tourism. Due to the country's unique biological and geographical characteristics, several highly endemic malaria zones persist. A significant majority of malaria cases are concentrated within specific states, including Madhya Pradesh, Odisha, Maharashtra, Rajasthan, Jharkhand, West Bengal, Chhattisgarh, and the North-Eastern states. The rural hinterlands of these regions are frequently characterised by socio-economic vulnerabilities and substandard healthcare infrastructure. Seeking employment and enhanced living standards, residents from these high-burden areas frequently migrate to urban and peri-urban centres across the country. Consequently, human mobility has become a critical determinant in the persistence and re-introduction of malaria within regions currently targeted for elimination.

Surveillance and Management Challenges in Urban Areas

Mobile and migrant populations present substantial structural challenges to urban malaria elimination programmes. These individuals frequently serve as primary carriers of genetically diverse parasite strains, effectively transporting them from endemic areas into non-endemic zones and occasionally triggering localised outbreaks. Migrant labourers often introduce these parasites as asymptomatic, sub-microscopic, or dormant liver-stage carriers. Such covert infections routinely evade detection during standard active surveillance operations conducted by local health authorities. Sub-microscopic infections pose a particular diagnostic challenge, as they frequently fall below the detection thresholds of both conventional light microscopy and rapid diagnostic tests (RDTs). This diagnostic delay enables mobile populations to serve as hidden reservoirs, sustaining transmission lines undetected.

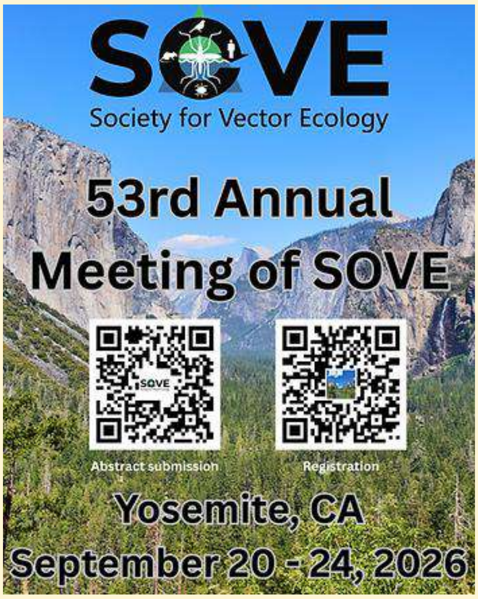
Furthermore, unpredictable and frequent travel patterns, high rates of loss to follow-up, and localised tracking difficulties severely compromise public health interventions. Poor clinical compliance and medication non-adherence among mobile workforces frequently result in incomplete parasite clearance, accelerating the development of early drug resistance. This poses a severe public health risk, as the dissemination of drug-resistant and mutated parasite strains can lead to more severe clinical manifestations and elevated mortality rates across the wider population.

Regional Case Study: Regional Dynamics in Goa

Following its liberation from Portuguese rule in 1961, the state of Goa experienced profound ecological, demographic, and economic transformations, alongside rapid urbanisation to sustain its expanding tourism sector—the state's primary economic driver. To meet the resulting labour demands, a massive influx of migrant workers arrived from diverse regions across India, primarily finding employment in the construction and hospitality industries. This rapid expansion culminated in Goa's capital city, Panaji, experiencing its first severe malaria outbreak in 1986. Since that pivotal event, malaria cases have consistently been reported throughout the urban and peri-urban expanses of the state.

The sustained escalation of malaria in Goa has been directly correlated with the ongoing construction boom in Panaji and surrounding areas. The continuous influx of migrant labourers from high-burden states to active construction sites has facilitated the regular introduction of new parasite populations, thereby driving active, localised transmission. In recent years, the vast majority of imported cases have been concentrated among vulnerable occupational groups—specifically construction site labourers, security guards, hotel staff, and shipyard workers—who migrate to Goa from high-burden states such as Odisha, Jharkhand, Chhattisgarh, Madhya Pradesh, and the North-Eastern states.

Addressing migration-associated malaria is both an urgent priority and an ongoing challenge for the state's public health sector. Preventing local transmission in high-influx areas demands a seamless intervention strategy: robust case surveillance, swift detection, and strict enforcement of the 14-day radical curative treatment for *Plasmodium vivax* in migrant labourers. Coupled with active vector surveillance and control at labour sites, these targeted measures are vital to halting the spread of the disease.



53rd Annual Meeting of Society for Vector Ecology (SOVE)
Dates: 20–24 September 2026
Registration: Before August 1, 2026
Venue: Yosemite, CA, USA
Website: https://www.sove.org/post/join-us-in-yosemite

4th International Conference on Vector-Borne Diseases 2027 (ICVBD 2027)
Hosted jointly by the Academy of Public Health Entomology (APHE) and the Society for Vector Ecology, Indian Region (iSOVE).
Dates: 4–7 February 2027
Registration: Early bird until 31 October; late registration until 15 December 2026
Venue: Bamboo Saa Resort, Udaipur, Rajasthan, India
Website: https://icvbd2027.aphe.org.in

Diploma in Public Health Entomology (DPHE) Course
Academic Year: 2026-27
Offered by: Public Health Entomology Laboratory, Department of Zoology, Mohanlal Sukhadia
University, Udaipur, with technical support from APHE.
Details: Official announcement is expected by the first week of July 2026.
Application forms can be downloaded from the MLSU website: www.mlsu.ac.in

MoU on Insecticide-Impregnated Papers
The World Health Organization (WHO), Geneva, and the ICMR-National Institute of Vector Control Research (NIVCR), Puducherry (a WHO Collaborating Centre), signed a Memorandum of Understanding on 6 March 2026. This agreement establishes local production and supply of insecticide-impregnated papers for monitoring resistance in mosquitoes and sand flies. Production is slated to begin soon, significantly alleviating the logistics of procuring these items from the existing facility in Malaysia.

Commemoration of World Malaria Day (25 April)

Established by the Sixtieth World Health Assembly in May 2007 (WHA60.18), World Malaria Day reminds us of intensified implementation of national malaria control strategies, including community-based activities for malaria prevention and treatment in endemic areas.

Year	Theme
2008	Malaria: a disease without borders
2010	Counting malaria out
2011	Achieving progress and impact
2012	Sustain gains, save lives: Invest in malaria
2013–2015	Invest in the future: defeat malaria
2016	End malaria for good
2017	Let's close the gap
2018	Ready to beat malaria
2019–2021	Zero malaria starts with me
2022	Harness innovation to reduce the malaria disease burden and save lives
2023	Time to deliver zero malaria: invest, innovate, implement
2024	Accelerating the fight against malaria for a more equitable world
2025	Malaria ends with us: Reinvest, reimagine, reignite
2026	Driven to end malaria: Now we can. Now we must.

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