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Malaria elimination challenges in countries approaching the last mile: a discussion among regional stakeholders

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Abstract

Background The national malaria control programmes in Cambodia, Nepal, and Bhutan aim to achieve malaria elimination by 2025–2030. While the vivax malaria burden remains challenging, the consistent decline in falciparum malaria in these countries over the last five years suggests that the goal is achievable. However, unexpected cases in previously falciparum malaria-free districts continue to occur. A virtual meeting was convened in May 2024, followed by smaller meetings, to discuss and share experiences among regional partners, focusing on falciparum malaria elimination.

Main text The discussion among regional partners from these three countries was prompted by an isolated outbreak of falciparum malaria in April 2022 in a previously malaria-free district in Pursat province, Cambodia. The National Center for Parasitology, Entomology and Malaria Control (CNM) worked with stakeholders to contain the outbreak, which was likely to have originated in forest goers. Community-based village malaria workers (VMWs) were augmented with the additional resources required to test and treat malaria among forest goers under the supervision of health centres and district hospitals. This response rapidly reduced malaria cases in the subsequent months. Regional partners from Nepal and Bhutan, who are also engaged in the final phase of malaria elimination, reported that isolated malaria outbreaks in their countries were not unusual and were mostly imported from a neighbouring country, India. Importation of cases was facilitated by unsupervised transborder travel including the movement of migrant workers. The imported cases were only established during the case investigation such as when responding to the isolated outbreaks. In contrast, in Cambodia, spread of malaria was known to be facilitated by mobile and migrant workers, and forest goers within the country. The specific differences between Nepal and Bhutan (South Asia), and Cambodia (Greater Mekong Subregion) offered insights into strategies for malaria elimination. A relevant component for countries embarking on malaria elimination included strengthening of local malaria surveillance and response in collaboration with the community health workers, and community members targeting the 'at risk' population.

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Conclusion In countries approaching malaria elimination, resourcing community-based health workers could play a critical role in enhancing malaria surveillance, early case detection and treatment, including interventions targeting migrant populations such as forest goers and seasonal migrant workers.

Keywords Last mile, Challenges in malaria elimination, Cambodia, Nepal, Bhutan, Outbreaks, Response

Background

The transmission of malaria, specifically *Plasmodium falciparum* malaria, has declined substantially over the last two decades in Cambodia, and the country is progressing towards malaria elimination at the sub-national level (Fig. 1) [1]. Malaria cases have decreased 25-fold, from 106,905 confirmed malaria cases in 2011 to 4,329 cases in 2021 with no recorded deaths from malaria since 2018 [1]. From October to December 2023, only 276 cases were reported, of which 94% were caused by *Plasmodium vivax* and only 1% by *P. falciparum* or a combination of these parasites—a 70% decrease compared to the same period in 2022 [2]. If current trends continue, the National Center for Parasitology, Entomology, and Malaria Control (CNM) and its partners are on track to reach the elimination of all malaria by 2025.

Nepal and Bhutan are also moving towards malaria elimination, but in these countries, malaria has always been primarily caused by *P. vivax* [3–6], whereas in Cambodia, *P. vivax* infections started to dominate only in the last decade after the sharp reduction in falciparum malaria [7–11]. In Nepal, in 2023, there were 665 cases of which 98% (649/665) were imported from India. This contrasts with 2013, when there were 1,024 indigenous cases of malaria which have reduced to only 16 in 2023. In Bhutan, there were 18 malaria cases (14 imported and 4 introduced), with zero indigenous cases in 2023 [12].

The Cambodian Malaria Elimination Action Framework (MEAF) 2021–2025 [13] provides a timeline for eliminating *P. falciparum* malaria by 2023 and all species of human malaria by 2025. The MEAF's strategy aligns with the World Health Organization's Global Technical Strategy (WHO-GTS) for malaria elimination [14]. The National Malaria Strategic Plan (NMSP) of Nepal also aligns with the WHO-GTS [14]. The steady decline in malaria over the last decades, however, has been impeded by the continued detection of indigenous malaria cases, 36 in 2022 and 16 in 2023 (Fig. 2) [NMSP 2024–2030]. The NMSP has thus embraced this challenge and shifted from the original target of zero indigenous cases by 2022; and has a revised timeline to achieve malaria elimination by 2030.

The national malaria control programme of Bhutan aimed to achieve zero indigenous malaria by 2020 and obtain WHO malaria-free certification by 2023. However, this goal was not reached, as indigenous cases continued

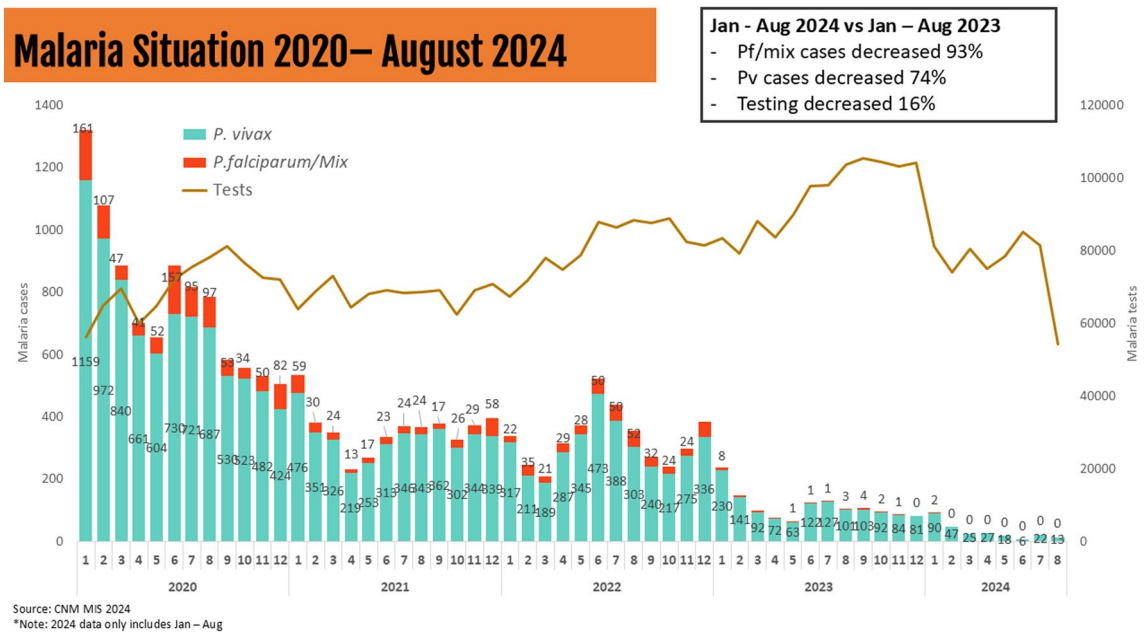

Fig. 1 Progressive decline in malaria from 2020 to 2024 in Cambodia

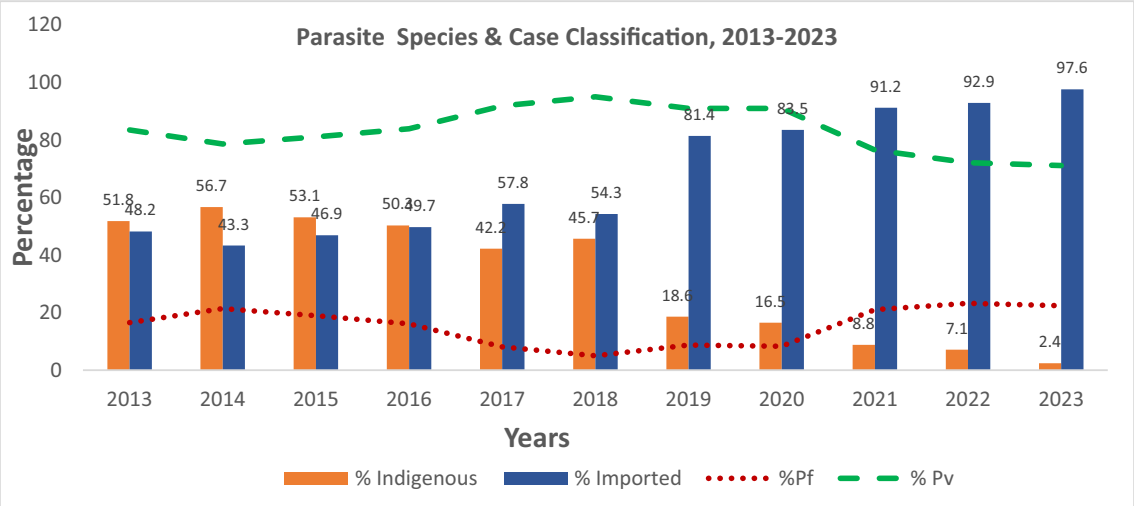

Fig. 2 Trends of malaria cases in Nepal (2013–2023)

to be identified in various districts within Bhutan [12]. In 2019, there were two cases of indigenous malaria compared to 30 imported cases in Bhutan (Fig. 3), which were reduced to zero indigenous, 14 imported, and 4 introduced cases in 2023 [15].

While there is a substantial decline in malaria in all three countries, the sporadic identification of indigenous malaria cases in areas previously free from malaria continues to challenge the goal of achieving malaria elimination. The main objective of this perspective was to share and discuss these challenges among regional NMCP partners from Bhutan, Nepal, and Cambodia together with scientists working on malaria to review the implementation of the last mile strategy.

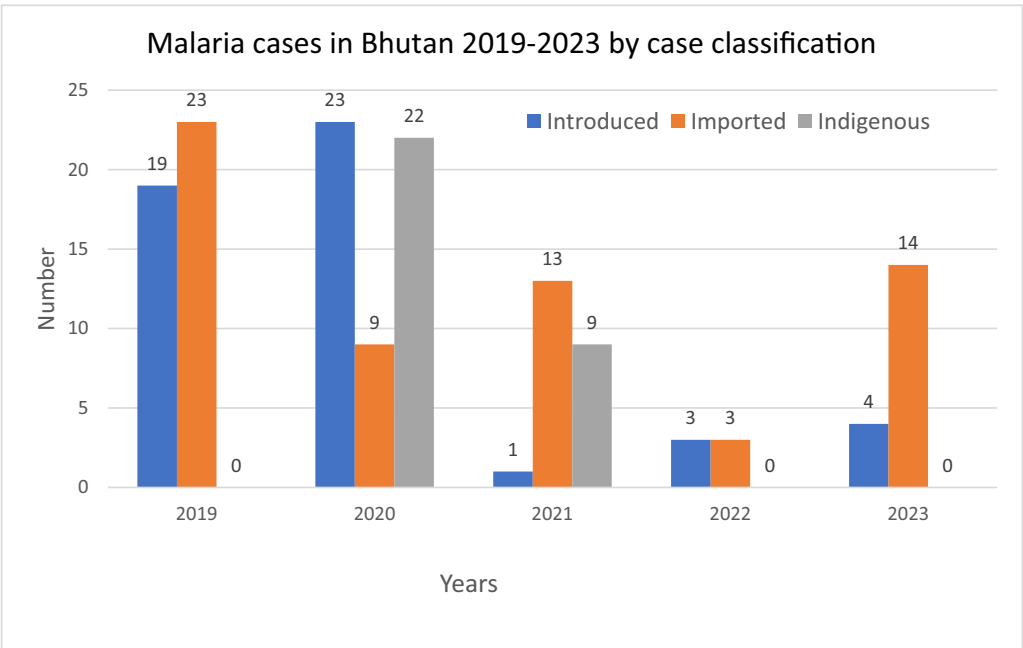

Fig. 3 Trends of malaria cases in Bhutan (2019–2023)

Malaria elimination strategies

The Cambodian MEAF has three primary objectives: 1) Detecting and treating all clinical malaria cases; 2) Intensifying focal interventions in malaria-endemic areas targeting high-risk populations; and 3) Investigating and documenting all malaria cases and malaria transmission foci to interrupt all malaria transmission. Each of these objectives has been translated into detailed action plans tailored to the Cambodian context. Specifically, the malaria elimination strategy embraces 'the last mile' elimination approach that consists of a package of activities such as community engagement, census of 'at risk' populations, top-up distribution of long-lasting insecticidal nets (LLINs) and long-lasting insecticidal hammocks (LLIHs), targeted drug administration (TDA), active fever screening (AFS), and Intermittent Preventive Treatment for Forest goers (IPTf). The strategy to deploy these aggressive, focused interventions (TDA, weekly AFS, and IPTf) in all active foci of falciparum malaria was designed by the CNM in collaboration with the WHO in 2020 [16–18]. The implementation started in January 2021 and has continued since as routine activities.

Nepal employs five key strategies [NMSP 2024–2030] and subsequent interventions to achieve malaria elimination that include: 1) Strengthening the malaria surveillance system for outbreak response and prevention of re-establishment; 2) Ensuring disease prevention through effective vector surveillance and control interventions; 3) Ensuring universal and prompt access to diagnosis and treatment; 4) Ensuring political commitment by all three levels of governance, and 5) Harnessing innovation and operational research. Specific activities aligning with these strategies are being planned. For instance, to align with the first strategy, the malaria control programme aims to implement targeted malaria testing and treatment of high-risk groups including the mobile migrant population (repatriating workers and UN peacekeepers in Africa) returning from malaria-endemic areas, reactive case detection and treatment, and targeted drug administration. Mandatory malaria screening using microscopy in addition to follow-up monitoring among these special populations has been planned. Aligning with strategy four, Nepal has yet another challenge of the governance process which is coordination, collaboration, and implementation within the three tiers of government since the inception of federalism in 2015 [19].

Bhutan has developed eight strategies [12] that align with the WHO-GTS, which include: 1) Strengthening targeted and focused preventive malaria interventions; 2) Establishing rigorous quality assurance for lab diagnosis, prompt and effective treatment; 3) Strengthening surveillance for case detection and outbreak response; 4) Strengthening effective collaboration and partnerships among stakeholders; 5) Improving programme management and performance; 6) Intensifying advocacy and IEC (information education and counselling) for malaria elimination; 7) Conducting operational research on malaria elimination; 8) Strengthening monitoring and evaluation of the malaria elimination programme. For instance, to align with the strategy 3, which is to strengthen surveillance for malaria case detection and response, Bhutan's control programme has been employing proactive case detection (PACD). PACD has been tailored to target the high-risk and vulnerable population living in remote areas with poor health access. These specific populations are likely to be the reservoir of asymptomatic infections in Bhutan [10].

Outlining these strategies at the community level, along with related activities and the ways in which community members and stakeholders can collaborate to detect, treat, and prevent malaria, is likely the first step toward eliminating malaria from the community [18, 20]. Any activity under these strategies should first explore the characteristics of the targeted community, for instance, movements of occupational workers, and migrant workers, and their travel patterns (from their residence to workplaces, within and outside the country), including forest activities [21]. Based on these baseline characteristics of the targeted communities, activities such as preventive measures, and proactive case detection and management could be implemented [22]. This also means, investing in community-based resources (e.g. community health workers, and infrastructure) to continue the monitoring and surveillance of high-risk populations in contrast to reactive response which is likely to incur challenges at several layers including delays in responses [23–25].

In near-elimination settings, the occasional diagnosis of malaria cases, particularly in previously malaria-free communities, prompts a case investigation, followed by foci investigations and responses. A detailed entomological investigation was deemed critical to identify the primary case and its potential transmission in Cambodia following the identification of falciparum malaria cases in previous falciparum malaria-free communities [26]. In areas with low or zero local transmission, the falciparum index case is the one that leads to the investigation, while the primary case is the one that began the chain of transmission. In practice, entomological investigations are often inadequately prioritized leading to a lack of motivation among health workers (entomologists), inadequate exploration, and consequently failing to identify the primary cases. Reports establishing the primary vectors, and the drivers of potential transmission can then guide the targeted multi-pronged responses towards the high-risk population.

In Cambodia, such responses also included the implementation of targeted anti-malarial drug administration to the entire village/community with high caseloads of falciparum malaria. In addition, based on the population's movement patterns, such as those of seasonal migrant workers, occupational workers (travellers), and forest activities, intermittent preventive treatment for forest-goers (IPTf) for falciparum malaria was identified as one of the population-specific approaches currently being undertaken.

In outbreak response, the aforementioned last mile approach starts with the identification of hotspots and entry points followed by the positioning and resourcing of community-based health workers (CHWs) [17, 27]. The CHWs consequently undertake testing and treatment for all malaria at checkpoints or entry points where migrant workers, occupational workers, and forest-goers can be reliably reached. Checkpoints (or entry points) are established as satellite stations to reach out to these specific populations. In addition, CHWs proactively conduct outreach activities in the endemic areas, entry points and hot-spots to provide testing, and treatment of acute malaria cases, counselling, and delivering a treatment pack that includes long-lasting insecticide-treated nets. In Cambodia, such outreach activities are prioritized in forested areas, or at entry points with additional intervention such as IPTf. In Nepal, the CHWs, who were previously limited to referring patients based on clinical symptoms and travel history to malaria-risk areas, are now authorized to conduct targeted malaria testing and treatment for high-risk groups, including the mobile migrant population, such as repatriating workers returning from malaria-endemic regions under the new strategic plan [NMSP 2024–2030]. However, in Bhutan, the CHW's role in malaria is restricted to health education and promotion.

While most activities in the last mile phase are based on *P. falciparum* malaria caseloads, *P. vivax* malaria continues to pose a significant threat to malaria elimination due to no particular attention given to the dormant liver-stage or the hypnozoites causing infections to relapse [28–33]. Vivax-specific interventions are essential to eliminate relapsing malaria, and vivax elimination has historically lagged behind that of falciparum malaria [34, 35]. The risk in near-elimination countries with a vivax burden like Cambodia and Nepal is that the lag in vivax elimination can be a major threat to their overall malaria elimination goals. Introducing radical cure to prevent vivax malaria relapses requires targeted engagement strategies in the communities [34, 36, 37]. This is particularly important in communities where knowledge of vivax malaria and the implications of relapses are poor. One of the strategies recently piloted in Cambodia entailed training and supporting VMWs (malaria specific CHWs), to diagnose vivax malaria, including testing of Glucose-6-Phosphatase Dehydrogenase (G6PD) deficiency among these patients at the first point of care. This permits safe treatment with appropriate drugs at the community level rather than referring them to health centres, and increases patients' access to the treatment, as in practice the patients often do not attend the referral centres [35, 36]. In contrast, G6PD tests are not performed routinely in Nepal and Bhutan [38].

The identification of simian malarias (*Plasmodium cynomolgi* and *Plasmodium knowlesi*) in Cambodia also adds to the challenges of elimination [39, 40]. Around 1.5% of the asymptomatic malaria patients in western Cambodia were found to have nonhuman primate malaria (11 *P. cynomolgi,* 8 *P. knowlesi* and 2 mixed with *P. vivax* out of 1361 cases) [40]. These malarias have a non-human reservoir and so are not targeted by current elimination efforts, but zoonotic transmission of these malarias to humans can delay elimination targets if they are not diagnosed accurately. Malaysia bears a high burden of these simian malaria with the prevalence of *Plasmodium inui* at 49%, followed by *P. cynomolgi* 33% and *P. knowlesi* and *Plasmodium coatneyi* at 26% [41]. Distinguishing simian malaria from human malaria requires more clarity from the WHO and specific activities within the last mile strategy [42, 43].

Near elimination phase (the last mile) challenges

NMCP members from Nepal, Bhutan and Cambodia shared their challenges and experiences during the near malaria elimination phase (Fig. 4). One of the commonalities between Nepal and Bhutan was the unexpectedly prolonged duration of the last mile phase. The extended prevalence of vivax malaria and the lack of a strategy to address the unique challenges of this parasite species, and the historical focus on falciparum malaira elimination only likely contributed to this prolongation [34]. The repeated postponement of the target year to reach malaria elimination was due to the re-emergence of *P. falciparum* cases in previously malaria-free areas, in addition to the vivax burden.

High burden of malaria among mobile and migrant populations

Most of the malaria cases in Bhutan and Nepal are attributed to importation from travellers and migrants who crossed the porous border with India [7, 11, 44]. Both Bhutan and Nepal have frequent movements of migrant workers to and from India, and these migrant workers are a mix of both local workers who travel to India, and of workers from neighboring districts in India who cross the border to work in Nepal and Bhutan [10, 45]. In Bhutan,

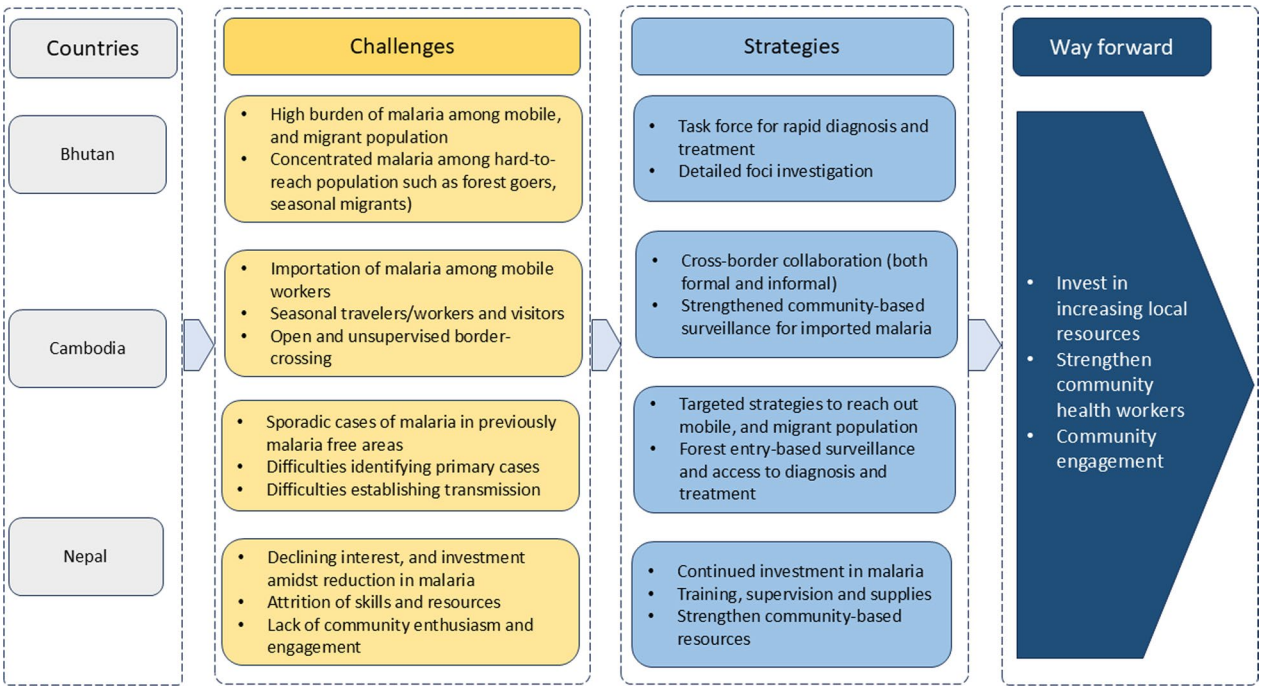

Fig. 4 Challenges and strategies faced by countries nearing malaria elimination. There are commonalities in challenges, strategies and way forward between these countries

seasonal workers from India cross the border to work in industries such as hydropower and construction, some on a daily basis. A study profiled Nepalese migrant workers to India and identified their travel patterns including the most visited districts in India [45]. There is no routine screening for malaria or documentation of health status at the India-Nepal or India-Bhutan borders. Thus, travellers with asymptomatic infections and those with symptoms of malaria can cross freely, presenting a major contextual challenge to elimination.

First, the transmission of malaria from travellers in the community can be difficult to track when they are outbound for their employment back to India or when they are travelling for work within the country (inter-district, and inter-province) which affects all three countries [45]. Second, when people are asymptomatic despite being able to transmit malaria, it becomes even more complex to identify the primary cases that lead to outbreaks. In recent years, the return of large numbers of United Nations Peacekeeping forces from Nepal, Bhutan, and Cambodia after deployment in Africa has been linked to the potential introduction of imported malaria cases [46].

Similar to the Nepalese and Bhutanese experience of malaria among mobile and migrant populations moving between countries, the population movement between provinces and districts in Cambodia, especially by forest goers, poses a risk of spreading malaria [47–50]. The internal migration of these populations is underrecorded, which creates a major challenge in identifying the index and primary cases. While the concept of indigenous and imported cases is relevant for international importation (which in itself can be difficult to delineate) [51], the concept has a different nature in Cambodia because most of the cases are 'imported' from elsewhere within the country. This adds to the complexity of identifying index and primary cases, and thus the conduct of foci investigations [52]. In both settings of the GMS (Cambodia) and South Asia (Nepal and Bhutan), identifying and tracking mobile and migrant population (e.g. forest goers, and migrant workers) for active case detection and treatment remain a major challenge.

Cross-border challenges

Considering the strategies for imported malaria, although formal, bilateral state-level and health service-level collaboration was considered beneficial by the NMCPs, the implementation was compounded by bureaucratic barriers and remains mostly aspirational [53]. Informal and local-level cross-border collaboration such as sharing data through online applications (e.g. WhatsApp) was found to be more useful than seeking a formal cross-border data exchange [46]. NMCP members from both Nepal and Bhutan emphasized the importance of local level coordination for cross-border malaria

related activities (e.g. active case detection and reporting across the border) rather than waiting for state level collaboration and coordination. Informal cross-border collaboration and coordination nonetheless requires high motivation from both sides including pursuing it when staff turnovers are frequent. Although WHO can play a critical role in sharing data for cross-border collaboration, the nature of retrospective data, methodology of recording and reporting, and time-lags can impede the real-time interventions [54, 55]. These challenges further echo a recent report that highlights the need to adopt tailored approaches relevant to each country as critical to tackle the border malaria challenges [56].

The state-level cross-border collaboration challenges are common in other GMS countries as well [54, 55, 57, 58]. An important current example stems from the resurgence of malaria cases in Myanmar because of political instability, as this has increased the number of cross-border migrants and a surge in malaria cases along the Thai-Myanmar border [59]. Political instability is likely to hinder the smooth operations of malaria control programs, and consequently jeopardize gains made towards elimination. Similarly, the recent COVID-19 pandemic demonstrated the need to maintain frontline community health workers – often the only resources accessible in the community for malaria diagnosis and treatment during lockdowns [60]. Contingency plans focused on local resources are promising strategies even in the face of such catastrophes.

Sporadic cases of malaria in previously malaria free areas

In April 2022, in several districts within Pursat province in Cambodia there was an upsurge of *P. falciparum* where cases had been previously declining [8]. At that time, two cases were reported in January, none in February, and three in March culminating in April with 14 cases. CNM responded to this outbreak by engaging with partners and community to launch series of interventions that started with census of forest goers, screening and treatment at dedicated health stations established at forest entry points. Soon after, interventions such as IPTf and TDA were introduced. The interventions were successful in interrupting transmission as there were no cases of *P. falciparum* detected in subsequent months.

More recently, on January 2nd, 2024, two cases of *P. falciparum* were detected in Phnom Kravanh and Krakor operational districts of Pursat province [CNM, entomological report]. An entomological investigation identified primary malaria vectors (*Anopheles dirus* and *Anopheles minimus*) in a water stream near camping areas for forest foragers, suggestive of malaria transmission. Nonetheless, no primary malaria vector was captured within the village. The entomological exploration highlighted that forest activity was the major source of the malaria but failed to identify the primary case.

Sporadic cases of malaria in previously malaria-free areas were thought to be significantly different between these countries. Although both Nepal [5, 7] and Bhutan [61, 62] attributed sporadic cases to importation, in Cambodia the major reasons for malaria outbreaks were mobile and migrant populations (MMPs) in particular high-risk forest-goers who travel between districts and provinces [50]. The MMPs and forest-goers continue to facilitate the transmission of malaria for a number of reasons. First their movements, especially forest-goers' activities are often clandestine and thus their movements are elusive, which poses challenges for mobile and/or village malaria workers, health centre staff and other community members [63]. Even the village head may experience difficulty tracking the movement of forest-goers, thus underscoring the potential for augmented community-based approaches to reach these populations [64]. As part of the last mile strategy, CNM has positioned health care providers at the point of entry/exit to forests—referred to as health stations.

Difficulties in identifying primary cases and establishing transmission

Both Nepal and Bhutan have experienced isolated cases and small outbreaks focused on falciparum malaria, which often remained underexplained, because apart from index cases, the primary case was rarely identified. One explanation was the role of asymptomatic malaria carriers in the communities who transmit malaria to community members and are often difficult to appreciate [65, 66]. NMCP members also explained how the primary cases of malaria may have been missed by the surveillance system because they could be highly mobile, particularly in the context of Nepal and Bhutan where migrant workers cross the poorly regulated porous border. In the context of Bhutan for example, a construction worker often crosses the border for a day's work and may return to his residence (India) in the evening. Amongst these special groups, the diagnosis and treatment are often difficult to track [11]. Targeted surveillance system particularly risk-population mapping, spatial analysis and exploring migrant movements can be promising strategies [67–69]. One study in Nepal explored the seasonal workers' movement patterns from Nepal to India and was able to highlight their timing, patterns and visit duration to inform the specific strategies to reach these population [45].

Declining interest and investment amidst the reduction in malaria

Robust approaches to outbreak or case investigation remain a major strategy to ensure malaria elimination [70]. A 1–3-7 approach targets reporting of confirmed cases within one day, investigation of specific cases within three days, and targeted control measures to prevent further transmission within seven days. Nonetheless, there are several barriers to the adoption of a 1–3-7 approach [70, 71]. The major challenge is the inability to follow the time-prescribed for specific activities. For instance, health workers are often unable to complete case notification within the first 24 h of case identification, including completing the 3 and 7 day activities because of the infrastructural challenges (e.g. remote locations, poor roads, lack of transport means, poor mobile reception), and disposition of patients (e.g. mobile and migrant persons, forest goers, and their treatment-seeking behaviour) [72]. An additional challenge related to the reactive case detection and treatment focused on specific area (or screening radii) in low transmission settings include uncertainty around the acquisition of malaria (e.g. outside the village, asymptomatic malaria), and its distribution over time and space [73].

Malaria patients may not seek treatment at formal health services which means they are not included in the malaria data recording system, thus it can distort the epidemiological burden, and responses to it [74–76]. The 1–3-7 approach was successful in the elimination of malaria from China. But exporting an approach from one country to another requires careful local adaptation [77]. As malaria declines, a thorough case profiling and complete treatment at the clinical centres becomes even more crucial. For instance, in Bhutan, cases of malaria during the last mile phase were hospitalized until the patient was fully cured including documentation of potential transmission and their interactions among family members and community members.

Lessons learned

Strengthen community-based network of malaria workers

With the substantial decline in malaria, community health workers, such as VMWs and health post staff must broaden their roles to remain relevant in the community and ensure continued uptake of their services [9, 25, 78–81]. A network of community-based health workers such as VMWs is pivotal in executing the approaches and strategies to reach the malaria elimination goals [36, 82]. As malaria recedes to remote villages in forested areas and forest fringes, including among the hard-to-reach population (e.g. seasonal workers, mobile and migrant population and occupational travellers) targeting these remote hotspot areas and specific populations is critical [63, 83, 84]. In addition, as malaria cases are concentrated among mobile and migrant populations especially those visiting forests, migrant workers between Bhutan and Nepal and India, CHWs with knowledge of local social and cultural context and capacity to reach, track, diagnose, and treat the remaining malaria cases are paramount [83, 85–87]. Nonetheless, the effectiveness of CHW-delivered approaches can depend on the local social and political context, including the resources and funding invested in their efforts [82, 88].

Increased preparedness to tackle malaria outbreaks and case investigation are critical [36], and perhaps more important when cases are few, but the malaria vectors remain. In the context of declining malaria cases, stakeholders can become complacent, and the lack of emphasis on malaria, especially at the community level weakens the preparedness of VMWs for any outbreaks or upsurges when elimination is nearly in sight [78]. NMCP members from Bhutan stressed the need to maintain the capacity and motivation among all stakeholders, including community members referring to the possible complacency and natural decline in CHWs' competency due to declining exposure to malaria [3]. Maintaining technical competence at all levels of the health system and particularly the most peripherally located health centres at-risk areas, requires continuous training and supervision where decreased malaria detection and treatment can reduce the practice. NMCPs of countries embarking on malaria elimination may be able to keep CHWs either focused on malaria alone or ensure their relevance by giving them additional responsibilities beyond malaria to maintain their position and standing in the communities [78, 89, 90]. The importance of having competent and prepared CHWs was apparent in Cambodia when malaria outbreak management required prompt and complete dedication of VMWs to implement the last mile packages [8]. The Kravanh malaria outbreak demonstrated the promptness of CNM in mobilizing VMWs from malaria-free districts into the outbreak district.

Increase local resources

Countries that establish zero indigenous malaria for three consecutive years are awarded a 'malaria elimination certificate' by the WHO. While the median period to achieve zero malaria cases has been 12 years, island nations, such as Trinidad and Tobago, Cabo Verde, and Maldives have achieved this in 8 years [91]. In countries embarking on their mission to achieve malaria elimination, 'maintenance' including intensified efforts at the community level is critical [3, 78, 92–95]. With the significant decline in malaria, the potential de-prioritization, stock-outs and decline in skills to diagnose and treat malaria can be

major problems. In Sri Lanka, years after malaria elimination, a malaria patient (an imported case) failed to receive prompt diagnosis and treatment leading to death [96]. One study found a significant delay (median 4 days) in diagnosis and treatment of severe malaria in Sri Lanka after elimination [97]. This highlights the need to maintain the skills and resources during and after elimination. In Vanuatu's Tafea Province, years after malaria elimination in the islands, local community microscopists were positioned at the border point to prevent malaria importation, highlighting the need to invest in maintenance [94, 95]. Such a level of preparedness and maintenance is practical and should be leveraged as a strategy for malaria elimination.

Community engagement

Community engagement remains central in maintaining the support and enthusiasm of village authorities, and community members [16, 18, 83]. For instance, in remote villages in Stung Treng, Cambodia, messages related to malaria were translated into ethnic languages and broadcasted through sound systems incorporating popular song lyrics, in addition to the distribution of printed pamphlets [18].

The recent outbreak management in Cambodia demonstrates the importance of sustained political will and continued investment in community-based resources, as VMWs were positioned to support the additional interventions which included TDA, IPTf, LLIN and LLIH distribution [8, 98]. Leveraging prior research on feasibility and acceptability of mass drug administration, and forest prophylaxis [83, 99] and the experience of prior operational research, Cambodia successfully conducted targeted drug administration embedded within their health system's activities [8]. The past failure of mefloquine monotherapy in MDA informed the selection of better-tolerated drugs (artemether-lumefantrine) for use in forest prophylaxis during a trial [99]. The most recent TDA used Pyramax® (artesunate-pyronaridine) and was found to be acceptable with high coverage and adherence [8]. Any potential TDA should consider using an anti-malarial that has a good safety profile, is well-tolerated and convenient (e.g. anti-malarials with fewer doses).

Reflecting on the discussions between NMCP members together with the malariologists about the recent outbreak response by CNM, Cambodia offers a lesson on how networks of community based health workers should be maintained and adequately resourced to function in an emergency [98]. Reallocating and augmenting CHWs from previously malaria-free areas, and intensified community engagement are essential features of such a response. Some of the NMCP members suggested forming community action groups to lead malaria-related engagement activities. Such community-based task groups can be a valuable resource within the community and can sustain malaria elimination activities.

Conclusions

As countries advance toward malaria elimination, adequately resourcing community health workers is pivotal in maintaining effective surveillance, prompt case identification, and treatment delivery, including tailored interventions targeting high-risk populations, including forest goers and seasonal migrant workers.

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The authors alone are responsible for any views expressed in this publication and they do not necessarily represent the decisions, policies, or views of the organizations whose members participated in this meeting/discussion.

Author contributions

LD raised the initial research question based on the recent malaria outbreak and its management in Cambodia with BA. BA subsequently discussed with MS for a meeting with regional partners for a discussion. All authors contributed to the synthesis and finalization of the content in the manuscript.

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Ethics approval and consent to participate

Not applicable.

Competing interests

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