The Mekong Malaria Elimination programme

Eliminating malaria in the Greater Mekong subregion by reaching the unreached

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World Health Organization

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Contents

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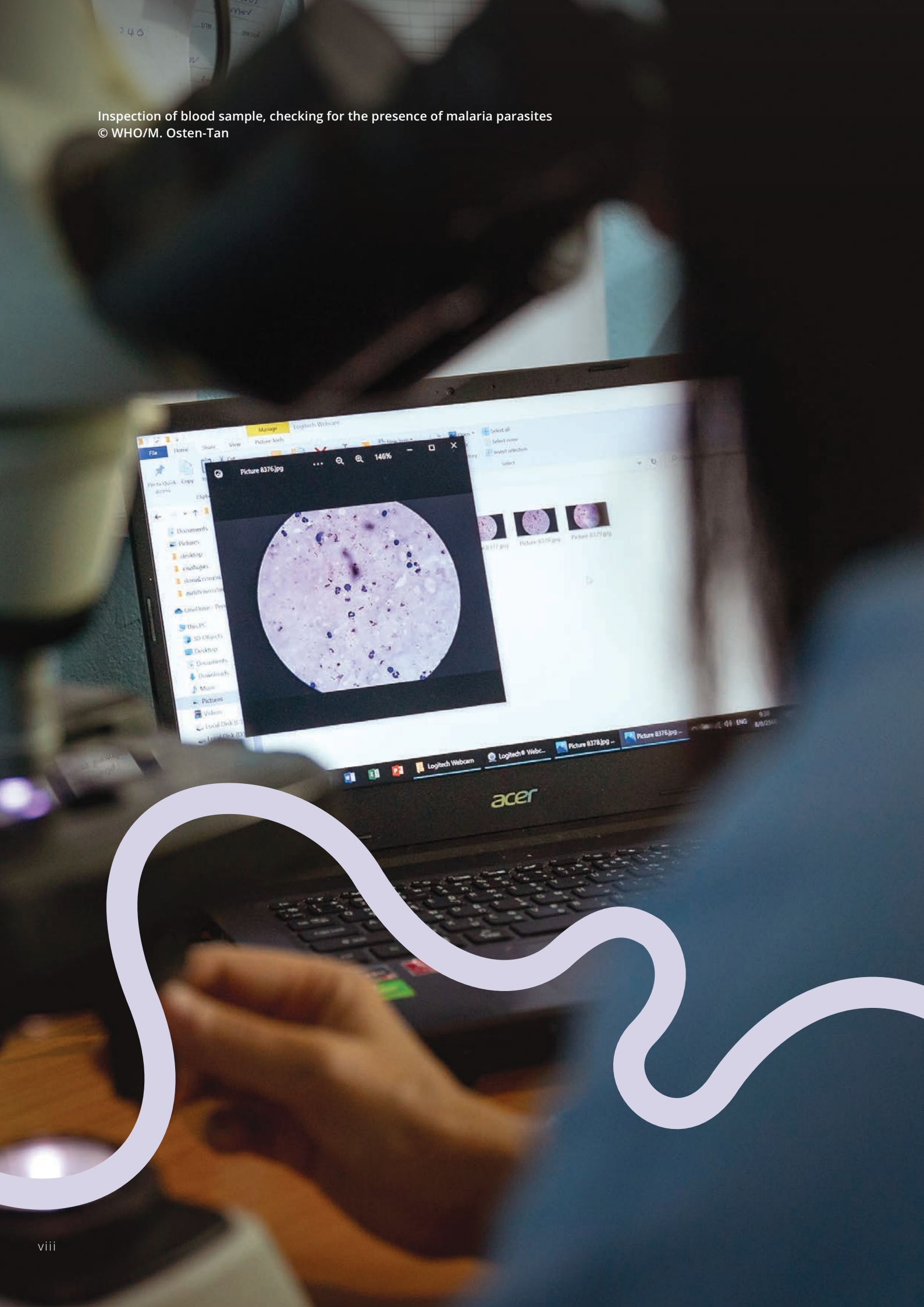
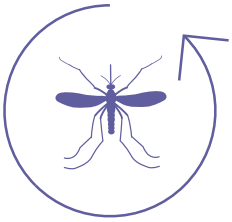
Abbreviations

ACT	artemisinin-based combination therapy
AFS	active fever screening
AL	artemether-lumefantrine
APLMA	Asia Pacific Leaders Malaria Alliance
ASMQ	artesunate-mefloquine
ASPY	artesunate-pyronaridine
CHAI	Clinton Health Access Initiative
CMPE	Center for Malariology, Parasitology and Entomology
CNM	National Center for Parasitology, Entomology and Malaria Control
COVID-19	coronavirus disease
CQ	chloroquine
CSO	civil society organization
CYP	cytochrome P450
DHA-PIP	dihydroartemisinin-piperaquine
DHIS2	District Health Information Software 2
DVBD	Department of Vector-Borne Diseases
G6PD	glucose-6-phosphate dehydrogenase
Global Fund	Global Fund to Fight AIDS, Tuberculosis and Malaria
GMS	Greater Mekong subregion
iDES	integrated drug efficacy surveillance
IPTf	intermittent preventive therapy for forest-goers
IRS	indoor residual spraying
LLIHN	long-lasting insecticide-treated hammock net
LLIN	long-lasting insecticide-treated bed net
MDA	mass drug administration
MEDB	Malaria Elimination Database

MEI	Malaria Elimination Initiative
MIS	malaria information system
MME	Mekong Malaria Elimination
NIMPE	National Institute for Malariology, Parasitology, and Entomology
NMP	national malaria programme
NTG	national treatment guideline
Pfcrt	*Plasmodium falciparum chloroquine resistance transporter*
PfK13	*Plasmodium falciparum Kelch 13*
Pfmdr1	*Plasmodium falciparum multidrug resistance 1 protein*
Pfpm2-3	*Plasmodium falciparum plasmepsin 2–3*
PMI	United States President's Malaria Initiative
PoR	prevention of re-establishment
PQ	primaquine
RACDT	reactive case detection and treatment
RAIE	Regional Artemisinin-resistance Initiative Elimination
TDA	targeted drug administration
TES	therapeutic efficacy study
TQ	tafenoquine
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
VMW	village malaria worker
WHO	World Health Organization



Inspection of blood sample, checking for the presence of malaria parasites
© WHO/M. Osten-Tan



Key messages

The Greater Mekong subregion (GMS) countries are strongly committed to malaria elimination and cases continued to decline in most areas in 2022. However, the continued unstable political situation in Myanmar caused an overall increase in cases across the GMS to 142 777 in 2022, compared to 91 048 in 2021. Although most of this increased burden occurred in Myanmar, the border regions of neighbouring countries, in particular Thailand, were also affected.

Reaching the unreached populations, particularly in remote and marginalized communities, is vital for malaria elimination. This requires a comprehensive, tailored and participatory approach that considers social, economic and political factors, with collaboration among stakeholders to ensure access to prevention and treatment interventions. The role of community-based volunteer health workers is especially important in gaining trust and understanding needs. Civil society organizations are also an important component in fostering community engagement and ownership.

Despite the presence of partial artemisinin resistance in the GMS, several artemisinin-based combination therapies remain highly effective against *Plasmodium falciparum*. The number of *P. falciparum* and mixed cases increased from 17 115 in 2021 to 25 105 in 2022, although the proportion of all cases that were caused by *P. falciparum* declined from 18.8% to 16.8% over the same period.

P. vivax is the dominant parasite in the region, causing 83% of cases in 2022 and presenting a significant barrier to malaria elimination. The number of *P. vivax* cases increased from 73 856 in 2021 to 121 309 in 2022, and effective strategies for addressing *P. vivax* malaria elimination are urgently needed.

As elimination goals are approached, high-quality epidemiological data are needed to identify and address transmission foci, particularly across country border zones. The Malaria Elimination Database continues to foster collaboration and facilitate data sharing and epidemiological monitoring, supporting strategic decision-making, coordination and communication across the GMS.

Integrated drug efficacy surveillance is being implemented in areas where malaria case incidence has sufficiently declined in order to enable comprehensive follow-up of every malaria case and ensure treatment completion, while monitoring antimalarial effectiveness.

Countries in the GMS are preparing for national malaria-free certification, with subnational verification serving as a valuable programmatic exercise to support compliance with processes and documentation. Planning for prevention of re-establishment of malaria is essential to fulfil the criteria for malaria-free status.

Given anticipated reductions in donor funding for malaria, ensuring the sustainability of malaria elimination programmes in the GMS is essential. GMS countries are actively developing transition plans to shift towards domestically financed and supported malaria responses.

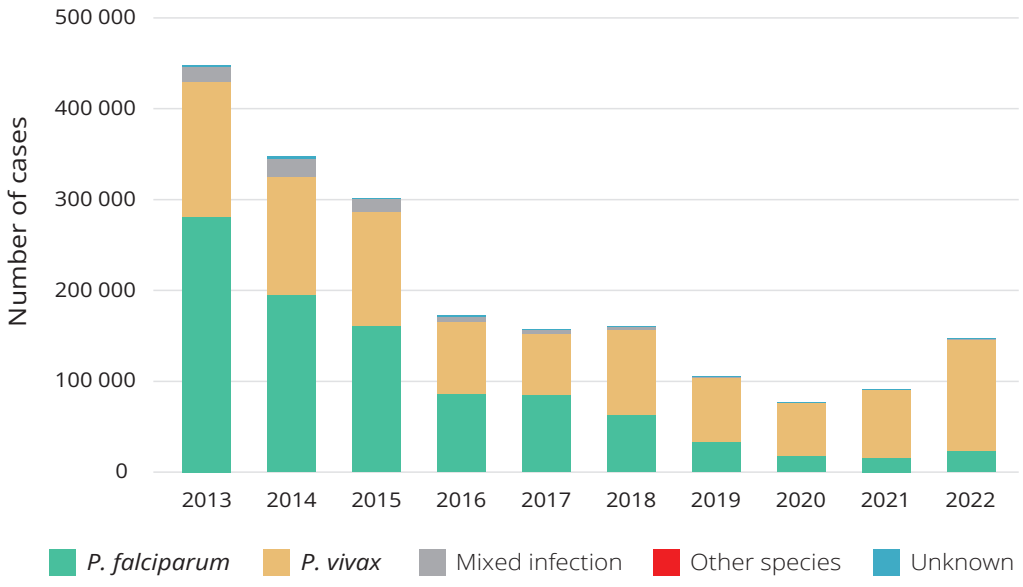
A village malaria worker visiting the remote village of Luon Thmey inhabited by the Kreung minority, Cambodia
© WHO/A. Raab

Background

In 2013, the six Greater Mekong subregion (GMS) countries of Cambodia, China (Yunnan province), Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam were faced with a momentous challenge. Multidrug resistance threatened to make *Plasmodium falciparum* malaria untreatable in the GMS, and potentially globally if resistant parasites were to escape the region and spread. The World Health Organization (WHO) developed an initial emergency response in 2013–2015 to contain resistance and address the *P. falciparum* malaria burden. However, to address the continuous threat posed by antimalarial drug resistance, a region free of malaria was envisaged in the WHO *Strategy for malaria elimination in the Greater Mekong subregion: 2015–2030 (1)*. This strategy was supported by the Ministerial Call for Action to Eliminate Malaria in the GMS before 2030 *(2)*, signed by the Ministers of Health of all the GMS countries in 2018. Since this call to action, sustained political momentum and extensive community mobilization have supported dramatic reductions in malaria case numbers and deaths across the region.

Over the last ten years, the GMS countries have made remarkable progress towards their collective goals of *P. falciparum* elimination by 2023 and elimination of all human malaria species by 2030. In 2013, there were 448 247 confirmed malaria cases in the GMS, compared to 146 718 in 2022 – a 67% reduction in cases overall. *P. falciparum* and mixed cases have declined from 297 998 to 25 105 over the same period – a 92% reduction – and deaths due to malaria have decreased by 95% (Figs. 1 and 2) *(3)*.

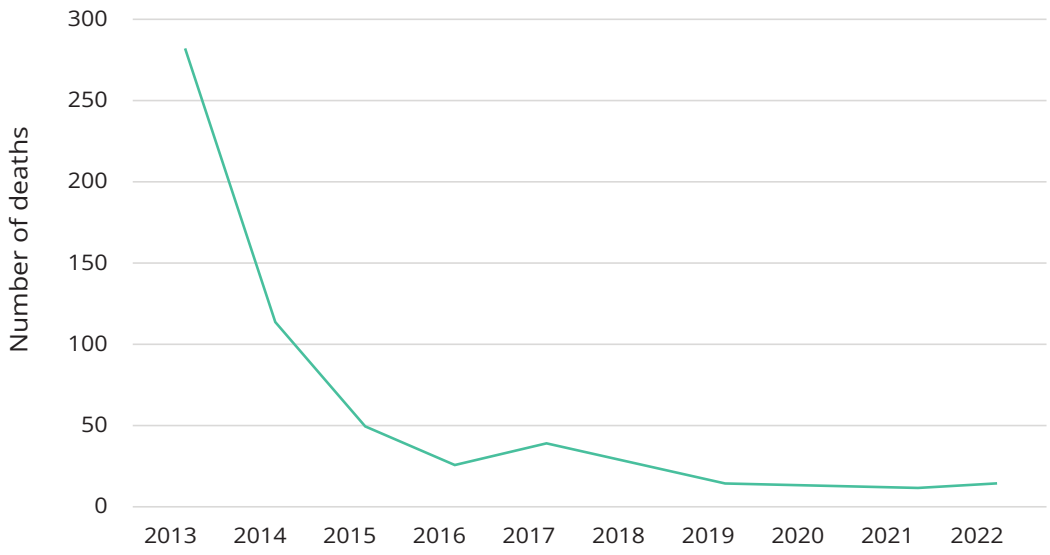
Fig. 1
Malaria cases in the GMS, 2013–2022



Source: Mekong Elimination Database *(3)*

Fig. 2

Malaria deaths in the GMS, 2013–2022



Source: Mekong Elimination Database *(3)*

The coronavirus disease (COVID-19) pandemic presented a major threat to malaria elimination efforts, disrupting malaria services and elimination activities, even though restrictions on population movement reduced malaria transmission. Once social restrictions were eased, rapid reinstatement of capacity for malaria control, diagnosis and treatment prevented the anticipated rebound in cases, with progress towards malaria elimination reverting to pre-pandemic trends in 2022.

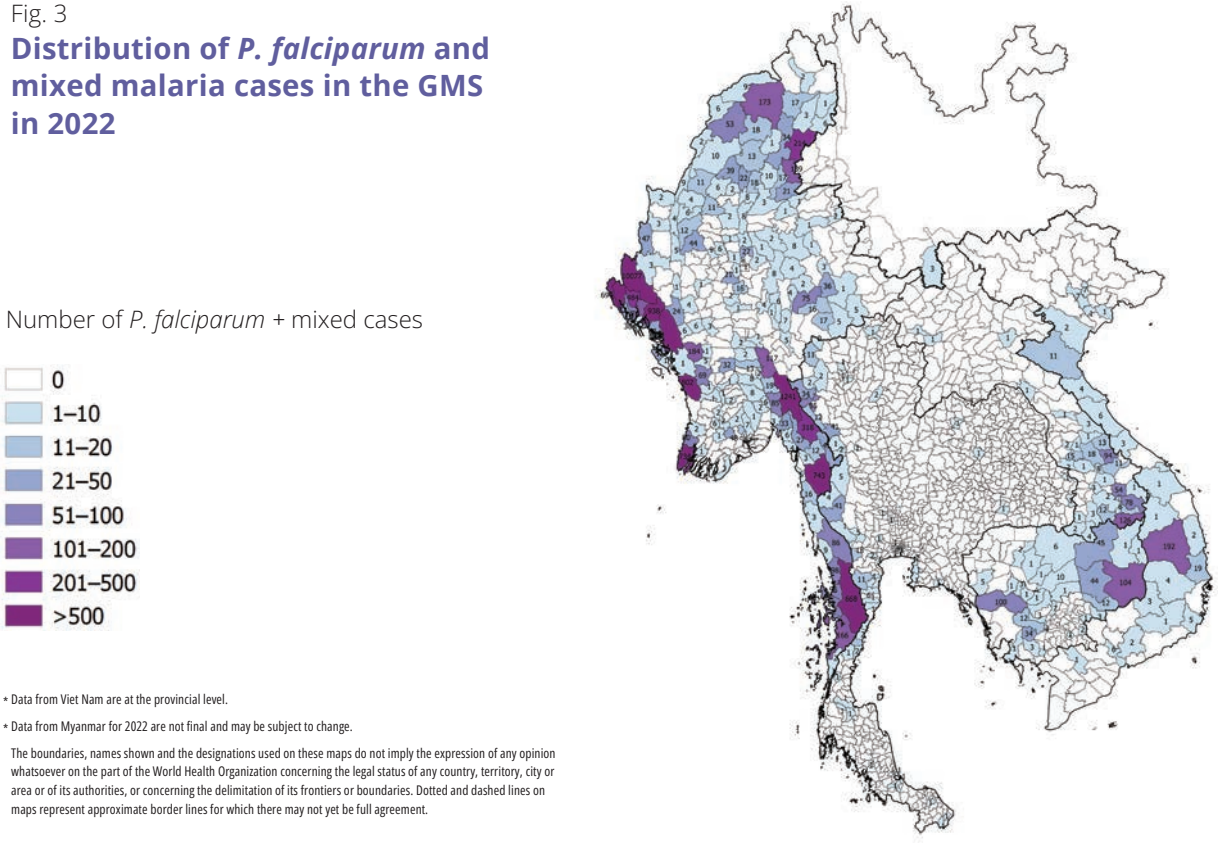
As malaria prevalence across the GMS has declined, cases have become concentrated in the most remote areas (Figs. 3 and 4). These geographically isolated areas are characterized by challenging terrain and limited access to health care. In addition, these areas often include minority/marginalized populations, and mobile and migrant populations, many of whom are involved in forest-related activities. Such communities are vulnerable to continued malaria transmission. Addressing these transmission foci requires tailored strategies that consider the unique geographical, social and cultural characteristics of the region. In 2022, there was an increased emphasis on decentralization of malaria services to community members designated as village malaria workers (VMWs). These initiatives have built upon the existing capacity of VMWs, expanding their responsibilities to enhance early diagnosis, vector control and preventive measures for vulnerable communities, including the implementation of targeted drug administration (TDA) and intermittent preventive treatment for forest-goers (IPTf). These approaches harness valuable local knowledge, enabling active engagement with the community to provide education on malaria risks, elimination objectives and the importance of preventive measures. This is particularly important in locations where new interventions and tools are introduced, as there may be hesitancy from communities, making it crucial to build trust and communicate effectively. As cases decline further, the next step will be to integrate VMWs into the primary health care and universal health coverage systems, while maintaining their specialized knowledge and leveraging their key perspectives on tackling malaria with the support of their community.

In 2022, Myanmar had the highest malaria burden in the GMS, with 129 614 cases – an increase of 64% from 2021, representing 88% of all cases across the GMS. The political situation in Myanmar continues to present challenges to malaria elimination goals, with disruptions to service delivery and supply chains. Internal displacement and the movement of people across borders has exacerbated the situation, threatening the progress made towards elimination not only in Myanmar, but also in neighbouring countries. WHO has assisted the national malaria programme (NMP) in developing plans to address the concentration of malaria cases in high-burden areas. However, COVID-19 travel restrictions and security concerns delayed the scale-up of activities in 2021 and 2022. Acceleration and intensification plans stratified by malaria risk are in place and will be implemented in 2023, as soon as the security situation allows.

Although *P. falciparum* partial artemisinin resistance is still prevalent across the GMS, multiple artemisinin-based combination therapies (ACTs) retain high levels of clinical efficacy. Data from therapeutic efficacy studies (TESs), integrated drug efficacy surveillance (iDES) and molecular markers of antimalarial drug resistance, considered alongside epidemiological data collated in the Malaria Elimination Database (MEDB), continue to support evidence-based updates to national treatment guidelines (NTGs). Of note, the June 2022 update to the *WHO guidelines for malaria (4)* recommends artesunate-pyronaridine (ASPY) for the treatment of adults and children with uncomplicated malaria. In addition, artemether-lumefantrine (AL) is recommended for the treatment of uncomplicated malaria in the first trimester of pregnancy. These new recommendations provide more options to deliver effective therapies to all malaria patients.

Fig. 3

Distribution of *P. falciparum* and mixed malaria cases in the GMS in 2022



* Data from Viet Nam are at the provincial level.

* Data from Myanmar for 2022 are not final and may be subject to change.

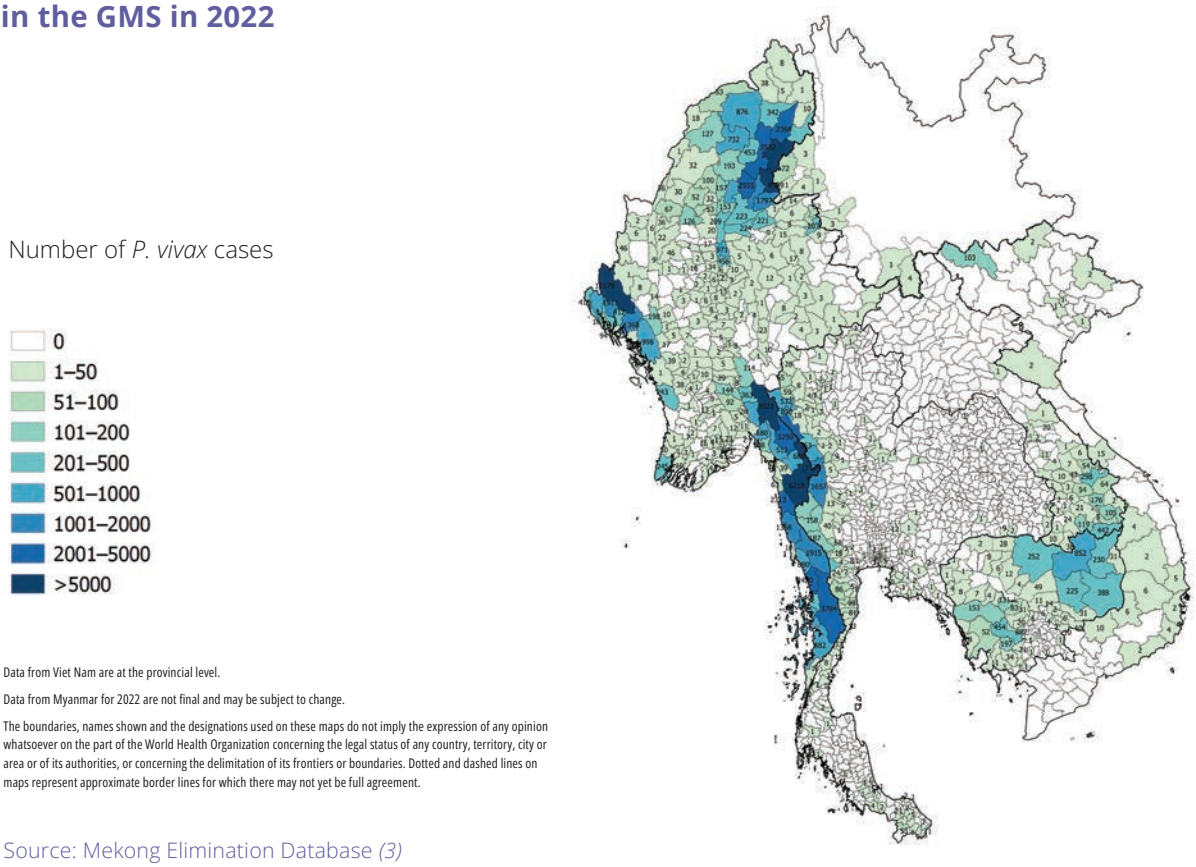
The boundaries, names shown and the designations used on these maps do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Source: Mekong Elimination Database *(3)*

Since 2018, *P. vivax* has been the most prevalent malaria parasite in the GMS and has been more refractory to elimination interventions. In 2022, there were 121 309 *P. vivax* cases in the GMS, representing 83% of all malaria cases in the region. The parasite has a dormant liver stage, during which hypnozoites are carried without symptoms until their reactivation causes a new acute malaria episode. Relapses inflate the burden of *P. vivax* malaria, as an individual can have many episodes from a single infective bite. In addition, hypnozoites represent a silent transmission reservoir that can be transported by infected individuals to new areas, potentially re-establishing transmission in places where transmission has been locally interrupted. Radical cure of *P. vivax* malaria requires the use of chloroquine (CQ) or an ACT to address the acute infection, plus primaquine (PQ) to clear hypnozoites from the liver and prevent relapse. However, ensuring adherence to the 14-day PQ regimen has been a barrier to effective deployment. The *WHO guidelines for malaria (4)* were updated in 2022 to recommend seven-day PQ, with the aim of improving adherence relative to the 14-day regimen. Although not yet included in WHO recommendations, tafenoquine (TQ) is a single-dose anti-relapse treatment with the potential to overcome the barrier to adherence. To date, there are few data on TQ in operational use.

Fig. 4

Distribution of *P. vivax* cases in the GMS in 2022



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Source: Mekong Elimination Database *(3)*

However, several pilot studies with CQ plus TQ were planned or initiated in 2022. Both PQ and TQ cause haemolysis in individuals with glucose-6-phosphate dehydrogenase (G6PD) deficiency. Consequently, prior G6PD testing is needed to ensure the safe use of these medicines. Access to G6PD testing across the GMS is limited, but point-of-care G6PD tests have recently become available. These are being evaluated in the hope that they will expand testing capacity and support the full and safe deployment of *P. vivax* radical cure.

In 2021, China became the first country in the GMS to achieve malaria-free status. The country is now focused on prevention of re-establishment (PoR) of malaria, targeting imported cases, in particular in the border areas (*P. vivax*) and from Africa (*P. falciparum*). Other countries in the GMS are aligning their processes and data management to meet the criteria for malaria-free certification. Subnational verification is being actively implemented in several countries and is contributing to programmatic strengthening. WHO is providing technical assistance to countries for subnational verification and the national certification process. In addition, the June 2022 *WHO guidelines for malaria (4)* include recommendations to specifically support the final phase of elimination and PoR.

The new guidelines *(4)* provide NMPs with the flexibility to deliver a package of interventions best suited to the local situation. Interventions include mass drug administration (MDA) to reduce *P. falciparum* burden in areas of moderate to high transmission and in emergency settings; to reduce transmission of *P. falciparum* in very low to low transmission settings; and to reduce transmission of *P. vivax*. Mass relapse prevention with an 8-aminoquinoline alone is not recommended. In areas with very low to low transmission or in post-elimination settings preventing re-establishment of transmission, other interventions refer to TDA for people with increased risk of infection relative to the general population, malaria testing and treatment of organized or identifiable groups arriving or returning from malaria-endemic areas, reactive drug administration or reactive case detection and treatment (RACDT) of all people residing with or near a confirmed malaria case and those who share the same risk of infection (e.g., co-travellers and co-workers), and reactive indoor residual spraying (IRS) of insecticide in the houses of confirmed cases and neighbours. To reduce the risk from imported malaria, interventions include testing and treatment and reactive drug administration targeting identifiable groups arriving or returning from malaria-endemic areas. By contrast, mass testing and treatment, targeted testing and treatment, and universal testing and treatment at points of entry are not recommended.

The Malaria Free Mekong platform, established in 2014, plays a crucial role in facilitating cross-border collaboration and communication among civil society organizations (CSOs) and communities in the GMS region. The platform has expanded its focus over time to include various aspects such as gender, disability, social inclusiveness and community systems strengthening. Currently, the platform supports coordination and communication among CSOs implementing malaria projects and works closely with

NMPs through its country representatives. It aims at fostering meaningful partnerships, advocating for inclusive policies and strategies, and building the capacity of CSOs by providing tools, guidance and training.

Underpinning the drive for malaria elimination, essential malaria services must continue, with the distribution of long-lasting insecticidal nets (LLINs) and testing and treatment of malaria cases, even in conflict-affected and border areas. In 2022, WHO focused its support on responding to malaria outbreaks related to COVID-19 and humanitarian emergencies, with an emphasis on reaching vulnerable and hard-to-reach populations. In collaboration with NMPs, partners and community volunteers, training programmes, surveillance system development and programme reviews were conducted to improve malaria control and elimination efforts. The updated plans and strategies have served as the basis for the funding request to the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund) Regional Artemisinin-resistance Initiative 4 Elimination (RAI4E) for the years 2024–2026.

Looking to the future, a decrease in donor funding is anticipated and the GMS countries are transitioning towards a domestically financed and supported malaria response, incorporating planning for PoR of malaria. This increased focus on the sustainability of malaria elimination includes effective integration of malaria activities into the wider health system, while maintaining expertise and remaining vigilant and responsive. This will ensure that the health, social and economic gains from malaria elimination are sustained in the long term throughout the GMS countries.

Reaching the unreached

Despite significant progress in recent years, there are still many challenges that need to be overcome to achieve malaria elimination. One of the most critical challenges is reaching the unreached populations who are at highest risk of malaria transmission, such as mobile and migrant populations, ethnic minorities, and those living in remote and forest areas. Reaching these populations is essential to ensure that they have access to the necessary malaria prevention and treatment interventions.

Reaching the unreached, particularly in remote and hard-to-reach communities, remains a significant challenge to achieving health goals such as malaria elimination. Such communities are often marginalized and lack access to basic health services due to their geographical location, cultural beliefs, and social and economic conditions.

Reaching the unreached is a global and regional health policy priority in line with the United Nations 2030 Agenda for Sustainable Development *(5)*. This priority is built on the principle of universality that aims at ensuring that no one is left behind. Efforts to reach the unreached require a comprehensive approach that considers the complex social, economic and political factors that contribute to these populations' vulnerability to malaria. This approach should involve collaboration between governments, health systems, CSOs and other stakeholders. Strategies for reaching the unreached should be tailored to the specific needs and circumstances of populations and should be based on an understanding of cultural beliefs, practices and preferences. Adopting a participatory and community-based approach will ensure that strategies are locally appropriate and acceptable. This will help to build trust and increase the uptake of malaria prevention and treatment interventions among these populations.

The case of Mondulkiri province, one of Cambodia's most remote regions, demonstrates that effective community engagement, strong partnerships and innovative strategies are key to overcoming challenges and achieving success in eliminating malaria. It would be impossible to reach the unreached in Mondulkiri without the use of VMWs such as Sean Borey from Pu-Kes Kapay village. He understands the needs and challenges of his community and was trained to implement TDA, conduct active fever screening (AFS) and provide IPTf. With support from the NMP and provincial health department, he also distributes long-lasting insecticidal hammock nets (LLIHNs) and LLINs and forest packs to forest-goers and isolated groups, including farmers and those working in forests. The deployment and use of these innovative and more aggressive strategies aimed at proactive disease elimination have been crucial in achieving the successes observed in Mondulkiri so far, with the number of *P. falciparum* cases declining from 2008 in 2018 to 104 in 2022. Such activities will need to be maintained and targeted to those most at risk to support the final push towards malaria elimination in the province.

A malaria village volunteer in Vonglakhone village receiving health-related training, Attapeu province, Lao PDR
© WHO/E. Catala

Country elimination progress

Cambodia

The Cambodia National Center for Parasitology, Entomology and Malaria Control (CNM), WHO and partners launched malaria elimination acceleration strategies in October 2020 to intensify the response to *P. falciparum* malaria in villages with local transmission. The response consists of the following steps: (i) community engagement and social mobilization is conducted immediately upon classification of a focus as active in order to raise awareness of the malaria situation in the focus and encourage participation and compliance with the activities; (ii) a census of the entire village is conducted to identify the target populations for TDA and IPTf, and the needs in terms of LLINs; (iii) two rounds of TDA are conducted to deplete the parasite reservoir in the focus, and LLIHNs and LLINs are distributed; and (iv) weekly AFS and monthly IPTf are conducted throughout the year to catch any cases as quickly as possible, prevent onward transmission and provide protection for people travelling to high-risk areas.

TDA and IPTf are given to men between the ages of 15 and 49, as this is historically the group at highest risk in Cambodia. There is the possibility of expanding these interventions to women and men in other age groups on an ad hoc basis in villages with outbreaks. Between January 2021 and August 2022, artesunate-mefloquine (ASMQ) was used for TDA and IPTf, but Cambodia switched to ASPY in August 2022 given the better acceptability and tolerability of this medicine; ASMQ is maintained as the first-line treatment for malaria cases.

From October 2020 to December 2022, 115 active foci were identified under 35 health centres in seven provinces. All seven provinces fully implemented the acceleration activities, with all health centres trained in the implementation of the activities. By December 2022, activities had started in 82% (94/115) of villages: census was completed in 82% of villages; LLIHN and LLIN top-up distribution was complete in 80%; two rounds of TDA were administered in 75%; and AFS was ongoing in 75% and IPTf in 66%. The first round of TDA achieved 75% coverage of the target population, and the second achieved 66% coverage, while AFS coverage ranged from 11% to 30%. The uptake of IPTf varied monthly and by season based on the number of people going to the forest and ranged between 11% and 55%, with an increase in uptake in all provinces immediately following the switch from ASMQ to ASPY.

From January to December 2022, Cambodia reported 4053 confirmed malaria cases, a 6% reduction compared to the same period in 2021 (4318 cases). Of the confirmed cases, six were imported internationally, accounting for 0.1% (6/4053). There were 414 *P. falciparum* + mixed cases reported, representing a 20% increase from the same period in 2021 (344 *P. falciparum* + mixed cases). The reported *P. falciparum* + mixed cases accounted for 10% of cases from all species, which represents a small but statistically significant increase from 8% in 2021. This increase should not pose a potential challenge to Cambodia's target to eliminate *P. falciparum* malaria by 2023 and all species of human malaria by 2025, as set out in the Cambodia malaria elimination action framework 2021–2025 *(6)*. In 2022, 3% of malaria cases occurred in children

aged 0–4 years, a 21% increase compared to 2021. Malaria testing continued to increase; 974 311 tests were performed in 2022, a 19% increase from 2021. However, 2022 saw a 29% decrease in test positivity rate compared to 2021 (0.42% vs 0.53%). Cambodia reported 58 severe malaria cases, which marked a 107% increase from 2021. Cambodia has not recorded any malaria deaths since 2018.

Out of the 4053 malaria cases reported, 77% were notified within 24 hours and 99.3% were investigated and classified. Following notification, villages with local *P. falciparum* cases were investigated and classified based on malariogenic potential, triggering an adapted focus response. In villages with *P. vivax* or imported *P. falciparum* cases, RACDT was deployed to identify other cases.

For the first time, Cambodia's malaria information system (MIS) reported 58 *P. malariae, P. ovale* or *P. knowlesi* cases, all from the south-west provinces of the country. This raises questions as to the real prevalence of these species in other parts of the country where microscopy is less routinely used for malaria diagnosis. WHO, with funding from the United States President's Malaria Initiative (PMI), is supporting the CNM in the training and capacity-building of microscopists and in a scheme for microscopy quality assurance for all hospitals in Cambodia.

Cambodia updated its NTGs in 2022 to include the most recent practices in diagnosis and treatment and relevant WHO recommendations, such as the treatment of *P. vivax* and *P. ovale* cases with seven-day PQ (0.5 mg/kg/day), and the treatment of pregnant women in the first trimester with *P. falciparum* malaria with AL. The mid-term review of the malaria programme was conducted in September 2022, leading to the revision of the monitoring and evaluation plan for the *Cambodia malaria elimination action framework 2021–2025 (6)*, and forming the basis of the Global Fund RAI4E funding proposal. Cambodia also updated the national *Surveillance for malaria elimination operational manual (7)* to reflect the urgent need to expand case and focus investigation, classification and response for all *P. falciparum* cases (locally acquired, and domestically and internationally imported) to achieve elimination goals. The concepts of subnational verification, documentation for the WHO malaria-free certification process and PoR of malaria transmission, and the criteria for malaria-free status for WHO certification were introduced through workshops and input from the WHO Mekong Malaria Elimination (MME) programme and Global Malaria Programme.

Challenges remain in fulfilling Cambodia's plans to eliminate *P. falciparum* malaria by the end of 2023 and all species of human malaria by the end of 2025, as intended, and innovation is required to build on the gains made in the past five years. New approaches, such as setting up volunteer-led malaria checkpoints to provide malaria services at forest entry sites, have been implemented in some provinces and have reinforced the early detection of malaria cases acquired in the forest. As recommended by the mid-term review, implementation partners in Cambodia are sharing knowledge and skills to enhance the provincial and operational district health systems' capacity for surveillance and response. Currently, treatment of *P. vivax* malaria with 14-day PQ is assured through supervisory visits by health centre staff or VMWs to patients, and G6PD testing occurs exclusively at the health centres. This represents a challenge in terms of reaching and ensuring follow-up of patients in remote communities. Consequently, the referral of *P. vivax* patients to health centres by VMWs has been reinforced through an incentive scheme.

Lao People's Democratic Republic

In 2022, Lao People's Democratic Republic rolled out accelerator strategies to target residual transmission of *P. falciparum* in the highest burden areas. These strategies were implemented in 60 villages, covering around 24 000 people: five villages during a pilot study in August–December 2021 and a further 55 villages in March–December 2022. These 60 villages reported around 70% of all *P. falciparum* cases in Lao People's Democratic Republic in 2020–2021. Strategies led by the Center for Malariology, Parasitology and Entomology (CMPE) included community engagement, household censuses, TDA, distribution of LLINs and preventive treatment.

Teams administered two rounds of TDA using ASPY at a one-month interval to anyone aged 7–49 years. Families received LLINs for their sleeping arrangements both in the village and in the fields. In addition, any family with a member who stayed overnight in the forest received an LLIHN. VMWs provided monthly IPTf to anyone aged 7–49 years sleeping overnight in the forest or cultivation fields. VMWs also conducted AFS of all village residents every two weeks. The implementation of these strategies resulted in an impressive 81% decline in *P. falciparum* cases and a 47% decline in *P. vivax* cases in 2022 compared to previous years.

To assess the quality of implementation and impact of the accelerator strategies and stakeholder satisfaction, a detailed review was conducted, which included four components: (i) a desk review of programmatic and epidemiological data; (ii) a knowledge, attitudes and practices survey; (iii) two large-scale review meetings at the subnational level; and (iv) programme evaluation during the national mid-term review. The results showed a high standard of implementation, successfully achieving the targeted project indicators. Stakeholder satisfaction was high at 90% among political leaders, implementers and communities at all levels. There was strong consensus to continue and expand the activities. However, the review identified gaps in reaching highly mobile populations, particularly in Phouvong district, Attapeu province. These communities engage in cultivation practices that include clearing new forest areas annually for crop growth. People conducting these practices often sleep in the fields in open shelters close to the forest, and they are at high risk for malaria. Tracing these populations is challenging, as the locations of the clearing work and cultivation fields change each year. The demand for cassava on the international market has contributed to an increase in these cultivation practices. Reaching and protecting these people from malaria is a high priority for the CPME. In 2023, teams of mobile malaria workers will conduct monthly outreach to deliver IPTf to approximately 150 scattered field locations.

The accelerator strategies have been highly effective at safeguarding individuals in the highest burden communities. A comprehensive review has played a crucial role in enhancing these strategies. Moving forward, CPME will continue to evaluate and provide guidance on the accelerator strategies towards the end of each year, thereby improving programme delivery, reaching the unreached and meeting their malaria elimination goal.

In 2022, Lao People's Democratic Republic made significant progress in reducing the malaria burden, with only 2340 reported cases, a 40% decrease from 2021 (3924 cases). The reduction in *P. falciparum* + mixed cases was 64% in 2022 (504 cases) compared to 2021 (1369 cases), whereas *P. vivax* decreased by 28% in 2022 (1835 cases) compared to 2021 (2555 cases). This impressive reduction in cases has occurred in parallel to a 31% increase in testing across all locations, including public and private health facilities, and among VMWs in communities. Unfortunately, one person died from *P. falciparum* malaria in 2022.

The strides made in progress towards malaria elimination can be attributed to the impact of the accelerator strategies targeting the highest burden communities, as well as intense efforts to rapidly identify transmission locations and target outbreak responses to these communities. Transmission locations are often outside of the village in remote cultivation fields near the forest, requiring outbreak response teams to travel long distances, often by foot, to reach these people and interrupt malaria transmission.

A comprehensive mid-term review of the national strategic plan was completed in 2022, and the findings and recommendations have played a pivotal role in shaping the forthcoming grant application to the Global Fund RAI4E. The mid-term review was structured around the eight key thematic areas of the programme (programme management; procurement and supply chain management; surveillance and epidemiology; advocacy and information, education and communication; vector control; case management; elimination; accelerator strategies) and involved a desktop review exercise, followed by verification of the results through stakeholder meetings and field visits, and finally an inclusive mid-term review validation and consensus meeting. There were more intensive reviews of the progress and impact of activities in two thematic areas: surveillance and epidemiology, and the accelerator strategies.

A stratification exercise conducted in 2022 classified 91% (134/148) of districts in Lao People's Democratic Republic as ready for elimination (annual parasite index < 1). In elimination districts, all cases are promptly reported within one day, investigated within three days, and if necessary, foci are responded to within seven days (1-3-7 strategy). Impressive progress has been made in meeting these core elimination indicators, with 99% of cases reported from elimination districts within 24 hours, 100% of reported cases investigated within three days and 90% of active foci responded to within seven days. Of the 157 cases reported from elimination districts, 89 were classified as being locally acquired. The same stratification exercise resulted in an additional 1 million of the 7 million population of Lao People's Democratic Republic being classified as living in malaria-free areas in 2020–2021 compared to 2017–2019.

Surveillance in the remaining 14 burden reduction districts is focused on transitioning the programme to being more elimination ready. An immediate notification system for all cases will be available in 2023 by integrating malaria case reporting from these areas into the Emergency Operations Centre hotline. This integration will lead to improved

timeliness in routine reporting, strengthen interdepartmental collaboration and establish a sustainable pathway for malaria notification and response beyond elimination. Starting in 2023, a simple case classification will be applied to all cases reported in burden reduction districts at the point of diagnosis. The availability of granular case classification data will improve the identification of transmission locations and speed up outbreak responses, resulting in greater impact. Outbreak response will be more aggressive, with routine outbreak response for all villages that surpass the outbreak threshold of more than four cases in one month, and two rounds of TDA in villages with more than four cases in two consecutive months.

WHO has provided technical support where it is most needed at the subnational level by placing two United Nations volunteers in the two highest burden provinces, and seven field staff in the highest burden districts. The impact has been seen in the improved quality of data and outbreak response. The malaria staff at the subnational level have improved their capacity to effectively manage outbreaks and coordinate the response efforts of the programme at each of these levels.

Significant updates were made to the NTGs in 2022. Notably, the inclusion of weekly PQ for eight weeks allows for prescription at the community level for *P. vivax* cases if the patient is unable to travel to a public health facility for G6PD testing. In addition, the NTGs includes a shorter seven-day PQ treatment regimen for *P. vivax* that can be prescribed at all public health facilities. This shorter regimen will support patient adherence and improve the effectiveness of radical cure. To strengthen *P. vivax* referral and treatment follow-up, dedicated compliance tracking forms are now being used, and budget has been allocated for routine follow-up by VMWs or health facility staff to support PQ adherence for all *P. vivax* patients. All these changes will be implemented in 2023.

Entomological surveillance in 2022 focused on collections from high-burden villages targeting three different ecotypes: (i) villages close to the forest (night collections); (ii) remote cultivation sites or katos (night collections); and (iii) forests (24-hour collections). The surveillance also included human behaviour observations. Results indicated high biting rates from primary and secondary vectors in both villages and katos, with a significant amount of biting occurring earlier in the day both indoors and outdoors. Although there were fewer primary and secondary vectors found in the forest, their biting patterns persisted throughout the day and night. The conclusions drawn from this work emphasize the high transmission risk of temporary seasonal cultivation sites scattered around the main villages, and the importance of LLINs as a preventive tool in villages and scattered sites. Innovative tools and new strategies are needed to address the biting that occurs in the early evening and early morning, both indoors and outdoors, and in hard-to-reach, scattered sites.

Myanmar

Myanmar experienced a significant increase in malaria cases in 2022, after a reduction in burden in the previous years, due to the complex political situation in the country. This situation caused interruption of case management, reporting and the supply chain in some areas, and has made it difficult to implement intensification or elimination acceleration activities in the country.

Since 2018, 20 high-burden townships have contributed 80% of all malaria cases. To address this, starting in 2020, WHO has supported the NMP to develop plans for the implementation of intensification and elimination acceleration activities in hotspot areas. However, because of the political developments in early 2021, restrictions were placed on travel within the country, which severely limited activities, including supervision and monitoring visits, due to security and safety concerns. Given these obstacles, intensification and elimination acceleration activities could not be scaled up in 2021 or 2022.

Following publication of new strategies recommended by WHO to accelerate malaria elimination, the WHO Country Office in Myanmar, with support from the MME programme, refined and designed new stratification criteria for the country, along with response intensification and elimination acceleration strategies adapted to the Myanmar context. The refined stratification is guided by transmission dynamics and intensity at the village level. A plan and protocol have been developed for conducting several of the new strategies, including MDA, TDA, IPTf, testing of people returning from high-risk areas, reactive IRS and reinforced adherence to PQ regimens. These strategies are to be implemented based on the stratification. The plans and standard operating procedures for the activities were finalized at the end of 2022, with input from all partners and state medical officers. A training and pilot implementation proposal is being developed with a start date scheduled for the second quarter of 2023.

In Myanmar, malaria cases increased by 64% in 2022 to 129 614, compared to 79 001 in 2021. The number of *P. falciparum* and mixed cases increased by 56% (23 590 cases in 2022 versus 15 127 cases in 2021), but the major surge was in *P. vivax* malaria, which almost doubled to 106 024 cases in 2022 from 63 874 in 2021. However, despite this increase in cases, the number of deaths reported remained similar, with 13 deaths recorded in 2022 and 11 in 2021.

Myanmar is facing a very complex operational environment due to ongoing COVID-19 transmission and the political climate, which has severely affected the NMP. Human resources have been greatly reduced, leading to a breakdown in service delivery (malaria prevention, testing and treatment, and case management) in the public health care facilities. There have also been serious disruptions to the malaria commodities supply chain.

Between February 2021 and the end of 2022, over 1.5 million people were displaced amid armed conflict. The migration of people from low to high transmission areas has already led to focal outbreaks and resurgences. This also poses a longer term threat to the gains that had been made in previous years towards the goal of malaria elimination, not only in

Myanmar, but also in the whole region. Over 80% of Myanmar's malaria cases are now concentrated in 20 townships along the international borders with Bangladesh, India, Thailand and Yunnan province in China, and the substantial progress towards malaria elimination achieved over the last decade is at stake. Myanmar is at risk of not meeting its malaria elimination goals, i.e. eliminating *P. falciparum* by the end of 2026 (a goal that was revised in 2022 and extended to 2026) and eliminating all human malaria by the end of 2030. Furthermore, the spillover into neighbouring countries contributed to an increase in cases in Thailand in 2022.

In conjunction with the NMP, partners and 23 000 integrated community volunteers, continue to provide essential malaria services. The NMP leadership plays an important role in coordinating efforts and support among partners and donors. Despite the difficult implementation situation, in 2022, around 306 000 LLINs were distributed to at-risk people. In addition, health workers conducted 2.2 million malaria tests, detecting 125 000 malaria cases, all of which were treated. The health workers provided services to all patients who sought care, irrespective of gender, ethnicity and geographical provenance; partners also continued to provide malaria services even in areas of protracted conflict and in areas with new clashes along the international borders.

In 2022, WHO focused its support on responses to malaria outbreaks related to COVID-19 waves and to the humanitarian emergencies in such a way as to reach the most vulnerable and hard-to-reach populations. Over 100 staff from the NMP and implementing partners were trained in delivering malaria services. The WHO Country Office also incorporated the new *WHO guidelines for malaria (4)* into the intensification and acceleration plans to overcome the programmatic loss suffered because of the COVID-19 pandemic and the political crisis. WHO continued to support malaria case notification and classification, and focus investigation, classification and response, as well as the development of a sensitive and specific surveillance system. The Country Office also supported the external malaria programme review conducted in October 2022, the recommendations of which led to the update of plans and the revision of national strategies, and served as a guide to develop the Global Fund RAI4E funding request for 2024–2026.

Thailand

In Thailand, the malaria transmission areas are identified and classified using a focus-based system to efficiently target interventions for malaria elimination. In 38 out of the 77 provinces in the country, interventions are being implemented that are specifically directed towards populations residing in A1 (active foci) and A2 (residual non-active foci) subvillages. The at-risk populations in 2022 were identified as follows: residents of A1 areas, non-Thai migrants, individuals exposed to outdoor transmission, children and adolescents, and people living in displaced population camps.

The estimated at-risk A1 area-resident population consists of 457 707 Thai people and 291 788 migrants living in Thailand for more than six months in 678 active foci subvillages (classified as A1), made up of 591 Thai subvillages and 87 sections within the nine displaced population camps. In addition, there are approximately 32 696 migrants living in Thailand for less than six months and 88 000 people living in 178 cross-border foci on the Myanmar side of the border. Based on patient records and case investigation data, approximately 19% of the Thai population is engaged in outdoor activities that may put them at risk of malaria. In 2022, these at-risk populations, such as agricultural workers, forest-goers, farmers and people living near forests, accounted for around 51% of confirmed cases. Border police, uniformed personnel and forestry personnel are also considered at-risk populations, but obtaining accurate numbers for these groups is challenging due to security concerns. However, in 2022, uniformed personnel, including police, reported 134 confirmed malaria cases (1.3%) to the Division of Vector-Borne Diseases (DVBD), Ministry of Public Health Thailand. Children of migrants, students attending one of the 93 schools in the nine displaced population camps, one of the remote schools operated by the border police, or one of the boarding/religious schools for children from remote areas, children accompanying their parents into the forest and children from forest fringe communities form a significant high-risk group. The number of cases reported among children increased five-fold in 2022 compared to 2021. Meticulous risk monitoring and transmission mapping helps to identify areas experiencing increased pressure and facilitates the targeting of foci in fluid and volatile transmission settings.

In 2022, Thailand witnessed a significant increase in malaria cases, reporting a total of 10 156 cases, which marked a 211% surge compared to the 3266 cases reported in 2021. During the same period, the crude testing rates rose by 7% to reach 688 350 tests, and the test positivity rate increased from 0.5% to 1.5%.

Case investigations in 2022 showed that 37% of cases were imported. Most cases in Thailand continue to be diagnosed among adult men (70%). However, a considerable proportion of cases (23%) were found among children aged 5 to 14 years, while children under 5 represented approximately 5% of malaria cases. *P. vivax* accounted for 95% of all cases (9604 cases, a three-fold increase compared to 2021), with *P. falciparum* and mixed cases representing just 3% of cases (321 cases, an almost four-fold increase compared to 2021) and *P. knowlesi* accounting for 2% of all cases (176 cases). One malaria death was reported in 2022 due to *P. knowlesi*. Most malaria cases in 2022 occurred in the non-Thai population, representing 53% of all reported cases, which marked a 377% increase compared to 2021. At the same time, cases detected among Thai individuals increased by 2.2%. Most non-Thai cases were among Myanmar nationality holders, who accounted for 99% of all non-Thai cases.

In terms of response time, throughout 2022, 85% of cases were notified within one day (compared to 87% in 2021), 97% cases were classified within three days (versus 94% in 2021), and a focus response was initiated within seven days in 76% of foci (compared to 87% in 2021).

To ensure the quality of malaria microscopy readings, the national reference laboratory launched a standardized malaria microscopy training curriculum in 2022. Work also commenced on establishing a national laboratory database linked to the MIS.

Thailand's malaria elimination policies continue to be integrated into the general health system. Throughout 2022, 540 village health volunteers in malaria-endemic villages received comprehensive training on supervised treatments, patient follow-up, case detection and behaviour change communication. At the subdistrict level, local governments pledged to continue increasing their annual budgets for malaria, with the aim of building sustainable subnational financing models. Thailand also focused on integrating PoR measures into the national system; the country has drafted a PoR plan, and a pilot implementation was initiated in two provinces in 2022. The DVBD plans to evaluate and update the plan accordingly, with the intention of scaling up implementation throughout 2023. Thailand's focus will now shift to PoR of malaria in six of the 46 provinces that were verified as malaria-free prior to 2022.

In 2022, Thailand's biggest challenge to achieving the intended goal of eliminating *P. falciparum* by 2023 and all species of human malaria by 2024 was the dramatic increase in the movement of people across the porous border between Myanmar and Thailand, caused by the political situation in Myanmar since February 2021. From 2000 up to 2022, malaria cases in Thailand had declined steadily, but as of early 2022 a reversal in this declining trend was apparent. In 2022, the continuing political crisis in Myanmar, coupled with the lifting of COVID-19 travel restrictions, resulted in malaria cases increasing dramatically, with the majority (94%) of malaria cases occurring in six provinces along the Thailand–Myanmar border. In addition, the escalation of the civil unrest in Myanmar has made it difficult for malaria control activities to be implemented effectively along the border.

Based on situation reports from the DVBD, the Department of Disease Control, Ministry of Public Health Thailand, instructed high-burden border provinces to step up interventions and develop a targeted response plan, in line with recommendations from the malaria programme review supported by WHO. Rapid within-country reprioritization enabled increased number of interventions, including proactive case detection among at-risk populations in the six affected provinces. Following the RAIE Regional Steering Committee Independent Monitoring Panel's finding that LLIN coverage was alarmingly low, including in refugee camps, and its recommendation that vector control policy be switched to proactive LLIN distribution and IRS, Thailand initiated the procurement of insecticides and the necessary equipment for LLIN re-treatment.

The DVBD revised Thailand's operational plan for malaria for the six provinces along the border to better reflect the current malaria risk. In addition, the malaria programme review, conducted in November 2022, identified key strategies to address the situation along the border. These include the development and implementation of a preparedness and response plan with cross-border focus-targeted activities that will require the focus response to target migrant workers in areas on both sides of the border. This will rely on strong collaboration, coordination and synchronization between Thailand and Myanmar. Within the Thai border areas, the programme will explore the possibility of using CQ as chemoprevention and will consider introducing TQ or a seven-day regimen of PQ. Other potential solutions include establishing more community malaria posts along the border and including malaria elimination as an agenda in the National Communicable Disease Committee, which is chaired by the Minister of Public Health at the national level and by the governors at the provincial level. It is also proposed that the National Communicable Disease Committee should establish a strategic and technical advisory group to oversee the elimination programme.

Thailand will continue to adapt its strategies to target malaria as the risk evolves both along the border and within the country, with support from WHO, partners and donors. With a flexible approach to addressing the changing and challenging situation, it is feasible for Thailand to get back on track to achieve malaria elimination within a timeframe that is as close as possible to the original goals set out in the *National malaria elimination strategy Thailand 2017–2026 (8)*.

Viet Nam

A recent mid-term review of Viet Nam's efforts to eliminate malaria included crucial recommendations based on an analysis of the results. As the malaria situation in the country changes, Viet Nam has continued to modify the ways in which its interventions are deployed.

The malaria management system in Viet Nam, which gathers information on case notification, case and foci investigations, foci registries, malaria stocks and commodities, has been continuously strengthened. Targeted interventions include the deployment of LLINs and LLIHNs throughout high-burden areas. The country uses a 2-7 method for surveillance that mandates a focus inquiry within two days and a focus reaction within seven days.
In cooperation with WHO, the National Institute of Malariology, Parasitology, and Entomology (NIMPE) in Hanoi, and the Institutes of Malariology, Parasitology, and Entomology in Quy Nhon and Ho Chi Minh City continued their efforts to verify subnational areas as being free of malaria. To date, 42 of 63 provinces have been verified. For these provinces, integrated services will be used to sustain high-quality malaria services for PoR of malaria transmission.

Viet Nam has also assessed the feasibly of MDA in the northern part of the country to interrupt *P. vivax* malaria transmission in targeted villages and is considering IPTf where a significant number of *P. falciparum* cases have been detected. Viet Nam is currently implementing a range of operational research projects to manage *P. vivax* foci and reservoirs, including a study on the feasibility of point-of-care G6PD testing among *P. vivax* cases. The financial support for eradicating malaria continues to face difficulties. Provincial malaria centres and other preventive health centres have merged in the past five years to become provincial centres for disease control and prevention. Resources for malaria at the provincial level have consequently been reduced. To maintain comprehensive coverage of malaria elimination activities in specified geographical areas in the upcoming year, a greater emphasis must be placed on advocacy, securing sustainable sources of finance and preserving the technical staff's capacity.

The prevalence of malaria in Viet Nam continues to fall and is now concentrated in the country's northern and central areas. The number of cases reported by Viet Nam in 2022 was 455, a 2.6% reduction compared to the same period in 2021 (467 cases). There were 273 *P. falciparum* + mixed cases reported, representing a 31.9% increase from the same period in 2021 (207 *P. falciparum* + mixed cases). The reported *P. falciparum* + mixed cases accounted for 60% of all species, representing the dominant species among all malaria-positive cases. Around 70% of *P. falciparum* cases were concentrated in Gia Lai province, one of the country's central areas (191/272). There were 166 *P. vivax* cases reported, a 35.7% reduction compared to the same period in 2021 (258 cases). Around 62% of *P. vivax* cases were concentrated in Lai Chau province (103/166) in the country's northern area adjacent to the border with China. *P. vivax* cases currently constitute 36.5% (166/455) of all malaria cases, but this proportion is set to rise as *P. falciparum* elimination continues to accelerate with the goal of reaching *P. falciparum* elimination by 2023. Malaria testing increased in 2022, with 1 416 690 tests performed, an increase of 8.3% compared to 2021. Therefore, there was still a very low test positivity rate in 2022. In the GMS, Viet Nam has the lowest test positivity rate because of the low number of malaria cases and high number of tests performed.

In 2023, efforts towards malaria elimination could be accelerated with MDA and IPTf in active transmission areas. For smooth implementation of MDA and IPTf, and community engagement will be further strengthened.

Patient data collection and inclusion into online database, Viet Nam
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MEDB: Malaria Elimination Database

The MEDB was established in 2014 as part of the *Emergency response to artemisinin resistance in the Greater Mekong subregion (9)* as the Regional Data Sharing Platform (later renamed MEDB) *(3)*. The database underwent a transition from business intelligence to District Health Information Software 2 (DHIS2) in 2015. During the 2018 Ministerial Call for Action, all GMS countries committed to exchanging core surveillance data on malaria, including data on imported or cross-border malaria cases and drug resistance.

As a platform established to facilitate data sharing with NMPs and malaria partners, the MEDB plays a critical role in monitoring and supervising the malaria situation across the subregion. The MME programme has provided training and access to the platform for NMP focal points at the central and subnational levels, as well as for malaria partners within the GMS. The database enables strategic decision-making and improves coordination and communication among countries, partners and stakeholders by providing detailed regional and country-specific epidemiological information. It offers access to data down to the health facility level for Cambodia and Lao People's Democratic Republic, the subdistrict level for Thailand, the township level for Myanmar, the provincial level for Viet Nam (with plans for expansion to the district and lower levels) and the county level for China's Yunnan province.

The MEDB data have proven instrumental in various initiatives. For instance, these data were used during the development of the RAI3E grant in 2020, providing guidance on the deployment of implementing partners to border areas to extend malaria services to mobile and migrant populations and vulnerable groups. The platform routinely provides information to advisory bodies, donors and stakeholders, such as the Global Malaria Programme Malaria Policy Advisory Group and the RAIE Regional Steering Committee during national and international conferences and workshops.

In conjunction with national databases, the MEDB supports monitoring activities during the RAIE Regional Steering Committee Independent Monitoring Panel's visits and provides evidence-based recommendations. Regular epidemiology summaries are produced on a monthly and quarterly basis, and shared with NMPs and partners to update them on the malaria situation in the GMS. The MEDB's value extends beyond the GMS, as lessons learned support other regional initiatives, such as the WHO South-East Asia regional database, the Regional Office of the Western Pacific's integrated strategic database initiative, and malaria elimination initiatives in the Guiana Shield.

Over the years, the GMS countries have enhanced their surveillance systems, progressively sharing more frequent and granular data through the MEDB. In addition, data on drug efficacy will be included in the MEDB in 2023. The MEDB is now used as a tool for WHO, NMPs and partners to routinely perform epidemiological analyses and guide countries to define new innovative strategies and malaria interventions towards malaria elimination. The countries will share more refined data, while improving surveillance systems and enhancing the quality of data captured within the MEDB for the GMS. As surveillance is a core intervention to achieve malaria elimination, the MEDB will continue to play an essential and dynamic role in collecting, processing and sharing information at the subnational, national and regional levels.

Antimalarial drug efficacy and drug resistance

TESs remain the gold standard to assess the efficacy of first- and second-line treatments for malaria. WHO has developed a standard TES protocol, which is updated regularly. Since 2008, WHO has organized meetings of the GMS TES Network to assist countries in reviewing data on drug efficacy and developing specific plans for monitoring efficacy. As more countries progress towards malaria elimination, they have begun iDES. Molecular markers of antimalarial drug resistance are complementary to TESs and iDES and help to improve understanding of the cause of treatment failures. Monitoring of validated molecular markers can detect the emergence of antimalarial drug resistance and follow trends over time. Detailed data can be accessed in WHO Malaria Threats Map *(10)*.

TESs

In 2022, TESs were conducted in Kratie, Ratanakiri and Stung Treng provinces in Cambodia. Two studies focused on *P. falciparum* and three on *P. vivax*, all testing the efficacy of ASMQ, which was found to be 100% effective for both species. In 2021–2022, the efficacy of the first-line treatment AL in Lao People's Democratic Republic was generally high in Attapeu and Savannakhet provinces, at 94.7% and 95.1%, respectively. For *P. vivax*, the efficacy of AL was 100% in Attapeu and Sekong, but only 88.2% in Savannakhet. Between 2019 and 2020, only four TESs were conducted in Myanmar, with > 96% efficacy found for AL and dihydroartemisinin-piperaquine (DHA-PIP) for *P. falciparum* and 95% efficacy for CQ for *P. vivax* in Rakhine state. In 2022, a TES of CQ for *P. vivax* reported 90.4% efficacy in Kachin state. In Viet Nam, high efficacy was reported for ASPY for *P. falciparum* (100%) in Binh Phuoc, Gia Lai and Phu Yen provinces, despite a high day-three positivity rate (> 50%). CQ efficacy for *P. vivax* ranged between 93.8% and 100% in the same provinces in Viet Nam.

iDES

In 2017, the Thailand DVBD agreed to implement iDES to ensure complete treatment of all malaria cases. While progress has been made, specific challenges persist, and continued efforts are needed to ensure successful iDES implementation nationwide. During the initial three years of implementation (2017–2020), field monitoring revealed numerous challenges. These included the need for improved coordination and regular on-site re-training and supportive supervision from the central level to the subnational level. Low compliance with the NTGs and inadequate follow-up rates were also identified as significant challenges. Moreover, the transition of the DVBD from a vertical malaria programme to integration with the general health services resulted in delays in the notification of cases from hospitals and reporting in the MIS. In addition, hospital staff were not adequately included in the training processes.

In 2017, the Office of Disease Prevention and Control Region 1 and the DVBD piloted iDES in three provinces (Chiang Mai, Mae Hong Son and Chiang Rai) in the north-west region, eventually expanding to eight provinces between 2018 and 2019 and then to the entire country by 2020. iDES was implemented countrywide, building on a history of drug efficacy monitoring and interventions, enabling the programme to collect comprehensive data using a case follow-up form. This form includes a patient history, parasite species, treatment regimen, and laboratory and clinical results in each follow-up day. Patients with *P. falciparum* malaria who receive DHA-PIP or ASPY and single-dose PQ are followed up at days 3, 7, 28 and 42. Patients with *P. vivax* malaria who receive CQ and PQ are also followed up at days 60 and 90. Standard operating procedures were developed at the DVDB and piloted by the Office of Disease Prevention and Control Region 1 Chiang Mai. These procedures were integrated with routine work as early as 2017, with the aim of encouraging local health provider adoption. The iDES dashboard and overall performance have evolved over the past six years and will continue to do so. iDES follow-up rates improved initially in 2022, with more patients presenting for at least one follow-up visit compared to 2021. However, the increase in cases in six provinces along the Thailand–Myanmar border has reduced the overall countrywide iDES follow-up rates. Overall efficacy for DHA-PIP for *P. falciparum* malaria (not polymerase chain reaction-corrected) was 94.3% in 2021 and 100% in 2022. For provinces using ASPY, there were no *P. falciparum* cases in 2021; of the three cases reported in 2022, two reported full follow-up and clearance and one was lost to follow-up after day zero. For *P. vivax*, CQ plus PQ efficacy at day 90 was 94.7% in 2021 and 95.8% in 2022.

In China, the primary challenge to implementing iDES for imported malaria is ensuring the follow-up of patients who may only temporarily be in the country. Training delivery, quality assurance and human resources investments in malaria surveillance were negatively impacted by the COVID-19 pandemic. To address these challenges, an updated iDES protocol complying with WHO recommendations will be issued in 2023 and the parasitic diseases information reporting management system will be updated to add indicators for drug resistance surveillance. iDES will be implemented nationwide in 2023, with quality assurance provided by provincial laboratories.

In Cambodia, the significant reduction in malaria case burden has prompted the implementation of iDES, with technical support from WHO, the Clinton Health Access Initiative (CHAI), Catholic Relief Services and Cambodia Malaria Elimination Project 2, and financial support from PMI. In 2022, operational guidelines for iDES were finalized, and the programme was launched in 10 provinces. Training of trainers' meetings were completed, and cascade training was scheduled to start in December 2022 and conclude by mid-January 2023.

In Lao People's Democratic Republic, the iDES programme enrols cases in elimination districts, but there are challenges in data collection at days 28 and 90 due to operational planning, budget constraints and limited human resources at the subnational level.

In Viet Nam, as part of its ongoing effort to follow up patient treatment outcomes and the effectiveness of antimalarial drugs, NIMPE began piloting iDES in Phu Yen province in 2019 and 2020, and Gia Lai and Binh Phuc provinces in 2020.

Molecular markers

Four main molecular markers of antimalarial drug resistance are monitored in the GMS:

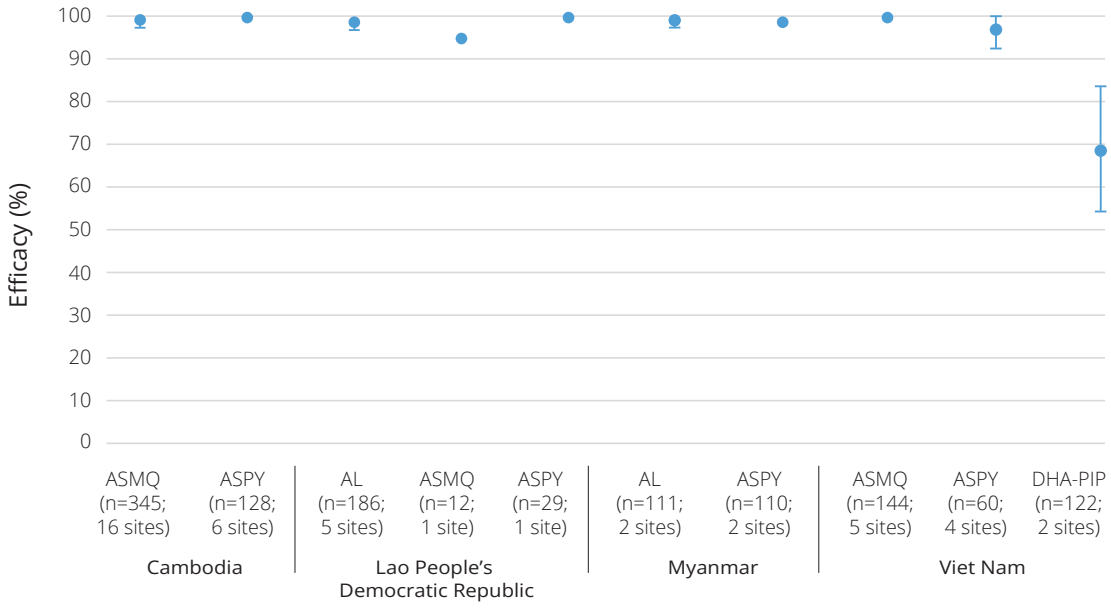
- *P. falciparum Kelch 13 (PfK13)*, a marker of artemisinin partial resistance;
- *P. falciparum multidrug resistance 1 protein (Pfmdr1*) copy number, a marker of mefloquine resistance;
- *P. falciparum plasmepsin 2–3 (Pfpm2-3)* copy number, a marker of piperaquine resistance;
- *P. falciparum chloroquine resistance transporter (Pfcrt)*, a marker of piperaquine resistance.

Artemisinin partial resistance persists throughout the GMS, except in the north of Lao People's Democratic Republic. In the eastern part of the GMS, *PfK13* C580Y remains the most prevalent mutation, although the mutation *PfK13* Y493H and wild-type parasite are increasingly present in Cambodia. In Lao People's Democratic Republic, a recent outbreak was driven by *PfK13* R539T, replacing *PfK13* C580Y. In Thailand, *PfK13* R561H seems to be more prevalent in the western part compared to the north-eastern part (*PfK13* C580Y) of the country. There was no selection of *Pfmdr1* amplification in Cambodia after implementation of ASMQ as first-line treatment and a significant decrease of *Pfpm2-3* in Cambodia and Lao People's Democratic Republic. There was also a decrease of *Pfpm2-3* after the deployment of ASPY in Viet Nam countrywide.

In conclusion, despite the high prevalence of partial resistance to artemisinin, several ACTs are highly efficacious against *P. falciparum* malaria in all GMS countries. ASPY is efficacious in Cambodia, Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam. ASMQ is efficacious in Cambodia, Lao People's Democratic Republic, Myanmar and Viet Nam. Mefloquine resistance did not emerge in these countries and reversed in Cambodia after the implementation of DHA-PIP as first-line treatment. DHA-PIP remains efficacious in Myanmar and western Thailand. The significant decrease of *Pfpm2-3* suggests that piperaquine resistance is progressively reversing in the GMS. AL efficacy remains high in Lao People's Democratic Republic and Myanmar. High failure rates of artesunate-amodiaquine and AL were reported in Cambodia in 2016–2017 and 2018–2020, respectively. Trends of the efficacy of ACTs against *P. falciparum* between 2018 and 2022, by country are shown Fig 5.

For *P. vivax* malaria, CQ treatment failure has been observed sporadically over the past few decades in Cambodia, Myanmar, Thailand and Viet Nam (almost always < 10%). CQ resistance was confirmed in Myanmar, Thailand and Viet Nam (always < 5%). ACTs tested against *P. vivax* are highly efficacious in the GMS, except for AL if not given with PQ, because of the short half-life of lumefantrine.

Fig. 5
Efficacy of ACTs against *P. falciparum* between 2018 and 2022, by country



Source: Malaria Threats Map *(10)*

Note: AL: artemether-lumefantrine; ASMQ: artesunate-mefloquine; ASPY: artesunate-pyronaridine; DHA-PIP: dihydroartemisinin-piperaquine.

P. vivax: challenges in control and elimination

There are many diverse technical difficulties involved in the successful diagnosis, treatment, clinical management and control of *P. vivax* malaria. Most of these are only very recently understood and present a diverse set of challenges. However, there are opportunities for innovation and progress in developing strategies to address this major barrier to malaria elimination in the GMS.

Whereas *P. falciparum* gametocytes appear after malaria symptoms, *P. vivax* produces gametocytes very early on in infection that are generated consistently during the infection. Consequently, infected individuals can transmit *P. vivax* before symptoms occur. This makes prevention of *P. vivax* infection critical if transmission is to be effectively interrupted.

P. vivax is able to reproduce over a greater range of temperatures than *P. falciparum.* This increases the range of biological habitats that are receptive to *P. vivax* transmission and hence the geographical area over which transmission can occur. This is particularly relevant for PoR, which may need more extensive consideration for *P. vivax* than for *P. falciparum.*

The high genetic variability of *P. vivax* requires adaptive responses to control efforts. Continued monitoring of CQ efficacy in TESs is needed, along with vigilance on the effectiveness of therapy through iDES. Programmes will need to incorporate the flexibility to switch to ACTs if necessary, while monitoring their effectiveness against the parasite.

Diagnosis of *P. vivax* is limited by low parasitaemia levels, as parasite biomass occurs predominantly in the extravascular spaces of deep organs such as the bone marrow, spleen and liver, rather than in the peripheral blood. This explains why severe *P. vivax* malaria can occur at parasitaemia levels far lower than those observed for severe *P. falciparum* malaria. In acute uncomplicated malaria, *P. vivax* parasitaemia can be submicroscopic and diagnosis may be missed, risking transmission from untreated infected patients. Point-of-care diagnostics that can reliably diagnose low-density *P. vivax* infections are urgently needed.

During the *P. vivax* hepatic stage, the hypnozoite remains in a latent, undetectable state. Hypnozoite activation causes relapses of acute malaria over weeks, months and even years following a single infective mosquito bite. In the GMS, most relapses (> 90%) occur in the first 3–4 months after the primary infection. Relapses greatly increase the malaria burden. In all endemic areas surveyed, at least 80% of patent parasitaemia resulted from activated hypnozoites. Severe morbidity and mortality associated with *P. vivax* infection occurs over months of repeated relapses at short intervals. In endemic zones, anaemia and thrombocytopaenia represent the dominant risk factors associated with severe and fatal *P. vivax* malaria. In addition, patients suffer the consequences of repeated infection of deep organ tissues with a proliferative biomass. Novel surveillance systems, sensitive to the harm caused by latent *P. vivax* malaria, are needed.

Hypnozoites are a major barrier to malaria elimination, representing a silent transmission reservoir that can be transported to new receptive areas or to areas where transmission has been locally interrupted, causing outbreaks. No method of malaria control, except for radical cure using 8-aminoquinoline antimalarials, will prevent repeated malaria episodes and onward transmission from relapses. The development of diagnostics that detects a high probability of latency as an indication for radical cure is crucial and urgent.

Treatment of latent *P. vivax* malaria requires the administration of 8-aminoquinoline therapies, either PQ or TQ. However, both drugs cause haemolysis in patients with G6PD deficiency, which can be severe, observed clinically as acute haemolytic anaemia. The prevalence of G6PD deficiency is about 8% on average for people living in malaria-endemic regions, but may be higher in some populations. To protect those at risk of severe haemolysis, the safe administration of 8-aminoquinolines requires screening for G6PD deficiency. Access to simple and affordable point-of-care screening methodologies that are practical and sustainable is required, and new G6PD diagnostics are being evaluated in pilot studies in the GMS.

For *P. vivax* radical cure, 8-aminoquinoline therapies must be co-administered with partner blood schizonticides. The safety and efficacy of 8-aminoquinolines against relapse may be profoundly impacted by the specific schizonticidal therapy. Therefore, it is important for partner therapies in radical cure to be maximized for efficacy and safety. For example, the combination of TQ plus DHA-PIP has demonstrated very low efficacy. Consequently, TQ is recommended only when co-administered with CQ. At the same time, TQ has schizonticidal activity, and it is unclear how this might support the efficacy of CQ against CQ-resistant *P. vivax*. Further investigations to understand the interaction between 8-aminoquinolines and potential partner schizonticides are needed.

Impaired cytochrome P450 (CYP) 2D6 metabolism genotypes are very common in South and South-East Asia, where the greatest burdens of *P. vivax* occur. Natural variation in inherited CYP2D6 functionality ranges from null to ultra-metabolizing activity. PQ is a CYP2D6-dependent prodrug. As PQ requires CYP2D6 metabolism for conversion to its therapeutically active form(s), a relatively high prevalence of poor or impaired PQ metabolizer phenotypes increases the risk of therapeutic failure, especially at low PQ doses. The challenge is to survey poor or impaired CYP2D6 metabolizers in endemic areas to assess the necessity of alternative approaches to PQ in *P. vivax* radical cure.

The effectiveness of *P. vivax* radical cure with PQ is undermined by poor adherence to seven-day and particularly to 14-day regimens. In clinical trials, single-dose TQ has shown similar relapse prevention efficacy to PQ and a similar safety profile. While overcoming the problem of adherence, single-dose TQ administration promises significant operational advantages. In addition, it does not require metabolic conversion and does not appear to be affected by CYP2D6 metabolism. However, TQ must be deployed with quantitative G6PD testing, and operational experience of the potential advantages and limitations of TQ in the real-life setting of the GMS is needed with pilot trials that are ongoing or planned.

In the context of malaria elimination, an important consideration is that 8-aminoquinolines cannot be given to pregnant women or children under 6 months old, including via breastfeeding. Although these individuals can be treated with CQ for the acute *P. vivax* infection, they will continue to harbour hypnozoites, risking repeated relapses with the potential for onward transmission. Therefore, preventive strategies for *P. vivax* malaria in pregnant women and infants need to be deployed effectively.

In the GMS, *P. vivax* continues to cause considerable harm and is challenging to control. Some tools are currently lacking, such as diagnostics for latent malaria and highly sensitive point-of-care *P. vivax* diagnostics, and will require investment in basic research. However, the most effective methods for deploying new tools, such as personal protection, point-of-care G6PD tests and TQ, are already being evaluated in the GMS. In addition, existing measures, such as IPTf and radical cure with PQ, need to be leveraged. Clearly, *P. vivax* requires a comprehensive and specific response if malaria elimination is to be achieved in the GMS and if re-establishment is to be prevented.

Malaria rapid diagnostic tests and thick blood smears collected during a survey, Viet Nam
© WHO/L. Pham

Certification of elimination

Certification of malaria elimination is an official recognition of a country's malaria-free status. It is granted by WHO to a country, following a request from its government, after it has been proven beyond reasonable doubt that local malaria transmission has been interrupted in the country. This is defined as zero indigenous malaria cases for at least the past three consecutive years, with a programme for the PoR of transmission in place and fully functional throughout the country *(11)*. Eligible countries are encouraged to perform malaria surveillance assessment and subnational verification, as this process contributes to the strengthening of surveillance and the PoR programme.

WHO malaria-free certification follows standard operating procedures, which involve the review and evaluation of a country's malaria-free status by an independent advisory committee – the Technical Advisory Group on Malaria Elimination and Certification (Fig. 6). The process is officially initiated when WHO receives a formal request from the government. However, the preparation for certification should start years before a country reaches zero indigenous cases with the proper documentation of the elimination programme and continuous improvement of the surveillance and response systems. In doing so, by the time countries become eligible for certification, the evidence has already been prepared *(12)*.

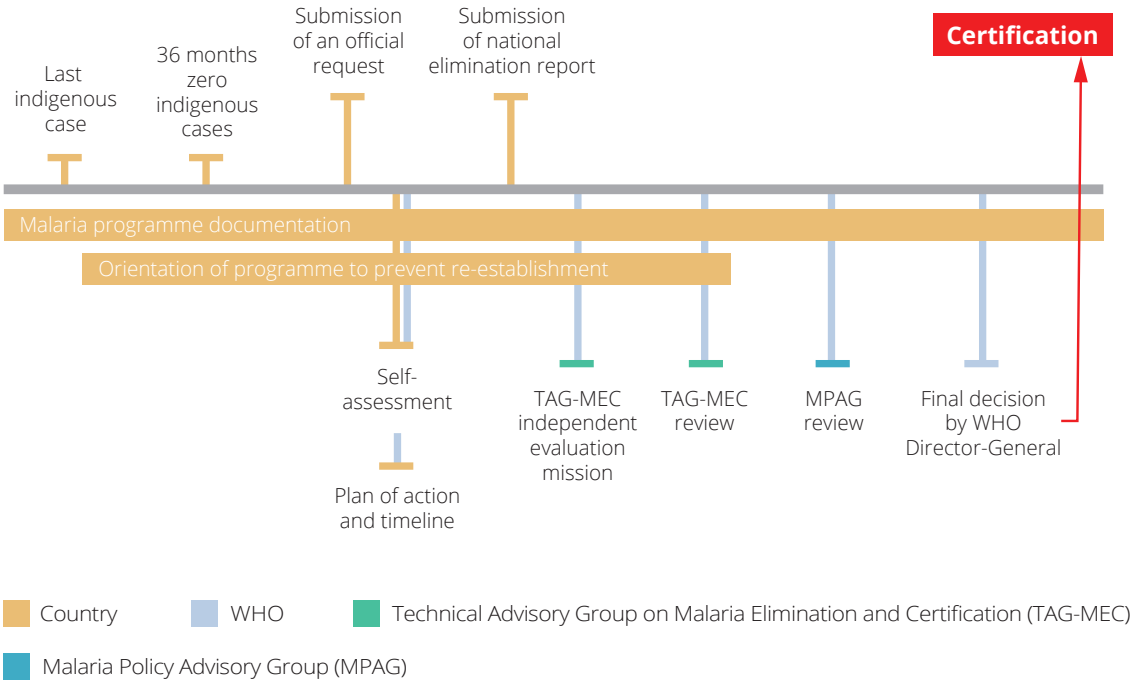
Subnational verification is a process recommended for large countries or countries with subnational elimination goals. The process is owned by the countries, but will ideally use the same criteria and similar processes as WHO certification, adapted to their health system, if the objective is to prepare the country for certification.

In June 2021, China was certified as malaria-free following a standardized process that included the independent evaluation mission in May 2021. It is the first GMS country to be certified as malaria-free. To prepare for certification and to ensure the strength of evidence of malaria elimination, China launched and implemented a nationwide subnational verification exercise. All 21 formerly endemic provinces were verified as malaria-free by national experts after counties and prefectures within their jurisdictions completed the subnational verification process. Subnational verification in China contributed to the success of certification. Other GMS countries are on the verge of elimination, with very low numbers of indigenous cases, and are actively working on subnational verification, thanks to the efforts and progress made in accelerating malaria elimination.

Thailand started subnational verification in 2017, and 46 provinces have been granted malaria-free certificates following a national process. In Viet Nam, following pilot testing of the methodology, 42 out of 63 provinces passed a subnational verification assessment. Lao People's Democratic Republic has made strides in preparing for subnational verification, launching validation guidelines, establishing national and provincial malaria elimination committees and training professionals on the methodology. Cambodia has included subnational verification in the *Cambodia malaria elimination action framework 2021–2025 (6)* and is actively developing guidance for subnational verification. Although the objectives and methodology vary among GMS countries, the subnational verification process has proven important for ensuring truly "zero" indigenous cases. It also adds value by maintaining momentum for elimination and strengthening the programme for PoR at the subnational level.

After malaria-free status has been certified, countries are entered into the Official Register listing areas where malaria elimination has been achieved. WHO created the Official Register to inform travellers' health and to support efforts for PoR, upon the request of Member States. In June 2023, 42 countries and one territory have been certified as malaria-free, and 61 countries are listed in the supplementary list of the Official Register *(13)*. Certification requires the full interruption of transmission of the four main *Plasmodium* species that are solely transmitted among humans. For countries that have reported zero indigenous cases of the four species, but zoonotic malaria cases occur, certification might be granted if the risk to humans is assessed as negligible.

Fig. 6
Steps in certification of malaria elimination



Source: *Preparing for certification of malaria elimination, second edition (12)*

Coordination and support from CSOs for malaria elimination

Community engagement is a crucial element in the fight against malaria. To achieve the ambitious goals of malaria elimination and prevent the re-establishment of the disease, community ownership and engagement are essential. This can be achieved through community systems strengthening, which involves developing the capacity and leadership of mobile, migrant and remote populations, and supporting organizations that are trusted by these communities. Creating a coordinated and interconnected system of community-based and community-led programmes and services can engage, inform and deliver services to those who do not benefit from the usual public sector services, thereby reaching the unreached in the GMS.

The Malaria Free Mekong is a network of CSOs and communities in the GMS, including Cambodia, Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam. The platform was created in 2014 to facilitate cross-border social and behaviour change communication strategies and interventions to combat malaria. Over time, the platform's focus has expanded to include gender, disability and social inclusiveness, community systems strengthening and the right to health, including the integration of malaria services.

Currently, the platform supports coordination and communication among CSOs implementing malaria projects and between CSOs and NMPs. The platform also works closely with its country representatives for coordination and support. The key focus of the platform is to facilitate meaningful coordination and partnership between CSOs, communities and other key actors; advocate for enabling policies, strategies and plans that include community-based services; respect the rights of all communities, including mobile and migrant, and ethnic communities; and strengthen capacity among civil society actors by leveraging tools, guidance and training.

Training

In December 2022, the malaria CSO platform organized training on surveillance, data utilization and project planning, in partnership with the WHO MME team, Malaria Consortium and the United Nations Office for Project Services (UNOPS). The aim of the training was to equip participants from CSOs in five Global Fund RAIE implementing countries (Cambodia, Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam) with the skills and knowledge needed to access and use the MEDB platform for decision-making. The training took place in Siem Reap, Cambodia, and was facilitated by five trainers, including representatives from the WHO MME team and the CSO platform.

The 22 participants who attended the training had a background in monitoring and evaluation and/or project management, and one participant from the NMP in Lao People's Democratic Republic was also in attendance. The gender split of the participants was even. Using case studies and work activities, the participants were able to develop a better understanding of DHIS2 data analysis, including through pivot tables, data visualizers, GIS maps, interpretation, messages, epidemiology summary application, and more. They were also able to develop short reports using their country's dashboard and analyse surveillance data to make decisions on responses, commodity management and equity, and use other sources of qualitative and quantitative community data to provide insight into and appropriate responses to issues raised.

Overall, the training enhanced the capacity of CSOs to use data for decision-making and improved the monitoring and evaluation of malaria control and elimination efforts in the five RAIE implementing countries.

One of the challenges faced by the CSOs is to provide malaria services to ethnic populations and migrants along international borders. These populations are often hard to reach through government services, making CSOs' work critical in supporting government efforts to eliminate malaria. One of the keys to their success has been their ability to recruit malaria volunteers from within migrant populations. These volunteers are able to work in the local migrant and ethnic languages, remove the fear of talking to people from different cultures, and build trust with the population they serve and from which they come.

Thailand

Thailand has become a key destination for migrant workers from neighbouring countries, with over 2 million registered migrants and a similar estimated number of undocumented migrants. Thailand has shown a significant reduction in malaria and is moving towards elimination. However, due to the internal displacement and mobility of people in Myanmar, malaria cases are increasing again in some Thai border provinces.

One initiative to address the needs of these populations is the buddy health clinic, which supports the government in planning and implementing malaria activities at the local level. This community initiative operates at formal and informal cross-border points to plan, guide and implement activities focusing on mobile and migrant populations. Local staff who know the geography, can speak local and migrant languages, and have established and trusted relationships with local health authorities and migrant communities. Migrant health volunteers are recruited to support activities and communication with migrant communities.

Buathong Monkachasarn, who is a Karen speaker, has worked as a village health volunteer and migrant health volunteer in Huay Kob of Sangklaburi district, Thailand. She is currently supporting the Alight (an international nonprofit organization) Kanchanaburi team in Thailand for malaria activities specific to migrant and ethnic communities. Most of the communities Buathong serves are non-Thai, and she travels to the villages and farms (rubber plantations) for social and behaviour change communication activities, LLIN distribution and other priority health activities requested to support the government, such as for COVID-19.

Viet Nam

To achieve the goal of a malaria-free Viet Nam, it is essential to extend the reach of the public health system through trained community health workers affiliated with CSOs, private clinics and pharmacies. These groups provide malaria prevention, information and services to forest-exposed communities as close as possible to where they live and work. The VietMCI consortium, led by Supporting Community Development Initiatives, Health Poverty Action and the Viet Nam Public Health Association, recruits, trains, supports and monitors community outreach workers to bring basic malaria prevention and testing services out of health facilities and closer to communities. They also improve convenient access to and uptake of vector control products and rapid point-of-care screening tools to more quickly prevent and identify malaria transmission. Community engagement is crucial to reach the remote and mobile communities at risk and ensure that every last person with malaria is found and treated.

CSOs play a crucial complementary role to government programmes focused on eliminating malaria in the GMS. They have been successful in reaching the unreached populations because they are local, able to work in remote locations and in community time and settings, can provide culturally appropriate services and health promotion, and are trusted by the communities they serve. Working with the government, private sector, international agencies and each other is foundational to their success, as is the maintenance of accountability and transparency of their work to the communities they serve, the governments they support and the funders who support their efforts. This work is built on a strong evidence base, including innovations that they employ and evaluate.

Lao people's Democratic Republic

In Savannakhet province, Lao People's Democratic Republic, Ms. Jiak, a member of the Makon people, has been working as a VMW since 1995. Ms. Jiak nominated herself, as she was concerned about the lives of people in her village and the need to protect them from malaria. She provides counselling and information on all health issues raised by the community, such as how to care for babies, and often travels with them to the clinic as their "patient navigator" and advocate. Her efforts in testing and treatment, adherence support, referral and health promotion activities have contributed to the significant decrease in malaria cases in her village.

Cambodia

In Cambodia, the Malaria Consortium's forest-goer project across six provinces and along the country's northern international borders supports communities to choose a peer from within their forest-going community to work as a malaria volunteer and a linkage between them and the routine health services – for malaria and other health needs. In addition to malaria posts at the frequently used border crossing areas (national and international borders), the project supports malaria volunteers going into remote areas to provide services, often requiring overnight stays, and volunteers who "co-travel" with these communities.

Supporting malaria elimination programme sustainability

Countries in the GMS have made impressive progress towards eliminating malaria. They have benefited from support from donors such as the Global Fund, the Asian Development Bank, Bill & Melinda Gates Foundation, the United States Agency for International Development (USAID), and the Australian Department of Foreign Affairs and Trade, as well as from partners including WHO, Asia Pacific Leaders Malaria Alliance (APLMA) and the University of California San Francisco Malaria Elimination Initiative (MEI). Following important gains in assistance for malaria, donor funding has plateaued in recent years, with anticipated reductions as countries experience economic growth, reduce malaria burden and work towards malaria elimination.

Anticipated declines in donor financing for malaria could result in disruptions to the health workforce, data and surveillance systems, supply chains, programme governance and programme management, and changes in the level of political will and attention to malaria. Sustaining gains will require improved domestic financing and preparedness for a transition to a domestically financed and supported malaria response through subnational targeting and tailoring of malaria interventions and a focus on PoR of malaria transmission.

In 2022, APLMA and MEI worked with country stakeholders and NMPs to develop malaria donor transition plans to be implemented over a multi-year period in Cambodia, Viet Nam and Thailand. They are also designing a capacity-building curriculum tailored to specific subnational conditions in Cambodia and Viet Nam, providing strategic support to subnational officials as they seek to implement their advocacy strategies.

Sustainability planning with a PoR focus in Thailand

Thailand is the first country in the region to have completed an assessment of transition readiness, with support from MEI. Thailand has completed several sustainability activities, including the development of evidence-based PoR plans that include the integration of malaria services in the public health structure and engagement with local administrative organizations in advocacy for financial support of targeted interventions in villages.

In 2021, the DVBD led two provincial workshops, with support from MEI, to develop a conceptual framework for PoR. Building on the conceptual framework, the DVBD developed a malaria hazard response plan comprising four components – prevention, preparedness, response and recovery – with five strategies related to malaria. In early 2022, the DVBD finalized the national-level PoR guidance to inform provincial PoR plan development, which requires provinces to stratify districts according to risk level, with a package of activities corresponding to each level.

Sustainability and transition readiness assessments in Cambodia and Viet Nam

In 2020–2021, MEI worked with CNM and NIMPE to provide capacity strengthening and strategic and technical support to plan for donor transition for malaria, taking a system-wide approach that addresses financing gaps alongside a review of opportunities to align the malaria programme with sustainability goals. As a first step in the transition planning process for CNM and NIMPE, both programmes completed sustainability and transition assessments to complement the countries' sustainability priorities highlighted in the *Cambodia malaria elimination action framework 2021–2025 (6)* and Viet Nam's *National strategy for malaria control and elimination in the period of 2011–2020 and orientation to 2030 (14)*, generating evidence to help inform the countries' next steps in sustainability planning.

To kick off sustainability planning efforts for malaria in Cambodia, CNM, MEI and APLMA hosted the meeting "Sustaining Cambodia's malaria response dissemination and prioritization", held on 7–8 July 2022. The objectives of this meeting were to ensure that the findings and recommendations from the sustainability and transition assessment were shared with the range of stakeholders that play an important role in the sustainability of Cambodia's malaria response and to establish core priority areas that will inform CNM's next phase of sustainability planning efforts. Key recommendations from participants to the Ministry of Health on sustainability priorities over the next five years included to:

- develop a PoR plan;
- develop a continuity plan for VMWs;
- learn from the National AIDS Authority's experience in the development of a sustainability plan.

On 22 November 2022, NIMPE hosted a one-day sustainability kick-off workshop to introduce the importance of sustainability planning for malaria, present the results of the sustainability assessment and discuss the key considerations for sustaining Viet Nam's malaria response. Building on the assessment, and considering the national and subnational needs identified during the workshop, NIMPE will be working with APLMA, MEI and CHAI in the coming year to pilot sustainability and budget advocacy activities in Bac Kan and Nghe An, two provinces where malaria has been eliminated.

Reflections from partners

French Ministry for Europe and Foreign Affairs

France plays a crucial role in the fight against malaria, actively contributing to multilateral financing through strong support to multilateral funds such as the Global Fund. Since its creation, the Global Fund has saved more than 50 million lives and reduced the number of deaths annually from AIDS, tuberculosis and malaria by almost 40%. France is the second major historical donor to the Global Fund, which provides 63% of the international aid to combat malaria. The French indirect contribution to the Global Fund, implemented by Expertise France, has supported the Regional Steering Committee in developing the funding requests for the RAIE grants to the Global Fund since 2013, supporting the countries in establishing ambitious regional objectives, quantifying regional needs, and identifying regional priorities. In addition, L'Initiative has assisted the Regional Steering Committee in reviewing the status of integration of services at community level as a priority for the RAI4E grant period (2024–2026) and making recommendations at country and regional levels. France is also involved in the governance of the RAI grant and has had a seat on the Regional Steering Committee since its creation as bilateral development partner. To achieve the zero malaria goal, France is working with its partners to fund research for better prevention, diagnosis and treatment of affected populations. France is also accelerating the introduction of innovative and cost-effective ways to prevent and treat HIV, tuberculosis and malaria, and increase the impact of the Global Fund investments.

Clarisse Veylon-Hervet, Global Health Advisor in Southeast-Asia

UNOPS

The countries of the GMS have made significant progress towards malaria control and elimination, despite challenges posed by COVID-19. The UNOPS Asia Regional Health Cluster is the regional principal recipient of the RAIE grant, working with NMPs and other partners at the country and regional levels to implement the grants under the strategic oversight of the Regional Steering Committee. Between 2014 and 2022, principal recipient UNOPS has contributed massively to the elimination of malaria in the region, managing over US$ 600 million during RAI1, RAI2, RAI3E and soon RAI4E. Over 53 million people were tested, over 2.4 million patients were treated for malaria, over 31.7 million LLINs were distributed and over 32 000 VMWs and malaria post workers were recruited to support community case management services. Procurement of pharmaceutical products, LLINs and rapid diagnostic tests was initiated and completed by principal recipient UNOPS on time based on details and approvals received from GMS countries. All health products were procured with strict compliance to the Global Fund quality assurance policy. A tracking tool, which provides real-time information on product status, is shared regularly with all partners (biweekly). Forecasting and quantification of health products for all years of implementation was completed on time in coordination with programme and procurement and supply management units. Upgrading of the Myanmar Food and Drug Administration through the RAI grant resulted in International Organization for Standardization certification. Principal recipient UNOPS has played a catalytic role in bringing together all malaria actors in the region under the leadership of the Regional Steering Committee and supporting increased malaria service coverage for hard-to-reach populations in border areas and other at-risk populations.

Faisal Mansoor, Head of Programmes

A forest-goer preparing his long-lasting insecticide-treated hammock net in forest located in Stung Treng province, Cambodia
© WHO/A. Raab

Conclusion

Malaria has been declining in the GMS over many years, but with impressive reductions in the last ten years as elimination efforts have started to gain traction and reduce transmission. The increase in malaria cases in the GMS in 2022 is disappointing, but the final steps towards malaria elimination are going to be the most challenging. Continued political momentum, lessons learned and the investments made in strengthening malaria service provision, surveillance and data management systems mean that GMS countries are in a strong position to effectively address the outstanding challenges and reach the goal of malaria elimination in the GMS.

There are many positives to be taken from 2022. China has continued to maintain its malaria-free status, and most countries in the GMS observed a decline in cases in 2022 compared to 2021, despite the increased mobility of populations following the lifting of COVID-19 restrictions. Overall, malaria services in the GMS have successfully recovered from the disruptions caused by COVID-19 and most countries are targeting subnational verification as they progress towards malaria-free status.

In general, the picture across the GMS is of malaria becoming increasingly concentrated among physically and culturally isolated populations. Innovative approaches are being implemented to overcome these barriers, including mobile outreach services, community engagement and tailored interventions, such as TDA and IPTf. Efforts to identify the populations most at risk and target appropriate interventions have been made across most of the GMS, with successful implementation of preventive measures for forest-goers in particular. Some areas have experienced sporadic outbreaks, requiring targeted interventions to prevent resurgence. Rapid response teams and community engagement play a crucial role in detecting and containing these outbreaks promptly, ensuring that they do not undermine elimination efforts.

Although remarkable progress has been achieved so far, efforts to eliminate malaria in the GMS are facing multiple challenges that require urgent attention and innovative solutions:

- Disruptions to the supply chain of antimalarial drugs and diagnostic tools can impede effective malaria control. Unreliable access to these essential resources jeopardizes treatment outcomes and hampers the progress made in combating the disease. Strengthening supply chains, improving storage conditions and establishing contingency plans will ensure a steady and uninterrupted flow of supplies to affected areas.

- Integration of VMWs into primary health care and universal health coverage systems is vital for sustainable malaria control. By leveraging the existing health care infrastructure and empowering these front-line workers, access to malaria services can be improved, leading to better diagnosis, treatment and surveillance.

- The situation in Myanmar adds another layer of complexity, and tailored interventions and increased vigilance are needed to both regain control of the malaria situation in Myanmar and minimize the impact on neighbouring countries. Plans are in place for acceleration and intensification efforts, which will be implemented in Myanmar once the security situation allows in 2023.

- *P. vivax* causes most of the malaria cases in the GMS, and implementing and scaling up radical cure coverage is essential to reduce the malaria burden and drain the transmission reservoir. Ensuring access to G6PD testing remains a challenge, especially for hard-to-reach populations. However, innovations in testing technologies are being explored to bridge this gap. Close monitoring, alternative treatment options and targeted interventions are critical for ensuring the safety and efficacy of radical cure in at-risk populations.

- Zoonotic malaria caused by *P. knowlesi* requires specific surveillance and control strategies. Strengthening zoonotic disease surveillance and promoting research and collaboration are essential to effectively address this threat.

Malaria exists at the intersection of complex social, economic, political and logistical factors that generate obstacles to malaria elimination. The diversity of knowledge, experiences and perspectives across the GMS and between partners, stakeholders and the community is a major strength, fostering more complete understanding of the interactions between these factors and generating more effective solutions. Some of the challenges to the next steps in malaria elimination include:

- Reaching hard-to-reach populations: Achieving universal coverage of malaria diagnosis and treatment services is essential for malaria elimination. However, reaching the hard-to-reach populations poses a significant challenge. This is particularly evident in Myanmar, given the political situation, but it also applies to other countries where malaria cases are increasingly concentrated among physically and culturally isolated populations. Innovative approaches are needed to overcome these barriers, including mobile outreach services, community engagement and tailored interventions.

- Loss of political interest and insufficient political engagement: Sustaining the momentum of malaria elimination efforts requires unwavering commitment and support from the highest levels of government. It is essential to maintain awareness of malaria prevention and control, ensuring that efforts trickle down from the topmost levels of government to the health centres and village authorities. Efforts should focus on preventing the loss of community-level knowledge and understanding of malaria, reminding communities of the ongoing threat and the importance of preventive measures.

- The need for cross-border collaboration: Malaria knows no boundaries, and effective cross-border collaboration is vital in addressing outbreaks and epidemics. When malaria transmission occurs near cross-border areas, both countries must demonstrate an active willingness to work together and address the transmission potential. Collaborative efforts should include joint surveillance, information sharing and coordinated response strategies.

- Procurement delays and wastage: As malaria cases decrease and elimination progresses, there may be challenges in procuring enough antimalarial medicines. Delays in procurement and potential wastage of medicines should be anticipated and addressed to ensure a continuous supply of effective treatments.

- Sustainability of malaria surveillance, control, diagnosis and treatment: Sustainable funding is essential to support ongoing malaria elimination efforts. The absence of consistent and sufficient resources hampers programme continuity and jeopardizes progress achieved. Governments, international organizations and donors must prioritize sustained funding to ensure the long-term success of malaria elimination initiatives in the GMS.

- Integration of malaria into the general health system: To ensure sustained control and prevention of malaria, governments must prioritize the integration of malaria services into the general health system and allocate sufficient resources to maintain current levels of effort, especially with the anticipated decline in international funding. This integration should be driven by a sense of urgency to achieve and maintain elimination.

- Balancing immediate elimination goals with WHO certification requirements: Striking the right balance between immediate elimination goals and the stringent requirements for WHO malaria-free certification is crucial. While the long-term goal of certification is important, too much focus on this ultimate goal may overshadow the immediate goals for elimination. However, adequate attention should be given to certification requirements and milestones along the way, in particular maintaining reliable microscopy for accurate diagnosis.

Addressing these challenges requires a comprehensive and multifaceted approach that involves governments, international organizations, civil society and local communities. Sustainable funding, political commitment, strengthened health systems and effective cross-border collaboration are all critical elements for successfully overcoming the obstacles on the path to malaria elimination in the GMS. By tackling these challenges head-on, with enthusiasm and energy, significant progress can continue to be made towards a malaria-free future in the region.

Malaria treatment provided to a patient living in a small ethic community village in Mae Hong Son province, Thailand
© WHO/M. Osten-Tan

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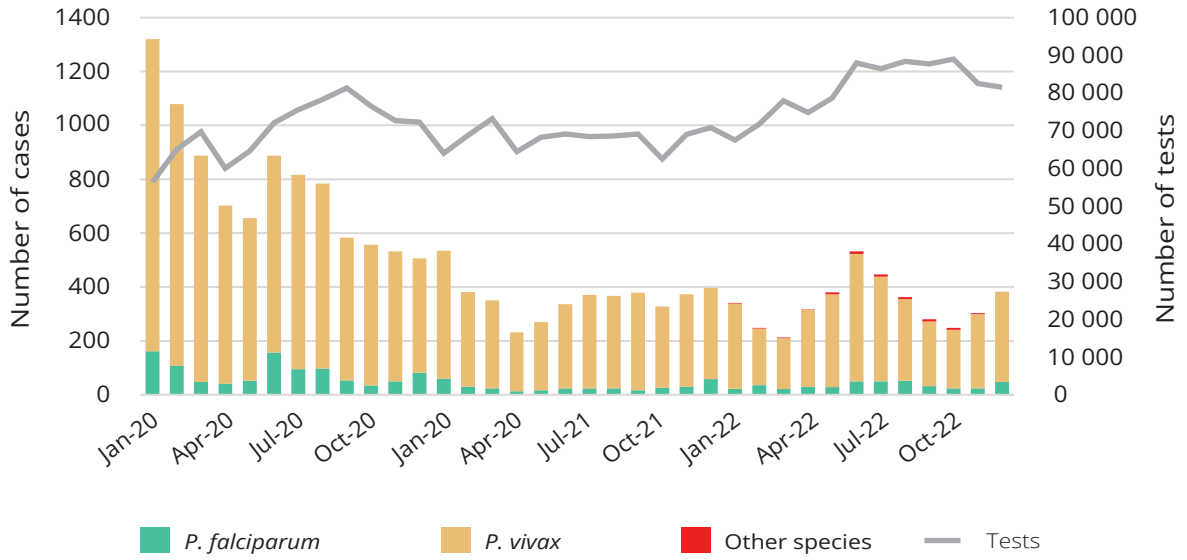
A 89-year old woman sitting below a bed net in Co Lo village, an isolated village at the forest fringe, Lai Chau province, Viet Nam, © WHO/L. Pham

Annex: Malaria country profiles

Cambodia

Fig. 7
Malaria cases and tests in Cambodia, 2020-2022



Epidemiological profile by month (2022)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Deaths	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Suspected cases tested	67 505	71 770	77 953	74 821	78 725	87 965	86 423	88 403	87 712	88 977	82 558	81 499	**974 311**
Confirmed cases	341	248	212	317	380	532	447	362	280	248	303	383	**4053**
P. falciparum cases	22	34	18	29	28	44	47	51	32	22	24	47	**398**
P. vivax cases	317	211	189	287	345	473	388	303	240	217	275	336	**3581**
Mixed cases	0	1	3	0	0	6	3	1	0	2	0	0	**16**
Other cases	2	2	2	1	7	9	9	7	8	7	4	0	**58**
Cases investigated	338	244	211	317	376	525	444	362	281	247	304	379	**4028**
Cases classified	337	244	211	317	376	524	444	360	280	246	304	379	**4022**
Imported cases	1	0	0	0	0	1	0	2	1	1	0	0	**6**

Source: Mekong Elimination Database *(3)*

National malaria strategy	Targets
Cambodia malaria elimination action framework (2021–2025).	• *P. falciparum* malaria eliminated by the end of 2023. • All species of human malaria eliminated by the end of 2025.

Interventions, policies and strategies	
Intervention	**Policies and strategies**
Case management	• Passive and active case detection.
LLINs/LLIHNs	• Yes. Last mass distribution in 2022.
IRS	• No.
IPTf	• Yes, for high-risk male population aged 15-49: people who go to malaria risk areas, i.e. forest.
Case classification	• L1: cases who have stayed every night within their current residence in the past two weeks. • LC: cases who have slept at least one night outside their village of current residence, but within Cambodia, in the past two weeks. • Imported: cases who have slept at least one night outside the country in the past two weeks. • Relapse: cases in which the patient is diagnosed with *P. vivax* infection and reported having *P. vivax* in the past 12 months.
Focus classification	• Active focus: a village from which at least one positive case has been investigated and classified as L1 in the last 12 months. • Residual focus: a village from which at least one positive case has been investigated and classified as L1 in the last 13 to 36 months. • Cleared-up focus: a village formerly defined as an active focus in which no cases investigated and classified as L1 have been detected in more than 36 months.
Focus response	• Implemented according to the receptivity and vulnerability scoring of the focus: > Recruitment and training of village and mobile malaria workers to provide passive case detection within the focus; > Top-up of LLINs and continual distribution of LLIHNs to high-risk populations; > AFS conducted on a weekly basis for all high-risk populations within the focus; > TDA: ASMQ distributed to men aged 15–49 years within the receptive focus for two consecutive months at the beginning of focus response; > IPTf: ASMQ provided as a preventive measure to residents in an active focus who plan to go into forested areas within the following month.
Antimalarial treatment policy (summary)	
First-line antimalarial treatment policy	
Uncomplicated *P. falciparum*	• ASMQ + single low-dose PQ. • ASMQ + 14-day PQ 0.25 mg/kg/day for radical cure for *P. falciparum* + mixed cases (*P. vivax* or *P. ovale*) according to G6PD test results.
Severe malaria	• Injection of artesunate or artemether followed by ASMQ. • Injection of quinine in first trimester of pregnancy.
P. vivax or *P. ovale* or *P. malariae* or *P. knowlesi*	• ASMQ + 14-day PQ 0.25 mg/kg/day for radical cure according to G6PD test results (PQ not given for *P. malariae* or *P. knowlesi*).
Pregnancy	• Quinine in first trimester; ASMQ in second and third trimesters.
Second-line antimalarial treatment policy	
Pregnancy	• Quinine plus tetracycline or doxycycline for seven days.

China (Yunnan province)

Epidemiological profile by month (2022)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Deaths	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Suspected cases tested	1871	6340	7800	12 212	19 367	19 856	26 11 6	24 891	12 092	11 623	8550	6740	**157 458**
Confirmed cases	3	4	6	10	10	12	15	41	12	10	7	6	**136**
P. falciparum + mixed cases	0	0	0	0	0	0	1	27	3	1	1	2	**35**
P. vivax cases	3	4	5	10	10	12	14	14	9	9	6	4	**100**
Other cases	0	0	1	0	0	0	0	0	0	0	0	0	**1**
% of indigenous cases	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Source: Mekong Elimination Database *(3)*

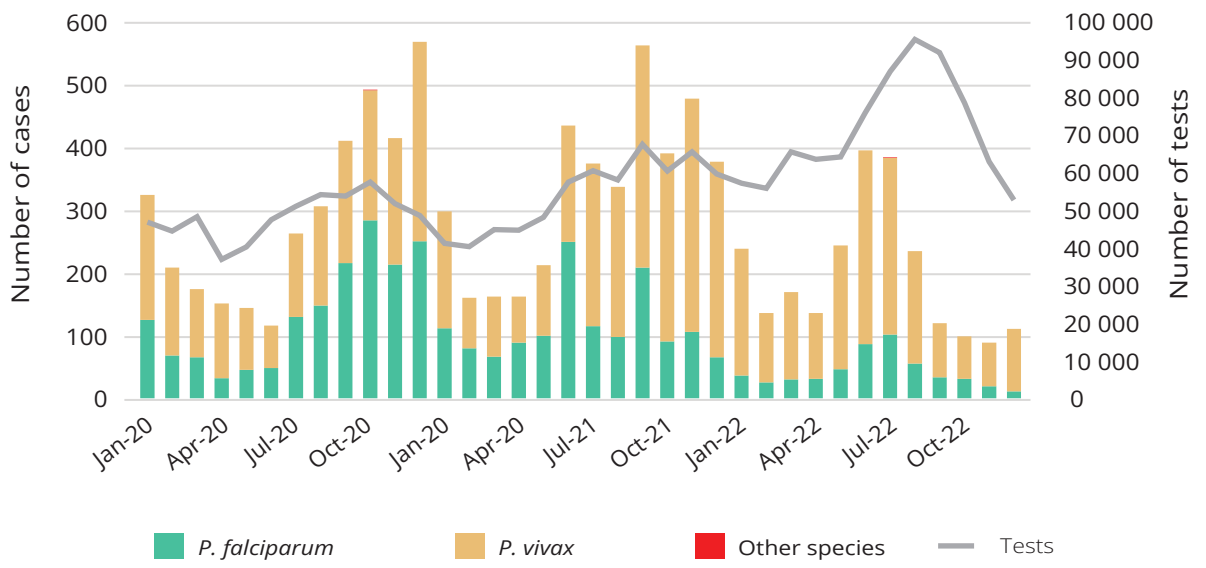
National malaria strategy	Targets
To prevent re-establishment of malaria transmission.	• No locally infected malaria cases.

Interventions, policies and strategies	
Intervention	**Policies and strategies**
Case management	• Passive case detection, active case detection in high-risk areas (such as border) and high-risk populations (border crossers), and reactive detection of imported malaria cases. • Policy: intensive surveillance, rapid response and border collaboration with neighbouring countries for malaria elimination."3+1" strategy: > Strategy 1: intensive interventions within 2.5 km-wide perimeter along the border to prevent border-spill malaria. The area within 2.5 km of the international border is the travel radius of *Anopheles* mosquitoes. Comprehensive interventions should include: (i) proactive and passive case detection; (ii) intensive vector surveillance; (iii) evidence-based vector control; and (iv) evidence-based preventive treatment with antimalarial drugs; > Strategy 2: community-based malaria detection and screening of migrants and travellers in frontier townships. Unpermitted travellers cross borders frequently and present in frontier townships. Maintenance of intensified malaria surveillance should include: (i) passive malaria detection in the township hospitals; (ii) assistance from village leaders and health workers to monitor cross-border travellers and referral of febrile patients to the township hospitals; and (iii) maintenance of regular proactive case detection by the county's Centre for Disease Control and Prevention; > Strategy 3: universal coverage of malaria surveillance to detect malaria cues. Passive detection should be consolidated with the normal health services. Health service personnel should remain vigilant to ensure universal coverage of malaria detection and react promptly to any malaria cues; > Strategy +1: strong collaborative support with neighbouring countries. Based on the agreement between the two countries, integrated control strategies should be carried out to reduce malaria burden for both countries. There should be a clear focus on the border areas between neighbouring countries.

Intervention	Policies and strategies
LLINs/LLIHNs	• Yes. In 2021, a total of 6000 insecticide-treated nets were distributed in high-risk areas of re-establishment Yunnan province.
IRS	• There has been no active focus in Yunnan province since April 2016, so no IRS has been carried out.
IPT	• IPT is provided to people who travel to high malaria endemic countries.
Case classification	• Indigenous case: a case contracted within national boundaries. • Imported case: a case for which the origin can be traced to a known malaria-endemic area outside the national borders to which the case has travelled within one month. • Unknown: a case for which the origin of infection cannot be determined.
Focus classification	• Focus with current transmission: focus reporting introduced case(s) and determined to be at risk of local transmission. • Focus with transmission potential: focus reporting imported cases during transmission season and having malaria vectors. • Focus without transmission potential: focus reporting imported cases that does not have malaria vectors, or malaria vectors are present but not during transmission season.
Focus response	• Focus with current transmission: > Focus with only one introduced case – enhanced laboratory detection of malaria parasites among patients with fever; clearing of infectious sources among residents through provision of antimalarials; IRS; mass health education; > Focus with two or more introduced cases – investigation to track the sources of infection; mass blood testing; enhanced surveillance of infectious sources in all town/township hospitals, community health centres and medical institutions; referral of suspected patients with fever from village health posts; interventions to clear infectious sources among residents; IRS; mass health education; • Focus with transmission potential: IRS and mass health education. • Focus without transmission potential: health education.
Antimalarial treatment policy (summary)	
First-line antimalarial treatment policy	
Uncomplicated *P. falciparum*	• DHA-PIP.
Treatment of severe malaria	• Injection of artemisinins.
Uncomplicated *P. vivax*	• CQ plus eight-day PQ (22.5 mg).
Second-line antimalarial treatment policy	
All malaria cases	• Piperaquine, pyronaridine injectable or ACTs.

Lao People's Democratic Republic

Fig. 8
Malaria cases and tests in Lao PRD, 2020-2022



Epidemiological profile by month (2022)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Deaths	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Suspected cases tested	56 808	55 472	65 081	63 118	63 708	75 440	86 277	94 754	91 274	78 023	62 496	52 388	**844 839**
Confirmed cases	237	135	168	135	242	393	382	233	119	98	88	110	**2340**
P. falciparum cases	36	23	28	28	44	85	94	53	31	31	19	11	**483**
P. vivax cases	201	110	138	104	196	307	280	178	86	67	69	99	**1835**
Mixed cases	0	2	2	3	2	1	7	2	2	0	0	0	**21**
Other cases	0	0	0	0	0	0	1	0	0	0	0	0	**1**
Cases investigated	17	8	17	8	15	19	30	12	6	8	8	6	**154**
Cases classified	17	8	17	8	15	19	30	12	6	8	8	6	**154**
Imported cases	0	0	0	0	0	0	0	0	0	0	0	0	**0**

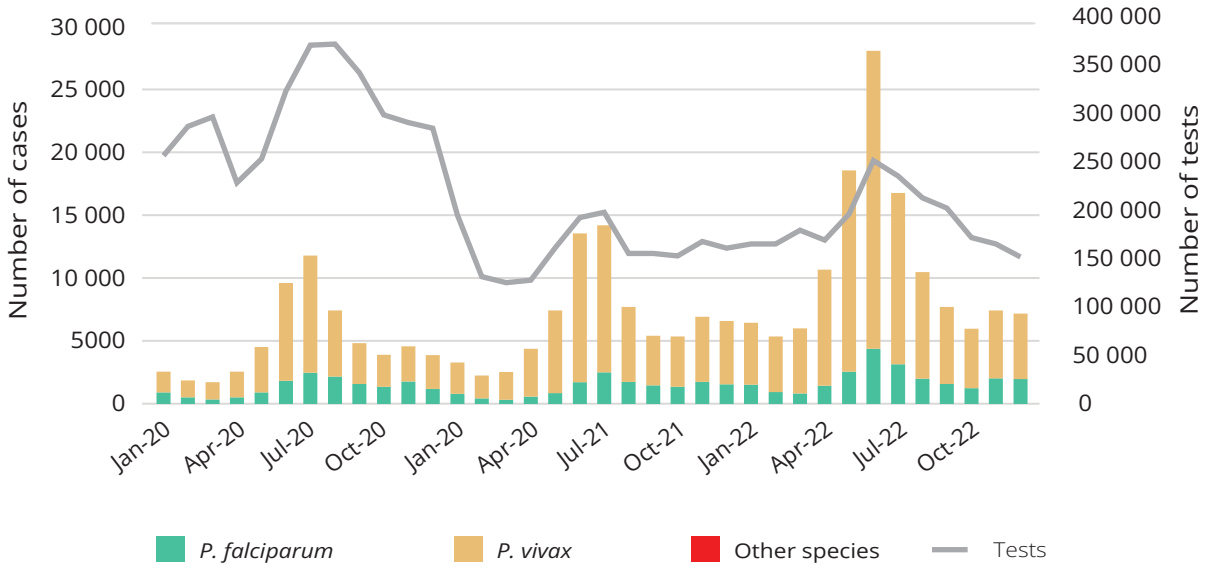
Source: Mekong Elimination Database *(3)*

National malaria strategy	Targets
Malaria national strategic plan 2021–2025 Lao People's Democratic Republic.	• *P. falciparum* malaria eliminated by the end of 2023. • All species of human malaria eliminated by the end of 2030.

Interventions, policies and strategies	
Intervention	**Policies and strategies**
Case management	• Passive and active case detection.
LLINs/LLIHNs	• Yes. Last mass distribution in 2021. LLIHNs distributed as part of "accelerator strategies".
IRS	• Yes, targeted in outbreak villages with transmission occurring in the village.
IPTf	• Yes, for high-risk populations aged 7–49 in the 60 highest risk villages: > People who go to the forest; > People who sleep overnight in the field; > Teenagers (12–20 years old) who socialize outside at night (after 9 pm).
Case classification	• Locally acquired if the patient has not travelled to any location away from their current address within the past two weeks and classified as either: > indigenous; or > introduced. • Not locally acquired if the patient has travelled away from their current address to an area that is known for, or receptive to, malaria transmission – the case is usually classified as imported: > recrudescent *P. falciparum* or relapse of *P. vivax* or *P. ovale*; > induced; > imported from another district; > imported from another province; or > imported from another country. • Reactive case detection for locally acquired cases: screening populations in the index case's household (patient's current address), in other households within a 1 km radius of the index case's house in rural areas and 500 m for cases in urban areas, and among travel companions with whom the patient travelled overnight in the previous 28 days.
Focus classification	• Active focus: locally acquired case found in the focus in the past 12 months. • Residual non-active focus: no new locally acquired cases detected in the focus for 12 months. • Cleared: no new locally acquired cases detected in the focus for three years.
Focus response	• Implemented in the whole focus (village) where a case is classified as locally acquired: > Reactive case detection to screen all populations within a 1 km radius of the index case (or 500 m radius for urban infections); testing criteria and treatment of all positive cases are based on the national malaria treatment guidelines; > Mapping the occurrence of transmission, adult vector presence (if available) and risk populations in the focus area; > Evaluating vector control activities and providing supplementary vector control if required (IRS and/or LLIN top-up); > Entomological data collection (ad hoc when it is considered critical to the focus response); > Supervision of health centre and village malaria workers; > Survey to identify at-risk populations and determine the focus population's behaviour and potential activities that might put them at risk of malaria; > Information, education and communication activities.
Antimalarial treatment policy (summary)	
First-line antimalarial treatment policy	
Uncomplicated *P. falciparum*	• AL + single low-dose PQ. • AL + seven-day PQ 0.5 mg/kg/day for radical cure for *P. falciparum* + mixed cases (*P. vivax* or *P. ovale*) according to G6PD test results.
Severe malaria	• Injection of artesunate or artemether followed by AL.
P.vivax or *P.ovale*	• AL + seven-day PQ 0.5 mg/kg/day for radical cure according to G6PD test results.
Pregnancy	• AL.
Second-line antimalarial treatment policy	
Uncomplicated *P. falciparum*	• ASPY or ASMQ + single low-dose PQ.
Severe malaria	• Injection of quinine followed by an ACT.
P.vivax or *P.ovale*	• ASPY or ASMQ + seven-day PQ 0.5 mg/kg/day for radical cure according to G6PD test results.

Myanmar

Fig. 9
Malaria cases and tests in Myanmar, 2020-2022



Epidemiological profile by month (2022)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Deaths	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Suspected cases tested	167 964	167 970	182 540	172 055	199 516	255 789	239 342	216 718	205 857	174 804	168 237	154 466	**2 305 258**
Confirmed cases	6412	5330	5962	10 596	18 404	27 825	16 619	10 393	7642	5935	7376	7120	**129 614**
P. falciparum cases	1473	897	796	1406	2461	4203	2988	1895	1486	1191	1952	1868	**22 616**
P. vivax cases	4877	4396	5124	9156	15 865	23 466	13 490	8388	6070	4681	5347	5164	**106 024**
Mixed cases	62	37	42	34	78	156	141	110	86	63	77	88	**974**
Other cases	0	0	0	0	0	0	0	0	0	0	0	0	**0**

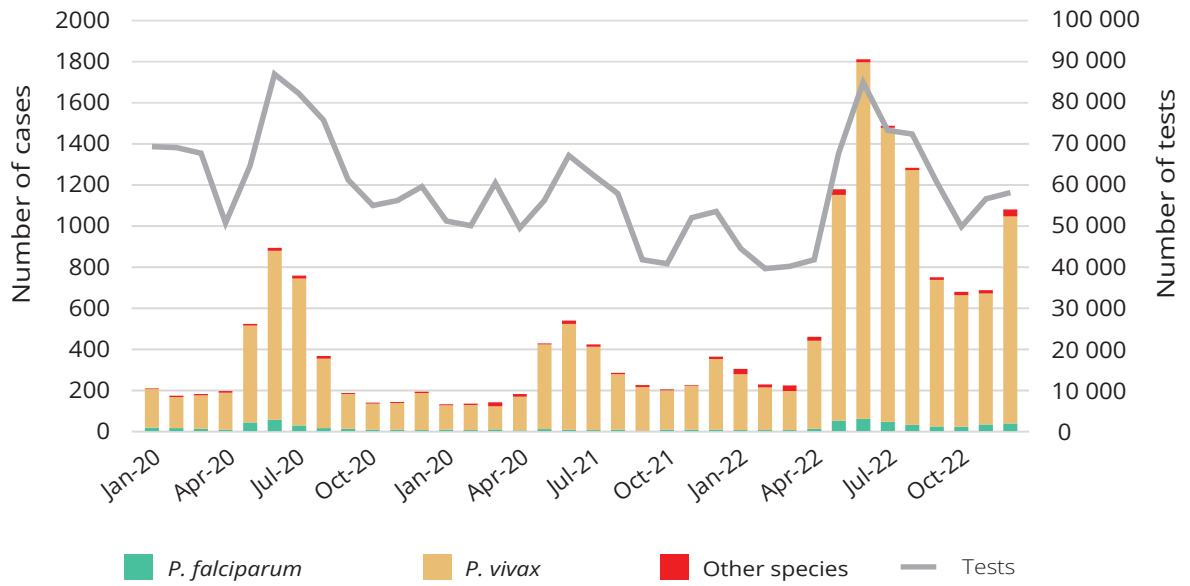
Source: Mekong Elimination Database *(3)*

National malaria strategy	Targets
National plan for malaria elimination in Myanmar 2016–2030. *National strategic plan for malaria elimination 2021–2025.*	• *P. falciparum* malaria eliminated by the end of 2026. • All species of human malaria eliminated by the end of 2030.

Interventions, policies and strategies	
Intervention	**Policies and strategies**
Case management	• Passive and active case detection.
LLINs/LLIHNs	• Yes. Mass distribution every three years and continuous distribution to pregnant women through antenatal care, and mobile and migrant populations. Last mass distribution was in 2019. The mass distribution scheduled in 2022 is ongoing in 2023.
IRS	• Yes. IRS is recommended in active foci and as outbreak response (alphacypermethrin 5% WP is used).
IPTf	• No.
Case classification	• Locally acquired if a case is due to mosquito-borne transmission and acquired within the area of investigation: > Indigenous: any case contracted locally, without strong evidence of a direct link to an imported case; > Introduced: any case contracted locally, with strong epidemiological evidence linking it directly to a known imported case; > Relapsed: true relapse from *P. vivax* or *P. ovale* hypnozoites that were contracted locally some time ago. • Not locally acquired: > Imported case: due to mosquito-borne transmission and acquired outside the area where it is diagnosed; the origin of imported cases can be traced to a known malarious area outside the elimination area to which the case has travelled (within the previous three months); > Induced case: not due to mosquito-borne transmission.
Focus classification	• Active focus: ongoing transmission in focus, with locally acquired cases detected in the current calendar year. • Residual non-active focus: the last locally acquired case(s) was detected in the previous calendar year or up to three years prior. • Cleared focus: a focus with absence of locally acquired cases(s) for more than three years, where only imported and/or relapsed/recrudescent cases and/or induced cases may occur in the current calendar year.
Focus response	• Active focus: high coverage of appropriate vector control (LLINs and IRS). Passive case detection throughout the year and active case detection (with screening and testing or with testing alone) at appropriate intervals, especially just before or during the transmission season. If testing is chosen and no cases have been found after several rounds of active case detection, frequency of active case detection may be reduced, or strategy may be changed to active surveillance for suspected clinical cases that can be tested and managed as necessary. • Residual non-active focus: passive case detection throughout the year and active case detection considered during key times. People most likely to have malaria are screened to identify local cases. If several rounds of active case detection reveal no cases, the frequency may be reduced. If new introduced or indigenous cases are identified, further evaluation is required to determine whether local transmission has resumed. • Cleared focus: programme relies on the surveillance system to rapidly identify any cases of suspected malaria and determine whether local transmission has resumed.
Antimalarial treatment policy (summary)	
First-line antimalarial treatment policy	
Uncomplicated *P. falciparum*	• AL + PQ 0.75 mg/kg single dose. • AL + 14-day PQ 0.25 mg/kg/day for radical cure for *P. falciparum* + mixed cases (*P. vivax* or *P. ovale*) according to G6PD test results.
Severe malaria	• Injection of artesunate or artemether followed by AL.
P.vivax or *P.ovale* or *P.malariae*	• CQ + 14-day PQ 0.25 mg/kg/day for all levels. PQ not given for *P. malariae*.
P. knowlesi	• AL.
Pregnancy	• Oral dose of quinine and clindamycin for seven days in the first trimester; AL in the second and third trimesters.
Second-line antimalarial treatment policy	
Uncomplicated *P. falciparum*	• ASMQ or DHA-PIP + single low-dose PQ.

Thailand

Fig. 10
Malaria cases and tests in Thailand, 2020-2022



Epidemiological profile by month (2022)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Deaths	Data not officially available												
Suspected cases tested	44 388	39 530	40 112	41 704	67 579	84 844	73 191	72 259	60 462	49 744	56 532	58 005	**688 350**
Confirmed cases	303	227	222	459	1177	1810	1486	1281	748	678	686	1079	**10 156**
P. falciparum cases	5	4	5	9	39	45	29	23	21	20	30	25	**255**
P. vivax cases	271	209	190	429	1101	1736	1431	1239	713	640	637	1008	**9604**
Mixed cases	0	0	0	2	10	14	16	8	1	1	2	12	**66**
Other cases	27	14	27	19	27	15	10	11	13	17	17	34	**231**
Cases investigated	300	226	218	457	1169	1802	1478	1276	745	676	676	1070	**10 093**
Cases classified	253	184	182	381	932	1495	1166	1054	605	506	543	792	**8093**
Imported cases	119	78	78	185	431	712	545	437	281	201	259	401	**3727**

Source: Mekong Elimination Database *(3)*

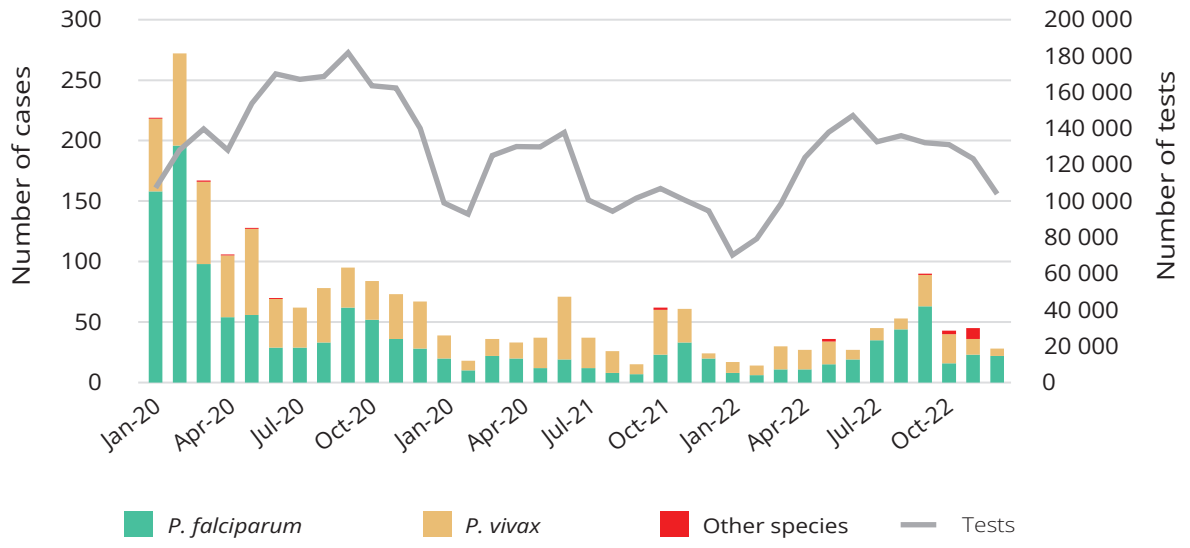
National malaria strategy	Targets
National malaria elimination strategy Thailand 2017–2026. Operational plan for malaria elimination 2021–2025.	• *P. falciparum* malaria eliminated by the end of 2023. • All species of human malaria eliminated by the end of 2024.

Interventions, policies and strategies

Intervention	Policies and strategies	
Case management	• Passive and active case detection.	
LLINs/LLIHNs	• Yes.	
IRS	• Yes.	
IPT	• No.	
Case classification	• Indigenous: > A: in resident village; > Bx: outside village; > By: outside canton; > Bz: outside district; > Bo: outside province.	• Imported: > Bf: outside country; > C: relapsed; > D: induced; > E: introduced; > F: unclassified.
Focus classification	• Active focus (A1): indigenous cases found in current year. • Residual non-active focus (A2): no indigenous cases for 1–3 years. • Cleared focus but receptive (B1): no indigenous cases for > 3 years + vector/suitable environment. • Cleared focus and non-receptive (B2): no indigenous cases for > 3 years + no vector.	
Focus response	• Active focus (A1): 1-3-7 surveillance; passive case detection at community level and health facilities; reactive case detection; two rounds of proactive case detection for persistent indigenous focus; supervised treatment and follow-up through iDES; focus investigation with entomological surveillance (for persistent indigenous focus); LLINs and/or LLIHNs (at least 90% coverage); and behaviour change communication. • Residual non-active focus (A2): 1-3-7 surveillance; passive case detection at community level and health facilities; reactive case detection; one round of proactive case detection; supervised treatment and follow-up through iDES; focus investigation with entomological surveillance (if active focus); LLINs and/or LLIHNs (at least 90% coverage); and behaviour change communication. • Receptive focus (B1): 1-3-7 surveillance; passive case detection at health facilities; supervised treatment and follow-up through iDES; and behaviour change communication. • Non-receptive focus (B2): 1-3-7 surveillance; passive case detection at health facilities; supervised treatment and follow-up through iDES; focus investigation, entomological survey and mass blood screening if indigenous case is confirmed; vector control (insecticide-treated nets and IRS) if transmission is confirmed; and behaviour change communication.	
Antimalarial treatment policy (summary)		
First-line antimalarial treatment policy		
Uncomplicated *P. falciparum*	• DHA-PIP + single low-dose PQ. • ASPY + single low-dose PQ in Sisaket and Ubon Ratchathani provinces. • DHA-PIP or ASPY (Sisaket and Ubon Ratchathani provinces) + 14-day PQ 0.25 mg/kg/day for radical cure for *P. falciparum* + mixed cases (*P. vivax* or *P. ovale*) according to G6PD test results. • DHA-PIP or ASPY (Sisaket and Ubon Ratchathani) + single low-dose PQ for *P. falciparum* + mixed with *P. malariae* or *P. knowlesi.*	
Severe malaria	• Injection of artesunate followed by an ACT.	
P.vivax or *P.ovale*	• CQ + 14-day PQ 0.25 mg/kg/day according to G6PD test results.	
P. malariae or *P. knowlesi*	• CQ.	
Pregnancy	• Quinine and clindamycin for seven days in first trimester; DHA-PIP in second and third trimesters; CQ for *P. vivax*, *P. ovale*, *P. malariae* or *P. knowlesi*.	
Second-line antimalarial treatment policy		
Uncomplicated *P. falciparum*	• ASMQ or DHA-PIP + single low-dose PQ.	
Severe malaria	• Injection of quinine followed by an ACT.	
Uncomplicated *P. vivax*	• DHA-PIP + 14-day PQ 0.25–0.30 mg/kg/day according to G6PD test results.	

Viet Nam

Fig. 11
Malaria cases and tests in Viet Nam, 2020-2022



Epidemiological profile by month (2022)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Deaths	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Suspected cases tested	70 290	79 193	98 474	123 998	138 038	147 127	132 773	136 093	132 193	131 183	123 319	104 009	**1 416 690**
Confirmed cases	17	14	30	27	36	27	45	53	90	43	45	28	**455**
P. falciparum cases	8	6	10	11	15	19	35	44	63	16	23	22	**272**
P. vivax cases	9	8	19	16	19	8	10	9	26	24	13	6	**167**
Mixed cases	0	0	1	0	0	0	0	0	0	0	0	0	**1**
Other cases	0	0	0	0	2	0	0	0	1	3	9	0	**15**
Cases investigated	0	0	0	0	2	0	0	0	1	3	9	0	**15**
Cases classified	17	14	30	27	36	27	45	53	90	43	45	28	**455**
Imported cases	4	4	5	2	13	9	6	9	19	3	4	12	**90**

Source: Mekong Elimination Database *(3)*

National malaria strategy	Targets
National strategic plan on malaria control and elimination 2021-2025.	• *P. falciparum* malaria eliminated by the end of 2023. • All species of human malaria eliminate by the end of 2030.

Interventions, policies and strategies

Intervention	Policies and strategies
Case management	• Passive and active case detection.
LLINs/LLIHNs	• Yes.
IRS	• Yes.
IPT	• No.
Case classification	• Indigenous case: a parasitologically confirmed malaria case, locally transmitted (commune/ward), with no evidence of being imported and not directly related to infection from an imported case. • Imported case: a parasitologically confirmed malaria case, transmitted from another place or country; in the context of subnational elimination, an imported case is defined as when the infection is acquired outside a designated geographical area, such as a province or commune. • Secondary malaria case: a parasitologically confirmed malaria case, locally transmitted from an imported malaria case; this is equivalent to an introduced case.
Focus classification	• Active focus: the area has at least one parasitologically confirmed case of locally transmitted malaria in the current calendar year. • Residual non-active: the area has no locally transmitted malaria cases in the current calendar year and at least one confirmed locally transmitted case of malaria was detected within the previous three calendar years. • Cleared: the area has had no parasitologically confirmed locally transmitted malaria cases in three calendar years or more.
Focus response	• Focus investigations depend on the extent of transmission of the focus: > Surveillance: enhanced focus surveillance, including number of malaria cases in the focus, use of malaria prevention and control measures, and patterns of mobile migrant populations; > Case detection and treatment: active and passive case detection; all confirmed malaria cases are treated; > Vector prevention and control measures, including IRS, distribution of LLINs, and management/clearance of larval sources; > Behaviour change communication.
Antimalarial treatment policy (summary)	
First-line antimalarial treatment policy	
Uncomplicated *P. falciparum*, or *P. falciparum* mixed with *P. malariae* or *P. knowlesi*	• DHA-PIP + 0.5 mg/kg PQ single dose. • ASPY or ASMQ or quinine doxycycline or clindamycin seven days + 0.5 mg/kg single dose PQ (provinces that reported treatment failure with DHA-PIP). • DHA-PIP + 14-day PQ 0.25 mg/kg/day for radical cure for *P. falciparum* + mixed cases (*P. vivax or P. ovale*) according to G6PD test results. • ASPY or ASMQ or quinine doxycycline or clindamycin seven days + 14-day PQ 0.25 mg/kg/day (provinces that reported treatment failure with DHA-PIP) for radical cure for *P. falciparum* + mixed cases (*P. vivax or P. ovale*) according to G6PD test results. • DHA-PIP + 0.5 mg/kg single dose for *P. falciparum* + mixed with *P. malariae or P. knowlesi.* • ASPY or ASMQ or quinine doxycycline or clindamycin + 0.5 mg/kg PQ single dose (provinces that reported treatment failure with DHA-PIP) for *P. falciparum* + mixed with *P. malariae or P. knowlesi.*
Severe malaria	• Injection of artesunate followed by an ACT.
P.vivax or *P.ovale*	• CQ + 14-day PQ 0.25 mg/kg/day for radical cure according to G6PD test results.
P. malariae **or** *P. knowlesi*	• CQ + 0.5 mg/kg PQ single dose.
Pregnancy	• Quinine and clindamycin for seven days in first trimester; DHA-PIP in second and third trimesters; CQ for P. vivax, P. ovale, P. malariae or P. knowlesi.
Second-line antimalarial treatment policy	
Uncomplicated *P. falciparum*	• ASPY or ASMQ or quinine + doxycycline or clindamycin seven days + 0.5 mg/kg PQ single dose.
Severe malaria	• Injection of quinine followed by an ACT.
P. vivax	• DHA-PIP + 14-day PQ 0.25 mg/kg/day.

For further information please contact:
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