TENTH MEETING OF THE
GREATER MEKONG SUBREGION (GMS) THERAPEUTIC
EFFICACY STUDY (TES) NETWORK

28–29 November 2022
Hybrid/Bangkok, Thailand
Tenth Meeting of the Greater Mekong Subregion (GMS)
Therapeutic Efficacy Study (TES) Network

Hybrid/Bangkok, Thailand
MEETING REPORT

TENTH MEETING OF THE GREATER MEKONG SUBREGION (GMS)
THERAPEUTIC EFFICACY STUDY (TES) NETWORK

Convened by:

WORLD HEALTH ORGANIZATION
REGIONAL OFFICE FOR THE WESTERN PACIFIC

Hybrid/Bangkok, Thailand
28–29 November 2022

Not for sale

Printed and distributed by:

World Health Organization
Regional Office for the Western Pacific
Manila, Philippines

June 2023
NOTE

The views expressed in this report are those of the participants of the Tenth Meeting of the Greater Mekong Subregion Therapeutic Efficacy Study Network and do not necessarily reflect the policies of the conveners.

This report has been prepared by the World Health Organization Regional Office for the Western Pacific for Member States in the Region and for those who participated in the Tenth Meeting of the Greater Mekong Subregion Therapeutic Efficacy Study Network on 28 to 29 November 2022.
## CONTENTS

### ABBREVIATIONS

### SUMMARY

1. INTRODUCTION .......................................................................................................................................... 1
   1.1 Meeting organization ............................................................................................................................ 1
   1.2 Meeting objectives ............................................................................................................................... 1

2. Proceedings .................................................................................................................................................. 2
   2.1 Opening session .................................................................................................................................... 2
   2.2 Regional updates ................................................................................................................................... 2
     2.2.1 Review of recommendations from 2021 and progress ................................................................. 2
     2.2.2 Epidemiological updates from the Mekong Malaria Elimination programme in the GMS ............ 3
     2.2.3 Plenary discussion ......................................................................................................................... 4
   2.3 Country presentations: results and future priorities, plans, studies needed ........................................ 4
     2.3.1 Cambodia ...................................................................................................................................... 4
     2.3.2 Lao People’s Democratic Republic .................................................................................................. 4
     2.3.3 Myanmar ........................................................................................................................................ 5
     2.3.4 Viet Nam ....................................................................................................................................... 6
     2.3.5 Thailand ....................................................................................................................................... 6
     2.3.6 Updates and trends on molecular markers during TES in the GMS .............................................. 7
     2.3.7 Genetic surveillance of drug-resistant malaria in the GMS ............................................................ 8
   2.4 Updates and specific technical presentations ....................................................................................... 9
     2.4.1 Opening session ............................................................................................................................ 9
     2.4.2 iDES and molecular markers of imported cases in a malaria-free country – China ....................... 9
     2.4.3 Quality control in TES and iDES: specific country implementation challenges ............................ 10
     2.4.4 Prevalence and management of *P. knowlesi*, Malaysia’s experience towards elimination ........ 11
     2.4.5 Update on the global drug resistance situation .............................................................................. 12
     2.4.6 WHO updated guidelines on treatment of malaria ....................................................................... 13
     2.4.7 Plenary discussion ......................................................................................................................... 13
   2.5 Topics and issues for discussion ........................................................................................................... 13
     2.5.1 ACT drug procurements issues ..................................................................................................... 13
     2.5.2 Update from WHO Western Pacific Region Ethics Review Committee on the new portal, SOP and suggested changes to relevant study protocol submissions .................. 14
   2.6 Partners .................................................................................................................................................. 15
     2.6.1 Partner inputs .............................................................................................................................. 15

3. Conclusions .................................................................................................................................................. 16
   3.1 Recommendations for Member States ................................................................................................. 16
   3.2 Recommendations for WHO ............................................................................................................... 17
   3.3 Next steps .............................................................................................................................................. 17
   3.4 Concluding remarks ........................................................................................................................... 17

4. Annexes ....................................................................................................................................................... 19
   Annex 1. List of participants ..................................................................................................................... 19
   Annex 2. Meeting programme .................................................................................................................. 24
KEYWORDS

Antimalarials - therapeutic use / Drug resistance / Malaria- prevention and control / Mekong Valley
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACPR</td>
<td>adequate clinical and parasitological response</td>
</tr>
<tr>
<td>ACT</td>
<td>artemisinin-based combination therapy</td>
</tr>
<tr>
<td>AL</td>
<td>artemether-lumefantrine</td>
</tr>
<tr>
<td>AQ</td>
<td>amodiaquine</td>
</tr>
<tr>
<td>AS-AQ</td>
<td>artesunate-amodiaquine</td>
</tr>
<tr>
<td>AS-MQ</td>
<td>artesunate-mefloquine</td>
</tr>
<tr>
<td>AS-PY</td>
<td>artesunate-pyronaridine</td>
</tr>
<tr>
<td>CQ</td>
<td>chloroquine</td>
</tr>
<tr>
<td>DHA-PPQ</td>
<td>dihydroartemisinin-piperaquine</td>
</tr>
<tr>
<td>ECAMM</td>
<td>external competency assessment of malaria microscopists</td>
</tr>
<tr>
<td>ERC</td>
<td>Ethics Review Committee</td>
</tr>
<tr>
<td>G6PD</td>
<td>glucose-6-phosphate dehydrogenase</td>
</tr>
<tr>
<td>Global Fund</td>
<td>The Global Fund to Fight AIDS, Tuberculosis, and Malaria</td>
</tr>
<tr>
<td>GMP</td>
<td>Global Malaria Programme</td>
</tr>
<tr>
<td>GMS</td>
<td>Greater Mekong Subregion</td>
</tr>
<tr>
<td>iDES</td>
<td>integrated drug efficacy surveillance</td>
</tr>
<tr>
<td>IPT</td>
<td>intermittent preventive treatment</td>
</tr>
<tr>
<td>LAMP</td>
<td>loop-mediated isothermal amplification</td>
</tr>
<tr>
<td>MDA</td>
<td>mass drug administration</td>
</tr>
<tr>
<td>MME</td>
<td>Mekong Malaria Elimination</td>
</tr>
<tr>
<td>MQ</td>
<td>mefloquine</td>
</tr>
<tr>
<td>NMP</td>
<td>national malaria programme</td>
</tr>
<tr>
<td>NRL</td>
<td>national reference laboratory</td>
</tr>
<tr>
<td>NTG</td>
<td>national treatment guideline</td>
</tr>
<tr>
<td>PCR</td>
<td>polymerase chain reaction</td>
</tr>
<tr>
<td>PDR</td>
<td>People’s Democratic Republic</td>
</tr>
<tr>
<td>PPQ</td>
<td>piperaquine</td>
</tr>
<tr>
<td>PQ</td>
<td>primaquine</td>
</tr>
<tr>
<td>QA</td>
<td>quality assurance</td>
</tr>
<tr>
<td>QC</td>
<td>quality control</td>
</tr>
<tr>
<td>SOP</td>
<td>standard operating procedure</td>
</tr>
<tr>
<td>SP</td>
<td>sulfadoxine-pyrimethamine</td>
</tr>
<tr>
<td>TDA</td>
<td>targeted testing and treatment</td>
</tr>
<tr>
<td>TES</td>
<td>therapeutic efficacy studies</td>
</tr>
<tr>
<td>TQ</td>
<td>tafenoquine</td>
</tr>
<tr>
<td>UNOPS</td>
<td>United Nations Office for Project Services</td>
</tr>
<tr>
<td>USAID-PMI</td>
<td>United States Agency for International Development – President's Malaria Initiative</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>WT</td>
<td>wild type</td>
</tr>
</tbody>
</table>
SUMMARY

The World Health Organization (WHO) has organized meetings of the Greater Mekong Subregion (GMS) Therapeutic Efficacy Studies (TES) Network since 2008. These meetings aim to assist countries in reviewing data on drug efficacy and developing specific plans for monitoring efficacy. The GMS countries consider TES to be the standard method for monitoring drug efficacy. As more countries progress towards malaria elimination, they have begun implementing integrated drug efficacy surveillance (iDES).

The WHO Mekong Malaria Elimination (MME) programme hosted the Tenth Meeting of the GMS TES Network. This two-day meeting, conducted in Bangkok, Thailand, and online, brought together representatives from national malaria programmes (NMPs) and focal points from the GMS countries – Cambodia, Lao People’s Democratic Republic (PDR), Myanmar, Thailand, Viet Nam and Yunnan province in China – as well as technical experts and partners. The meeting provided a forum to review the status of TES and iDES, consider the antimalarial efficacy, and identify alternative artemisinin-based combination therapies (ACTs) for the revision of national treatment guidelines (NTGs).

Significant progress has been made in implementing quality TES in four countries, while iDES is being rolled out in Cambodia, Lao PDR, Thailand and Vietnam. External competency assessment of malaria microscopists (ECAMM) and national competency assessment of malaria microscopists were conducted in several countries. Collaboration with Institut Pasteur du Cambodge on molecular assays of TES and iDES samples continued.

Since 2011, malaria cases in the GMS declined dramatically, particularly for *P. falciparum*, though cases increased in 2022 due to the political situation in Myanmar, especially for *P. vivax*. A clear policy on *P. vivax* elimination is needed owing to its predominance in the region.

Country presentations highlighted ongoing efforts and challenges:
- Cambodia reported low and declining malaria cases, reduced prevalence of resistance markers, and high efficacy of recommended treatments.
- Lao PDR implemented strategies targeting forest goers and showed declining malaria cases, while the effectiveness of treatments varied across regions.
- Myanmar experienced a substantial increase in cases, particularly for *P. vivax*, and emphasized the need for molecular surveillance in border areas.
- Viet Nam saw a decline followed by a rebound in malaria cases, with varying efficacy of treatments for *P. falciparum* reported in different regions.
- Thailand noted increased cases, particularly on the Myanmar border, but showed improvement in iDES implementation and follow-up rates.

The prevalence of mutations associated with artemisinin partial resistance and resistance markers for partner antimalarial drugs varied across countries, and continued vigilance is necessary. However, currently deployed antimalarial therapies remain generally efficacious in the relevant countries. The meeting also discussed updates on imported cases in China, the WHO TES protocol, zoonotic malaria caused by *P. knowlesi*, updated WHO Guidelines for malaria, challenges in antimalarial drug procurement and research ethics review. Efforts to address challenges and improve surveillance, quality assurance and treatment adherence were highlighted, emphasizing the importance of continued vigilance, collaboration and timely malaria elimination in the GMS region.
1. INTRODUCTION

1.1 Meeting organization

In 2018, ministers of health from the Greater Mekong Subregion (GMS) countries signed the Ministerial Call for Action to Eliminate Malaria in the GMS before 2030. This declaration recognized the threat of multidrug resistance to regional and international health security. It emphasized the urgent need to implement the World Health Organization (WHO) Strategy for Malaria Elimination in the GMS (2015–2030).

WHO actively supports the implementation of this strategy through various entities, including six GMS country offices, two regional offices (South-East Asia and Western Pacific), the subregional team of the Mekong Malaria Elimination (MME) programme, and the Global Malaria Programme (GMP) at WHO headquarters.

The WHO MME programme hosted the Tenth Meeting of the GMS Therapeutic Efficacy Studies (TES) Network. This two-day meeting, conducted in Bangkok, Thailand, and online, brought together representatives from national malaria programmes (NMPs) and focal points from GMS countries – Cambodia, Lao People’s Democratic Republic (PDR), Myanmar, Thailand, Viet Nam and Yunnan province in China – as well as technical experts and partners. The meeting provided a forum to review the status of TES and integrated drug efficacy surveillance (iDES), consider the efficacy of antimalarial drugs, and identify alternative artemisinin-based combination therapies (ACTs) for the revision of national treatment guidelines (NTGs).

1.2 Meeting objectives

The overall objective of the meeting was to review the available results from the ongoing TES and iDES and develop action plans for the next two years.

The specific objectives of the meeting are:

1. to present the results of the recent TES and iDES in line with recommendations from the last meeting;
2. to present the trends of PfK13, the molecular marker for tracking artemisinin partial resistance, and of other molecular markers for monitoring malaria drug resistance;
3. to assess the impact of the COVID-19 pandemic on TES and iDES and identify risk mitigation measures; and
4. to develop GMS and country workplans and budgets for TES and iDES implementation and monitoring for 2023–2024.

The meeting participants and agenda are provided in the Annexes.
2. PROCEEDINGS

2.1 Opening session

Dr Luciano Tuseo (WHO MME programme) initiated the meeting and Dr Deyer Gopinath (WHO Thailand) delivered a welcome address on behalf of Dr Jos Vandelaer (WHO Thailand), expressing gratitude to the participants for their commitment to malaria elimination in the GMS.

Dr Pascal Ringwald (WHO GMP) provided an overview of progress made in malaria elimination, highlighting a decline in cases and particularly a decrease in *P. falciparum* cases since 2011. It was emphasized that GMS countries have a critical opportunity to eliminate *P. falciparum* and contain artemisinin partial resistance. Monitoring antimalarial drug efficacy through TES is crucial for developing evidence-based treatment policies.

Dr Tuseo presented the meeting objectives and nominated the Chair for Day 1 of the meeting, Dr Huy Rekol (National Centre for Parasitology, Entomology and Malaria Control, Cambodia) and Co-chair, Dr Keobouphaphone Chindavongsa (Centre of Malariology, Parasitology and Entomology, Lao PDR). Dr Maria Dorina Bustos (WHO Regional Office for South-East Asia) made an administrative announcement, and Dr Rekol accepted the nomination and opened the conference.

2.2 Regional updates

2.2.1 Review of recommendations from 2021 and progress

Dr Bustos reviewed the recommendations for GMS countries and WHO from the Ninth Meeting of the GMS TES Network in 2021 and provided updates on progress.

Recommendations for Member States included the following:

1. Continue monitoring the quality of TES implementation based on the WHO quality control (QC) checklist while ensuring the safety of front-line workers in the context of the COVID-19 pandemic.

2. Continue to review the results of TES within countries and consider switching the first-line drug nationally rather than subnationally.

3. Continue to refine and roll out iDES, where feasible, as countries approach elimination and the number of malaria cases decreases. Ensure integration of iDES with laboratory microscopy and procedures to measure molecular markers. Cambodia is encouraged to pilot iDES through existing mechanisms with simple standard operating procedures (SOPs), training and supervision of health staff and village malaria workers to further strengthen the national surveillance system.

4. In the context of COVID-19, test suspected cases as per national guidelines, ensuring compliance to infection prevention and control measures and safety of patients and health staff.

5. Continue efforts to strengthen quality assurance (QA) for microscopy, especially at the peripheral level for achieving elimination.

6. Continue to strengthen microscopy capacity during the COVID-19 pandemic using innovative methods, such as the virtual external competency assessment of malaria microscopists (ECAMM), where feasible.

7. Continue efforts to strengthen QA in molecular assays and analyse trends in the GMS.

8. The reversal of mefloquine (MQ) resistance in Cambodia and the return of efficacy of artesunate-mefloquine (AS-MQ) have highlighted the potential for reintroducing failed drugs. However, maintaining strong surveillance of AS-MQ efficacy in Cambodia remains a priority.

9. The situation should be closely monitored in Viet Nam after the full implementation of artesunate-pyronaridine (AS-PY) with regards to KEL1/PLA1, as the country still uses dihydroartemisinin-piperaquine (DHA-PPQ) in other provinces.
As chloroquine (CQ) resistance in *P. vivax* parasites has been identified in the past in the GMS, continue monitoring through iDES. Results for CQ efficacy studies should be reported at day 28 and day 90 follow-ups.

There were three recommendations for WHO:

1. The Regional Office is requested to support countries to review and revise their NTGs based on available TES and iDES data and coordinate bottleneck resolutions with national regulatory agencies.

2. The GMP and MME programmes are requested to provide support to GMS countries on TES protocol development and implementation based on standard guidelines, national workplans and budgets by doing the following: (a) support countries moving towards elimination, particularly as they transition to iDES, including finalizing the iDES protocol and scaling up activities to ensure drug efficacy in elimination settings; and (b) coordinate with partners on potential pooled drug procurements, especially second-line ACTs (in low quantities).

3. The WHO country offices are requested to support the operationalization of revised NTGs and the expansion, strengthening and monitoring of iDES.

Since the last meeting, progress has been made on a number of these recommendations. WHO extended support in the revision of NTG, provision of technical assistance for TES, implementation of iDES, QA for malaria microscopy, and national reference laboratory (NRL) development. Quality TES studies have been successfully conducted in Cambodia, Lao PDR, Myanmar, and Viet Nam. iDES implementation has continued in Cambodia, Lao PDR, Thailand and Viet Nam. Efforts to update or revise NTG are underway in Cambodia, Lao PDR and Viet Nam. To strengthen the QA of malaria microscopy, ECAMM was carried out in Cambodia, Lao PDR, Thailand and Viet Nam, while national competency assessment of malaria microscopists was conducted in Cambodia and Thailand. The regional external quality assessment programme involved the participation of eight NRLs from all six GMS countries. Additionally, collaboration with the Institut Pasteur du Cambodge continued, focusing on molecular assays of TES and iDES samples collected in the GMS.

### 2.2.2 Epidemiological updates from the Mekong Malaria Elimination programme in the GMS

Dr Tuseo from WHO MME provided updates on malaria epidemiology in the GMS. Elimination targets are 2023 for *P. falciparum* and 2030 for all human malaria species (2024 in Thailand and 2025 in Cambodia). China was certified malaria-free in June 2021, and Viet Nam may advance its elimination target to 2025 due to low case numbers.

Since 2011, malaria cases have declined dramatically in the GMS, particularly for *P. falciparum*. However, in 2022 *P. falciparum* and mixed cases increased by 16% and *P. vivax* by 50% versus 2021. This can be attributed to the complex political situation in Myanmar, which also affected malaria control in Thailand. In Cambodia and Viet Nam, the COVID-19 pandemic reduced population movement, leading to a decline in *P. falciparum* and mixed malaria cases in 2021. However, cases rebounded in 2022, aligning with the pre-pandemic downward trend.

The increase in *P. vivax* cases and its predominance in the GMS highlight the need for well-defined policies to eliminate this parasite. The updated WHO *Guidelines for malaria* include a conditional recommendation for targeted drug administration (TDA) specifically for *P. vivax* in elimination settings.

Country overviews were presented:

- **Cambodia**: Malaria cases are low and continue to decline. An intensification plan was initiated in 2018, and case- and foci-based elimination and foci response were implemented in 2021.
- **Lao PDR**: Accelerating strategies were initiated in 2021, targeting forest goers, and malaria cases have declined in 2022, particularly for *P. falciparum*. 
• Myanmar: There was a substantial increase in malaria cases in 2022, compared with 2020, particularly for *P. vivax*. There was a decline in testing rates in 2021 and 2022 compared with 2020. Most cases are at the borders with Thailand, India, Bangladesh and China.

• Thailand: *P. falciparum* and particularly *P. vivax* cases increased in 2022 versus 2021, mainly concentrated on the border with Myanmar caused by imported cases and local cases.

• Viet Nam: Cases have declined since 2020 and are now very low and mainly restricted to foci. Aggressive strategies are being implemented to address these foci.

• China: *P. vivax* imported cases are detected at low frequency in Yunnan province.

2.2.3 Plenary discussion

Participants discussed malaria epidemiology in the GMS.

Simian malaria: *P. knowlesi* presents challenges in distinguishing it from human malaria species. When certifying countries as malaria-free, WHO will assess the risk and evidence of human-to-human transmission of simian malaria. The presence of *P. knowlesi* alone does not automatically disqualify a country from receiving malaria-free certification.

Procurement: In countries with low case numbers approaching elimination, the procurement of drugs for implementation of changes in drug policies, as for interventions like TDA, may take longer because of the low order values.

Testing: Maintaining high levels of testing is crucial, as demonstrated in Cambodia and Lao PDR. Cambodia increased testing by transitioning from passive to active case detection and employing mobile malaria workers. Also, TDA, intermittent preventative treatment (IPT) and active fever screening all involve testing. These approaches have been successful in reaching remote populations and reducing malaria transmission. Testing could be reduced post-elimination, but an excellent surveillance system is essential for certification to demonstrate the absence of local transmission.

Polymerase chain reaction (PCR) testing: Where feasible, this may be considered for case investigation to detect asymptomatic infections and cases with low parasite numbers, particularly for *P. vivax*.

2.3 Country presentations: results and future priorities, plans, studies needed

Participants presented their country experiences.

2.3.1 Cambodia

Dr Rithea Leang from the Cambodia National Centre for Parasitology, Entomology and Malaria Control explained that malaria cases are low and continue to decline. TES studies are ongoing and operational guidelines for iDES have been finalized, with the programme launched in 10 provinces. Training-of-trainers meetings were completed, and cascade training will conclude by mid-January 2023. Strengthening supervision and monitoring of iDES is a priority for 2023. However, some study sites are still reserved for TES in provinces with *P. falciparum* cases.

The prevalence of mutations in *P. falciparum Kelch 13 (PfK13)* associated with artemisinin partial resistance has decreased. Markers for piperaquine (PPQ) resistance have markedly declined in prevalence and there was a small increase in markers for MQ resistance. Both AS-MQ and AS-PY remain highly efficacious for *P. falciparum* and *P. vivax*.

2.3.2 Lao People’s Democratic Republic

Dr Keobouphaphone Chindavongsa from the Centre of Malariology, Parasitology and Entomology explained that malaria cases, especially *P. falciparum*, are concentrated in small pockets of residual
transmission within remote ethnic minority communities. Accelerator strategies were initiated in 2021, including TDA, targeting forest goers, leading to a decline in malaria cases in 2022, particularly for *P. falciparum*.

Artether-lumefantrine (AL) remains effective for *P. falciparum* and *P. vivax* malaria, though efficacy in Attapeu province was 94% in 2021–2022, and *PfK13* markers for artemisinin partial resistance were detected. *Pfmdr1* copy number increase was observed in 9% of samples. NTGs were updated to include AS-PY in addition to AS-MQ as second-line therapy for *P. falciparum*. Quantitative glucose-6-phosphate dehydrogenase (G6PD) testing is being implemented and 14-day primaquine (PQ) for *P. vivax* radical cure is recommended for G6PD-normal patients and weekly PQ for 8 weeks in G6PD-deficient patients. AS-PY plus PQ is second-line treatment for *P. vivax*.

In 2023, TES will continue in high-burden areas. iDES is being implemented in elimination districts and will be strengthened to improve data capture. Malaria microscopy QA was implemented nationwide in 2022, with ongoing monitoring and communication between the NMP and WHO. To support diagnosis in low-endemic areas, loop-mediated isothermal amplification (LAMP) PCR is being introduced, in partnership with the Institut Pasteur de Lao. Additionally, a pilot TDA with CQ for *P. vivax* malaria and a potential TES for CQ are planned for 2023.

Key discussion points were:

- **NTG update**: Replacing quinine with ACTs as second-line is a positive step, but it is crucial to secure and deliver an adequate supply of second-line drugs to countries. The WHO Guidelines for malaria will soon recommend AL in the first trimester of pregnancy, which would simplify the Lao PDR NTG if included.
- **P. vivax** radical cure: The 7-day PQ (0.5 mg/kg/day) regimen may improve adherence in mobile at-risk populations. Conversely, the feasibility of providing sufficient pharmacovigilance for the 7-day regimen requires consideration.
- **P. vivax** treatment with CQ: Using ACTs for *P. vivax* and *P. falciparum* simplifies deployment and CQ could still be used for TDA targeting *P. vivax*.
- **P. vivax** TDA: While the planned TDA with CQ in *P. vivax* is interesting, an effective monitoring and assessment plan is needed to maximize learning. Note that the revised WHO guidelines do not recommend mass drug administration (MDA) with PQ for *P. vivax*.
- **iDES follow-up**: Obtaining day 28 and day 90 samples is a new challenge, with further training of district-level staff on sample collection planned.
- **Data management**: The Lao PDR NMP has transitioned from a paper-based to the web-based system (District Health information System 2) and can map to the village level. iDES is also linked to this system. Merging the systems for case identification, case tracking and iDES may be technically feasible and the shift in data entry responsibilities from the health centre to the district level may represent an opportunity for merging systems. A representative from Thailand indicated that they have discussed how to collect and integrate laboratory and clinical data in the country. An opportunity to discuss data management best practice and standardization across the GMS would be useful.

### 2.3.3 Myanmar

Dr Moe Kyaw Myint from the Department of Medical Research Pyin Oo Lwin branch presented the situation for Myanmar. Although malaria cases declined until 2020, there was a substantial increase in 2022, particularly for *P. vivax*. Testing rates also declined in 2021 and 2022 compared with 2020. Most cases occurred at the borders with Thailand, India, Bangladesh and China. For the last two years, ongoing political instability has impacted surveillance activities. There is also a shortage of trained technical and health facility staff. A workshop on intensification and acceleration has been conducted, with plans to deploy MDA, TDA, IPT, active fever screening and reactive case detection, based on malaria risk stratification.
First-line treatment is AL plus single-dose PQ, and second-line therapy is any alternate ACT. A TES conducted in 2020 showed high efficacy for AL and DHA-PPQ against *P. falciparum*. Non-falciparum malaria is treated with CQ plus 14-day PQ (0.25/mg/day) and without PQ for *P. malariae*. CQ had high efficacy against *P. vivax* in 2020 and this is being re-examined in an ongoing TES in Kachin state.

For 2023, routine TES is planned, QC and external QA have been strengthened and PCR validation by WHO and NMP is in place. Studies of 7-day PQ (0.5 mg/kg/day) and tafenoquine (TQ) for *P. vivax* are being considered. Molecular surveillance of drug resistance is limited and requires strengthening.

Key discussion points were:
- PQ: For *P. vivax* radical cure 0.75 mg/kg/week for eight weeks is recommended in G6PD-deficient patients. For *P. falciparum* a single 0.75 mg/kg is recommended.
- Mass screen and treat: This approach is not recommended in WHO malaria treatment guidelines. Intensification plans are still under discussion, and Myanmar intends to do MDA and TDA among high-risk groups.

2.3.4 Viet Nam

Associate Professor Bui Quang Phuc and Dr Huynh Hong Quang from the Institute of Malariology, Parasitology and Entomology described how malaria had declined substantially between 2019 and 2021 but rebounded somewhat in 2022, with *P. falciparum* cases exceeding *P. vivax*. The situation is complex, but foci are mainly in central and northern areas.

TES between 2019 and 2021 reported high efficacy for AS-MQ and AS-PY against *P. falciparum* and CQ against *P. vivax*. However, for *P. falciparum*, high rates of day 3 positivity were reported for ACTs in some regions. Pilot iDES demonstrated that this approach is possible, but there is a lack of malaria-specialized staff, limited funding for follow-up completion and limited data analysis capabilities. DHA-PPQ resistance markers are declining following the shift from DHA-PPQ to AS-PY. Resistance markers for MQ are rare. NTGs are being revised to use AS-PY first-line in all provinces. Observations of single-nucleotide polymorphisms and amplification in genes linked to CQ resistance suggest vigilance, though CQ efficacy remains 100%.

In 2023, TES is prioritized in areas with the highest malaria burden, and AS-PY for *P. falciparum* should be done. A pilot of TQ with prior G6PD screening is being considered. Operational research is also planned, including a small-scale pilot TDA of CQ. Training for molecular resistance markers and parasite culture will be evaluated.

Key discussion points were:
- DHA-PPQ: The current use of DHA-PPQ in Viet Nam is uncertain.
- Day 3 positivity: Due to the high prevalence of *PfK13* molecular markers, high rates of day 3 positivity would be expected for any ACT. AS-PY remains highly clinically efficacious, but careful monitoring is required to promptly detect any decline in efficacy.
- TQ studies: A pilot study with TQ is appropriate, but not a TES given the long duration of follow-up required (three to six months).
- *P. vivax* molecular markers: Despite the high prevalence of putative resistance markers for CQ, treatment failures with CQ are rare, and such markers require validation.
- *P. vivax* on China–Viet Nam border: Cases appear to be almost exclusively indigenous in Viet Nam in the China border area.

2.3.5 Thailand

Dr Panupong Kowsurat from the Division of Vector Borne Diseases presented the update for Thailand. In 2022, there was an increase in *P. falciparum* and particularly *P. vivax* cases, primarily concentrated on the Myanmar border. Malaria cases caused by *P. knowlesi* are increasing in the south and east of
Thailand. Surveillance in long-tailed monkeys found no evidence of the parasite. Suspected *P. knowlesi* cases are confirmed by PCR.

iDES has been implemented and shows high adherence to NTGs with improved follow-up rates in fiscal year 2021 compared to previous years. DHA-PPQ efficacy against *P. falciparum* was high in most areas, though iDES identified regions of decreased DHA-PPQ efficacy, leading to the adoption of AS-PY in two provinces. CQ+PQ efficacy against *P. vivax* is high in most areas. Activities that require improvement include data management and the collection of dried blood spot specimens. Stringent QC processes, including proficiency testing for microscopists, are in place. There are large variations in *PfK13* mutation prevalence and markers. *PfK13* C580Y was at fixation in the Thailand–Cambodia border area, whereas at the Thailand–Malaysia border all isolates were wild type (WT), and on the Thailand–Myanmar border *PfK13* R561H is at fixation.

Ongoing research includes the feasibility of quantitative G6PD testing and TQ deployment for *P. vivax* radical cure and MDA with AS-MQ targeting high-risk populations. A pilot is planned for chemoprevention with CQ in Tak. Molecular marker surveillance is ongoing with iDES samples and with partners. Genome sequencing is to be implemented.

Key discussion points were:

- **Follow-up:** Follow-up adherence in fiscal year 2022 has decreased, possibly because of the difficulty in tracing migrants from Myanmar. iDES effectiveness is reduced if follow-up is not completed.
- **P. knowlesi:** Surveillance is planned in macaques. Increases in case detection can be attributed to PCR species confirmation and increased travel between southern Thailand and Malaysia.
- **AS-MQ in MDA:** In Cambodia and Lao PDR, adverse events were associated with AS-MQ use in MDA. Prior to DHQ-PPQ, AS-MQ was used in Thailand and adverse events were reported.

### 2.3.6 Updates and trends on molecular markers during TES in the GMS

Jean Popovici, Institut Pasteur du Cambodge, summarized the prevalence of molecular markers validated for resistance surveillance, as well as putative *Pfcrt* markers for AL resistance, from samples collected from TES studies from 2020 to 2021 and an outbreak in Cambodia in 2022.

In Viet Nam, *PfK13* mutation prevalence was high and stable whereas MQ resistance prevalence was low and stable. PPQ resistance prevalence decreased but is still around 20%. Alternatives to DHA-PPQ should be fully deployed (AS-PY, AS-MQ).

In Lao PDR, there was a significant increase in *PfK13* C580Y. The prevalence of MQ resistance markers remained low and stable. There was no evidence of selection of PPQ resistance. However, the prevalence of *Pfcrt* mutations increased. Notably, there were distinct regional differences, with 100% of *Pfmdr1* Y184F/*PfK13* parasites from Attapeu and 94% of *Pfcrt* F145I/*PfK13* WT from Savannakhet. There was possibly two recrudescences from Savannakhet, both *Pfmdr1/PfK13* WT, one F145F *Pfcrt* and one unknown *Pfcrt*. It is unclear whether the observed changes in drug resistance markers are caused by continued selection from AL or are imported cases. In vitro data and genomic analyses are needed to resolve this.

There were no samples from the Cambodia–Lao PDR border area in 2021–2022 so comparisons with 2020 data cannot be made. There was no selection of *Pfmdr1* amplification and AS-MQ remains effective, but more extensive surveillance is needed. An outbreak in Pursat did not appear to be related to AS-MQ treatment failure. Overall, 99% of parasites had *PfK13* Y493H, though *Pfpm2–3* and *Pfmdr1* gene amplification were both uncommon.
Key discussion points were:

- **Outbreak in Pursat**: The outbreak was not driven by treatment failures. However, artemisinin partially resistant parasites generate gametocytes quickly, increasing transmission potential, even if the partner drug remains effective. If single-dose PQ is administered, this should reduce transmission. Case numbers were very low, so it may be confusing to term this an “outbreak”. When approaching elimination, even with low case numbers, there is still variation in malaria prevalence, which may or may not have biological meaning.

- **Cambodia recurrences**: These occurred at day 26 (probably reinfection), day 33 (recrudescence) and day 42 (reinfection). Early reinfection could be caused by reduced parasite susceptibility but could also be caused by the individual patient’s metabolism or drug absorption. Ideally, day 0 and follow-up samples should be cultured and drug sensitivity tested to define the parasite phenotype before and after drug treatment.

- **Elimination**: The presence of artemisinin partial resistance increases selection pressure for resistance development for the partner drug. Swift elimination of *P. falciparum* is crucial.

- **Pfmdr1 amplification**: The use of AS-MQ should select for Pfmdr1 amplification in Cambodia, but this has not been observed and there appears to be a window for MQ use. The small sample size and limited surveillance may have affected the detection of MQ-resistant parasites. Cambodia has reduced *P. falciparum* cases significantly, decreasing the risk of resistance selection.

- **AS-MQ failures**: In Cambodia all treatment failures over the past few years have been PfK13 Y493H and Pfmdr1 single copy. Publication of these data should be considered.

- **Amodiaquine (AQ) resistance**: Suspected markers of AQ resistance observed in Africa were not detected in Cambodia. Examining the Cambodia isolates for the additional markers seen in Lao PDR should be considered.

- **Additional markers**: In Lao PDR, the occurrence of reinfections indicates that chemoprevention is impaired – that is, low levels of drug no longer kill the parasite. Recrudescence has also been observed. Additional markers associated with these failures should be investigated.

- **Lao PDR samples**: Since 2013, there have been regional differences in marker prevalence. Low sample size can increase the effect of such biases. Ideally, every case should be investigated.

### 2.3.7 Genetic surveillance of drug-resistant malaria in the GMS

Dr Olivo Miotto from Oxford University outlined the GenRe-Mekong project which aims to deliver timely information on genetic markers to NMPs across the GMS. A broad set of genetic markers is investigated, based on published data and WHO criteria. Genetic barcodes are also reported summarizing the parasite genome, allowing estimation of population diversity and epidemiological signals. Reports are sent to NMPs and other repositories, such as the WHO Malaria Threats Map. The project is active in Cambodia, Lao PDR and Viet Nam, and will expand to Thailand in 2023.

Molecular markers in samples from TES studies and genetic surveillance showed concordant results. The decline in malaria cases has fragmented the geographic distribution of *P. falciparum* populations. Across the GMS, the prevalence of MQ resistance is low, resistance to PPQ is declining and PfK13 mutations are variable. Notably, parasites in northern Lao PDR were mostly WT, and there was an increase of PfK13 R539T in southern Lao and Y493H in Cambodia. In Attapeu province in 2020–2021, an outbreak was associated with a huge expansion in PfK13 R39T and a collapse in parasites with PfK13 C580Y and Pfpm1 gene amplification. The outbreak strain was highly local to a particular district and related to parasites isolated in Cambodia 10 years previously. This illustrates the potential for different parasite populations to expand if the conditions are suitable. For historical drugs, there was re-emergence of *P. falciparum* WT for CQ in Lao PDR and Viet Nam and for sulfadoxine-pyrimethamine (SP) in the north of the GMS. Public health interventions can dramatically change the population balance and continued vigilance is needed.

In vitro data are needed to determine the phenotype of parasites harbouring resistance-associated mutations. Genetic monitoring is less expensive and easier to scale than TES, but the approaches are complementary.
Information Reporting Management System will be updated.

The primary challenge to implementing iDES is ensuring adequate clinical and parasitological response ACPR, with two parasite-positive at day 3. Of the 91 non-falciparum cases, 37 P. vivax cases were included in iDES and treated with DHA-PPQ (+PQ) (n=2) or CQ+PQ (n=35); 32 had day 28 adequate clinical and parasitological response (ACPR), with two parasite-positive at day 3. Only 13% of P. falciparum cases and 30% of P. vivax cases had more than one follow-up visit. Amendments to the malaria information system to improve data capture and orient to iDES outcomes are needed.

The primary challenge to implementing iDES is ensuring patient follow-up. The COVID-19 pandemic negatively impacted training delivery, QA and human resource investment in malaria surveillance. In 2023, a revised iDES protocol compliant with WHO recommendations will be issued before nationwide implementation. Additionally, QA will be provided by provincial laboratories and the Parasitic Diseases Information Reporting Management System will be updated.

Key discussion points were:

- Confirmatory data: Concordance between genetic surveillance, TES and molecular marker monitoring completed by different groups provides confidence that the results are reliable. Genetic monitoring can be used to explain why there are sudden changes in resistance markers.
- Historical drugs: There are plans to do MDA for P. vivax with CQ but it might not work against P. falciparum in the GMS. P. falciparum CQ resistance reversal was observed in Africa, whereas SP resistance reversal has not been observed. Rather than losing resistance mutations, sensitive parasites may have been present at low numbers, re-emerging once drug pressure was lifted.
- Pfmdrl amplification: As a resistance mechanism, gene amplification has a significant fitness cost and may disappear rapidly in the absence of MQ drug pressure.
- Parasite phenotype: In Viet Nam, parasites are being collected for culture, and Institut Pasteur is conducting in vitro studies in Cambodia and Lao PDR, with the opportunity to collaborate. Data regarding the capacity of different mutants to generate gametocytes would be useful.
- Reintroduction: In the context of elimination, genetic monitoring can determine whether a parasite is imported or a residual local parasite.
- Sampling: All samples were human parasites from symptomatic patients. Analysing samples from asymptomatic infections with lower parasite densities is more challenging. It may be possible to sample mosquito parasites, but these are not currently available.

### 2.4 Updates and specific technical presentations

#### 2.4.1 Opening session

Dr Tuseo opened the second day of the meeting and nominated the Chair, Dr Tran Quang Phuc, Vice Director, Viet Nam National Institute of Malariaology, Parasitology and Entomology, and Co-chair, Dr Nay Yi Linn, Programme Manager, National Malaria Control Programme, Myanmar.

#### 2.4.2 iDES and molecular markers of imported cases in a malaria-free country – China

Dr He Yan, National Institute of Parasitic Diseases, and Dr Hui Liu, Yunnan Institute of Parasitic Diseases presented. Until 2021, imported malaria were declining in China, but in 2022, P. falciparum cases increased, with implications for case management. Most P. falciparum cases originated in Africa, and most P. vivax cases came from Asia. Of the 28 imported P. falciparum cases in 2021–2022, one had a PfK13 Q613H. Various other mutations were reported in Pfmdrl, Pfdrfr and Pfhhps.

China has implemented iDES, with four drugs available in Yunnan – injectable artesunate, DHA-PPQ, CQ and PQ. In 2022 (January to October), there were 30 P. falciparum cases and four were included in iDES. Two were treated with injectable artesunate plus DHA-PPQ and two with DHA-PPQ; all four cases had day 28 ACPR, but two were parasite positive at day 3. Of the 91 non-falciparum cases, 37 P. vivax cases were included in iDES and treated with DHA-PPQ+PQ (n=2) or CQ+PQ (n=35); 32 had day 28 adequate clinical and parasitological response (ACPR), with two parasite-positive at day 3. Only 13% of P. falciparum cases and 30% of P. vivax cases had more than one follow-up visit. Amendments to the malaria information system to improve data capture and orient to iDES outcomes are needed.
Key discussion points were:

- **PQ regimen:** In China, the 14-day regimen (0.25 mg/day) was reduced to eight days with the same total dose; this is not consistent with any WHO-recommended regimen.
- **CQ for \textit{P. vivax}:** Surveillance is being expanded to monitor clinical efficacy.
- **China’s drug resistance surveillance is not compliant with WHO guidelines:**
  - Injectable artemisinin: This is not recommended for uncomplicated falciparum malaria.
  - Molecular markers: Validated molecular markers should be used for drug resistance surveillance.
  - Surveillance gaps: iDES must be comprehensive and the systems in place require review and improvement.
  - Compliance: WHO headquarters can provide support for TES and iDES compliance.

2.4.3 Quality control in TES and iDES: specific country implementation challenges

Dr Bustos highlighted that all countries should use the most recent WHO TES protocol with the relevant tools available on the WHO website. The TES protocol should be reviewed and approved by the national ethics committee and WHO Ethics Review Committee (ERC). Clinical trial registration before study start is mandatory on the Australian and New Zealand Clinical Trials Registry (https://www.anzctr.org.au), ClinicalTrials.gov (https://clinicaltrials.gov/) or Clinical Trials Registry India (http://ctri.nic.in/).

TES sample size calculation requires a review of local epidemiology at sentinel sites. Modifications are allowed for initial parasitaemia and patient age, based on transmission intensity, microscopy quality and whether inclusion of children is permitted by the country. Recent antimalarial drug administration within four weeks is not an exclusion criterion. Patient follow-up may require travel support in remote areas.

Microscopy should be used for diagnosis with robust QA and comply with TES protocols for parasite counts, QC and validation. Slides need to be collected beyond day 3 until negative. PCR confirmation is required for any \textit{P. falciparum} recurrence to differentiate recrudescence from reinfection. The WHO protocol outlines the methodology for dried blood spot sample collection and analysis using specific molecular markers.

Supervised administration of antimalarial drugs is necessary, and second-line drugs must be available. All drugs should be appropriately stored. Double data entry and validation should be used, and complete data reporting is crucial for the WHO Malaria Threats Map. Merging data from different study sites should be avoided to avoid obscuring resistance emergence.

Severe malaria within 24 hours of the first drug administration is not an early treatment failure and should be excluded from the TES analysis. Outcomes are evaluated in the per-protocol population using Kaplan-Meier analysis. WHO conducts monitoring using a QC monitoring template, providing feedback and recommendations for improvement throughout the study. Case records, protocols and ethics documents should be readily available onsite.

For iDES, a WHO template is not available, though guidance on surveillance requirements is provided. iDES requires effective planning, budget allocation, SOP establishment, and training, particularly for microscopy and laboratory QC. Cases should be managed according to the NTGs, with adequate drug stock available, including injectable artemisinin for severe cases. Consolidation of surveillance reports and laboratory results is necessary, ideally with linked reporting forms. A focal person at the central level must regularly review the data management and analysis and identify gaps. Operational challenges include following up with hard-to-reach and mobile populations, ensuring adherence to treatment guidelines, and addressing implementation barriers through field supervision and monitoring.

Key discussion points were:

- **Population:** It is not clear whether pregnant women treated with AL can be enrolled in TES.
Microscopy: Harmonizing the WHO guidelines for microscopy and TES microscopy protocols would simplify training and avoid confusion.

PCR genotyping: In Lao PDR, using the WHO protocol, the same genotype was found in different patients. A recent WHO technical advisory board confirmed that this protocol is suitable for low transmission areas. In Africa where there are multiple clones in one patient, poly-alpha microsatellite markers are recommended. Institut Pasteur are looking at next-generation markers using amplicon sequencing. In the GMS there are limited haplotypes, so the recrudescence rate is probably being overestimated.

Training materials: It may be helpful to include the reasons for certain procedures in the TES protocol, such as follow-up at days 28, 40, 42 and 90.

Merging data: Merging iDES data across different regions risks losing information on resistance emergence. However, disaggregation and visualization by smaller discreet areas is possible, flagging areas of concern. In Thailand, the emergence of DHA-PPQ resistance in the Cambodia border areas was quickly noted.

TES versus iDES:
(a) TES is the standard for driving drug policy.
(b) iDES is a surrogate and should not be used to drive policy changes. However, individual patient data can trigger action when concerning findings are reported.
(c) TES does not evaluate PQ for *P. vivax* relapse prevention, whereas iDES is oriented to malaria elimination, so PQ should be administered, and the patient followed for 90 days to determine the possibility of onward transmission.

Follow-up completion is fundamental to iDES:
(a) Complete follow-up is needed to monitor drug resistance where TES is unfeasible.
(b) As a tool for elimination, treatment failures must be identified as these will promote transmission and may generate additional foci.
(c) For *P. vivax* patients must be followed up for 90 days as suboptimal PQ adherence risks repeated relapses, and gametocytes are generated concurrently with asexual forms, increasing the risk of transmission.
(d) WHO malaria elimination certification requires proof that all cases are followed up.
(e) A high degree of training and commitment is required to follow up patients. There may be lessons to be learned from follow-up of people living with HIV.

2.4.4 Prevalence and management of *P. knowlesi*, Malaysia’s experience towards elimination

Dr Jenarun Jelip from the Malaysian Ministry of Health explained that, although Malaysia has eliminated indigenous human malaria cases since 2018, the burden of the zoonotic parasite *P. knowlesi* has increased. Transmitted by *Anopheles leucosphyrus* group mosquitoes, the natural hosts are long-tailed and pig-tailed macaques, with spillover into humans. Out of 3575 malaria cases in 2021, 97% were caused by *P. knowlesi*. Zoonotic malaria elimination is not included in the WHO certification scheme, but Malaysia’s certification has been postponed while the Malaria Elimination Certification Panel considers setting criteria for defining a negligible risk of transmission.

Diagnosing *P. knowlesi* is challenging, and increased diagnostic capacity has contributed to the rise in reported cases. Contributing factors are the loss of relative immunity because of low malaria incidence and a change in land use patterns causing closer association between humans, hosts and vectors. Ongoing studies aim to assess the prevalence of *P. knowlesi* in macaques.

Hospital admission is mandatory for all malaria cases. ACT is recommended for *P. knowlesi* and appears successful. Vector control measures, warning notices and personal protection strategies are implemented. Note that vectors for *P. knowlesi* can be different to those for human malaria, and entomological surveillance is needed to inform vector control.

Recommendations for GMS countries are:
(1) Establish a testing policy for *P. knowlesi*, with mandatory PCR confirmation for all *P. malariae* and *P. falciparum* cases.

(2) Identify the primary vector.

(3) Determine parasite prevalence in macaques.

Key discussion points were:

- **Drug efficacy:** CQ efficacy against *P. knowlesi* is suggested by the literature but a local clinical study in Malaysia found a relatively high day 3 positivity rate with CQ compared to ACT. It is important to note that day 3 positivity rate is not an efficacy measure but rather reflects the parasite killing rate and is used to define the phenotype for artemisinin partial resistance. CQ drug efficacy is assessed using ACPR at day 28.

- **ACPR rates for *P. knowlesi***: These are low because of missing data for day 28 and reflect limited follow-up coverage rather than treatment failure.

- **Human-to-human transmission**: While *P. knowlesi* gametocytes have been observed in humans, there is no clear evidence of human-to-human transmission.

- **Protection**: The primary vectors are outdoor-biting mosquito species, and vector control measures used against human malaria vectors are not effective. Outdoor residual spraying has shown promise in Sabah state, using a specially formulated product. However, this approach only addresses peri-domestic transmission and does not address transmission in forested areas.

### 2.4.5 Update on the global drug resistance situation

Dr Ringwald highlighted that all antimalarial drug resistance data are available on the WHO Malaria Threats Map. In the GMS, molecular markers for PPQ and MQ resistance are uncommon, while artemisinin partial resistance markers are prevalent. Clinical efficacy of AS-MQ, AS-PY and AL remains high in Cambodia, Lao PDR and Viet Nam.

In Guyana, *PFK13* C580Y mutants were found in a mining area near the Venezuelan border in 2016−2017. Analysis of flanking microsatellites showed the origin of these parasites was South America, not Southeast Asia. Subsequent samples did not show any *PFK13* mutations, and improved case management, case investigation and vector control appear to have eliminated the mutant parasites. In Papua New Guinea, *PFK13* C580Y emerged locally and has reached a high prevalence. This country can now be considered an area of partial artemisinin resistance and urgent action is needed to prevent the spread of these parasites to other areas and neighbouring countries.

In Africa, an extensive surveillance system is in place and *PFK13* mutations were detected in 3.9% of *P. falciparum* cases between 2015 and 2020. Eritrea, Rwanda and Uganda have the highest prevalence of *PFK13* mutants, and TES studies in these countries show artemisinin partial resistance, though ACTs remain effective. At least four markers associated with artemisinin partial resistance have emerged and these are distinct from the GMS markers. These findings have prompted a shift in effort from partner organizations to address drug resistance in Africa. Thus, elimination efforts in the GMS must be completed promptly, while funding and support are still available.

In terms of antimalarial efficacy, AL and AS-PY remain effective in the GMS and Africa. Concerns have emerged regarding AL resistance in Africa, although further confirmation is needed. DHA-PPQ continues to be efficacious in Africa despite high failure rates in the GMS. AS-MQ, which faced resistance in Cambodia, has regained efficacy. Artesunate-amodiaquine (AS-AQ) shows suboptimal efficacy in the GMS but remains effective in Africa. Artesunate plus SP, once used in the horn of Africa, is now considered ineffective and is no longer a first-line treatment in the region. Continuous monitoring and research are necessary to address emerging resistance and ensure effective antimalarial treatment.
2.4.6 WHO updated guidelines on treatment of malaria

Ms Charlotte Rasmussen, WHO GMP, outlined the changes made to the *WHO Guidelines for malaria*, which is available as an online resource. WHO employs a rigorous guideline development process, and the online format allows recommendations to be reviewed and updated as new evidence becomes available. The next update is planned for 30 November 2022. The guidelines indicate the quality of the evidence and the strength of the recommendation. Strong recommendations can be adopted as policy in most situations, while conditional recommendations require stakeholders to assess the risk-to-benefit ratio in a specific context before implementation.

There were several updates to the malaria treatment recommendations. AS-PY is recommended for the treatment of uncomplicated malaria, supported by strong evidence. For pregnant women with uncomplicated *P. falciparum* malaria, AL is recommended during the first trimester (strong recommendation, low-certainty evidence). For relapse prevention in *P. vivax* and *P. ovale* malaria, a strong recommendation was made for 7-day PQ (0.5 mg/kg/day) as an alternative to the 14-day (0.25 mg/kg/day) regimen. It was emphasized that G6PD testing should be conducted before administering PQ. However, a conditional recommendation was made against the use of 7-day PQ (1.0 mg/kg/day) due to the increased risk of adverse events.

2.4.7 Plenary discussion

Participants engaged in discussion on the topics in the presentations.

Short-course PQ: Concerns were raised regarding the efficacy of 7-day PQ (0.5 mg/kg/day) for *P. vivax* relapse prevention in Southeast Asia. Data on this topic are limited and the evidence was of low certainty. It was suggested that the *P. vivax* Chesson strain may require a higher dose (1.0 mg/day for 7 days). Institut Pasteur du Cambodge is currently conducting a study comparing the efficacy of PQ 0.25 mg/day for 14 days versus 0.5 mg/day for 14 days, and preliminary data indicate that the lower dose is insufficient. If the higher 1.0 mg/kg dose is unsafe, then 14-day PQ 0.5 mg/kg may need to be considered. However, where the 14-day 0.25 mg/kg regimen is known to be effective, then the 7-day 0.5 mg/kg regimen is now an alternative option.

PQ dosing: PQ dosing is based on body weight, with no maximum specified dose. The limited available tablet strengths (15 mg and 7.5 mg) and the impracticality of tablet division make achieving the correct dose challenging, particularly for individuals with higher body weight.

G6PD testing: Mandatory G6PD testing is necessary for *P. vivax* radical cure with PQ or TQ. If G6PD testing is not available, weekly PQ for eight weeks could be an option.

PQ and anaemia: *P. vivax* patients are often anaemic. If the patient has haemoglobin < 8 g/dL but is G6PD normal, caution is required when initiating PQ therapy as haemoglobin may decline further.

PQ and schizonticide timing: The timing of the PQ dose after CQ or ACT is not well described in the guidelines. Starting PQ and CQ on day 1 limits the treatment course to seven days in total and maximizes the potential for synergistic activity. There is no contraindication for PQ/CQ co-administration. Note that TQ is only approved for co-administration with CQ.

2.5 Topics and issues for discussion

2.5.1 ACT drug procurements issues

Meeting drug procurement requirements is essential for effective malaria management. This should include ensuring availability of first-line and second-line ACT in both adult and paediatric formulations, treatment options for *P. vivax* malaria, and access to PQ for *P. vivax* radical cure. Additionally, injectable artemisinin is required for the treatment of severe malaria. However, there needs to be clarity regarding
which drugs are registered in the country, whether drug registrations align with the NTGs, and whether registered drugs can be reliably procured. Problems in drug procurement in the GMS and potential solutions were highlighted for Cambodia and Myanmar as examples:

- Cambodia faces challenges in procuring AS-MQ due to limited global demand. The Global Fund to Fight HIV, Tuberculosis, and Malaria (The Global Fund) provides support, but QC issues with the AS-MQ paediatric formulation led to the adoption of AS-PY for children. TDA and IPT in forest goers also now uses AS-PY, sparing AS-MQ stocks for malaria treatment. PQ acquisition is not problematic, but the lack of a paediatric formulation hinders its use in children. Procurement of PQ and injectables for severe malaria is managed by the Government with stringent quality requirements to ensure the pre-qualification and quality of imported drugs.

- Myanmar had insufficient supplies of PQ to address a rapid increase in P. vivax cases and had to obtain emergency supplies through the United Nations Office for Project Services (UNOPS). AL is the first-line malaria treatment, with good availability from multiple manufacturers. While the NTGs recommend any ACT as second-line treatment, procurement is limited, and quinine is still used. AS-PY is registered and has demonstrated efficacy; it would therefore be a viable option for second-line therapy. AS-PY is also being considered for MDA and TDA.

The issue of drug registration lies with manufacturers rather than countries, and manufacturers may not apply for registration in countries with low numbers of malaria cases. Where a non-registered drug is needed, a special waiver can be granted by the regulatory authority for donated drugs supplied at no cost. However, proper planning and readiness from the country’s regulatory authority are necessary to accept the drug. The NTG should also incorporate contingency plans in case recommended drugs become unavailable.

The establishment of a regional stockpile of antimalarial drugs has faced challenges, such as disagreements on storage locations and limitations on cross-border drug transfer due to regulatory authority restrictions. However, agreements have been made with manufacturers to maintain a stock of certain ACTs. The potential use of AS-PY in Africa, following changes in WHO treatment guidelines, may allow revisiting the option of regional stockpiling, which could benefit the GMS.

Avoiding stock-outs of antimalarial drugs requires ordering higher quantities to ensure availability, even if some drugs may expire. The Global Fund supports this approach, recognizing that stock-outs must be avoided as countries progress towards elimination. Over-ordering and creating stockpiles at different levels can optimize response time for malaria treatment in villages.

2.5.2 Update from WHO Western Pacific Region Ethics Review Committee on the new portal, SOP and suggested changes to relevant study protocol submissions

Dr Duan Mengjuan outlined the revised SOP for the WHO Research ERC in the Western Pacific Region, approved in October 2022. The revisions ensure consistency across regions and at the global level.

The ERC aims to conduct formal ethics reviews for all WHO research projects involving human subjects, ensuring the protection of participants’ dignity, safety and rights. The SOP emphasizes key considerations such as safety, equity and informed decision-making for research participants. It provides detailed information on the role and structure of the ERC, meeting procedures, submission and review processes for research proposals, conflict-of-interest guidelines, and the adoption and amendment of rules of procedure.

To submit research proposals, technical units are required to use the Health Research Portal (https://researchportal.wpro.who.int/hrp/), which serves as the platform for proposal submission and review. The SOP outlines the necessary requirements and documents for proposal submission. Two new additions include the need for an independent scientific review to validate the study design’s soundness.
and the declaration of conflicts of interest. Initial reviews may require additional documentation; typically, two reviewers are invited to assess the proposal.

The SOP categorizes the review process into four pathways based on the level of risk involved in the study – exempt from review, expedited review, committee review, and accelerated review for health emergencies. Each pathway has a designated timeline for review, ranging from fewer than five working days to up to 30 working days. Following the review, proposals can be approved, rejected, or marked as not approved, indicating the need for additional information, rewriting, or clarification and amendments to the proposal.

Key discussion points were:

- **Template:** A template was developed for the TES protocol, which facilitated expedited review with the WHO ERC. This template may also be beneficial for regional ERC applications.
- **ERC review process:** TES proposals are categorized as surveillance rather than research and follow a standardized protocol. Therefore, they usually do not require external review and are reviewed internally by members of the ERC through expedited review. Unlike the WHO ERC, the Western Pacific ERC does not charge a fee to review.
- **Timescales:** Due to recent restructuring there have been some delays in protocol approvals at the Western Pacific ERC. However, with implementation of the new process and access through the portal, it is expected that the review process will align with the stated timescales.
- **Website instructions and training:** Uploading a proposal into the portal should be a straightforward administrative task but can be time-consuming and frustrating. While some countries have had positive experiences using the portal, others have found it difficult to navigate. Reviewers also face challenges with the system.

### 2.6 Partners

#### 2.6.1 Partner inputs

In the last session of the workshop, representatives from partner organizations offered their thoughts and inputs.

The importance of investing in QA for microscopy was emphasized, especially as malaria cases decrease during elimination efforts. Maintaining a functional QA system is crucial for both accurate diagnosis and a surveillance system necessary for malaria-free certification. Also highlighted was the need to strengthen activities for malaria elimination given the low prevalence of cases in some countries. Key areas include case management with quality drugs, research into diagnostic tools, regional stockpiling, and up-to-date protocols based on drug efficacy and resistance information. Continued support is required to address malaria in mobile and migrant populations. In particular, the situation in Myanmar may require re-evaluation of the 1-3-7 programme to address current challenges.

New approaches may be needed to address asymptomatic infections with low parasite densities, particularly in *P. vivax* cases. Installing highly sensitive detection methods, such as LAMP systems, in district hospitals can accelerate elimination by identifying and treating these cases.

Appropriate surveillance, including molecular surveillance, is a crucial activity. There also is a need for in vitro drug testing of *P. falciparum* parasites to complement molecular marker surveillance. The challenge of transitioning from TES to iDES was also raised, particularly the evolving data management needs. Countries must adapt their data management systems to accommodate iDES data, visualize data effectively, and assign responsibility for taking action based on the data. To achieve the aim of elimination there must be effective planning and quantification for the next funding cycle of the Global Fund.
3. CONCLUSIONS

Dr Ringwald highlighted that only recently ACTs were failing across the GMS and a global catastrophe was expected. However, this was averted because the GMS countries increased surveillance and changed policies based on trusted advice. Currently, each country has multiple ACTs with sufficient efficacy, ensuring effective treatment. However, ongoing vigilance is necessary.

The elimination of *P. falciparum* malaria could be achieved within the next two years. Molecular marker data from TES and surveys were concordant, indicating that *P. falciparum* artemisinin partial resistance is still present and will likely remain until the parasite is eliminated, with the parasites continuing to evolve. While some cases of CQ-resistant *P. vivax* occur, ACTs remain efficacious. However, PQ implementation for *P. vivax* relapse prevention is operationally complex and adherence is a concern.

Implementing iDES faces challenges, including questions about understanding the process and purpose of the activity. The importance of malaria microscopy QA was emphasized, not only for iDES, but for obtaining malaria-free certification. Additionally, the presence of *P. knowlesi* raises concerns about differential diagnosis and its implications for malaria-free certification.

Artemisinin partial resistance molecular markers have independently emerged in South America and parts of Africa with no relationship to the GMS drug-resistant parasites. The situation in Africa is concerning and has relevance to the GMS because funding and support will be diverted. Thus, malaria elimination in the GMS becomes even more urgent.

The WHO *Malaria guidelines* were updated, recommending AL for the first trimester of pregnancy, a shorter 7-day PQ regimen for *P. vivax* relapse prevention, and AS-PY for uncomplicated malaria. TQ is not available as a pre-qualified drug, although some countries are conducting pilot implementation studies. The issues around antimalarial drug procurement have not been solved, but continued dialogue is essential to reach an agreement. It is unacceptable that the tools required for malaria elimination are not available in the GMS.

The Western Pacific ERC provided a review of their updated SOPs aligned with central processes. For TES studies, the changes should not be overly complicated as they will adhere to the WHO standard protocol. However, issues regarding the functioning of the website and training need to be addressed.

The progress achieved in malaria elimination in the GMS would not have been possible without the support of the partner organizations and the synergistic collaborations that have been established. These collaborations need to continue and will play a crucial role in achieving the goal of malarial elimination in the GMS.

3.1 Recommendations for Member States

Member States are encouraged to consider the following:

(1) Continue monitoring the quality of TES implementation based on the WHO protocol and QC checklist.
(2) Continue to review the results of TES within countries and consider switching the first-line drug nationally.
(3) Continue to refine and roll out iDES where feasible as countries approach elimination and the number of malaria cases decreases.
(4) Continue efforts to strengthen NRLs for malaria diagnosis, and QA for microscopy, especially at the peripheral level for achieving elimination.
(5) Continue efforts to strengthen QA in molecular assays and analyse trends in GMS.
(6) Based on the new WHO chemotherapy guidelines, update the NTG – in particular, the use of AL in the first trimester of pregnancy and shorter regimen of PQ, keeping the same total dose.
(7) Support the operationalization of revised NTGs and the expansion, strengthening and monitoring of iDES.
(8) Continue to strengthen surveillance on the prevalence of *P. knowlesi* in the GMS.

### 3.2 Recommendations for WHO

1. Support countries to develop the protocol and submit it to the national Institutional Review Boards and Research ERC of the WHO Western Pacific Regional Office, and the clinical trial registry.
2. Support countries to review and revise NTGs based on available TES and iDES data and the new WHO guidelines, and coordinate resolution of bottlenecks with national regulatory agencies.
3. Lead the effort to increase QA of malaria microscopy through trainings and competency assessment, and strengthen country NRLs.
4. Continue dialogues with implementing partners on drug supplies to avoid delays or stock-outs (e.g., AL and AS-AQ for Africa).
5. Encourage and coordinate with countries for registration of ACT and other medicines listed in the NTGs.
6. Support countries to move towards elimination, particularly as they transition to iDES, including finalizing the iDES protocol and scaling up activities to ensure drug efficacy in elimination settings.
7. Coordinate with partners on potential pooled drug procurements, especially second-line ACTs (in low quantities).

### 3.3 Next steps

An overview of the next steps for ongoing projects and initiatives was provided by representatives.

Cambodia has already initiated TES, while Lao PDR has recently received approval from the ERC to proceed with their studies. In the case of Viet Nam, feedback was received from the ERC and a response is being prepared. Funding has been made available for a TES in Gia Lai province. However, with malaria cases continuing to decline, 2023 might be the last feasible year to conduct TES in these countries. In Myanmar, there is optimism that WHO funding will be allocated for conducting a *P. falciparum* TES in 2023. The responsibility for TES funding now lies at the country level, requiring an agreement to be signed between WHO country offices and the NMPs.

In terms of iDES, Thailand is progressing with its implementation, Viet Nam is also moving forward in adopting this approach and Cambodia has also begun implementing iDES in select areas. These initiatives are supported by the Global Fund and the United States Agency for International Development – President’s Malaria Initiative (USAID-PMI), with iDES representing an integral part of their grant applications. WHO can provide technical support for QC and offer advice on iDES implementation where requested.

To ensure the competence of malaria microscopy, external competency assessments will be conducted in 2023 with the support of USAID-PMI. The WHO regional offices will facilitate additional assessments and country workshops will be organized accordingly. In case there is a need for refresher training, countries are advised to collaborate with the focal points at WHO country offices to arrange these sessions. The scheduling process for assessments and training facilitators will commence soon. ACT Malaria is currently engaged in discussions regarding training of trainers, aiming to enhance in-country capacity for conducting competency assessments.

### 3.4 Concluding remarks

At the close of the two-day workshop, Dr James Kelley from the WHO Regional Office for the Western Pacific thanked all the participants for their attendance and support, and for raising awareness about the
importance of taking measures to protect antimalarial drug efficacy. All GMS countries have made progress, but also face ongoing challenges. Further hard work and technical, financial and human resources are needed to overcome these challenges and achieve a malaria-free GMS.

Dr Tuseo concluded the meeting by highlighting the outcomes of the four key meetings held during the previous two weeks directed towards developing the new funding proposal. However, the concerning emergence of artemisinin partial resistance in Africa may cause donors to reorient resources from the GMS to Africa. Thus, the proposals for RAI4E funding from the GMS need to be robust and aim to deliver malaria elimination in the GMS.
## Annex 1. List of participants

<table>
<thead>
<tr>
<th>Government participants</th>
<th>Cambodia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dr Huy Rekol</td>
</tr>
<tr>
<td></td>
<td>Director, National Centre for Parasitology, Entomology and Malaria Control, #477 Betong Street (Corner St.92), Village Trapangsvay, Sangkat Phnom Penh Thmey, Phnom Penh, Cambodia, email: <a href="mailto:director@cnm.gov.kh">director@cnm.gov.kh</a></td>
</tr>
<tr>
<td></td>
<td>Dr Leang Rithea</td>
</tr>
<tr>
<td></td>
<td>Deputy Director, National Centre for Parasitology, Entomology and Malaria Control, #477 Betong Street (Corner St.92), Village Trapangsvay, Sangkat Phnom Penh Thmey, Phnom Penh, Cambodia, email: <a href="mailto:rithealeang@gmail.com">rithealeang@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Lao PDR</td>
</tr>
<tr>
<td></td>
<td>Dr Keobouphaphone Chindavongsa</td>
</tr>
<tr>
<td></td>
<td>Deputy Director, Centre of Malariology, Parasitology and Entomology</td>
</tr>
<tr>
<td></td>
<td>N° 365, Unit 22, DongDok village, Xaythany district, Vientiane, Lao PDR, email: <a href="mailto:chinda07@gmail.com">chinda07@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Dr Vonethalom Thongpaseuth</td>
</tr>
<tr>
<td></td>
<td>Deputy Head of Malaria Diagnosis &amp; treatment Division, Centre of Malariology, Parasitology and Entomology, N° 365, Unit 22, DongDok village, Xaythany district, Vientiane, Lao PDR, email: <a href="mailto:t.vonethalom@gmail.com">t.vonethalom@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Myanmar</td>
</tr>
<tr>
<td></td>
<td>Dr Nay Yi Yi Linn</td>
</tr>
<tr>
<td></td>
<td>Deputy Director/Programme Manager, Vector Borne Disease Control Programme, Department of Public Health, Ministry of Health, Office No. 4, Nay Pyi Taw, Myanmar, email: <a href="mailto:nayyiyilinn@gmail.com">nayyiyilinn@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Dr Kyawt Mon Win</td>
</tr>
<tr>
<td></td>
<td>Assistant Director, Vector Borne Disease Control Programme, Department of Public Health, Ministry of Health, Office No. 4, Nay Pyi Taw, Myanmar, email: <a href="mailto:kyawtmonwin@gmail.com">kyawtmonwin@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Dr Moe Kyaw Myint</td>
</tr>
<tr>
<td></td>
<td>Director, Department of Medical Research, Pyin Oo Lwin Branch, Anisakan, Mandalay, Myanmar, email: <a href="mailto:dr.myintmoekyaw@gmail.com">dr.myintmoekyaw@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
</tr>
<tr>
<td></td>
<td>Ms Thanunikar Thongard</td>
</tr>
<tr>
<td></td>
<td>Public Health Technical Officer, Professional Level, Division of Vector Borne Diseases, Department of Disease Control, Ministry of Public Health, 88/21 Taladkwan Sub-district, Muang District, Nonthaburi, Thailand, email: <a href="mailto:tani_pui101@hotmail.com">tani_pui101@hotmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Ms Rungrawee Tipmontree</td>
</tr>
<tr>
<td></td>
<td>Chief of Malaria Unit, Public Health Technical Officer, Professional Level, Division of Vector Borne Diseases, Department of Disease Control, Ministry of Public Health, 88/21 Taladkwan Sub-district, Muang District, Nonthaburi, Thailand, email: <a href="mailto:rtipmontree@gmail.com">rtipmontree@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Dr Panupong Kowsurat</td>
</tr>
<tr>
<td></td>
<td>Medical Officer, Malaria Group, Division of Vector Borne Diseases, Department of Disease Control, Ministry of Public Health, 88/21 Taladkwan Sub-district, Muang District, Nonthaburi, Thailand, email: <a href="mailto:isomer35884@gmail.com">isomer35884@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Viet Nam</td>
</tr>
<tr>
<td></td>
<td>Dr Tran Quang Phuc</td>
</tr>
<tr>
<td>International partners</td>
<td>Vice Director, National Institute of Malariology, Parasitology and Entomology (NIMPE), #34, Trung Van Street, Nam Liem district Hanoi, Viet Nam, email: <a href="mailto:tquangphuc@yahoo.com">tquangphuc@yahoo.com</a></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| | Dr Bui Quang Phuc  
Head of Department, Department of Clinical and Experimental Research, National Institute of Malariology, Parasitology and Entomology (NIMPE), #34, Trung Van Street, Nam Liem district Hanoi, Viet Nam, email: phuncanimpe@yahoo.com |
| | Dr Huynh Hong Quang  
Vice Director, Head of Tropical Disease Research and Treatment, Institute of Malariology, Parasitology and Entomology Quy Nhon, Zone 8, Nhon Phu Ward, Quy Nhon City, Binh Dinh Province, email: huynhquangimpe@yahoo.com |
| China | Prof Liu Hui  
Professor, Yunnan Institute of Parasitic Diseases, 6 Xiyuan Road, Simao District, Puer, Yunnan 665000, P.R. China, email: liubible@126.com |
| | Dr He Yan  
National Institute of Parasitic Diseases, Chinese Centre for Disease Control and Prevention (NIPD), No. 207 Ruijin Er Road, Huangpu district, Shanghai 200025, P.R. China, email: yanhe@nippd.chinacdc.cn |
| Temporary advisor | Dr Jean Popovici  
Head, Malaria Research Unit, Pasteur Institute in Cambodia, 5 Preah Monivong Blvd (93), Phnom Penh, Cambodia, email: jpopovici@pasteur-kh.org |
| Pasteur Institut in Cambodia | |
| International partners | |
| Bill & Melinda Gates Foundation | Dr Jonathan Cox  
Senior Programme Officer, Malaria, Global Health Programme, 440 5th Ave N., Seattle, WA 98109, Washington DC, United States of America, email: jonathan.cox@gatesfoundation.org |
| United States Agency for International Development (USAID)/President’s Malaria Initiative | Dr Saad El-Din Hassan  
Resident Advisor, Office of Public Health and Education, USAID-Cambodia, American Embassy, #1, Street 96, Sangkat Wat Phnom, Khan Daun Penh, Phnom Penh, Cambodia, email: shassan@usaid.gov |
| The Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) | Ms Doungkamon Oeuvray  
High Impact Asia Grant Management Division, Global Health Campus, Chemin du Pommier 40, 1218 Grand-Saconnex, Geneva, Switzerland, email: doungkamon.oeuvray@theglobalfund.org |
| Mahidol-Oxford Tropical Medicine Research Unit (MORU) | Dr Olivo Miotto  
University of Oxford, Mahidol-Oxford Tropical Medicine Research Unit, Faculty of Tropical Medicine, Mahidol University, 420/6 Rajvithi Road, Bangkok, Thailand, email: Olivo@tropmedres.ac |
| United Nations Office for Project Services (UNOPS) | Dr Attila Molnár  
Programme Director, United Nations Service Building, 2nd Floor Rajdamnern Nok Avenue, Bangkok, Thailand, email: attilami@unops.org |
| | Dr Eisa Hamid  
Regional M&E and Health Systems Specialist, United Nations Service Building, 2nd Floor Rajdamnern Nok Avenue, Bangkok, Thailand, email: eisah@unops.org |
<p>| | Dr Faisal Mansoor |</p>
<table>
<thead>
<tr>
<th>Name of Organization</th>
<th>Name of Individual</th>
<th>Position</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of the Programme, 12 (O)m Pyithu Lane, Bahan Township, Yangon</td>
<td>Dr Farooq Sabawoon Muhammad</td>
<td>Programme and M&amp;E Specialist</td>
<td>Email: <a href="mailto:faisalm@unops.org">faisalm@unops.org</a></td>
</tr>
<tr>
<td></td>
<td>Mr Naeem Durrani Mohammad</td>
<td>Senior Programme Coordinator</td>
<td>Email: <a href="mailto:naeemd@unops.org">naeemd@unops.org</a></td>
</tr>
<tr>
<td></td>
<td>Dr May Thinza Kyi</td>
<td>Programme Manager</td>
<td>Email: <a href="mailto:maythinzk@unops.org">maythinzk@unops.org</a></td>
</tr>
<tr>
<td></td>
<td>Dr Min Zin</td>
<td>Programme Manager</td>
<td>Email: <a href="mailto:minz@unops.org">minz@unops.org</a></td>
</tr>
<tr>
<td></td>
<td>Ms Farah Sayegh</td>
<td>Programme Coordinator</td>
<td>Email: <a href="mailto:farahsa@unops.org">farahsa@unops.org</a></td>
</tr>
<tr>
<td></td>
<td>Dr Myat Yi Lwin</td>
<td>Programme Management Specialist</td>
<td>Email: <a href="mailto:myatyil@unops.org">myatyil@unops.org</a></td>
</tr>
<tr>
<td></td>
<td>Dr Maung Maung Sein</td>
<td>Monitoring and Evaluation Officer</td>
<td>Email: <a href="mailto:maungmaungs@unops.org">maungmaungs@unops.org</a></td>
</tr>
<tr>
<td>ACT Malaria Foundation</td>
<td>Ms Cecilia Hugo</td>
<td>Executive Coordinator</td>
<td>Email: <a href="mailto:cecil_hugo@actmalaria.net">cecil_hugo@actmalaria.net</a></td>
</tr>
<tr>
<td>RTI (Inform Asia)</td>
<td>Ms Jui Shah</td>
<td>Chief of Party</td>
<td>Email: <a href="mailto:juishah@rti.org">juishah@rti.org</a></td>
</tr>
<tr>
<td>Clinton Health Access Initiative (CHAI)</td>
<td>Ms Sonia Cheung</td>
<td>Regional Case Management Associate</td>
<td>Email: <a href="mailto:hccheung@clintonhealthaccess.org">hccheung@clintonhealthaccess.org</a></td>
</tr>
<tr>
<td>Malaria Consortium</td>
<td>Dr Poe Aung</td>
<td>Regional Representative and Technical Specialist</td>
<td>Email: <a href="mailto:p.aung.85@malariaconsortium.org">p.aung.85@malariaconsortium.org</a></td>
</tr>
<tr>
<td>Institut Pasteur du Laos</td>
<td>Dr Moritoshi Iwagami</td>
<td>Laboratory Manager</td>
<td>Email: <a href="mailto:iwagami@hotmail.com">iwagami@hotmail.com</a></td>
</tr>
<tr>
<td>University of California San Francisco (UCSF)</td>
<td>Dr Adam Bennett</td>
<td>Surveillance Research and Regional</td>
<td>Email: <a href="mailto:adam.bennett@ucsf.edu">adam.bennett@ucsf.edu</a></td>
</tr>
<tr>
<td></td>
<td>Dr Chris Cotter</td>
<td>Elimination Asia Pacific, Malaria Elimination Initiative</td>
<td>Email: <a href="mailto:chris.cotter@ucsf.edu">chris.cotter@ucsf.edu</a></td>
</tr>
</tbody>
</table>
| WHO Headquarters Global Malaria Programme | Dr Pascal Ringwald  
Coordinator, Director office, 20 Avenue Appia, Geneva, Switzerland, email: ringwaldp@who.int |
| Secretariat | Ms Charlotte Rasmussen  
Technical Officer, Diagnostic, Medicines and Resistance unit, 20 Avenue Appia, Geneva, Switzerland, email: rasmussenc@who.int |
| WHO WPRO | Dr James Kelley  
Technical Officer, Regional Office for the Western Pacific, P.O. Box 2932, Manila, Philippines, email: kelleyj@who.int |
| WHO SEARO | Dr Risintha Gayan Premaratne  
Technical Officer, Department of Communicable Diseases, I.P. Estate, Mahatama Gandhi Marg, 110002, New Delhi, India, email: premaratner@who.int |
| WHO Thailand | Dr Maria Bustos  
Technical Officer, Malaria, 88/20 Permanent Secretary Building, Ministry of Public Health Tiwanon Road 11000, Nonthaburi, Thailand, email: bustosm@who.int |
| | Dr Deyer Gopinath  
Programme Officer, Communicable diseases, 88/20 Permanent Secretary Building, Ministry of Public Health Tiwanon Road 11000, Nonthaburi, Thailand, email: gopinathd@who.int |
| | Ms Kalayanee Laempoo  
Programme Assistant, 88/20 Permanent Secretary Building, Ministry of Public Health Tiwanon Road 11000, Nonthaburi, Thailand, email: laempook@who.int |
| WHO Myanmar | Dr Badri Thapa  
Scientist (Malaria Control), No. 403 (A1), Shwe Taung Kyar Street, Bahan Township, Yangon, Myanmar, email: thapab@who.int |
| | Dr Yin Mon  
National Programme Officer Malaria, No. 403 (A1), Shwe Taung Kyar Street, Bahan Township, Yangon, Myanmar, email: mony@who.int |
| WHO Lao PDR | Dr Matthew Shortus  
Medical Officer, 125 Saphanthonh Road, Unit 5 Ban Saphangthongtai, Sisattanak District, Vientiane, Lao PDR, email: shortusmi@who.int |
| | Dr Chitsavang Chanthavisouk  
Technical Officer, 125 Saphanthonh Road, Unit 5 Ban Saphangthongtai, Sisattanak District, Vientiane, Lao PDR, email: chanthavisouk@who.int |
| WHO Viet Nam | Dr Ngon Sapal Mya  
Medical Officer, 63 Tran Hung Dao Street, Hoan Kiem District, Hanoi, Viet Nam, email: ngonm@who.int |
| | Dr Tran Cong, Dai  
National Programme Officer, Malaria, 63 Tran Hung Dao Street, Hoan Kiem District, Hanoi, Viet Nam, email: trancongd@who.int |
| WHO Cambodia | Dr Luciano Tuseo  
MME Coordinator, No. 61-64, Preah Norodom Blvd. (corner St. 306), Sangkat Boeung Keng Kang I, Khan Chamkamorn, Phnom Penh, Cambodia, email: tuseol@who.int |
|---------------------------------------------------------------|
| Mr Rady Try  
Technical Officer (Database Manager), No. 61-64, Preah Norodom Blvd. (corner St. 306), Sangkat Boeung Keng Kang I, Khan Chamkamorn, Phnom Penh, Cambodia, email: tryr@who.int |
| Ms Muna Haq  
Consultant, Communication and Programme Management Officer, No. 61-64, Preah Norodom Blvd. (corner St. 306), Sangkat Boeung Keng Kang I, Khan Chamkamorn, Phnom Penh, Cambodia, email: haqmu@who.int |
| Ms Sreyleak Kheng  
MME Assistant, No. 61-64, Preah Norodom Blvd. (corner St. 306), Sangkat Boeung Keng Kang I, Khan Chamkamorn, Phnom Penh, Cambodia, email: khengs@who.int |
| Ms Celine Christiansen Jucht  
Consultant, Project Specialist, No. 61-64, Preah Norodom Blvd. (corner St. 306), Sangkat Boeung Keng Kang I, Khan Chamkamorn, Phnom Penh, Cambodia, email: celinechrjucht.who@gmail.com |
| Dr Zhang Zaixing  
Medical Officer, No. 61-64, Preah Norodom Blvd. (corner St. 306), Sangkat Boeung Keng Kang I, Khan Chamkamorn, Phnom Penh, Cambodia, email: zhangz@who.int |
Annex 2. Meeting programme

<table>
<thead>
<tr>
<th>Date and Time</th>
<th>Agenda</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday 28 November 2022</td>
<td>Day 1</td>
<td>Chairperson: Dr Huy Rekol, Director, CNM - Cambodia Co-Chair: Dr Keobouphaphone Chindavongsa, Deputy Director, CMPE - Lao PDR</td>
</tr>
<tr>
<td><strong>Opening Ceremony</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08:30 - 09:00</td>
<td>Registration of participants</td>
<td>Dr Deyer Gopinath on behalf of Dr Jos Vandelaer, WHO Thailand</td>
</tr>
<tr>
<td>09:00 - 09:30</td>
<td>Welcome address from WHO Representative Thailand</td>
<td>Dr Pascal Ringwald, Coordinator, WHO GMP</td>
</tr>
<tr>
<td></td>
<td>Opening remarks from WHO Global Malaria Programme</td>
<td>Dr Luciano Tuseo, Coordinator WHO MME</td>
</tr>
<tr>
<td></td>
<td>Meeting objectives</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nomination of chairperson and co-chair</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Self-introduction of participants</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Administrative - Meeting rules and announcements</td>
<td>Dr Maria Dorina Bustos, Malaria Technical Officer, WHO SEARO</td>
</tr>
<tr>
<td></td>
<td>Group Photo</td>
<td></td>
</tr>
<tr>
<td><strong>Session 1: Regional updates</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09:30 - 09:45</td>
<td>Review of Recommendations from 2021 and Progress</td>
<td>Dr Maria Dorina Bustos</td>
</tr>
<tr>
<td>09:45 - 09:55</td>
<td>Epidemiological updates from the Mekong Malaria Elimination Programme in the GMS</td>
<td>Dr Luciano Tuseo</td>
</tr>
<tr>
<td>09:55 - 10:10</td>
<td>Plenary Discussion, Q/A</td>
<td>All participants</td>
</tr>
<tr>
<td>10:10 – 10:30</td>
<td>Coffee/tea break</td>
<td></td>
</tr>
<tr>
<td><strong>Session 2: Country Presentations: Results and future priorities, plans, studies needed (20 mins country presentation and 10 mins Q&amp;A per country)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:30 - 11:00</td>
<td>Cambodia</td>
<td>CNM TES Principal Investigator</td>
</tr>
<tr>
<td>11:00 - 11:30</td>
<td>Lao People's Democratic Republic</td>
<td>CMPE TES Principal Investigator</td>
</tr>
<tr>
<td>11:30 – 12:00</td>
<td>Myanmar</td>
<td>TES principal Investigator</td>
</tr>
<tr>
<td>12:00 – 13:30</td>
<td>Lunch Break</td>
<td></td>
</tr>
<tr>
<td>13:30 - 14:00</td>
<td>Viet Nam</td>
<td>NIMPE Principal Investigator</td>
</tr>
<tr>
<td>14:00 - 14:30</td>
<td>Thailand</td>
<td>DVBD Principal Investigator</td>
</tr>
<tr>
<td>14:30 – 15:00</td>
<td>Plenary discussion, Q/A</td>
<td></td>
</tr>
<tr>
<td>15:00 – 15:30</td>
<td>Coffee/tea break</td>
<td></td>
</tr>
<tr>
<td>15:30 - 16:00</td>
<td>Updates and trends on molecular markers during TES in the GMS</td>
<td>Dr Jean Popovici, Institute Pasteur Cambodia</td>
</tr>
<tr>
<td>16:00 – 16:30</td>
<td>Genetic surveillance of drug resistant malaria in the GMS</td>
<td>Assistant Prof. Olivo Miotto, Nuffield Department of Medicine, Oxford University</td>
</tr>
<tr>
<td>16:30 – 17:00</td>
<td>Plenary discussion, Q/A</td>
<td>All participants</td>
</tr>
<tr>
<td><strong>Day end</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date and Time</td>
<td>Agenda</td>
<td>Speaker</td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Tuesday 29 November 2022</strong>&lt;br&gt;<strong>Day 2</strong>&lt;br&gt;<strong>Chairperson: Dr Tran Quang Phuc, Vice Director, NIMPE - Viet Nam Co-Chair: Dr Nay Yi Yi Linn, Program Manager, NMCP, Myanmar</strong>&lt;br&gt;&lt;br&gt;<strong>Session 3: Updates and specific technical presentations</strong>&lt;br&gt;09:00 – 09:30</td>
<td>iDES and molecular markers of imported cases in a malaria-free country – China</td>
<td>China – NIPD/YIPD</td>
</tr>
<tr>
<td>09:30 - 10:00</td>
<td>Quality Control in TES and iDES: specific country implementation challenges (monitoring, MM QA, data analysis, etc.)</td>
<td>Dr Maria Dorina Bustos</td>
</tr>
<tr>
<td>10:00 - 10:30</td>
<td>Prevalence and Management of <em>P. knowlesi</em>, Malaysia’s experience towards elimination</td>
<td>Dr Jenarun Bin Jelip, Program Manager, MOH Malaysia</td>
</tr>
<tr>
<td>10:30 - 10:45</td>
<td>Plenary discussion, Q/A</td>
<td></td>
</tr>
<tr>
<td>10:45 - 11:00</td>
<td>Coffee/tea break</td>
<td></td>
</tr>
<tr>
<td>11:00 - 11:30</td>
<td>Updates on the Global Drug Resistance Situation</td>
<td>Dr Pascal Ringwald</td>
</tr>
<tr>
<td>11:30 - 11:50</td>
<td>WHO Updated Guidelines on treatment of Malaria</td>
<td>Ms Charlotte Rasmussen, DMR, WHO GMP</td>
</tr>
<tr>
<td>11:50 - 12:10</td>
<td>Plenary discussion, Q/A</td>
<td></td>
</tr>
<tr>
<td>12:10 - 13:30</td>
<td>Lunch break</td>
<td></td>
</tr>
<tr>
<td><strong>Session 4: Topics/issues for discussion</strong>&lt;br&gt;13:30 - 14:00</td>
<td>Pooled ACT drug procurements issues (artesunate injection, paediatric formulation, DRA registration, etc.) Antimalarial drugs for <em>P. vivax</em></td>
<td>Open discussion</td>
</tr>
<tr>
<td>14:00-14:30</td>
<td>Update from WHO WPRO Ethics Review Committee - ERC on the New Portal, SOP and suggested changes to relevant Study Protocol Submissions (10 minutes Q/A)</td>
<td>Dr Duan Mengjuan WPRO – Ethics Review Committee</td>
</tr>
<tr>
<td><strong>Session 4: Partners</strong>&lt;br&gt;15:00-15:30</td>
<td>Partner Inputs</td>
<td>All partners</td>
</tr>
<tr>
<td>15:30-16:00</td>
<td>Coffee/tea break</td>
<td></td>
</tr>
<tr>
<td><strong>Session 5: Closing remarks</strong>&lt;br&gt;16:00-16:20</td>
<td>Conclusion, next steps and recommendations</td>
<td>Dr Pascal Ringwald</td>
</tr>
<tr>
<td>16:20-16:30</td>
<td>Closing remarks</td>
<td>Dr James Kelley, WHO WPRO</td>
</tr>
<tr>
<td><strong>Day end</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>