
WHO Malaria Policy Advisory Group (MPAG) meeting report

4, 5 and 7 March 2024



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Abbreviations

ACTs	artemisinin-based combination therapies
An.	<i>Anopheles</i>
COVID-19	coronavirus disease
EPI	Expanded Programme on Immunization
G6PD	glucose-6-phosphate dehydrogenase
GDG	Guideline Development Group
HBHI	High burden to high impact
ITNs	insecticide-treated nets
K13	PfKelch13
MPAG	Malaria Policy Advisory Group
MVIP	Malaria Vaccine Implementation Programme
SAGE	Strategic Advisory Group of Experts on Immunization
SNT	Subnational tailoring
WHO	World Health Organization

1. Background

The World Health Organization (WHO) convened the Malaria Policy Advisory Group (MPAG) for its 25th meeting held virtually and in person in Yaoundé, Cameroon, on 4, 5 and 7 March 2024. MPAG convenes twice annually to provide an independent strategic advice to WHO on technical issues related to malaria control and elimination. The MPAG advises the WHO Director-General and the Global Malaria Programme specifically on:

- appropriate malaria policies and standards based on data from malaria programme implementation by Member States and malaria control partners as well as reviews of the best available evidence;
- engagement of WHO in malaria-related initiatives;
- major issues and challenges to achieving global malaria goals; and
- identification of priority activities to address identified challenges.

This meeting included participation of MPAG members and observers joining either in person or remotely via a virtual conferencing platform.

The meeting was chaired by Professor Dyann Wirth. Over the course of the two days of open meetings, 15 MPAG members, more than 10 national malaria programme managers, the WHO Secretariat, and 205 registered observers discussed updates and progress in the following work areas presented:

- Report from the Global Malaria Programme
- Malaria vaccine introduction and scale-up, and the Gavi-supported malaria learning agenda
- High burden to high impact (HBHI) approach
- Subnational tailoring (SNT)
- Guiding principles for prioritization
- Biological threats to vector control in Africa
- Strategy to respond to antimalarial drug resistance in Africa – updates and identification of needs
- Development of guidelines recommendations on tafenoquine, primaquine and near-patient glucose-6-phosphate dehydrogenase (G6PD) diagnostic tests to support radical cure of *Plasmodium vivax*
- Malaria elimination, including zoonotic malaria

MPAG discussed conclusions and advice to the Global Malaria Programme in a closed session on day three.

All 15 MPAG members participating in the meeting updated their Declarations of Interest in advance of the meeting, which were assessed by the WHO Secretariat; 12 members reported interests. The full report on members' Declarations of Interest was published two weeks before the meeting and is available on the meeting website. No MPAG members reported conflicts of interest specifically related to the agenda topics. It was assessed that all members could fully participate in all sessions (see Annex 1).

The agenda is reproduced in Annex 2, and the participants are listed in Annex 3.

2. Overview of the Malaria Policy Advisory Group (MPAG) sessions

2.1 Update from the Global Malaria Programme

Background

The Director of the Global Malaria Programme highlighted key achievements in the malaria response since the last MPAG meeting, notably the World Health Organization (WHO) certification of Cabo Verde as malaria-free, the release of the *World malaria report 2023 (1)* with a dedicated chapter on the malaria–climate nexus, and the launch of the *Global Malaria Programme operational strategy 2024–2030* vision and implementation. He shared the Global Malaria Programme’s latest meeting reports, updates across all technical areas, including progress since November 2023, and priorities for the next quarter.

The Director acknowledged the Malaria Ministerial Conference to be held in Yaoundé on 6 March 2024, convening Ministers of Health from high-burden countries and key malaria stakeholders to review progress and challenges in meeting the targets of the *Global technical strategy for malaria 2016–2030 (2)*, discuss mitigation strategies and funding, agree on effective strategies for accelerated mortality reduction in Africa, and establish a roadmap for increased political will and societal engagement, with a clear accountability mechanism. The Director shared the Programme’s plans for the upcoming World Malaria Day, which focuses on health equity, gender equality and human rights. Finally, the Director informed participants about upcoming technical publications.

MPAG conclusions

MPAG congratulated the Director and the Global Malaria Programme staff on their accomplishments since the last MPAG meeting, including the progress made on the guiding principles document, the completion of the implementation strategy, the roll-out of the malaria vaccine and the progress in addressing the threat of emerging drug resistance. The discussion highlighted the urgent need to recruit and retain those with expertise at the country, regional and global levels.

MPAG recognized the enormous productivity of the Global Malaria Programme staff, particularly knowing that staff reductions have meant that some are carrying multiple responsibilities. However, there are unmet needs, including country support for implementing the “High burden to high impact” (HBHI) approach and for undertaking the subnational tailoring (SNT) of interventions based on epidemiological analysis at country level. To support initiatives in the latter area, in-house expertise is required in epidemiology, mathematical modelling and vector biology. To address the emerging threat of drug resistance, additional staff and capacity-building are essential. These are urgent and pressing needs.

MPAG also recognized the need for increased capacity-building of the workforce at the country and regional levels to ensure optimal implementation of the current programme and the exciting new initiatives outlined at this meeting. MPAG recommended including this topic with high priority at the next MPAG meeting.

2.2 Malaria vaccine introduction and scale-up, and the Gavi-supported malaria learning agenda

WHO background

WHO now recommends two WHO-prequalified vaccines for the prevention of *Plasmodium falciparum* malaria in children: RTS,S/AS01 (RTS,S) and R21/Matrix-M (R21). The WHO recommendation for malaria vaccines was informed by findings from the Malaria Vaccine Implementation Programme (MVIP) in Ghana, Kenya and Malawi, conducted from 2019 to 2023. The MVIP demonstrated the feasibility, safety and substantial impact of the RTS,S vaccine in routine use. R21 was recommended for use in October 2023. Priority research questions on R21 were identified during the joint review by MPAG and the Strategic Advisory Group of Experts on Immunization (SAGE). Accordingly, WHO convened an internal coordination team to monitor initiation of and findings from those studies. Demand for malaria vaccines is high, and, to date, 20 countries have been approved by Gavi, the Vaccine Alliance, to receive support for introduction. The many lessons learned from vaccine implementation in the MVIP countries have been documented and shared to support non-pilot countries in the planning of vaccine introduction. With two vaccines now available, supply constraints have been relieved. Therefore, countries are able to scale up with either RTS,S or R21, and the *Framework for allocation of limited malaria vaccine supply* (3) is no longer being applied.

The evaluation of RTS,S safety and impact was conducted through community mortality and sentinel hospital surveillance in the three countries implementing the vaccine – Ghana, Kenya and Malawi – through pilot introductions; the planned 46 months of surveillance was completed in Ghana and Malawi in February 2023 and in Kenya in July 2023. The results were presented to the SAGE/MPAG Working Group on Malaria Vaccines in November 2023. In late 2023, the results were also presented at the annual meeting of the American Society of Tropical Medicine and Hygiene and the third International Conference on Public Health in Africa in Lusaka, Zambia. The results show that RTS,S malaria vaccine implementation over 46 months was associated with a 13% vaccine-attributable reduction in all-cause mortality (excluding injuries) in children age-eligible for vaccination [0.87 (95% CI: 0.78, 0.98)] and a 22% reduction in hospitalization with severe malaria in vaccinating areas [0.78 (95%CI: 0.64, 0.96)]. Use of insecticide-treated nets (ITNs), coverage of other vaccines and care-seeking behaviour were balanced between the vaccinating and comparator areas. This impact was achieved during the period of vaccine scale-up (with coverage of the three primary doses of 75% in Ghana, 69% in Kenya and 63% in Malawi in 1-year-old children surveyed in 2022; and coverage of the fourth dose of 54%, 34% and 33%, respectively, in children aged 30–41 months, or 28–39 months in Malawi, also surveyed in 2022). Impact is expected to increase further, as vaccine coverage has increased over time.

The demand for malaria vaccines among governments and communities in malaria-endemic countries is high. As of February 2024, 20 countries have been approved by Gavi to receive support for initial malaria vaccine introduction, and six applications are currently under review: four from countries to support vaccine scale-up and two from new countries planning to introduce the vaccine. Burkina Faso and Cameroon have become the first countries outside the pilot programme to introduce malaria vaccines into their childhood immunization programmes. WHO is coordinating partners and providing technical support for vaccine introduction, ensuring that the experience and lessons learned from the pilots are incorporated.

WHO and Gavi continue to co-lead the Malaria Vaccine Coordination Team, which includes membership from malaria and vaccine stakeholders; this team has been meeting regularly for two years. The Gavi Board recently approved the provision of funds for a learning agenda to help identify and address potential implementation challenges to the uptake and roll-out of the malaria vaccine. PATH has provided technical support to WHO to develop a country-driven global malaria vaccine research agenda specifically focused on operational and implementation research.

MPAG conclusions

MPAG discussed the implementation of RTS,S in the first countries that were not part of the MVIP. In Cameroon, there was close collaboration between the Expanded Programme on Immunization (EPI) and the national malaria control programme to implement the vaccine in 42 districts with high malaria burden and efficient EPI delivery. EPI and national malaria control programme personnel and other health workers at the peripheral level were trained together, which contributed to the success of the implementation. Burkina Faso was the second country to implement the RTS,S vaccine. Given that Cameroon and Burkina Faso encountered similar initial implementation challenges as the countries involved in the MVIP, MPAG encouraged the creation of a forum where experiences and lessons learned can be shared.

MPAG emphasized that the implementation of the malaria vaccine should be considered in the context of comprehensive national malaria control plans, noting that all currently available malaria control interventions reduce malaria, and the highest impact will be achieved by using a mix of interventions. Messaging around vaccine implementation should emphasize that it is part of the package of control measures, following the examples of countries that have already launched. MPAG also suggested investigating the impact of the vaccine in combination with other control interventions. MPAG also noted that guidelines are needed for the assessment of potential new vaccines or modified current vaccines. Given that non-inferiority trials are likely to require extremely large sample sizes, it may be worth identifying surrogate measures of efficacy.

MPAG members discussed the importance of preparing for implementation of the malaria vaccine, either RTS,S or R21, at least six months before the target start date. Effective risk communication is key to managing rumours, and each country should determine its approach to handling it.

MPAG congratulated Gavi on supporting malaria vaccine roll-out and implementation research to support malaria vaccine introduction. Previously, MPAG and SAGE identified priority research questions that need to be investigated, such as the efficacy of R21 in perennial high transmission settings. During this MPAG meeting, MPAG suggested investigation into vaccine impact where coverage of other control interventions, e.g. ITNs, is low (noting that vaccine efficacy does not differ by ITN use, as shown in the large Phase 3 trial of RTS,S, and impact may be greater where other interventions are not in place).

MPAG highlighted that the recommendations for vaccine use are not limited to Africa but apply to all *P. falciparum* malaria-endemic countries. Gavi's current funding guidelines specify that support can be requested for vaccine use in areas of moderate and high transmission, in line with WHO recommendations on where to prioritize vaccine introduction.

At the October/November 2023 meeting, MPAG was awaiting updates on the findings from ongoing trials of R21/Matrix-M. These include, among others, the 24-month findings on safety, efficacy and immune response from the Phase 3 trial (and subsequent follow-up end-points), results on vaccine safety and efficacy in HIV-infected children, and results on vaccine coadministration. Ideally, vaccine developers should provide a timeline for the planned availability of these data. MPAG also requested further mathematical modelling based on findings from the Phase 3 trial, including by additional modelling groups. MPAG has not observed any progress on this mathematical modelling. MPAG strongly urged the developers to make these data available to additional modelling groups, as requested by WHO. MPAG requested an update on progress, ideally in advance of the next MPAG meeting.

2.3 HBHI approach

WHO background

The HBHI Evaluation Report compiled insights from separate evaluations of 10 HBHI countries, conducted by the RBM Partnership to End Malaria and WHO. These evaluations aimed at documenting the lessons learned, best practices and challenges encountered in implementing HBHI to bolster global malaria control efforts. Rather than focusing solely on individual country performance, the Evaluation Report emphasizes the process, analysing what worked well and what did not across the countries. Key findings underscore the significance of the HBHI approach in engaging leadership, guiding planning and advocating for funding. Successful aspects include political commitment, improved decision-making and programme coordination, while challenges were related to resource competition, data analysis limitations and resistance to change.

In response to the findings, high-level recommendations have been proposed to address the significant burden of malaria on health systems in HBHI countries. These recommendations emphasize the urgent need for a renewed emphasis on key HBHI elements, including political will to reduce malaria deaths, strategic information to drive impact, better guidance, policies and strategies, and a coordinated national response with capacity-building at all levels of the health system to effectively deliver malaria interventions.

The Yaoundé Declaration of the recent Malaria Ministerial Conference, held back-to-back with the MPAG meeting, underscores the need for a concerted effort towards accelerated malaria mortality reduction in HBHI countries. Ending malaria mortality is an achievable goal, but it requires a well functioning primary health care system in addition to malaria-specific prevention and treatment interventions. The commitment of regional and national authorities to concrete action is required for success. The success of similar endeavours, such as minimizing mortality from coronavirus disease (COVID-19), HIV/AIDS and tuberculosis, underscore the feasibility of this objective. Achieving this requires robust leadership, accountability and optimization of the health system components crucial for reducing malaria mortality. The concept note for accelerated malaria mortality reduction in HBHI countries in sub-Saharan Africa builds on these insights, targeting the most vulnerable populations and hotspot areas. The concept note underscores the complexity of the malaria burden and mortality in Africa due to socioeconomic factors, health system deficiencies, population vulnerability and emerging biological threats. Strategies for accelerated malaria mortality reduction include mortality mapping and understanding the main drivers in local contexts, implementing socioeconomic interventions, strengthening health care accessibility and the quality of services with adequate infrastructure, enhancing surveillance and coordination, targeting vulnerable populations with interventions, and addressing emerging biological threats. The integrated approach seeks to leverage existing capacities, maximize the HBHI pillars and prioritize efforts tailored to specific high-burden areas, with the overarching goal of effectively reducing malaria mortality.

Data sources for tracking accelerated malaria mortality reduction will include WHO sources and national routine surveillance data on outpatient cases, severe cases and deaths. There will be a focus on inpatient malaria cases as surrogate indicators to assess the trends in severe cases and the driving factors for mortality. Systematic capacity-building and an effective monitoring and evaluation framework are essential for tracking progress and developing effective mitigation strategies.

MPAG conclusions

MPAG observed that the countries evaluated in the HBHI report viewed HBHI as a standalone project, rather than as a comprehensive approach to enhance the effectiveness of their malaria control efforts. It was further noted that countries had

expected to receive a separate funding stream for HBHI implementation. MPAG therefore emphasized that HBHI implementation should not be seen as a parallel process. The current set of tools for implementation and reporting should be updated and applied within the HBHI context so that countries are better supported in their efforts. MPAG noted the enthusiasm shown by countries towards implementing the malaria vaccine and recommended that the Global Malaria Programme leverage this enthusiasm to embed the HBHI approach in national and subnational malaria control strategy development.

There was an extensive discussion around the issue of clear metrics. MPAG recommended that HBHI countries be supported to develop and embed in their national strategic plans frameworks that articulate how and why a given set of interventions is expected to lead to a specific change and how this change will be measured.

MPAG noted with concern that HBHI implementation in most countries did not extend beyond the national level to the subnational levels and that awareness of HBHI at the subnational levels was limited. MPAG therefore recommended making a concerted effort to mainstream HBHI in malaria programme implementation at all levels.

MPAG stressed that capacity-building is a crucial factor in enabling countries to assume full responsibility and control over the implementation of HBHI, empowering them to drive progress and sustain success. MPAG therefore strongly recommended that the Global Malaria Programme make an effort to involve local institutions in the country and in the region, including academic and research institutions, to lead capacity-building efforts at all levels. This should include capacity-building in the areas of analysis and use of data for evidence-based decision-making, and soft skills for malaria programme managers and their teams.

MPAG observed that countries highlighted the absence of a platform or community of HBHI-implementing countries for the exchange and dissemination of lessons learned, innovations and successful strategies. MPAG was of the view that this is a very critical element to ensure the success of HBHI implementation, and therefore recommended that the Global Malaria Programme set up such a network or forum, with the involvement of HBHI countries. MPAG further emphasized that this network should be country-led, with regular virtual meetings scheduled. In-person meetings could be strategically coordinated to coincide with other key meetings, such as those organized by WHO/RBM Partnership, to maximize efficiency.

MPAG noted that a number of countries in the African Region, including where HBHI was being implemented, were experiencing ongoing conflict and emphasized the importance of developing specific strategies for implementing HBHI in countries where there is conflict.

Finally, MPAG supported the renewed focus on malaria mortality reduction by the Global Malaria Programme, with mortality as currently assessed in the World Malaria Report. However, MPAG recommended supporting the development of improved methods for collecting mortality data. MPAG also strongly emphasized that reducing the proportion of infections that lead to death should not detract from efforts to prevent infection through effective prevention measures.

2.4 SNT for decision-making: overview and update

WHO background

SNT is the use of local data and contextual information to determine the appropriate mix of interventions and strategies in a given area to achieve optimal impact on mortality, transmission and overall burden of disease at the strategic level or within a specific

resource envelope. SNT can also be used to inform how new tools can be most effectively integrated within previously planned mixes of interventions, or for dynamic resource mobilization as additional funding opportunities become available.

The SNT process builds on the essential steps that are involved in the development, implementation and monitoring of prioritized malaria control and elimination programmes throughout a given national strategic plan life cycle:

1. Establish a national SNT team.
2. Determine the criteria for tailoring interventions.
3. Stratify malaria risk and its determinants to inform the criteria.
4. Identify the areas eligible for each intervention according to the specified criteria (step 2) and informed by the stratification process (step 3), leading to the development of various scenarios of intervention mixes.
5. Project the impact of these scenarios and refine the plan.
6. Select the final mix of interventions and strategies through a consensus-based approach informed by the evidence.
7. Cost the resulting strategic plan and trigger resource mobilization.
8. If the resources are insufficient to cover the costed strategic plan, proceed to the rational prioritization of investments to maximize impact through further use of stratification of determinants and mathematical modelling.
9. Plan to monitor the delivery and impact of the deployed interventions to optimize effectiveness of all interventions and reprioritize resources as needed.

Since 2018, the Strategic Information and Response Unit of the Global Malaria Programme has worked in close collaboration with WHO regional and country offices to respond to requests from more than 30 countries in the WHO African, Eastern Mediterranean and South-East Asia Regions for support in the implementation of the SNT process, specifically to inform strategic planning, resource mobilization, funding requests, budget negotiations, optimization of intervention implementation, and so on, for single or multiple interventions. Throughout this process, several national malaria control programme and WHO country office technicians were directly trained. The Strategic Information and Response Unit and the WHO Regional Office for Africa also organized a series of malaria epidemiological stratification workshops in July, September and November 2023, in which 33 national malaria programme staff and local universities participated. In addition, the Strategic Information and Response Unit has supported 14 countries to date in the establishment of national data repositories integrated within the health management and information systems to make relevant data for decision-making readily available to national malaria control programmes. Efforts are ongoing to transition the support provided by the Strategic Information and Response Unit to the WHO regions, although the organizational structures, human resources and funding available for these activities vary substantially between regions.

In 2024, the Strategic Information and Response Unit intends to develop an SNT implementation manual that will provide the information required for national malaria programmes and partners to follow the process recommended by WHO. The SNT manual is intended to provide an overview of the vision and key concepts underpinning the SNT of malaria interventions for decision-making. It will also provide practical guidance on indicators and associated methods to inform the criteria for the SNT of interventions and strategies and resource prioritization, building on the “Guiding principles for prioritizing malaria interventions in resource-constrained country contexts to achieve maximum impact”. The manual will be drafted jointly by the Global Malaria Programme and the WHO regions, in collaboration with Dr Abdisalan Noor at the Harvard T.H. Chan School of Public Health, Harvard University. There will be a consultative process to request feedback

from malaria-endemic countries and partners engaged in activities to support SNT. A near-final version will be presented for review at the MPAG meeting planned for October 2024.

MPAG conclusions

Overall, MPAG acknowledged that the feedback from its previous meeting had been well accommodated and addressed, particularly with respect to developing better interconnection and cross-reference with the “Guiding principles for prioritizing malaria interventions in resource-constrained country contexts” (a critical SNT step). MPAG was pleased to see the significant progress made in recent months to transition support for SNT to regional offices (including for countries in complex environments), the clearer distinction between prioritization and optimization processes within the SNT cycle and the plan to publish the SNT manual by the end of the year.

For the upcoming SNT manual, MPAG members encouraged the Global Malaria Programme to list and describe in detail all relevant criteria to be considered during the SNT process, rather than grouping key health system factors under “etc.” or “other factors”. MPAG was concerned that the latter approach could raise the perception that these are secondary factors, when in fact they are extremely relevant for achieving optimal effectiveness of malaria-specific interventions. Similarly, when considering malaria interventions and strategies, MPAG recommended not grouping any interventions as “other” or “etc.” to avoid the perception that malaria interventions are ranked by their importance. This is particularly relevant for “targeted improvements of case management”, which is an essential intervention that needs focused attention during the SNT process.

Given the renewed focus on mortality in the HBHI approach, MPAG recommended breaking down the various components linked to case management interventions (e.g. community case management, severe malaria case management, etc.) so that each component is addressed separately and aligns with/responds to the upcoming HBHI country-specific mortality mapping assessments.

While there are efficiencies to be gained in some SNT steps (e.g. automating data compilation processes), MPAG noted that it is critical to build capacity at country level to successfully perform all SNT steps. This requires different SNT capacities to be developed in a phased approach, so that competencies can be built at the central level and gradually cascaded down to subnational levels.

Although it is already intrinsically part of the SNT process, MPAG recommended explicitly including a learning component in the SNT cycle. Learnings should include i) understanding and identifying data needs; ii) conducting data analysis of varying levels of complexity; iii) reflecting on model predictions and model improvement needs; and iv) incorporating learnings from optimization strategies to achieve the maximum impact of interventions. These learnings would then improve future SNT iterations to inform subsequent national strategic plans and funding proposals.

2.5 Guiding principles for prioritization overview

WHO background

Based on MPAG’s advice at its 24th meeting on 30 October–1 November 2023, the WHO Global Malaria Programme has updated the document “Guiding principles for prioritizing malaria interventions in resource-constrained country contexts to achieve maximum impact”. The document has been revised through a second consultation with national malaria programmes that received support from WHO for SNT, and through additional inputs from key malaria stakeholders.

The updated version of the document clarifies the target audience and geographical settings, i.e. national decision-makers in areas of moderate to high malaria transmission (according to WHO definitions). In line with the renewed focus of the HBHI approach and the Yaoundé Ministerial Declaration, decision-makers of high-burden countries should prioritize reduction of malaria mortality in the most vulnerable populations. The document provides a framework for country decision-making to define the appropriate mix of malaria interventions for specific geographical areas or risk groups when resources are constrained. The alignment with SNT of malaria interventions has been explained, and the conceptual differences between the prioritization and optimization of malaria interventions have been outlined. Prioritization needs to be complemented at the national level by budget optimization analysis to estimate the health impact of the different scenarios under consideration.

The new version more clearly presents a specific set of interventions that should never be scaled back at any level of financial constraint, in particular:

- prompt access to malaria diagnosis and effective treatment maintained in existing services across all levels of the health care delivery system, including in the community;
- investments in epidemiological and entomological surveillance;
- ensuring the quality and effectiveness of interventions;
- access to intermittent preventive treatment of pregnant women as part of antenatal care services at the health facility level;
- access to ITNs for pregnant women and children under 5 years of age in countries deploying routine ITN distribution; and
- indoor residual spraying (IRS) as part of preparedness and response to malaria epidemics.

The document has simplified the guidance on vector control based on which ITNs to deploy in areas of pyrethroid resistance, in relation to dual active ingredient nets, pyrethroid-piperonyl butoxide nets and pyrethroid-only nets, also taking into consideration dynamic changes in the cost of ITNs, net durability and vector resistance. The guidance on malaria vaccines, which prioritizes areas of moderate to high transmission, is aligned with recent WHO recommendations.

The document provides guidance on measures to consider when scaling back coverage of IRS, ITNs or seasonal malaria chemoprevention, based on the principles of “least harm” and minimizing the possibility of a rebound in malaria transmission. It also presents considerations for expanding case management at the community level and in the private sector, scaling up IRS and introducing/expanding new chemoprevention strategies when resources are limited.

MPAG conclusions

MPAG acknowledged the extensive work it has taken by many stakeholders to develop this document and made the following observations:

- Different stakeholders may require different guidance, for example, when making a case for funding from the Global Fund to Fight AIDS, Tuberculosis and Malaria to finance national priorities versus deciding which interventions to prioritize in a subnational plan. Consequently, different documents may be required to meet the needs of these different audiences.
- There is considerable overlap between the principles outlined in this presentation and the information provided on SNT. Before the document is released, the Global Malaria Programme should ensure consistency with

WHO guidelines and other WHO guidance documents. Any statements should be consistent with other WHO policy documents with respect to vaccine introduction, drug use and insecticide resistance.

- As indicated in an earlier session, there has been a strategic shift towards accelerated malaria mortality reduction in HBHI countries. The implications of this shift should be explained and incorporated early on in the document.
- It was reassuring that the national malaria control programme managers who had been calling for such a document were pleased with the progress so far and would have further input in the final stages. It was noted by some stakeholders that more detailed information on decision-making would strengthen the document and requested that the Global Malaria Programme consider adding this to future updates.

2.6 Biological threats to malaria vector control interventions in Africa

WHO background

Control of the anopheline mosquito vector of malaria is faced with two key biological threats: i) the evolution and spread of insecticide resistance, and ii) the spread of efficient mosquito vectors such as *Anopheles stephensi* and *An. albimanus*.

Insecticide-based vector control is a cornerstone in the fight against malaria, yet insecticide resistance in malaria vectors poses a constant threat. Data reported to WHO have highlighted that there is widespread resistance to the four insecticide classes that have historically been most widely used: pyrethroids, organophosphates, carbamates and organochlorines. Further evolution and spread of resistance to recently introduced insecticides needs to be anticipated and mitigated to the extent possible. Development of discriminating dosages and test procedures for broflanilide is a key priority planned for 2025.

New options for resistance management are urgently needed, which requires innovation and strategic market-shaping. In addition to the new insecticides recently prequalified and recommended by WHO for IRS and new ITNs, WHO will evaluate spatial repellents/emanators and attractive targeted sugar baits in 2024, and eave tubes and endectocides in 2025. If public health value is demonstrated, new recommendations covering these interventions will be available within 6–12 months of the trial data being provided to WHO.

Invasive anopheline mosquitoes pose the second potential threat to malaria vector control efforts. The invasion of the African continent by *An. stephensi* provides the most recent example. In this case, the vector was originally native to parts of Asia and the Arabian Peninsula, where it is a major malaria vector in rural and urban areas. In 2012, it was detected in Djibouti, followed by Ethiopia, Sri Lanka and Sudan (2016) and Somalia (2019). In response, WHO published a vector alert on *An. stephensi* (4) and extended the Malaria Threats Map (5) to include a new theme on invasive vectors. Subsequently, WHO received further reports of the presence of *An. stephensi* in Nigeria (2020), Yemen (2021), Eritrea, Ghana and Kenya (2022).

To step up WHO's response, a regional initiative aimed at stopping the spread of *An. stephensi* in Africa was launched in September 2022 (6). The WHO initiative seeks to determine whether the vector can be eliminated from areas of Africa that have already been invaded. The focus lies on increasing collaboration, strengthening surveillance, improving information exchange, developing evidence-based guidance and prioritizing research to identify the most effective ways to respond to this invasive vector. It provides

an opportunity to explore the potential for integrating *An. stephensi* surveillance and control with that of *Aedes* spp., as both thrive in urban and peri-urban settings.

A response framework to address these and other threats to the control of disease vectors is available in the form of the *Global vector control response 2017–2030 (7)*. This response aims at strengthening vector control worldwide through increased capacity, improved surveillance, better coordination and integrated action across sectors and diseases.

Vector control guidance updates are foreseen for the above areas when new evidence becomes available. Current guidance updates are focused on documentation related to the topic of mainstreaming comparative efficacy data generation and its use in WHO guidelines development, as presented at previous MPAG meetings.

MPAG conclusions

MPAG encouraged the Global Malaria Programme to accelerate updates and dissemination of two WHO technical publications on vector control – namely, the protocol for comparative data generation and associated non-inferiority analysis, and the norms, standards and process document – to ensure that the recent mainstreaming of non-inferiority in WHO guidelines development for malaria vector control is comprehensively communicated to all stakeholders. MPAG appreciated the Global Malaria Programme’s efforts to continue tracking the key biological threats in different countries and thanked the Programme for the recent updates to the Malaria Threats Map. Since the data are already being presented for specific locations within the affected countries, MPAG encouraged greater integration of these data to support evidence-based decision-making for malaria control at subnational levels. In addition, MPAG recommended updating the Malaria Threats Map more frequently so that the information stays current.

MPAG also recommended that the Global Malaria Programme encourage countries to adapt their insecticide resistance monitoring programmes to match the evolving landscape of insecticide-based vector control. The prequalification of novel insecticides with new modes of action presents opportunities for insecticide resistance management and improved vector control. However, the absence of established discriminating concentrations required to monitor vector resistance to these new insecticides could hinder their adoption. MPAG therefore recommended that WHO investigate opportunities to work with industry partners and independent evaluators to accelerate the development of suitable susceptibility testing methods for novel active ingredients, so that these are available as soon as products are prequalified. In addition, MPAG encouraged WHO (the Global Malaria Programme and the Prequalification Team) to develop strategies to ensure that the quality of vector control interventions is maintained.

In terms of the spread of invasive malaria vector species, MPAG appreciated the many convenings organized or coordinated by the Global Malaria Programme and partners to share experiences on the *An. stephensi* invasion in African countries. MPAG encouraged the Global Malaria Programme to expand these discussions and share the findings and lessons learned more widely, and, where possible, to work with regional partners to localize these efforts. The Global Malaria Programme should also encourage countries to enhance their surveillance strategies to detect and track invasive vector species – for example, by relying on modelled projections to prioritize areas for surveillance and by integrating surveillance to include other vectors with similar aquatic habitats, e.g. *Ae. aegypti*. MPAG noted the importance of continuing to explore the biology and taxonomy of *An. stephensi*, given that in its historical range in South-East Asia, this mosquito is recognized to have multiple “types”, not all of which may be efficient vectors.

Finally, in addition to malaria vectors' physiological resistance to insecticides, a related problem is their widely recognized behavioural adaptation, with substantial proportions exhibiting biting patterns outside the effective reach of indoor interventions such as ITNs – specifically, biting outdoors, in early evenings or mornings when bed nets are less likely to be used. MPAG recommended that the Global Malaria Programme initiate technical discussions on how this phenomenon can be best assessed, to eventually integrate the relevant metrics into the Malaria Threats Map to help target residual malaria transmission.

2.7 Strategy to respond to antimalarial drug resistance in Africa: updates and identification of needs

WHO background

Mutations in *PfKelch13* (K13) associated with delayed clearance post-treatment with artemisinin-containing regimens are on the rise in the Horn of Africa and East Africa. In the Horn of Africa, the 622I mutation has been identified in multiple countries, including Eritrea, Ethiopia, Somalia and Sudan. Notably, the 622I mutation is present in parasites exhibiting histidine-rich protein 2/3 (*hrp2/3*) deletions, making them challenging to detect through conventional *hrp2*-based rapid diagnostic tests. In Uganda, various K13 mutations seem to be spreading, with certain areas showing a prevalence of validated markers indicating partial resistance to artemisinin in the majority of sampled parasites. Meanwhile, in Rwanda, the 561H K13 mutation is spreading, although the 675V mutation is more prevalent in western Rwanda. The 561H mutation has also been identified in the United Republic of Tanzania, particularly in the Kagera Region, near the border with Rwanda. With prevalence of a validated marker for artemisinin partial resistance exceeding 5% and evidence of delayed clearance, four African countries have now confirmed artemisinin partial resistance: Eritrea, Rwanda, Uganda and the United Republic of Tanzania. In Ethiopia and Sudan, artemisinin partial resistance is suspected, as studies have detected > 5% patients carrying K13 mutations (622I) validated to be associated with artemisinin partial resistance; however, delayed clearance has yet to be confirmed.

Since the last MPAG meeting, several initiatives have been undertaken to advance the implementation of the *Strategy to respond to antimalarial drug resistance in Africa* (8). In November 2023, two regional meetings for Africa were held in Uganda. The first meeting was a regional stakeholder meeting for countries across Africa aimed at aligning intervention priorities to assist countries in addressing resistance. During this meeting, key drivers of antimalarial drug resistance were discussed along with necessary interventions to respond at the country level. The second meeting focused on surveillance of drug efficacy and resistance for countries in East Africa and the Horn of Africa. The meeting provided technical updates on methods of surveillance of drug resistance and efficacy, and results of country studies on drug efficacy and resistance were shared, including plans for future studies and research. Additional activities included conducting an assessment of the factors that may be contributing to resistance in Rwanda and devising a strategy to address these challenges.

A crucial priority is ensuring the accuracy of data generated by therapeutic efficacy studies, which inform drug policy decisions. The *Strategy to respond to antimalarial drug resistance in Africa* (8) highlights the different interventions needed to support this. These include strengthening the subregional networks for monitoring efficacy and resistance, and enhancing the capacity of national teams to generate better quality and standardized data on antimalarial drug efficacy and parasite resistance. Planned activities to support these objectives include:

- updating the document *Methods for surveillance of antimalarial drug efficacy (9)* to serve as a reference for national programmes and investigators assessing drug efficacy;
- establishing a roster of consultants trained to support therapeutic efficacy studies in line with WHO study protocols, aiming to mainly train individuals with local expertise and experience in conducting therapeutic efficacy studies in the African context; and
- expanding the ongoing WHO External Quality Assessment scheme for malaria molecular diagnostics, managed by UK NEQAS, to include molecular K13 markers of artemisinin partial resistance.

MPAG conclusions

MPAG commended the substantial work done by the Global Malaria Programme since the last MPAG meeting to confront this issue, especially considering the very limited resources.

Following the presentation, there was a broad discussion. MPAG agreed on the urgency of the situation and the need for immediate action, and developed the following recommendations:

- MPAG resolutely emphasizes the urgency of this situation:
 - MPAG calls for urgent prioritization of responsive actions to mitigate artemisinin partial resistance and to reduce the risk of partner drug resistance and treatment failures.
 - Regional collaboration is essential to engage local expertise and facilitate data acquisition and sharing across areas and countries. Quality-controlled data need to be obtained with standardized protocols.
 - MPAG recommends in vitro/ex vivo phenotypic analyses where possible to monitor parasite susceptibility to artemisinins and partner drugs in artemisinin-based combination therapies (ACTs).
 - The Global Malaria Programme plays a vital role in the norms and standards for data generation and analysis.
- Immediate action is required to reduce selective pressure for emergence of artemisinin partial resistance and to limit transmission of resistant parasites:
 - MPAG supports adding a single low dose of primaquine to first-line ACTs, as recommended by WHO to reduce onward transmission in areas of artemisinin partial resistance.
 - Vector control measures should reduce parasite biomass at the population level and their implementation should be intensified. These interventions must be sustained to avoid malaria resurgences in the event of waning immunity.
 - MPAG recommends a renewed emphasis on accelerating malaria elimination in sub-Saharan Africa.
- The following recommendations are essential to reduce selective pressure on lumefantrine:
 - MPAG strongly supports the Global Malaria Programme meeting in May 2024 to review evidence for pivoting to multiple first-line treatments.

- MPAG supports the use of artesunate–pyronaridine and dihydroartemisinin–piperazine as alternative ACTs with demonstrated efficacy and safety in sub-Saharan Africa.
- According to MPAG, triple ACTs should be considered. Evidence from the Greater Mekong subregion shows strong efficacy of artemether–lumefantrine + amodiaquine and mefloquine–artesunate + piperazine in areas of multidrug-resistant malaria.
- Non-artemisinin-based combination therapies are required:
 - MPAG encourages increased support and investment from stakeholders to accelerate the development of medicines that could replace artemisinin derivatives for the treatment of both uncomplicated and severe malaria and for chemoprevention.
- Funding support for the Global Malaria Programme and regional networks is essential to meet the needs for mitigating resistance:
 - Funding agencies need to invest to support the work of the Global Malaria Programme, including to support therapeutic efficacy studies and genomic surveillance work.
 - The Global Malaria Programme needs resources to work with national malaria control programmes and experts to identify strategies to reduce the malaria burden, assist with training and technical support, and analyse and communicate data.
 - Support is required for regional networks to take the lead, with the Global Malaria Programme providing oversight.

2.8 Update on development of guidelines recommendations on tafenoquine, primaquine and near-patient G6PD diagnostic tests to support radical cure of *P. vivax*

WHO background

The Global Malaria Programme has convened two Guideline Development Group (GDG) meetings to develop guidelines recommendations on the use of 8-aminiquinolines and near-patient G6PD tests for radical cure of *P. vivax* and *P. ovale*. On 14–15 November 2023, the GDG on malaria chemotherapy reviewed the evidence and generated recommendations on tafenoquine and primaquine as anti-relapse therapy. For primaquine, this included review of the standard WHO recommendation for daily primaquine for 14 days and the recommendation for high-dose primaquine for seven days, and review of the safety of administering primaquine to infants aged < 6 months and women breastfeeding infants aged < 6 months. On 30 November–1 December 2023, the GDG on malaria diagnostics reviewed the evidence on near-patient diagnostic tests for G6PD deficiency. Since then, the systematic review on G6PD tests has been further refined and cost-effectiveness analysis completed to inform a second meeting of the GDG on G6PD tests, convened on 26 and 29 February 2024. The GDG on G6PD tests developed recommendations on the use of qualitative and semi-quantitative G6PD tests, comparing their diagnostic accuracy to quantitative spectrophotometric G6PD assays as the reference test, at the thresholds critical to inform administration of 8-aminoquinolines, i.e. < 30%, 30–70%, and > 70% G6PD activity.

The recommendations on the use of single low-dose primaquine to reduce the transmissibility of *P. falciparum* were not reviewed by the GDG, as the current WHO guidelines already provide recommendations for areas of low transmission to reduce

the transmissibility of treated *P. falciparum* malaria infections, and for areas with artemisinin-resistant *P. falciparum* malaria, where a single low dose of primaquine of 0.25 mg/kg should be given with an ACT to patients with *P. falciparum* malaria (10).

Following the elaboration of the new sections for the *WHO guidelines for malaria*, inputs from the external review group and submission to the WHO Guidelines Review Committee, the plan is to finalize the new recommendations on the use of tafenoquine, primaquine and near-patient G6PD tests by April 2024. In line with the “Master plan for developing recommendations on the use of tafenoquine and companion quantitative point-of-care G6PD in vitro diagnostics” (WHO internal document, 2019), these new recommendations will be released when near-patient G6PD tests are included in the WHO list of prequalified in vitro diagnostic products (11). The aim of the master plan is to coordinate “one WHO” to generate WHO guidelines recommendations on the use of tafenoquine and companion G6PD point-of-care tests (3); update the WHO lists of prequalified finished pharmaceutical products (12) and in vitro diagnostic products (11); and update the WHO Model Lists of Essential Medicines (13) and Essential In Vitro Diagnostics (14).

Following the inclusion of tafenoquine and near-patient G6PD tests in the WHO prequalification lists and the release of the new guidelines, the Global Malaria Programme will convene a technical consultation to develop a field guide on the case management of *P. vivax*, providing practical guidance to support the implementation of the new WHO recommendations on the use of 8-aminoquinolines and near-patient G6PD tests.

MPAG conclusions

MPAG appreciated the Global Malaria Programme’s initiative in convening the GDGs for tafenoquine and primaquine and near-patient G6PD tests. MPAG noted the progress made and looks forward to the report. It was recognized that *P. vivax* requires additional attention at subsequent MPAG meetings.

Following the release of the new WHO recommendations on the use of primaquine, tafenoquine and G6PD tests and pending the WHO prequalification of a semi-quantitative G6PD test, the Global Malaria Programme will be developing a field guide for case management of *P. vivax* and practical guidance for G6PD testing. The WHO recommendations will take into consideration availability, accessibility and acceptability, as well as cost-effectiveness of qualitative and semi-quantitative tests for G6PD deficiency.

Furthermore, MPAG recommended that the Global Malaria Programme proactively support the development of a test for hypnozoites, in line with the WHO preferred product characteristics for tests to detect the risk of *P. vivax* relapses. Other innovations may also be given some consideration.

The availability of an accurate measurement of haemoglobin at the point of care, in addition to the measurement of G6PD activity, may be potentially useful to identify patients at risk of acute haemolytic anaemia following anti-relapse treatment, and to monitor the haemolytic response to treatment.

2.9 Update on malaria elimination, including zoonotic malaria

WHO background

Building on the foundation and successes of the Elimination-2020 (E-2020) initiative, in 2021, WHO launched the E-2025 initiative. The 26 countries and territories of the initiative are Belize, Costa Rica, Dominican Republic, Ecuador, French Guiana (France), Guatemala, Honduras, Mexico, Panama and Suriname (WHO Region of the Americas); Malaysia, Republic of Korea and Vanuatu (WHO Western Pacific Region); Islamic Republic of Iran and Saudi Arabia (WHO Eastern Mediterranean Region); Botswana, Cabo Verde, Comoros, Eswatini, Sao Tome and Principe and South Africa (WHO African Region); and Bhutan, Democratic People's Republic of Korea, Nepal, Thailand and Timor-Leste (WHO South-East Asia Region). The purpose of the E-2025 initiative is to achieve the 2025 elimination milestone of the *Global technical strategy for malaria 2016–2030* (2) by providing increased visibility, both globally and domestically, to countries' efforts to eliminate malaria; specialized technical assistance to identify and resolve technical and operational bottlenecks; opportunities for the exchange of innovative approaches and lessons learned among countries from different regions; guidance to accelerate elimination and the certification process; and support for the development of robust programmes to prevent re-establishment of transmission. According to the *World malaria report 2023* (1), at the end of 2022, two countries reached the milestone reduction of > 1000 indigenous cases in 2019 to < 1000 cases, three countries reached the milestone reduction of 100–999 indigenous cases in 2019 to < 100 cases and three countries reached zero indigenous cases.

In relation to certification, in 2023, Azerbaijan, Tajikistan and Belize were declared malaria-free. On 12 January 2024, certification of malaria elimination in Cabo Verde was officially announced. With this announcement, Cabo Verde joins the ranks of 43 countries and one territory that have been awarded this certification by WHO. Currently, the Global Malaria Programme is working with several countries to prepare for certification of malaria elimination.

Work continues on the update of *A framework for malaria elimination* (15) and development of global guidance on prevention of re-establishment of malaria transmission. Both documents are expected to be finalized in 2024.

In recent years, *P. knowlesi* has emerged as a notable concern in malaria cases, especially in the WHO South-East Asia Region countries of Indonesia, Malaysia and Thailand. In 2022, a total of 2768 *P. knowlesi* cases were reported globally, a decrease of 24.2% from 2021 (3651 cases). Indigenous *P. knowlesi* cases also saw a decrease of 26% – from 3629 cases in 2021 to 2682 cases in 2022. Malaysia experienced a 30% decline in total *P. knowlesi* cases, from 3575 in 2021 to 2505 in 2022. Most (99.9%) of the *P. knowlesi* cases detected in 2022 were classified as indigenous. The total number of *P. knowlesi* cases rose from five reported cases in 2021 to 87 in 2022 in Indonesia, and 71 cases in 2021 to 176 in 2022 in Thailand. Although Malaysia reported the highest absolute numbers of *P. knowlesi* cases, the rate of increase in 2022 was most pronounced in Indonesia and Thailand. More information on *P. knowlesi* burden and transmission can be found in section 4.4 of the *World malaria report 2023* (1). The increase in the burden and transmission of *P. knowlesi* poses unique challenges to malaria elimination; it also has implications for malaria-free certification. Until now, certification has been awarded exclusively to countries where only the four human *Plasmodium* species (*P. falciparum*, *P. vivax*, *P. malariae* and *P. ovale*) were transmitted. Given the context of emerging *P. knowlesi* transmission, WHO has convened its advisory groups to discuss the implications of *P. knowlesi* for certification. If a country is able to eliminate transmission of the four main human species but other species are still being transmitted, certification might be granted if the risk of infection is assessed as negligible. Following discussions on *P. knowlesi* at the fifth meeting of the Technical Advisory Group on Malaria Elimination and Certification, a subgroup on *P. knowlesi* was established with the aim of developing a draft of the procedure and requirements for certification of countries

that have achieved elimination of the four human *Plasmodium* species but transmission of zoonotic malaria continues. The subgroup is also expected to draft guidance on the process and conditions for de-certification of countries where *P. knowlesi* is transmitted.

MPAG conclusions

MPAG strongly commended the Global Malaria Programme on the significant progress made by the elimination team, particularly in terms of the landmark certification of Cabo Verde and advances in countries in the European Region and elsewhere. MPAG also noted the increase in cases in some countries (e.g. Costa Rica and the Islamic Republic of Iran) and encouraged the Global Malaria Programme to share best practices from other comparable settings to target these cases. MPAG agreed with the timeliness of the review of the framework for elimination document (15) and sections therein, including streamlining of the Malaria Elimination Audit Tool guidelines.

The lessons learned from STOP Malaria are well noted. The fact that funding for this has ceased and there is likely to be a loss of the recently trained capacity at the local level, as well as at the regional level and in the Global Malaria Programme itself, is a concern. MPAG noted the need to reiterate that both financial investment and political commitment must continue once malaria indices drop and focus shifts to other health issues.

MPAG noted that it would be useful to have a research agenda to allow more rapid transition to elimination. The agenda should include the use of molecular epidemiology to improve surveillance approaches, gaining a better understanding of waning immunity. The research agenda should be coordinated with the Technical Advisory Group on Malaria Elimination and Certification.

MPAG welcomed the focus on zoonotic malaria, recognizing its growing relevance in multiple countries and the complexity of this issue for certification. It is important to develop an operational research and development agenda comprising clinical and surveillance diagnostics, community engagement and vector control, including personal protection measures. Such innovations could enable countries to achieve the “negligible risk” thresholds that may be established. MPAG acknowledged that, although the current certification process of malaria elimination has been refined over several decades, due consideration should be given to alternative certification options for countries where the transmission of human malaria cases has ended but zoonotic malaria cases remain. MPAG noted that such options are under consideration by the *P. knowlesi* subgroup established under the Technical Advisory Group on Malaria Elimination and Certification.

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Annex 1. Declarations of interest

1. Professor Evelyn Ansah, University of Health & Allied Sciences, Ghana

Research Support – Ghana Co-Investigator on funding from PATH for the Health Utilization Study on a qualitative assessment of the pilot implementation of RTS,S. This interest was assessed as non-personal, non-specific and financially significant.*

2. Emeritus Professor Graham Brown, Professor, University of Melbourne, Australia

Consulting – WHO/Global Malaria Programme contract to write the interim draft of the Executive Summary of Strategic Advisory Group on malaria eradication (SAGme) report (2019). This interest is assessed as personal, non-specific and financially significant.*

3. Professor Umberto d'Alessandro, Director, Medical Research Council Unit, Gambia, London School of Hygiene and Tropical Medicine, United Kingdom of Great Britain and Northern Ireland

Research support – All interests assessed as non-personal, non-specific and financially significant.*

- (a) Principal investigator in phase 1b multi-stage *P. falciparum* malaria vaccine study to assess the safety and immunogenicity of the blood-stage vaccine candidate RH5.2 virus-like particle (VLP) in Matrix-MTM and the preerythrocytic stage vaccine candidate R21 in Matrix-MTM, both along and in combination, in adults and infants in Gambia (ongoing until March 2025).
- (b) Principal investigator in seasonal R21 mass vaccination for malaria elimination funded by Applied Global Health Research MRC UKRI (ongoing until June 2026).
- (c) Principal investigator of a multicentre randomized controlled non-inferiority trial to compare efficacy, safety and tolerability of the Triple Artemisinin-based Combination Therapies versus first-line ACTs + placebo for the treatment of uncomplicated *p. falciparum* malaria in Africa, funded by the University of Oxford (ended June 2023).
- (d) Principal investigator in a clinical trial on the safety and efficacy of pyronaridine-artesunate (Pyramax) in asymptomatic malaria-infected individuals. The Medical Research Council Unit, Gambia, received funding from Medicines for Malaria Venture for this work in 2018–2019.

Consultant – Development of M5717 new antimalarial drug for Merck Health care KGaA (ongoing since 2022). This interest is assessed as personal, non-specific and non-financially significant.*

4. Professor Abdoulaye Djimde, Head, Molecular Epidemiology Drug Resistance Unit, University of Mali, Mali

Research support – All interests assessed as non-personal, non-specific and financially significant.*

- a) DELTAS Africa – Principal investigator for Developing Excellence in Leadership and Genetics Training for Malaria Elimination (DELGEME) with funding from the Wellcome Trust (2016–2021).
- b) PAMGEN study funded by the African Academy of Sciences looking at genetic interactions between human populations and malaria parasites in different environmental settings across Africa (2018–2022).
- c) WANECAMII – Principal investigator of the West African Network for Clinical Trials of Antimalarial Drugs with funding from EDCTP (2019–2024).

- d) Clinical evaluation of ASAQ+Atovaquone-Proguanil tri-therapy for malaria treatment in African children funded by EDCTP (2019–2023).
- e) Funding from the United Kingdom Medical Research Centre for using single-cell RNAseq to deeply investigate human malaria parasite transmission dynamics (2020–2021).
- f) MalariaGEN Resource Center – Software Development Support (2021–2022).
- g) RTS,S – SMC trial – sub-investigator on trial which contributed minimal salary support through the London School of Tropical Medicine & Hygiene.
- h) RIA2017MC-22 – Principal investigator for study with funding from ASAAP (2019–2023).

5. Professor Chris Drakeley, Immunologist, Department of Infection Biology, London School of Hygiene and Tropical Medicine, United Kingdom

Research support – All interests assessed a non-personal, non-specific and financially significant.*

- (a) Support from BMGF up until 2025 for programme grant Vivax serology partnership (VISPA). Multicomponent grant attempting to provide umbrella for those working on vivax serology. Two components have been funded so far, management and oversight (including policy) largely delivered by WEHI and a set of biobanking studies which include Brazil, Ethiopia and Pakistan. Professor Drakeley is co-principal investigator with Professor Ivo Mueller with key support from Michael White and Leanne Robinson. The grant is held by WEHI. (<https://vispa.online/about-vispa/>).
- (b) United Kingdom funded component (UKRI) of an EU Horizon 2020 study up until 2027. Award for a study on *P. vivax* serology test and treat in Madagascar. Professor Drakeley is co-principal investigator and LSHTM is an external recipient. The study centres around a randomized-controlled trial with the intervention based on treatment of those serology-positive in the assay developed by WEHI/Pasteur for the identification of the hypnozoite carriers compared to the standard of care alone. Other aspects are social acceptability, digital health related to G6PD testing and capacity building. Partners are AHRI Ethiopia, Pasteur Madagascar, FIND, University of Galway, Medea Italy and WEHI.
- (c) Research support from BMGF up until 2025 to fund study to evaluate the effect of increasing the age range of SMC on malaria transmission.

6. Professor David Fidock, Director, Centre for Malaria Therapeutics and Antimicrobial Resistance, Columbia University, United States of America

Research support – All interests assessed a non-personal, non-specific and financially significant.*

- (a) Research support – from Medicines for Malaria Venture in 2021 supporting studies of drug resistance risks in their portfolio of antimalarials in late discover or undergoing development. The research assesses whether compounds are prone to resistance and studies the mechanisms of resistance and modes of action.
- (b) Research support – from the Bill & Melinda Gates Foundation for work on the Malaria Drug Accelerator Consortium (MaLDA) which works to define the ‘drugable genome’ of *P. falciparum* parasites to develop new target-based drug screens from 2021–2022. This interest is assessed as non-personal, non-specific and financially significant.*
- (c) Research support – from the Bill & Melinda Gates Foundation on antimalarial drug resistance using genetic crosses and studies to accelerate the throughput

7. Professor Caroline Jones, Senior Social Scientist, KEMRI-Wellcome Trust Research, Kenya

Research support – All interests assessed a non-personal, non-specific and financially significant.*

- a) Senior social scientist on the project funded by UNITAID called the “Broad One Health Endectocide-based Malaria Intervention in Africa (BOHEMIA)”. This clinical trial of ivermectin mass drug administration (MDA), which runs from February 2019 to February 2024, is being conducted in Mozambique and Tanzania. Professor Jones is the lead social scientist and is investigating community and local stakeholder perceptions and responses to ivermectin MDA for malaria control. It aims to understand the local context and possible influences on uptake.
- b) Research support – Senior social scientist on a household-randomized controlled trial which is multi-organization grant with United Kingdom Department for International Development (DFID), MRC, Wellcome Trust Global Health trials grant on “*Can improved housing provide additional protection against clinical malaria over current best practice?*” from 2014 to 2019. This interest is assessed as non-personal, non-specific and financially significant.*

8. Dr Nilima Kshirsagar, Emeritus Scientist, Indian Council of Medical Research, India

Consulting – Zydus Lifesciences, company driven by the purpose of delivering care and nurturance for the patients, backed by power of innovation, science and cutting edge technology. Providing scientific advice. Honorarium provided. This interest is assessed as non-personal, non-specific and financially significant.*

9. Dr Corine Ngufor, Associate professor, London School of Hygiene and Tropical Medicine, United Kingdom

Research support – Principal investigator for research for the evaluation of insecticide treated nets (ITNs) and indoor residual spraying (IRS), funded by Vestergaard (closed 2023), Shobikaa Impex (closed 2023), AtoZ (Closed 2023), SC Johnson, Tianjin Yorkool, the Global Fund to Fight AIDs, Tuberculosis and Malaria (GFATM) (current). This interest is assessed as non-personal, non-specific and financially significant.*

10. Dr Fredros Okumu, Director of Science, Ifakara Health Institute, United Republic of Tanzania

- Employment – with Ifakara Health Institute. This interest is assessed as non-personal, non-specific and financially significant.*
- Consulting – for WHO Vector Control Product Prequalification as a consultant assessor ending in December 2020. This interest is assessed as personal, non-specific and financially significant.*
- Research support – All interests assessed a non-personal, non-specific and financially significant.*
 - a) Research support – grants received from the Bill & Melinda Gates Foundation; WHO-TDR programme; Wellcome Trust; Foundations of the National Institutes of Health, United States; Africa Research Excellence Fund; UKRI/EPSRC, United Kingdom; Rudolf Geigy Foundation, Switzerland; Hanako Foundation, Singapore; The Royal Society, London; The British Academy, London, UNITAID, Medical Research Council, United Kingdom; Swiss National Science Foundation, USAID, Innovative Vector Control Consortium, Grand Challenges, Canada, Scottish Funding Council and Consortium for Advanced Research Training in Africa. All grants were

- awarded to Ifakara Health Institute and are assessed as non-personal, non-specific and financially significant.*
- b) Patent Applications held by Ifakara Health Institute and assessed as non-personal, non-specific and non-financially significant.*
 - c) World Intellectual Property Organization. Patent number WO 2010/101462-A2: *Behavior modifying odorant mixture for malaria mosquitoes* (Joint patent by Ifakara Health Institute, TZ and Wageningen University, The Netherlands [Kingdom of]): <https://patents.google.com/patent/WO2010101462A2/en>
 - d) World Intellectual Property Organization. Patent number WO 13187690.6-1656: *A complex of structures for delivering pesticidal agents to arthropods*. (Joint patent by Ifakara Health Institute, TZ & In2Care Holding B.V, The Netherlands [Kingdom of]): <https://patents.google.com/patent/EP2859794A1/en>
- Expert opinions: contributed to the following assessed as personal, non-specific and non-financially significant.*
 - a) Currently serves as a member of the Malaria Strategic Advisory Panel for the Bill & Melinda Gates Foundation.
 - b) Contributed in Research and Draft team for Africa Union on: African Union High Level Panel on Emerging Technologies (2018): Gene Drives for Malaria Control and Elimination in Africa. <https://www.nepad.org/publication/gene-drives-malaria-control-and-elimination-africa>
 - c) Contributed as a co-chair of malERA Refresh Consultative Panel on Tools for Malaria Elimination. (2017). malERA: An updated research agenda for diagnostics, drugs, vaccines, and vector control in malaria elimination and eradication. PLoS Med. 2017 Nov 30;14(11):e1002456.doi: 10.1371/journal.pmed.1002456. eCollection 2017 Nov. Review: <https://doi.org/10.1371/journal.pmed.1002455>
 - d) Contributed as a member of this panel: James S, Collins FH, Welkhoff PA, Emerson C, Godfray HCJ, Gottlieb M, Greenwood B, Lindsay SW, Mbogo CM, Okumu FO, Quemada H, Savadogo M, Singh JA, Tountas KH, Touré YT (2018). Pathway to deployment of Gene drive mosquitoes as a potential biocontrol tool for elimination of malaria in Sub-Saharan Africa: recommendations of a Scientific Working Group. Am J Trop Med Hyg. 2018 Jun;98(6_Suppl):1-49. <https://doi.org/10.4269/ajtmh.18-0083>

11. Dr Aranxta Roca Feltrer, Regional Malaria Director, Malaria Consortium, Mozambique

- Employment with the Malaria Consortium (non-profit organization). This interest is assessed as personal, non-specific and financially significant.*
- Research grants from the Bill & Melinda Gates Foundation on surveillance strengthening in Mozambique. This interest is assessed as non-personal, non-specific and financially significant.*
- Employment with PATH (non-for profit organization) for a grant funded by BMGF aiming to provide technical assistance to malaria endemic countries. This interest is assessed as personal, non-specific and financially significant.*

12. Professor Dyann Wirth, Richard Pearson Strong Professor and Chair, Harvard T.H. Chan School of Public Health, USA

- Research support – Research grant support to Harvard University received from the following organizations (all current): All interests assessed as non-personal, non-specific and financially significant.*

- (a) National Institute of Health, United States – Principal investigator or Co-principal investigator on four grants on new drug discovery and drug resistance (DHODH/mitochondrial targets, ProRS and targeting parasites in mosquitoes, and ACT resistance).
- (b) Bill & Melinda Gates Foundation
 - Support for Genetic epidemiology of malaria, Rethinking malaria global leaders initiative, and Malaria drug accelerator (MalDA) consortium. MalDA consortium is a global consortium of researchers and drug developers identifying and sharing compounds deemed to be effective candidates for the drug pipeline for malaria treatment and prevention.
 - Support for the Malaria Drug Accelerator (MalDA) Consortium, as co-principal investigator on a grant housed at the University of California San Diego.
 - Support for Rethinking Malaria Global Leaders Initiative, as co-principal investigator. No salary or honorarium received.
- (c) PATH – Principal Investigator for Mal095 using RTS,S to look at the issue of allele specific immunity.
- Educational support to Harvard University for the Eradication of Malaria Leadership course provided by BMGF, JC Flowers Foundation, Sumitomo Corporation and ExxonMobil. These interests are assessed as non-personal, non-specific and financially significant.*
- Advisory roles – All interests assessed as non-personal, non-specific and financially significant.*
 - (a) Medicines for Malaria Venture (MMV) Expert Scientific Advisory Committee (ESAC). Honorarium and travel provided.
 - (b) Board of Trustees of the Marine Biological Laboratories, Wood Hole, MA. No honorarium or travel expenses received.
 - (c) Warren Alpert Foundation Scientific Advisory Committee for the annual award. Honorarium received.
 - (d) PATH/PMI Insights initiative which is a collaborative body of global experts on malaria research and policy to increase access and information to forward the goal of malaria elimination.
 - (e) Reviewer for National Institutes of Health (NIH) grants. No salary or honorarium received.
 - (f) Reviewer of research and development projects for Global Health Innovative Technology Fund (GHIT). No salary or honorarium received.

* According to WHO's Guidelines for Declaration of Interests (WHO expert), an interest is considered "personal" if it generates financial or non-financial gain to the expert, such as consulting income or a patent. "Specificity" states whether the declared interest is a subject matter of the meeting or work to be undertaken. An interest has "financial significance" if the honoraria, consultancy fee or other received funding, including those received by expert's organization, from any single vaccine manufacturer or other vaccine-related company exceeds US\$ 5000 in a calendar year. Likewise, a shareholding in any one vaccine manufacturer or other vaccine-related company in excess of US\$ 1000 would also constitute a "significant shareholding".

Annex 2. Agenda

Monday, 4 March 2024			
Session 1		Open	
09:00 – 09:05	Welcome by the Chairperson, MPAG	Professor Dyann Wirth MPAG Chairperson	
09:05 – 10:30	Report from the Director, GMP	Dr Daniel Ngamije M. Director, Global Malaria Programme	For information
Session 2		Open	
11:00 – 12:00	Progress on malaria vaccine introduction and scale up	Dr Mary Hamel Senior Technical Officer, Product & Delivery Research	For information
12:00 – 12:30	Update on Gavi supported malaria learning agenda	Dr Stephen Sosler Head of Vaccine Programmes, GAVI, the Vaccine Alliance	
Session 3		Open	
14:00 – 15:00	“High burden to high impact” (HBHI) approach and catalytic role of GMP & RBM in support to countries to own and implement HBHI approach	Dr Maru A. Weldedawit Unit Head, High Burden to High Impact MPAG subcommittee on HBHI NMCP	For advice
Session 4		Open	
15:00 – 17:00	Sub-national tailoring (SNT) for decision-making – Overview and update	Dr Beatriz Galatas Technical Officer Strategic Information for Response Unit (virtual)	For information
	Guiding principles for prioritization overview	Dr Andrea Bosman Unit Head, Diagnostics, Medicines & Resistance	For decision
	Biological threats to malaria vector control interventions	Dr Jan Kolaczinski Unit Head, Vector Control & Insecticide Resistance	For Information
Tuesday, 5 March 2024			
Session 5		Open	
10:05 – 11:05	Strategy to respond to antimalarial drug resistance in Africa – updates and identification of needs	Ms Charlotte Rasmussen Technical Officer, Diagnostics, Medicines & Resistance (virtual) MPAG subcommittee on drug resistance	For decision
Session 6		Open	
11:05 – 11:35	Update on development of guidelines recommendations on tafenoquine, primaquine and near-patient G6PD diagnostic test to support radical cure of <i>P. vivax</i>	Dr Andrea Bosman Unit Head, Diagnostics, Medicines & Resistance Dr Peter Olumese Medical Officer, Diagnostics, Medicines & Resistance (virtual) MPAG subcommittee on <i>P. vivax</i> malaria	For advice

Tuesday, 5 March 2024 (continued)**Session 7****Open**

12:00 – 13:00	Update on malaria elimination, including zoonotic malaria	Mr Elkhan Gasimov Unit Head, Elimination MPAG subcommittee on Zoonotic malaria	For information
13:00 – 13:15	Closing remarks	Dr Jérôme Salomon Assistant Director-General, UCN	

Thursday, 7 March 2024**Session 10****Closed (MPAG members and WHO Secretariat only)**

14:00 – 17:00	Finalization of conclusions	Professor Dyann Wirth MPAG Chairperson	For advice
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Annex 3. List of participants

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