

WHO Malaria Policy Advisory Group (MPAG) meeting report

18–20 April 2023

SUMMARY

On 18–20 April 2023, the World Health Organization (WHO) Malaria Policy Advisory Group (MPAG) convened to review updates and progress, and to provide guidance on thematic areas of work by the Global Malaria Programme.

The meeting opened with the report from the Global Malaria Programme Director, followed by remarks from the U.S. President’s Malaria Initiative (PMI) Global Malaria Coordinator. The hybrid meeting included the participation of MPAG members and observers joining either in person at WHO headquarters or remotely via a virtual conferencing platform. The meeting focused on 12 topics in seven open sessions: 1) the RBM Partnership to End Malaria evaluation of the “High burden to high impact” (HBHI) approach; 2) updates on the vector control, treatment and diagnostic recommendations in the *WHO guidelines for malaria*; 3) revisiting comparative effectiveness in the context of the arrival of new vector control products; 4) an update on certification of malaria elimination and the E-2025 Global Forum; 5) an update on the RTS,S/AS01 Malaria Vaccine Implementation Programme and WHO evidence review for the R21/Matrix-M vaccine; 6) an update on the work areas of the Strategic Information for Response Unit; 7) a report from the technical consultation on the effectiveness of rectal artesunate (RAS) and field implementation manual; 8) a report from the technical consultation on community-based delivery of intermittent preventive treatment of malaria in pregnancy (IPTp); 9) an update on the WHO/TDR field implementation manual for seasonal malaria chemoprevention (SMC); 10) an update on the *Anopheles stephensi* regional strategy; 11) an update on histidine-rich protein 2 (HRP2) gene deletions and global response plan; and 12) an update on antimalarial drug resistance in Africa.

The key conclusions of MPAG to the Global Malaria Programme included the following:

- **WHO guidelines for malaria:** MPAG commended the process followed by the Global Malaria Programme to develop the recommendations on dual active ingredient insecticide-treated nets (ITNs). Members
-

highlighted the need for periodic review of intervention classes of insecticides in light of new product development. MPAG highlighted the need for clarity in the dissemination and implementation of the recommendation against space spraying for malaria so that it is not confused with current recommendations for its indoor use for dengue control against *Aedes aegypti*. Members supported the existing flexibility in the ITN prioritization guidance, which enables country-specific decisions based on the local context and available resources. MPAG appreciated the planned review of the treatment recommendations and emphasized the need for community-level glucose-6-phosphate dehydrogenase (G6PD) testing, particularly to support the introduction of tafenoquine. MPAG also appreciated the online platform MAGICapp as a very good tool for communicating current information on the latest recommendations.

- **Comparative assessments in the context of the arrival of new vector control products:** MPAG welcomed the update from the Global Malaria Programme on the data requirements to support development and implementation of normative guidance for new vector control products. MPAG reiterated its earlier guidance, first issued in 2017, that comparative assessments of entomological data are required for all products other than the “first-in-class” products that generate the epidemiological data used to establish an intervention class. Given the need to balance rapid market access to new products with the need for rigorous data that demonstrate comparative effectiveness relative to existing products, MPAG requested that the Global Malaria Programme urgently clarify and resolve issues associated with the implementation of this process. MPAG emphasized the need to ensure that there is a single coordinated process for WHO to evaluate and approve new products. Once internal implementation issues have been resolved between the Global Malaria Programme and the Prequalification Team, MPAG considers it important for the process to be better communicated to external stakeholders to ensure consistent messaging and a common understanding of the data required for new products.
- **Certification of malaria elimination and the E-2025 Global Forum:** MPAG highlighted that progress is on track to attain the *Global technical strategy for malaria 2016–2030* milestone for the number of countries achieving elimination. MPAG members noted with concern, however, the increase in case numbers in some E-2025 countries and potential disruption to resources as a result of the COVID-19 pandemic, as well as budget constraints to sustain elimination efforts. MPAG noted the importance of recognizing species differences and the unique challenges presented by *P. vivax*. Advice to countries for *P. knowlesi* and other zoonotic malaria parasites, including on case thresholds, vector control and diagnostics needs urgent attention. MPAG strongly supported the need for new technical guidance on prevention of re-establishment of malaria.
- **RTS,S Malaria Vaccine Implementation Programme and evidence review for R21 vaccine:** MPAG was impressed with the continuing progress of MVIP according to schedule, despite the challenges presented by the COVID-19 pandemic. MPAG members also noted the substantial progress on implementing the framework for the allocation of limited supply and suggested that the process of its development and implementation be published for future reference. Timelines for technology transfer to India for the production of RTS,S/AS01 will be watched closely to ensure that as many children as possible can be protected as soon as possible. However, concerns remain as the manufacturer has only committed to producing 18 million doses for the 2023–2025 period. Results of early trials of the R21/Matrix-M malaria vaccine are promising; MPAG noted the importance of the R21/Matrix-M developers submitting the requested data on efficacy and safety as soon as possible to enable the WHO recommendation development and prequalification processes to continue.

- **Strategic Information for Response Unit work areas:** MPAG members commended the Strategic Information for Response Unit on the substantial progress achieved and emphasized the need to consolidate current efforts and expand across all malaria-endemic countries. MPAG strongly recommended that the Global Malaria Programme seek sustainable funding to support the surveillance agenda, given that current support will end this year. MPAG highlighted the need for countries to prioritize the development of national capacity to conduct and use subnational tailoring and mobilize resources using their existing funding mechanisms. MPAG welcomed the formation of the WHO Regional Office for Africa's Precision Public Health Metrics Unit to support the uptake and refinement of these initiatives moving forward.
- **Effectiveness of RAS for severe malaria and field implementation manual:** MPAG welcomed the report from the technical consultation convened to conduct a formal evidence review of all studies involving the deployment of RAS. MPAG emphasized the importance of health systems strengthening to support the introduction of RAS and ensuring a continuum of care for severe malaria and other diseases at the primary care level. MPAG requested that the Global Malaria Programme work closely with other WHO departments to look at innovative approaches to providing the needed health system continuum of care to ensure that the impact of RAS introduction is maximized. Members supported the development of a field manual which clearly outlines the conditions under which the introduction of RAS can be effective and provides guidance to countries on how to carry out readiness assessments. MPAG members further emphasized the need for quality control at the national level with the inclusion of a system for checking the quality of the commodity at peripheral sites.
- **Technical consultation on community-based IPTp:** MPAG congratulated the Global Malaria Programme on completing the technical consultation, on publishing the meeting report and on the ongoing development of the field guide on community deployment of IPTp. MPAG members were encouraged by the results of the community-based IPTp pilot studies assessed during the June 2022 WHO technical consultation. MPAG raised the issue of ensuring that community health worker networks are functional and integrated into health systems to be able to absorb new activities such as community-based deployment of IPTp. MPAG also encouraged consideration of sustainable approaches to implement the intervention that do not rely on external funding.
- **WHO/TDR SMC field implementation manual:** MPAG congratulated the Global Malaria Programme on finalizing the SMC field guide and noted that it would be used as a template for the development of field guides for other chemoprevention interventions. MPAG suggested that the field guide should include documentation of the number of unreached children and the reasons why they are not receiving SMC. MPAG questioned the feasibility and usefulness of recording SMC usage routinely for clinical patients and asked the Global Malaria Programme to reconsider this requirement. MPAG suggested that national malaria programmes should investigate the reasons for low impact in areas where malaria prevalence has remained high despite the implementation of SMC.
- **An. stephensi regional strategy:** MPAG highlighted the need to encourage proactive and strengthened adaptations of routine surveillance systems in countries that have yet to identify *An. stephensi*. MPAG suggested that initiatives against *An. stephensi* should continue to be integrated into broader vector surveillance and control initiatives, including the Global vector control response, which includes other vectors. MPAG noted that such an integrated effort would yield multiple positive externalities along the way, including against malaria

transmission by other vector species. MPAG further noted that appropriate biosafety control should be in place before establishing laboratory colonies of *An. stephensi* in countries where the vector has not been detected.

- **HRP2 gene deletions and global response plan:** MPAG commended the Global Malaria Programme on the progress made in standardizing the methods for the detection of *pfhrp2/3* deletions. MPAG recommended that WHO organize networks and build capacity for *pfhrp2/3* deletion monitoring, adapted to regional contexts. For surveillance purposes, MPAG suggested that, in addition to microscopy, new technologies such as serological- or molecular-based detection of *Plasmodium* antigens should be considered. MPAG recommended that the Global Malaria Programme encourage funding agencies to support programmes in developing alternate RDTs that are not solely dependent on *pfhrp2/3*.
- **Antimalarial drug resistance in Africa:** MPAG emphasized the urgent need to increase action on the ground to stop the spread of artemisinin partial resistance in the countries where partial resistance has been confirmed. Mitigation efforts include increased emphasis on vector control, expanded use of single low-dose primaquine, limiting artemisinin monotherapy, increased molecular and therapeutic efficacy surveillance and deployment of multiple first line therapies. There should be a prioritization of mitigation efforts based on the local context. MPAG recognized the need for more molecular surveillance with associated capacity across sub-Saharan Africa to measure the true magnitude of artemisinin partial resistance on the continent. MPAG welcomed the reactivation of the subregional networks for monitoring the efficacy of antimalarial drugs in Africa. MPAG stressed the ongoing risk of artemisinin partial resistance in Asia and the Western Pacific and the importance of preventing the dissemination of artemisinin partial resistance in South America was also highlighted.

BACKGROUND

The World Health Organization (WHO) Global Malaria Programme convened the Malaria Policy Advisory Group (MPAG) for its 23rd meeting in Geneva on 18–20 April 2023. A Zoom link was available for members and observers to join virtually. MPAG convenes twice annually to provide independent strategic advice to WHO on technical issues related to malaria control and elimination. Over the course of the two days of open meetings, 19 MPAG members, two national malaria programme managers, the WHO Secretariat, 18 observers in person and over 500 registered observers on Zoom discussed updates and progress in the work areas presented. MPAG discussed conclusions and recommendations to the Global Malaria Programme in a closed session on day three.

All 19 MPAG members participating in the meeting updated their Declarations of Interest in advance of the meeting, which were assessed by the WHO Secretariat. Thirteen members reported interests; the full report was published two weeks before the meeting and is available on the meeting website. No MPAG members reported specific conflicts of interest relating to the agenda topics. It was assessed that all members could fully participate in all sessions.

Updates from the Global Malaria Programme

The Director's report reflected on the Programme's work since October 2022, including highlights from the *World malaria report 2022 (1)* and its four key themes: response, risk, resilience and research. The key messages were:

1. Despite coronavirus disease (COVID-19)-related disruptions to malaria prevention, testing and treatment services, and the often-devastating impacts of the pandemic on health, social and economic systems, malaria-endemic countries and their partners largely held the line against further setbacks to malaria control in 2021.
2. Efforts to curb malaria continue to face a convergence of threats, particularly in the African Region, which carries the heaviest burden of the disease. Disruptions during the pandemic, together with other humanitarian crises, health system challenges, restricted funding, rising biological threats (insecticide resistance, antimalarial drug resistance, parasite *pfhrp2/3* gene deletions and invasive vector species) and a decline in the effectiveness of primary malaria control interventions, are undermining progress towards global malaria goals.
3. Despite these challenges, national malaria programmes have demonstrated their resilience through the worst of times. Targeted new strategies, restored funding and strengthened health systems could help countries to regain lost ground and build an even more resilient response to malaria.
4. A promising research and development (R&D) pipeline is poised to bring next-generation malaria control tools that could help to accelerate progress towards global targets.

Updates on normative work included the publication of two new preferred product characteristics (PPCs) on tests for glucose-6-phosphate dehydrogenase (G6PD) activity (2) and vector control products targeting outdoor malaria transmission (3). Two additional PPCs on monoclonal antibodies (4) and malaria chemoprevention (5) were published shortly after the meeting. Over the last six months, there have been two updates to the consolidated *WHO guidelines for malaria (6)* in case management and new recommendations on two classes of insecticide-treated nets (ITNs; more details in the second topic below). The work to improve the dissemination of the malaria Guidelines and other guidance has continued with input from an informal dissemination taskforce. Outcomes include translations of the available Guidelines in French, Arabic and Spanish, an update of the mobile app, and the use of animated videos.

Technical updates on work since October 2022 were provided from each of the units of the Global Malaria Programme. In vector control, the document *Vector alert: Anopheles stephensi invasion and spread in Africa and Sri Lanka (7)* was published in January 2023, followed by a convening by WHO of partners for a regional response to the invasion of *Anopheles stephensi* in Africa, held in Addis Ababa in March 2023. The report of the seventeenth meeting of the WHO Vector Control Advisory Group (8) was published in January 2023. In addition, in March 2023, WHO published recommendations on new types of insecticide-treated nets in the malaria Guidelines. Two technical consultations were convened, the first to review the effectiveness of rectal artesunate (RAS) as pre-referral treatment of children with severe malaria and the second to update the field implementation manual for seasonal malaria chemoprevention (SMC). The *Strategy to respond to antimalarial drug resistance in Africa (9)* was published in November 2022 and two surveys were launched to collect information on the planned and ongoing

studies of drug efficacy and molecular markers of drug resistance. The Strategic Information for Response Unit has made updates to the District Health Information Software (DHIS2) modules, conducted joint modelling of routine data and *Plasmodium falciparum* parasite rates for risk mapping for “High burden to high impact” (HBHI) stratification, planned the convening of the Strategic Information Technical Advisory Group to be held in June 2023, and finalized the *Global response framework for malaria in urban areas (10)*. This is the final year of the Malaria Vaccine Implementation Programme (MVIP), and work is ongoing to try to measure the vaccine’s impact on childhood mortality and the effectiveness of four versus three vaccine doses. Support was provided to more than 15 African countries to prepare applications to Gavi, the Vaccine Alliance, for the introduction of RTS,S/AS01 in priority areas. The review of data on a new malaria vaccine, R21/Matrix-M, is well under way, supported by an independent WHO advisory group of immunization and malaria experts. If approved, this second vaccine could increase global supply, reduce cost, and optimize impact.

Country support updates from the HBHI unit included support to over 20 countries on subnational tailoring and for programme reviews in five HBHI countries and six non-HBHI countries. Technical support was provided to develop Global Fund applications, to support malaria control in health emergency settings, and to evaluate implementation of the 1,7-malaria reactive community-based testing and response (1,7mRCTR) approach in four countries. The fourth Global Forum of malaria-eliminating countries met in Cape Town in February. The Malaria Elimination training course on OpenWHO has been translated into French and Spanish, and the technical consultation on prevention of re-establishment was launched. The malaria elimination certification mission to Belize was conducted in February 2023 and Azerbaijan and Tajikistan were certified as malaria-free in March 2023.

Remarks and update from the U.S. President’s Malaria Initiative (PMI)

The Global Malaria Coordinator of PMI presented an update on PMI’s strategic plan 2021–2026: end malaria faster (11). Since 2006, PMI has invested approximately US\$ 9 billion to help countries fight malaria and strengthen health systems through ITNs, indoor residual spraying (IRS), case management, preventive medicines for pregnant women and children, training of health workers and cross-cutting investments. There are five strategic focus areas: (i) reach the unreached, (ii) strengthen community health systems, (iii) keep malaria services resilient, (iv) invest locally and (v) lead and innovate.

PMI has two near-term strategic goals: addressing escalating threats and defining and implementing “localization” for PMI. Key actions to address the escalating threats include monitoring and mitigating against emerging artemisinin resistance in Africa, supporting the roll-out of new tools to combat insecticide resistance, understanding and responding to *Anopheles stephensi* in the Horn of Africa, and increasing the focus on mitigating the impact of climate change while reducing the agency’s carbon footprint. The focus on localization involves increasing funding to local organizations, positioning local voices to guide PMI’s work, and enabling a shift in the manufacturing of commodities to Africa.

PMI seeks to complement and align with global malaria partners in supporting national malaria strategy implementation. Key areas of focus include contributing to country-level learning to inform WHO recommendations; supporting partner countries to implement WHO-recommended interventions; and aligning guidance, priorities and procurement strategies with the Global Fund to Fight AIDS, Tuberculosis and Malaria at the central level, with PMI investments complementing and synergizing support for national malaria strategies in countries. PMI participates in and supports the RBM

Partnership to End Malaria at all levels – from leadership to the Country/Regional Support Partner Committee and RBM technical working groups. PMI also collaborates with the Bill & Melinda Gates Foundation to address implementation bottlenecks and to leverage R&D, novel surveillance and other innovative approaches.

RBM Partnership evaluation of the HBHI approach

The HBHI approach to accelerating progress against malaria was launched in 2018 by WHO and the RBM Partnership, with a focus on improving the public health response in the 11 highest burden malaria-endemic countries. The approach categorizes the public health response in terms of four elements (political will, strategic information, better guidance and a coordinated response) and recognizes the foundational supporting role played by the overall health system and the multisectoral response.

The evaluation was designed to assess how well the HBHI conceptual approach has supported countries over the three years of country implementation, including two years under the challenges of the COVID-19 pandemic. The RBM Partnership evaluation focused on Burkina Faso, the Democratic Republic of the Congo, Mozambique, Nigeria, Uganda and the United Republic of Tanzania. The WHO evaluation of the remaining countries (Cameroon, Ghana, India, Mali and the Niger) is ongoing. The evaluation was not an evaluation of country performance or the impact of the approach on malaria burden; instead, it focused on the process and value of the HBHI approach and included four specific objectives:

- to evaluate country-level outcomes of applying the HBHI approach, to identify best practices and barriers to success, and to suggest course corrections for future actions;
- to evaluate the global-level processes supporting the HBHI approach;
- to consolidate recommendations to inform scale-up of the approach for the four response elements, effective health system and multisectoral action in all HBHI focus countries; and
- to make further recommendations using the lessons learned for expanding the HBHI approach to additional malaria-endemic countries.

The primary added value of this approach is that its conceptual framing gives a common language for national malaria programmes to use for internal advocacy with government officials and other stakeholders at all levels and for external advocacy with bilateral and multilateral financing organizations to increase funding for different aspects of the national malaria response. Overall, country stakeholders were largely satisfied with the conceptual framing of the HBHI approach and claimed that it encompasses the necessary components of a successful malaria programme. Many argued that the approach was equally valuable for countries with lower malaria burdens. Stakeholders were also satisfied that the HBHI approach effectively encompassed activities and initiatives that were already in progress. HBHI provided a framing and a justification that could be useful for communications with national leaders and international funders. It was especially noteworthy that all HBHI countries received comparative increases in their Global Fund malaria allocations, and that the HBHI approach informed the funding requests and proposed intervention mixes.

The extent to which HBHI will continue to be useful will depend on its ability to incorporate and adapt to changing programme needs and to provide guidance on how to allocate financial resources to effective interventions at the right place and at the right time, including when funding falls short.

SUMMARY OF THE MPAG SESSIONS

WHO guidelines for malaria: vector control and guidance on ITN prioritization and treatment and diagnostics

Background: Two updates to the *WHO guidelines for malaria (6)* were published since the last MPAG meeting: the first to the treatment recommendations, published on 25 November 2022, and the second to the vector control recommendations, published on 14 March 2023. The March update included the following new recommendations for dual active ingredient nets:

- Pyrethroid-chlorfenapyr ITNs should be deployed instead of pyrethroid-only long-lasting insecticidal nets (LLINs) for prevention of malaria in adults and children in areas with pyrethroid resistance (strong recommendation for, moderate-certainty evidence).
- Pyrethroid-chlorfenapyr ITNs can be deployed instead of pyrethroid-piperonyl butoxide (PBO) ITNs for prevention of malaria in adults and children in areas with pyrethroid resistance (conditional recommendation for, moderate-certainty evidence).
- Pyrethroid-pyriproxyfen ITNs can be deployed instead of pyrethroid-only LLINs for prevention of malaria in adults and children in areas with pyrethroid resistance (conditional recommendation for, moderate-certainty evidence).
- Pyrethroid-pyriproxyfen ITNs are not recommended for deployment over pyrethroid-PBO ITNs for prevention of malaria in adults and children in areas with pyrethroid resistance (conditional recommendation against, moderate-certainty evidence).

Guidance on the prioritization of ITNs in situations where resources are limited was published as a companion document to support national malaria programmes in their decision-making on the procurement of ITNs. The guidance details six ITN deployment prioritization steps: (i) ensure access for vulnerable groups; (ii) define ITN deployment scope; (iii) maximize coverage; (iv) maximize effectiveness; (v) identify funding gaps; and (vi) ensure adequate funding for surveillance.

The next steps will be to publish updated recommendations on IRS and topical repellents, anticipated in June 2023. This will complete the planned update of the vector control recommendations that began in 2021. Future steps include the commissioning in 2023 of systematic reviews and stakeholder interviews on contextual factors, particularly acceptability and feasibility, across a range of vector control interventions. Interventions on the horizon that are being evaluated by the Vector Control Advisory Group and that may trigger a systematic review of the evidence include spatial repellents, attractive targeted sugar baits and ivermectin.

The update to the treatment recommendations published in November 2022 included the following:

- Artesunate-pyronaridine is recommended as an artemisinin-based combination therapy (ACT) option for the treatment of uncomplicated *P. falciparum* malaria (strong recommendation for, low-certainty evidence).
- Pregnant women with uncomplicated *P. falciparum* malaria should be treated with artemether-lumefantrine during the first trimester (strong recommendation for, low-certainty evidence).

- To prevent relapse, an additional treatment option of using primaquine 0.5 mg/kg/day for seven days is recommended to treat *P. vivax* or *P. ovale* malaria in children and adults (except pregnant women, infants aged < 6 months, women breastfeeding infants aged < 6 months, women breastfeeding older infants unless they are known not to be glucose-6-phosphate dehydrogenase [G6PD] deficient, and people with G6PD deficiency) (strong recommendation for, very low-certainty evidence).
- To prevent relapse, an additional treatment option of using primaquine 1.0 mg/kg/day for seven days to treat *P. vivax* or *P. ovale* malaria is not recommended (conditional recommendation against, very low-certainty evidence).

Updates to both the diagnosis and treatment recommendations are anticipated this year. For diagnostics, the scope is to make recommendations on the use of near-patient G6PD tests based on their accuracy around thresholds important to support safe administration of 8-aminoquinoline drugs for the treatment of *P. vivax* malaria. The systematic review of the diagnostic accuracy of near-patient G6PD tests in people undergoing treatment or prophylaxis with primaquine or tafenoquine or in people susceptible to malaria is currently under way. The Guidelines Development Group (GDG) is expected to meet in June 2023 to review the evidence and formulate recommendations, and publication is anticipated in November. For treatment, a GDG scoping meeting is planned in May 2023. Systematic reviews are expected to be commissioned in June, and the GDG meeting to formulate recommendations is expected in October, with publication in December 2023.

MPAG conclusions: MPAG commended the process followed by the Global Malaria Programme to develop the recommendations on dual active ingredient ITNs. MPAG has been regularly updated throughout the effort to reach a revised classification of ITN classes. The process is intended to foster innovation without compromising on the need to generate data that support recommendations. MPAG noted that the process has been transparent, inclusive and well documented. MPAG highlighted the need for periodic review of intervention classes of insecticides in light of new product development. MPAG also highlighted the need for clarity in the dissemination and implementation of the recommendation against space spraying for malaria so that it is not confused with current recommendations for its indoor use for dengue control against *Aedes aegypti*.

MPAG noted that the companion *Guidance on the prioritization of insecticide-treated nets in situations where resources are limited* (12) was published alongside the recommendations. Members highlighted and supported the existing flexibility in the prioritization guidance, which enables country-specific decisions based on the local context and available resources.

MPAG appreciated the planned review of the treatment recommendations. MPAG members noted that the addition of artesunate-pyronaridine to the list of approved ACTs was timely because of the emergence of partial artemisinin resistance and the importance of reducing drug pressure on lumefantrine. MPAG further noted the updated recommendations on treatment of uncomplicated malaria during the first trimester of pregnancy and on the dosage of primaquine for prevention of relapses of *P. vivax* and *P. ovale*. MPAG emphasized the need for community-level G6PD testing, particularly to support the introduction of tafenoquine. MPAG noted the need to clarify that in the new WHO classification of G6PD genetic variants, the threshold for normal variants, group C, is based on median G6PD activity $\geq 60\%$ in males and is not intended to be used in clinical decisions on the use of 8-aminoquinolines. Members were of the view that this should be stressed in further dissemination of the new classification, explaining the difference with the threshold of G6PD activity $> 70\%$ required for tafenoquine administration. MPAG appreciated the online platform MAGICapp as a very good tool for communicating current information on the latest recommendations.

Revisiting comparative assessments in the context of the arrival of new vector control products

Background: Since the October 2022 MPAG meeting, WHO has released three key communications related to new vector control interventions: (i) publication of new ITN recommendations based on data from randomized controlled trials (RCTs) on pyrethroid–chlorfenapyr and pyrethroid–pyriproxyfen nets; (ii) prequalification of a new IRS product containing an insecticide (broflanilide) from an insecticide class never used before in malaria control (organohalogen); and (iii) prequalification of a second ITN containing pyrethroid and chlorfenapyr. The Global Malaria Programme reiterated the importance of the data to inform vector control guidance development and associated updates. Explicit demonstration of an intervention’s epidemiological impact (public health value) is essential for the development of WHO recommendations. In most cases, data are generated by conducting at least two RCTs that assess new interventions against one or more standards of care. However, RCTs are costly and lengthy.

To minimize the required investment and speed up market access, WHO broadened the vector control intervention classes. The resulting increase in the diversity of products within a class covered by a WHO recommendation, however, raised new questions with regards to the efficacy of products falling within this class when compared to the product that established the class and which provided epidemiological data demonstrating disease impact. In 2017, WHO advisory groups identified the need for assurance that at least similar entomological impact will be achieved by the products grouped within an intervention class (13). Such comparison of products against the standard of care is already common practice for the generation of epidemiological data and should equally apply to the assessment of entomological data.

PPCs were introduced as part of the Global Malaria Programme’s revised process for developing recommendations. Information from technical consultations and MPAG guidance regarding data requirements for comparative assessments was incorporated into the PPC on IRS/indoor residual surface treatments (14) published in 2022. Other PPCs will need to be updated to incorporate information on comparative effectiveness.

Since 2017, the Global Malaria Programme and its advisory groups have consistently identified the need for comparative data within intervention classes. The implementation of this comparative assessment has been evolving within WHO. The Global Malaria Programme has now issued a specific data call for entomological data to enable further comparative assessment of ITN and IRS products, building on past practices of assessing neonicotinoid insecticides for IRS, which led to an extension of WHO’s recommendation on IRS, and assessing pyrethroid–PBO nets. These data are clearly of relevance in the context of WHO’s normative guidance in informing the discussions of evidence review groups, technical consultations and MPAG. In addition, these data may be of value to WHO Member States and their procurement partners in contributing to prioritization decisions.

The 2023 technical consultation plans to review comparative effectiveness data on pyrethroid–PBO nets, which have been WHO–prequalified since the 2021 review, as well as data on other new types of nets and data on new insecticide classes for IRS. Summary data, technical discussions and conclusions will be communicated in a meeting report. With comparative assessments starting to become routine, alternative mechanisms for the assessment of data and dissemination of findings will be explored, potentially including a dedicated WHO website to bring together the outcomes of different technical meetings. With the aim of formulating an organization-wide position on comparative assessments in support of WHO’s broader mandate to provide evidence-based guidance to Member States, the Global Malaria Programme has

expanded its collaboration across WHO to include the Legal team and the Quality Assurance, Norms and Standards department, which houses the Secretariat of the Guidelines Review Committee.

MPAG conclusions: MPAG welcomed the update from the Global Malaria Programme on the data requirements to support development and implementation of normative guidance for new vector control products. MPAG reiterated its earlier guidance, first issued in 2017 (15), that comparative assessments of entomological data are required for all products other than the “first-in-class” products that generate the epidemiological data used to establish an intervention class. MPAG noted that WHO has made a series of attempts to address this need in recent years, including convening several technical meetings. MPAG also noted that, despite these efforts, there was continued confusion in the wider community over how the process of assessing comparative entomological data operates in practice.

Given the need to balance rapid market access to new products with the need for rigorous data that demonstrate comparative effectiveness relative to existing products, MPAG requested that the Global Malaria Programme urgently clarify and resolve issues associated with the implementation of this process with other relevant WHO departments. MPAG emphasized the need to ensure that there is a single coordinated process for WHO to evaluate and approve new products. Once internal implementation issues have been resolved between the Global Malaria Programme and the Prequalification Team, MPAG considers it important for the process to be better communicated to external stakeholders to ensure consistent messaging and a common understanding of the data required for new products. It would also be helpful in this communication to further clarify the basis upon which products are grouped into intervention classes.

In requesting comparative data, it is also important for the Global Malaria Programme (and WHO more generally) to communicate how such data will be used and by whom – and, in particular, how it is anticipated countries will use these data to inform their commodity choices. Input from WHO Member States is critical to ensure that the process can be tailored to fully meet their needs. The process should emphasize the importance of formalizing a systematic link in the dissemination of the Guidelines to WHO Member States to ensure that national malaria programmes have the most up-to-date information and to enable feedback loops so that their programmatic questions can be addressed prior to decision-making (e.g. prioritization/choice of interventions).

MPAG also noted that comparative assessment of new vector control products should aim to provide clarity on other aspects relevant to procurement and implementation. For example, comparable data on LLINs should consider durability and wash resistance over the period of time for which products are expected to exert their impact (e.g., on mortality, fertility, etc). It was also highlighted that it would be helpful to provide guidance on when changes to the manufacturing process of a specific product would require new data on comparative effectiveness.

Certification of malaria elimination and the E-2025 Global Forum

Background: The presentation included an update on the fourth Global Forum of malaria-eliminating countries, which was held in January 2023 in Cape Town. The three-day meeting covered progress made and challenges that E-2025 countries are facing on their road to elimination; strategies and interventions to accelerate elimination; and the launch of the technical consultation on prevention of re-establishment. An update was provided on the progress made by the countries involved in the E-2025 Initiative to

indicate how many countries might be able to achieve elimination. The key challenges specified by countries included lack of political commitment, lack of awareness and urgency of malaria elimination among local authorities and key stakeholders; a shortage of human and financial resources for malaria elimination; poor resilience of the health system; inadequate multisectoral collaboration; insufficient implementation of cross-border collaborative activities; population movement (within and between countries); and reduced risk perception and delayed health-seeking behaviours. The conclusions from the Forum were as follows:

- Country leadership and political will are vital, and WHO has an important role to play in advocating for elimination.
- Acceleration towards elimination is needed to get countries back on track. There is a need to better document where acceleration has been successful and how this was facilitated.
- Strengthening the capacity of WHO staff at the regional and country levels is as important as building the capacity of the national malaria programme.
- Sustained funding of elimination programmes must be ensured.
- A regional/subregional perspective is important, particularly in situations where malaria in neighbouring countries affects those working towards elimination.
- Additional efforts are needed to disseminate the new WHO recommendations on elimination and provide clear guidance on their implementation.

An update was provided on the certification of malaria elimination, which was achieved by Azerbaijan and Tajikistan in March 2023. Other countries in process include Belize and Cabo Verde, where the certification process is expected to be completed in 2023, and Georgia and Timor-Leste, which are expected to complete their processes in 2024.

The workplan to develop guidance on the prevention of re-establishment is on track. The technical consultation on prevention of re-establishment of malaria transmission was launched in January 2023 at the Global Forum and was followed by a series of virtual meetings in February 2023 to review case studies and updates on WHO policies and recommendations on health systems. The evidence review meeting was convened in Georgia in March 2023 to consider the results of the literature review on the factors that contributed to the stability of malaria elimination in recently certified countries, the factors that led to the occurrence of outbreaks after the interruption of malaria transmission, the refractoriness of *Plasmodium* in *Anopheles* mosquitoes and biological factors that could result in refractoriness. The meeting also summarized the experiences and lessons learned from several countries on the prevention of resurgence. The guidance is expected to be published by the end of the year.

MPAG conclusions: MPAG noted the substantial progress made by the elimination team, including the presentation of approaches to elimination in different countries, declines in reported cases in a number of E-2025 countries, certification of Azerbaijan and Tajikistan and the establishment of the technical consultation on prevention of re-establishment of malaria transmission. MPAG highlighted that progress is on track to attain the *Global technical strategy for malaria 2016–2030 (16)* milestone for the number of countries achieving elimination. MPAG noted with concern, however, the increase in case numbers in some E-2025 countries and potential disruption to resources as a result of the COVID-19 pandemic, as well as budget constraints to sustain this level of work on elimination. MPAG encouraged the Global Malaria Programme to continue supporting countries to achieve elimination.

The discussion included the need to consider the potential future complex and unstable dynamics of malaria if transmission is reduced but elimination is not achieved. MPAG particularly noted the importance of recognizing species differences and the unique challenges presented by *P. vivax*. Noting that the revision of *A framework for malaria elimination (17)* has been initiated, it was suggested that the guidance should reiterate the needs for programmes as they shift from population-based interventions to individual case/focus-based interventions, especially for countries aiming to eliminate by 2025. Advice to countries for *P. knowlesi* and other zoonotic malaria parasites, including on case thresholds, vector control and diagnostics needs urgent attention. MPAG strongly supported the need for new technical guidance on prevention of re-establishment of malaria. MPAG suggested documenting and learning from the experience in countries that have almost achieved elimination but then observed a dramatic rise in cases, and considering new challenges, mechanisms and technologies for use in prevention of re-establishment.

Update on RTS,S/AS01 Malaria Vaccine Implementation Programme (MVIP) and WHO evidence review for the R21/Matrix-M vaccine

Background: In October 2021, WHO recommended the first malaria vaccine (RTS,S/AS01) to be used for the prevention of *P. falciparum* malaria in children living in regions with moderate to high malaria transmission (18). The recommendation was informed by data and insights generated by the pilot implementation of the malaria vaccine in routine immunization programmes in selected areas of Ghana, Kenya and Malawi, and other available RTS,S/AS01 clinical evidence (6). Subsequently, the Gavi Board approved a malaria vaccine programme to support roll-out in Gavi-eligible countries. In July 2022, the vaccine was prequalified by WHO.

The MVIP will continue in the three pilot countries until December 2023, with continued monitoring of data on the safety, impact and coverage achieved, including with the fourth vaccine dose. An embedded case-control study, led by the Kintampo Health Research Centre, is measuring the added value of a four-dose schedule over a three-dose schedule, with results expected in 2024. Following the 2021 WHO recommendation for vaccine use beyond the pilot areas, WHO and partners are facilitating the scale-up of the malaria vaccine, drawing on the lessons learned from the pilot implementations. Gavi has reported unprecedented demand for the vaccine, with at least 29 countries expressing interest in introducing it, and the three pilot countries plus 12 additional countries submitting applications to introduce the malaria vaccine during the first available Gavi application rounds. Due to the high demand, which outstrips supply, a framework for allocation of malaria vaccine supply is guiding the allocation of the limited vaccine doses available (19).

Since the recommendation of RTS,S/AS01, the R&D pipeline for malaria vaccines has continued to advance. R21/Matrix-M, developed by the University of Oxford and manufactured by Serum Institute India, is the second malaria vaccine under review by WHO for a potential recommendation for use. If R21/Matrix-M is considered sufficiently similar to RTS,S/AS01 and safety and efficacy criteria are reached, it could be included under the existing WHO recommendation for malaria vaccines.

MPAG conclusions: MPAG was impressed with the continuing progress of MVIP according to schedule, despite the challenges presented by the COVID-19 pandemic. MPAG further noted that while MVIP will be formally completed by the end of 2023, the documentation of results and broader work to support vaccine roll-out will continue in 2024. Completion of the case-control study (funded by the European & Developing

Countries Clinical Trials Partnership) to assess the value of the fourth vaccine dose is a high priority, as it should determine whether the limited supply of RTS,S/AS01 vaccine could protect more children if only three doses are required. MPAG supported every effort to identify the US\$ 2 million required to complete this study.

MPAG noted the substantial progress on implementing the framework for the allocation of limited supply and suggested that the process of its development and implementation be published for future reference. Timelines for technology transfer to India for the production of RTS,S/AS01 will be watched closely to ensure that as many children as possible can be protected as soon as possible. However, concern remains as the manufacturer has only committed to producing 18 million doses for the 2023–2025 period.

Results of early trials of the R21/Matrix-M malaria vaccine are promising and MPAG members look forward to seeing the follow-up data. MPAG noted the conclusion of the Strategic Advisory Group of Experts on Immunization/MPAG Working Group from the March 2023 meeting report: “Direct comparisons of vaccine efficacy between R21 and RTS,S cannot be made; the study sites selected for the R21 Phase 3 trial have a narrower and lower range of transmission intensities than the study sites included in the RTS,S Phase 3 trial” (unpublished report). Members noted that no plans are in the public domain for trials to compare the efficacy of RTS,S/AS01 and R21/Matrix-M, or to test R21/ Matrix-M in areas of high perennial transmission. MPAG advises that systematic data be collected in high transmission areas to assess the effectiveness and impact of R21/Matrix-M in these settings.

MPAG noted that the supplier of R21/Matrix-M has stated that it “has already established potential manufacturing capacities of more than 200 million doses annually” (20). If R21/Matrix-M is recommended for use by WHO, it will be a significant advance in addressing the shortage of vaccines. MPAG noted the importance of the R21/ Matrix-M developers submitting the requested data on efficacy and safety as soon as possible to enable the recommendation development and prequalification processes to continue, as national marketing authorization is likely to stimulate calls for vaccine funding allocations. A WHO recommendation for use and WHO prequalification are both prerequisites for vaccine procurement by the United Nations Children’s Fund and for Gavi financing for vaccine deployment.

MPAG expressed concern about the high cost of vaccines and whether their purchase would divert funds away from other life-saving interventions, particularly with the growing gap between funds available and funds required for elimination. The expectation was that with more than one efficacious product and with production transferred to India, the cost could come down.

Strategic Information for Response Unit work areas

Background: The Strategic Information for Response Unit presented key updates on progress made on several initiatives, including digital tools for strengthening malaria surveillance (21), the malaria surveillance assessment toolkit (22), the strategic use of information to guide on subnational tailoring of malaria interventions, and the *World malaria report*.

Digital tools for strengthening malaria surveillance build on the foundation of the DHIS2, which is a free, open-source software platform for the collection, reporting, analysis and dissemination of data for all health programmes. Malaria modules have been

developed in consultation with partners and adopted in over 40 countries. These include standardized data elements, collection forms, data validation rules, graphs and maps, and dashboards. Key modules include the epidemiological and entomological modules. Modules in development are for SMC, Expanded Programme on Immunization subnational stratification, and efficacy studies. Dashboards have been developed to support data use and include data quality, district-level reporting, national malaria repositories and the WHO regional malaria databases. The malaria elimination module has been developed to support case-based surveillance, follow up cases at the household level, register and monitor foci, and record case and investigation data. The module provides improved data visualization for interpretation through dashboards.

The *Malaria surveillance assessment toolkit implementation reference guide (23)* was published in August 2022 to enable national malaria programmes to (i) measure the performance of the surveillance system in terms of coverage and data quality; (ii) describe and evaluate aspects of the context and infrastructure that might influence performance; (iii) describe and evaluate process and technical aspects, such as the processes, tools and personnel involved in recording and reporting; and (iv) describe and evaluate behavioural aspects, including governance structures, promotion of an information culture and motivation of staff involved. Once the scope of the assessment has been determined, one of three potential approaches is used – rapid, tailored or comprehensive – to implement the four phases: assessment initiation, data collection and review, data analysis and output development, and prioritization of recommendations and dissemination. Three countries have piloted the tools (Burkina Faso, the Democratic Republic of the Congo and Ghana), which revealed poor concordance between the data recorded in registers at the service delivery level and aggregate data reported to the national level. In Ghana, the main reasons for this discrepancy were poor staffing, limited access to data, gaps in surveillance training, and lack of supervision and data validation meetings. Key recommendations to resolve data quality issues were:

- to develop a single malaria data repository that includes data validation rules and dashboards for all thematic areas;
- to ensure that all care-seeking points can report to the malaria data repository;
- to increase data use at lower levels through improved access to dashboards, refresher training on data analysis and use, and improved standard operating procedures; and
- to improve the frequency of data validation meetings and add components for checking variable completeness.

A digital version of the tool will be available through a web portal in July 2023.

Subnational tailoring is the use of local data and contextual information to determine the appropriate mixes of interventions and strategies for a given area to optimize the impact on transmission and burden of malaria. There are four general steps each country should take to enable a successful subnational tailoring analysis: (i) creation of an analysis team in country and identification of technical assistance needs; (ii) data assembly and cleaning; (iii) stratification, intervention targeting and modelling; and (iv) building consensus on and development of strategic plans and funding applications. Four key concepts underpinning subnational tailoring were described and discussed:

- Stratification is the process of geographically (and temporally) classifying malaria risk and its determinants into meaningful categories to inform the tailored targeting of the intervention under consideration for an optimal and a

prioritized strategy. Eventually, this process leads to intervention (and strategy) mixes for each subnational unit. Geospatial analysis and other statistical approaches are useful for stratification.

- Optimization is the process of ensuring that the interventions and strategies selected for the national strategic plan are most likely to lead to the best possible impact with respect to national targets. These analyses should ensure that system-wide synergies are considered. This is the basis for national strategic plan costing. National malaria strategic plans ought to reflect the ambition of a country in its fight against malaria. These targets are linked to overall national health and development targets.
- Prioritization is the process that aims at providing the right evidence to inform the hard decisions countries need to make to prioritize investments for impact, social justice and equity.
- Impact projections through mathematical modelling aim at predicting the impact of different mixes of interventions and comparing them to each other to inform the optimization and prioritization processes. Dynamic mathematical models calibrated to the local context are used to project impact. While models are useful in scenario projections, they are not essential for subnational tailoring and countries can still conduct subnational tailoring without modelling. However, modelling serves as a tool to provide empirical evidence that one combination of interventions is better than another.

The key lessons learned from the 33 countries supported on subnational tailoring implementation include the following:

- National malaria programme leadership is key to enabling a comprehensive review and validation of each step of the analysis, and promoting a culture of evidence-informed decision-making.
- The availability, quality and appropriateness of the routine and non-routine data for analysis are still suboptimal, but the use of these data adds value to decision-making, highlights areas of weakness and the need for improvement, and promotes national ownership. Investments to support the establishment of integrated data repositories will be key to ensure that there are structured mechanisms for exploring the data, and to reduce the data analysis timelines.
- Deep engagement with local and regional research institutions and funders is important to ensure the sustainability of undertaking and updating evidence-driven decisions, and to align over a single plan.
- Cost-effectiveness analysis is challenging due to the lack of granular costing data per intervention available.
- The use of mathematical models to support subnational tailoring is limited by the time to develop model parametrizations and calibration processes, limited data on intervention effectiveness sizes and the lack of robust outputs on severe malaria.
- A common blueprint is required to provide clear guidance on the subnational tailoring process. The Global Malaria Programme will develop a manual in response to this need.
- Local and regional capacities need to be created to ensure sustainability of subnational tailoring. The Global Malaria Programme's support to the formation of the WHO Regional Office for Africa's Precision Public Health Metrics Unit is intended to fulfil this need for capacity building.

World malaria report: Lastly, the presentation looked back at the last six annual World malaria reports published and themes over time, which have consolidated the efforts of 25 partners and over 200 people. The process to develop the *World malaria report 2023* was described and the timelines outlined to achieve the launch during the week of 5 December 2023.

MPAG conclusions: MPAG members expressed their thanks to the Strategic Information for Response Unit for the substantial progress achieved, and strongly emphasized the need to consolidate the current efforts and expand across all malaria-endemic countries. MPAG strongly recommended that the Global Malaria Programme seek sustainable funding to support the surveillance agenda, given that the current support will end this year. MPAG highlighted the need for countries to prioritize the development of national capacity to conduct and use subnational tailoring and mobilize resources using their existing funding mechanisms. Key points raised during discussion for additional consideration by the Global Malaria Programme included the following:

- **Digital solutions:** Several recommendations were raised regarding current and upcoming DHIS2 modules, including linkages between aggregate and case-based modules and incorporating information from referral hospitals and the private sector. There was also support for plans to develop additional modules, such as for intermittent preventive treatment of malaria in pregnancy (IPTp), vaccines, and genomic and pharmacovigilance surveillance. MPAG questioned the extent to which these modules are used at country level and the need to track usage moving forward. The team acknowledged that there is a need to balance the development of new modules with the incorporation of existing modules into routine practice, and the need for more efforts to support the next steps.
- **Surveillance assessment toolkit:** Updates and highlights from the pilot experiences of implementing the toolkit were very well received. MPAG suggested giving more prominence to the health workforce needs of the surveillance systems and the associated chronic health system issues that need attention when surveillance priorities are identified.
- **Subnational tailoring of interventions:** MPAG congratulated the team on the relevance of this work and the great effort made to support this initiative. MPAG emphasized the need to document the subnational tailoring processes and experiences, and the importance of ensuring that the quality of care components can be better captured in the subnational tailoring process in the future. Areas for potential improvements included adding a costing and cost-effectiveness component and economic impact, and expanding the approach to capture *P. vivax* and micro-level classifications within districts to optimize interventions at the local level. The Strategic Information for Response Unit acknowledged that subnational tailoring has so far mainly been applied in areas of moderate to high transmission and further work is needed to apply the approach in areas of low to very low transmission. With regard to quality of care analysis, although case management indicators are rarely good enough to analyse, some examples exist (e.g. Burkina Faso) to explore these aspects in more detail and could inform recommendations in the near future.

Lastly, MPAG welcomed the efforts on the online training courses and the formation of the WHO Regional Office for Africa's Precision Public Health Metrics Unit within the communicable and non-communicable diseases cluster to support the uptake and refinement of these initiatives moving forward.

Technical consultation on the effectiveness of RAS and field implementation manual

Background: Since 2006, rectal artesunate (RAS) has been recommended by WHO as an effective pre-referral treatment for severe malaria. RAS rapidly clears 50% of malaria parasites or more within 6–12 hours. In a placebo-controlled trial of pre-referral rectal artesunate (PMID: 19059639), the most significant effect was observed in those subjects who had not reached the clinic for 6 hours or longer (29/1566 [1.9%] vs 57/1519 [3.8%], risk ratio 0.49 [95% CI 0.32–0.77], $p=0.0013$). This is the study that underpins the current policy recommendation of 2015 (24). In 2017, the Community Access to Rectal Artesunate for Malaria Project (CARAMAL) was set up to implement and evaluate the introduction of RAS in selected areas of three countries. Preliminary results from CARAMAL were presented to the Global Malaria Programme and MPAG in 2021. It appeared that these results did not confirm the reduction in mortality that had been observed in the controlled trial. Consequently, WHO released an information note on RAS in January 2022, suggesting immediate risk mitigation measures.

In October 2022, WHO convened a technical consultation of independent experts to conduct a formal evidence review of several studies evaluating the effectiveness of RAS as a pre-referral treatment of severe malaria to provide clarity on the evidence available. In addition to the CARAMAL study publications, the review included other studies from early-use countries deploying RAS at the programmatic level. The objective of the technical consultation was to develop evidence-based guidance for the safe and effective implementation of RAS. Independent experts reviewed all available studies and identified questions for the study teams. The responses were provided to a WHO expert panel, which recommended additional analyses of the study database. The outcomes of the review and results of the additional analyses underpin the conclusions of the technical consultation:

- Countries that are already implementing or considering implementation of RAS for pre-referral treatment of severe malaria need to strengthen all aspects of the continuum of care for a severely sick child – from community health workers being adequately trained and stocked for giving RAS in the areas where it is most needed, to ensuring rapid transfer and access to referral facilities where a complete course of post-referral treatment is given as per WHO recommendations for the treatment of severe malaria.
- Support for adequate supply chain management and referral systems from community health workers and facilities to treatment centres is essential for achieving the intended impact of RAS. Barriers to referral completion need to be addressed, as this will improve outcomes not only for severe malaria but also for other severe diseases.
- Effective community sensitization is needed to increase understanding of severe malaria, its causes, how dangerous it is for children, how to recognize danger signs and the need to promptly seek care if such signs are present.
- Malaria programmes and their partners in the public, nongovernmental organization and private sectors should ensure that health providers adhere strictly to malaria treatment guidelines and make sure that caregivers of children with severe malaria are aware of the importance of completing treatment courses.
- Antimalarial resistance surveillance should be strengthened at the population level across Africa, and most urgently in East Africa, with prioritization of interventions to holistically address the drivers of resistance selection and prompt response in line with the WHO *Strategy to respond to antimalarial drug resistance in Africa* (9).

MPAG conclusions: MPAG welcomed the report from the technical consultation convened to conduct a formal evidence review of all studies involving the deployment of RAS. Members noted that by far the most important challenges among all those identified were the health systems weaknesses in the settings where RAS was introduced in the CARAMAL study. It was further noted that two of the countries, the Democratic Republic of the Congo and Nigeria, were not adequately prepared for the introduction of the intervention. This contrasted with another study carried out in Zambia, which included strengthening of the referral system and specific training of community health workers for RAS administration. The Zambia study reported decreases in the case fatality rates of severe malaria in the intervention districts, whereas in the CARAMAL study, no such positive impact was observed. MPAG emphasized the importance of health systems strengthening to support the introduction of RAS and ensuring a continuum of care for severe malaria and other diseases at the primary care level.

As noted by MPAG members, the independent analysis of the data from the CARAMAL study concluded that the evidence for an increased case fatality rate in RAS-treated subjects was not robustly supported. The issue of under-dosing RAS in some sites was also raised. However, the main area highlighted by the technical review was the lack of readiness of the referral system at the time of RAS introduction, which emphasizes the critical importance of countries focusing on readiness to provide an effective continuum of care as a prerequisite for introduction of RAS.

The ability to provide an effective continuum of care is aligned with universal health coverage, which many countries have adopted, and should be prioritized. Strengthening of the referral system will not only benefit those with malaria, but also provide a critical service for all acutely ill individuals. An example of how this could be achieved in the face of limited resources was cited from Ghana, where a system of networks of practice has been initiated. These networks enable health facilities, both private and public, in a specific geographical area to share human and other resources. The establishment of the network of practice was found to result in a strengthened referral system due to improved institutional relationships and trust. MPAG members requested the Global Malaria Programme to work closely with other WHO departments to look at innovative approaches to providing the needed health system continuum of care to ensure that the impact of RAS introduction is maximized.

Experts from the technical consultation had noted that the partial artemisinin resistance found in Uganda could not be solely attributed to the introduction of RAS during the CARAMAL study, since evidence of resistance was present in areas outside of those in which RAS had been introduced. A high use of injection monotherapy had been reported in the private sector in the same areas. MPAG emphasized that continued use of artemisinin monotherapy of any formulation without being followed by definitive ACT treatment could lead to increased artemisinin resistance. The recently published *Strategy to respond to antimalarial drug resistance in Africa (9)* emphasizes that patients with severe malaria who do not receive the recommended ACT following the initial monotherapy may not be cured and could contribute to the de novo emergence and spread of resistance. Artemisinin-based monotherapies (injectable and rectal) are only recommended for use in severe malaria with specific follow-up care and treatment.

MPAG members supported the development of a field manual, which clearly outlines the conditions under which the introduction of RAS can be effective and provides guidance to countries on how to carry out readiness assessments. MPAG members further emphasized the need for quality control at the national level with the inclusion of a system for checking the quality of the commodity at peripheral sites. Members emphasized that this should be included in the field manual to avoid a situation in which the suppositories are rendered ineffective on account of the conditions under which they are transported and stored at the periphery.

Technical consultation to assess evidence on community-based delivery of IPTp

Background: IPTp with sulfadoxine-pyrimethamine (IPTp-SP) is a long-standing WHO recommendation. However, its uptake has been slow and well below targets: IPTp3 coverage (i.e. three doses of SP administered during pregnancy) was estimated at 35% in 2021 (25). The TIPTOP (Transforming IPT for Optimal Pregnancy) project – the main study assessed during the WHO technical consultation – was designed in 2015/2016 to address low IPTp coverage through piloting a community-based delivery approach of IPTp in four African countries. Trained community health workers mapped pregnant women in the community, educated them, screened them for IPTp eligibility, provided SP to eligible pregnant women in line with country policies¹ and referred them to antenatal care (ANC) for comprehensive care. Shortly before the approval of the TIPTOP project in April 2017, WHO changed its recommendations on antenatal care for a positive pregnancy experience (26) from four recommended ANC visits to eight contacts during pregnancy, offering an increased number of opportunities to administer IPTp-SP. The WHO IPTp recommendation was updated in early June 2022 to the following: In malaria-endemic areas pregnant women of all gravidities should be given antimalarial medicine at predetermined intervals to reduce disease burden in pregnancy and adverse pregnancy and birth outcomes (strong recommendation for, moderate-certainty evidence) (6). Remarks on the recommendation include the following:

- SP has been widely used for malaria chemoprevention during pregnancy and remains effective in improving key pregnancy outcomes.
- IPTp-SP should start as early as possible in the second trimester and not before week 13 of pregnancy.
- Doses should be given at least one month apart, with the objective of ensuring that at least three doses are received.
- ANC contacts are an important platform for delivering IPTp. Where inequities in ANC service and reach exist, other delivery methods (such as the use of community health workers) may be explored, ensuring that ANC attendance is maintained and underlying inequities in ANC delivery are addressed.
- IPTp is generally highly cost-effective, widely accepted, feasible for delivery and justified by a large body of evidence generated over several decades.

WHO assessed the pilot experiences from eight countries (including the four TIPTOP countries) in June 2022 during a technical consultation. The objectives of the meeting were to: (i) assess the effectiveness and impact of community-based IPTp on IPTp coverage and ANC attendance, (ii) discuss molecular markers of SP resistance monitored in the TIPTOP project; and (iii) agree on best practice for the implementation of community-based IPTp if proven successful. The TIPTOP study concluded that the community-based IPTp approach improved overall IPTp coverage without a negative impact on ANC use; ANC4+, ANC1+ and early ANC visits either increased or remained the same (27). Experiences and best practices from the eight pilot countries will inform the field guide on community deployment of IPTp, which is currently under development.

¹ Some country policies make the provision of the first SP dose mandatory in ANC facilities (e.g. Madagascar and Mozambique) while others allow community health workers to initiate SP dosing in the community for eligible pregnant women (e.g. Democratic Republic of the Congo and Nigeria). Follow-up doses may, thereafter, be given in the community.

MPAG conclusions: MPAG congratulated the Global Malaria Programme on completing the technical consultation, on publishing the meeting report and on the ongoing development of the field guide on community deployment of IPTp. MPAG noted that IPTp-SP is a long-standing WHO recommendation, and while global trends of IPTp-3 coverage slowly but steadily increased over the last decade, nearly two thirds of pregnant women still do not benefit from this protective intervention. Therefore, MPAG members were encouraged by the results of the community-based IPTp pilot studies assessed during the WHO technical consultation, which identified the community-based IPTp approach as a useful additional tool for increasing IPTp-3 coverage in specific settings, thereby complementing ANC services, aligned with the WHO IPTp recommendation as updated in June 2022.

Some challenging and enabling conditions based on country experiences were discussed, and MPAG raised the issue of ensuring that community health worker networks are functional and integrated into health systems to be able to absorb new activities such as community-based deployment of IPTp. Of particular note was the issue of sustainability, both in terms of the retention of the community health workers and financial resources for the community-based IPTp approach. The Global Malaria Programme highlighted that the community-based IPTp field guide will refer to the *WHO guideline on health policy and system support to optimize community health worker programmes (28)*, which addresses these points, including the remuneration of community health workers.

MPAG discussed the enabling factors for the community-based IPTp approach, including the uninterrupted availability of SP for IPTp, strong community ownership and good collaboration among all stakeholders at the different levels. Experiences from the TIPTOP pilot project further suggests that a community-based IPTp approach is more likely to be successful when it is implemented in areas with an initial low IPTp coverage.

These topics will be incorporated into the field guide on community deployment of IPTp, which is currently under development. MPAG encouraged consideration of sustainable approaches to implement the intervention that do not rely on external funding. MPAG also noted the opportunity to target community-based IPTp to settings where burden estimates or poor access to health facilities would make it a higher priority.

Update of the WHO/TDR field implementation manual for SMC

Background: In 2021, the Global Malaria Programme launched the consolidated *WHO guidelines for malaria* on the online MAGICapp platform (6). As new evidence becomes available, the recommendations are reviewed and updated following WHO's guideline development process, and the content of the platform is updated. The version of the guidelines published on 3 June 2022 provided an update on the recommendations for SMC. Preventive interventions recommended for specific high-risk groups in areas of moderate to high malaria transmission include SMC, IPTp, IPT in school-aged children, perennial malaria chemoprevention in children, post-discharge malaria chemoprevention and malaria vaccination.

Following the recommendation to scale-up SMC in 2012, WHO published the first edition of the field guide for SMC in 2013 (29), recommending the use of amodiaquine plus SP to support SMC implementation. Since then, SMC has been adopted and implemented on a large scale in 13 African countries (Benin, Burkina Faso, Cameroon, Chad, the Gambia, Ghana, Guinea, Guinea-Bissau, Mali, the Niger, Nigeria, Senegal and Togo), reaching more than 45 million children in 2021. Pilot programmes have been completed in Mozambique and Uganda.

Best practices for SMC implementation based on the experiences of African countries since 2013 have been compiled in the updated field guide. The guide is intended to share best practices to improve SMC implementation, coverage and monitoring and evaluation. Examples of materials, tools and links to resources are included to support managers and health workers in conducting successful SMC activities and preventing malaria among vulnerable children.

MPAG conclusions: MPAG congratulated the Global Malaria Programme on finalizing the SMC field guide and noted that this would be used as a template for the development of field guides for other chemoprevention interventions. MPAG suggested that it would be useful to include the mention of potential synergies between SMC and malaria vaccine implementation in the field guide. MPAG noted that once the vaccine is introduced, the malaria burden could shift to older children and, as a result, SMC could be extended to those age groups. It is important to provide guidance on how countries should consider this shift.

MPAG suggested that the field guide should include documentation of the number of unreached children and the reasons why they are not receiving SMC. MPAG questioned the feasibility and usefulness of recording SMC usage routinely for clinical patients and requested the Global Malaria Programme to reconsider this requirement. MPAG suggested reviewing the language of the chemoprevention recommendations to clarify which interventions are specific to the prevention of *P. falciparum* malaria. MPAG suggested that national malaria programmes should investigate the reasons for low impact in areas where malaria prevalence has remained high despite the implementation of SMC.

Update on *An. stephensi* regional strategy

Background: *An. stephensi* is a malaria vector in south Asia. This vector was first reported in Africa in 2012, where its distribution in Africa appears to be spreading. This trend is of concern, as it may result in increased malaria, particularly in urban settings, thus adding to the burden and requiring limited malaria resources to be stretched even further.

Since the last update at the October 2022 MPAG meeting, *An. stephensi* has been reported in three additional countries:

- In Kenya, *An. stephensi* was found in two counties (Turkana and Marsabit) in 2022.
- In Eritrea, it was found in two locations in the north-western part of the country in 2022.
- *An. stephensi* was detected in two sites in Ghana, near Accra, in collections from 2022.

The invasive vector has now been reported in eight countries in Africa (Djibouti, Eritrea, Ethiopia, Ghana, Kenya, Nigeria, Somalia and Sudan). How long the vector has been in these sites and the extent of its spread across the continent remain unclear.

An initial vector alert was issued by WHO in 2019 to provide guidance to countries on surveillance and control of *An. stephensi* (30). An update to the vector alert (8) was made in late 2022 to provide guidance to countries on activities to conduct before *An. stephensi* is found and activities to conduct once *An. stephensi* has been detected. The update provided additional information on methods for identification, surveillance, control and strategy.

A recent partnership convening was held in Addis Ababa from 8 to 10 March 2023. This meeting gathered members of national malaria control programmes, researchers, funders and policy-makers to further the aims of the *WHO initiative to stop the spread of Anopheles stephensi in Africa* (31). This meeting provided updates on the surveillance, control and development of policy against *An. stephensi* in 13 countries (Chad, Djibouti, Eritrea, Ethiopia, Ghana, Kenya, Mauritius, Nigeria, Somalia, South Sudan, Sudan, United Republic of Tanzania, and Yemen). Nine of the participating countries (eight in Africa and Yemen) reported finding *An. stephensi*, whereas four countries had not conducted specific surveillance for *An. stephensi* and/or had not detected it.

There remain several key areas where the lack of knowledge on *An. stephensi* hampers an organized response. These include:

- a comprehensive understanding of the distribution of *An. stephensi* to provide baseline data to monitor any potential further spread. It is also essential to understand the distribution of *An. stephensi* within countries, particularly in terms of its penetration into peri-urban and rural areas;
- understanding of how the vector has invaded the continent and the various countries it has been reported from, which would help in devising ways to prevent further spread. Population genetics may be a useful tool in this regard, and careful observation of transportation hubs and vehicles may also be useful;
- the impact of *An. stephensi* on malaria transmission, which would be useful for understanding its importance as a malaria vector;
- optimal vector control for *An. stephensi*, including entomological impact studies to determine which methods work best. Larviciding and larvivorous fish are the most widely used methods in India and these interventions should be assessed in Africa;
- overlap of *An. stephensi* and *Ae. aegypti* larval sites, which would enable increased opportunities for integration of surveillance and control of these disease vectors. Examples of this integration should be shared.

In 2023, the Global Malaria Programme plans to complete a “deep dive” into the history of successes and failures in *An. stephensi* control, and will undertake at least one case study of integrated mosquito surveillance and control with the aim of informing action, as envisaged under the *Global vector control response 2017–2030* (32). The quarterly update calls and updates to the Malaria Threats Map (33) will also continue in 2023.

MPAG conclusions: MPAG highlighted the need to encourage proactive and strengthened adaptations of routine surveillance systems in countries that have yet to identify *An. stephensi*. The surveillance should not be limited to urban areas and should include surveys in rural areas outside points of entry, since *An. stephensi* may have been present previously or disseminated beyond ports of entry before detection which is often the case. MPAG encouraged attention to be paid to capacity-building for vector surveillance to enable *An. stephensi* detection.

MPAG suggested that the Malaria Threats Map should include modelled likelihood maps, as well as the locations where specific surveys designed to detect *An. stephensi* have yielded negative findings (i.e. no *An. stephensi*). MPAG further noted that the dissemination of *An. stephensi* highlights the limitations of the International Health Regulations in detecting incursions of invasive species, as most invasive species are not detected at ports of entry.

MPAG suggested that initiatives against *An. stephensi* must not be isolated, but should continue to be integrated into broader vector surveillance and control initiatives, including the *Global vector control response*, which includes other vectors. MPAG noted that such an integrated effort would yield multiple positive externalities along the way, including against malaria transmission by other vector species. Finally, MPAG noted that appropriate biosafety control should be in place before establishing laboratory colonies of *An. stephensi* in countries where the vector has not been detected.

Update on histidine-rich protein 2 (HRP2) gene deletions and global response plan

Background: Accurate, timely diagnosis of malaria is critical to case management and is a key element in national and global malaria control and strategies for elimination. Malaria microscopy, the traditional diagnostic approach, is difficult to implement in peripheral health care settings where most malaria cases are diagnosed; therefore, the advent of disposable lateral-flow immunoassays for malaria (widely known as rapid diagnostic tests [RDTs]), has been of fundamental importance in malaria case management, for targeting therapy, reducing drug wastage and limiting pressure towards the development of drug resistance.

The clinically relevant RDTs for malaria diagnosis detect parasite proteins circulating in the blood. Some are configured to detect only *P. falciparum*, whereas others detect other *Plasmodium* species. The tests that are most sensitive in diagnosing falciparum malaria contain antibodies to detect the HRP2 and/or the related HRP3. Some 15 years ago, researchers working in the Peruvian Amazon region identified patients infected with *P. falciparum* strains that had acquired deletions in the genes encoding these proteins (*pfhrp2* and *pfhrp3*), rendering them undetectable by HRP2-based RDTs. Since 2015, many studies have demonstrated the presence of such gene-deleted strains in other countries and regions (34). The frequency and global distribution of this phenomenon is not yet fully understood, but, in a limited number of countries, the relative incidence of these deletion variants has been found to be high enough to require a change to RDTs that do not exclusively detect HRP2 antigens.

The updated response plan to gene deletions that limit the effectiveness of HRP2-based RDTs comprises a framework intended to support national malaria programmes and their implementing partners to address this problem pragmatically. The original document (35) was updated to summarize current knowledge and critical gaps in knowledge to guide future research and product development. The four objectives of the response plan are to:

- define the frequency and distribution of false-negative RDT results caused by these *P. falciparum* gene deletions;
- provide concrete guidance to countries on malaria diagnosis and treatment in settings where such deletions are frequent, including advice on when to incorporate alternative diagnostic tests;
- identify gaps in knowledge about the emergence and spread of strains with *pfhrp2* and/or *pfhrp3* deletions and the actions required to develop new, accurate tests for malaria based on alternative target antigens; and
- coordinate advocacy and communication with donors, policy-makers, test developers, research agencies, technical partners and disease control programmes to assist in planning.

MPAG conclusions: MPAG commended the Global Malaria Programme on the progress made in standardizing the methods for the detection of *pfhrp2/3* deletions. It was noted that mathematical models can be useful to guide surveillance, providing indications of areas at risk where the deletion could spread or become established. MPAG encouraged the Global Malaria Programme to ensure that countries monitor deletions using standardized and quality-assured protocols. MPAG suggested that current models be continuously refined to better reflect trends using existing data. WHO should organize networks and build capacity for *pfhrp2/3* deletion monitoring, adapted to regional contexts. The global response plan for *pfhrp2/3* deletions should be translated into other languages, including Spanish. For surveillance purposes, MPAG suggested that, in addition to microscopy, new technologies such as serological- or molecular-based detection of *Plasmodium* antigens should be considered. MPAG recommended that the Global Malaria Programme encourage funding agencies to support programmes in developing alternate RDTs that are not dependent on *pfhrp2/3*.

Update on antimalarial drug resistance in Africa

Background: The presentation included an overview of the development of the *Strategy to respond to antimalarial drug resistance in Africa (9)*, an update on the resistance situation since the strategy was launched in November 2022 and an update on strategy implementation. In early 2022, experts on drug resistance reviewed the data on antimalarial drug resistance in Africa and concluded that the situation was still under control, but that measures should be implemented to avoid ACT treatment failure. The review concluded that molecular markers of artemisinin partial resistance had been found at high prevalence in three African countries: Eritrea, Rwanda and Uganda; however, so far, there was no confirmed partner drug resistance in Africa.

Since that review, the *kelch 13* (K13) mutation R622I has been detected in several countries in the Horn of Africa, but evidence of delayed parasite clearance in areas of high prevalence has only been found in Eritrea. R622I has also been detected in parasites with *pfhrp2/3* deletions. The K13 mutation R561H has been found at high prevalence in studies with evidence of delayed clearance in Rwanda and has also been detected in the United Republic of Tanzania in a study with a high proportion of patients with delayed clearance. Extensive molecular surveillance is ongoing in Uganda, and data show an evolving situation and foci where validated markers of partial artemisinin resistance have been found in most parasites sampled. In Kenya, there are some potentially concerning signs, but more quality data are needed to inform an assessment.

An update was provided on planned and ongoing WHO activities to implement the *Strategy to respond to antimalarial drug resistance in Africa*. To generate better quality and standardized data on antimalarial drug efficacy and parasite resistance, WHO is developing a roster of qualified consultants to support therapeutic efficacy studies; supporting the quality of malaria microscopy through external competency assessment; and establishing an external quality assessment scheme for markers of resistance. To increase coverage of surveillance systems for efficacy and resistance and to improve data dissemination, WHO is providing support for therapeutic efficacy studies focusing on countries without recent data; continually updating the Malaria Threats Map data, including the launch of two dashboards to map gaps and direct resources; expanding the use of molecular surveillance; and planning to reconvene subregional networks of antimalarial drug resistance and efficacy surveillance in Africa. Finally, WHO is in discussions with countries to support country-specific responses and plans and will convene a regional stakeholder meeting to align on intervention priorities to support countries in responding to resistance.

MPAG conclusions: Data presented from drug efficacy studies clearly show that K13 mutations, associated with artemisinin partial resistance, are emerging de novo and spreading in the eastern part of sub-Saharan Africa. Parasites with K13 mutations have been detected in multiple countries, including Eritrea, Rwanda and Uganda, and have also been detected in Ethiopia, Somalia, South Sudan, Sudan and the United Republic of Tanzania. There is some evidence that *P. falciparum* susceptibility to lumefantrine might be decreasing in some areas, including Uganda. It is likely just a matter of time before bona fide clinical failures due to drug resistance begin to emerge.

MPAG members emphasized the need to increase action on the ground to stop the spread of artemisinin partial resistance in the countries where partial resistance has been confirmed. There needs to be a sense of urgency in addressing this issue. In areas where artemisinin partial resistance has been detected, mitigation efforts need to include increased emphasis on:

- ensuring effective prevention of infection, including vector control;
- expanding the focus on reducing parasite transmission with single low-dose primaquine;
- ensuring that the use of monotherapies is limited to severe malaria and is followed by a full oral ACT dose. Patients with severe malaria who do not receive the recommended ACT following the initial monotherapy may not be cured and could contribute to the de novo emergence and spread of resistance;
- increasing molecular surveillance to detect both newly emerging and spreading K13 mutations across regions;
- increasing the collection of quality data on antimalarial drug efficacy through therapeutic efficacy studies;
- identifying innovative approaches using currently available drugs including through exploring the deployment of multiple first-line therapies; and
- increasing access to high quality drugs.

There should be a prioritization of mitigation efforts based on the local context. In areas where artemisinin partial resistance has not been detected, increased molecular and efficacy surveillance and associated capacity-building should be implemented.

MPAG stressed the ongoing risk of artemisinin partial resistance in Asia and the Western Pacific, including the recent increase in malaria in Myanmar and western Thailand, where multidrug-resistant parasites are prevalent, and the detection of K13 mutations in Papua New Guinea. The importance of preventing the dissemination of artemisinin partial resistance in South America was also highlighted.

MPAG recognized that there is a need for more molecular surveillance with associated capacity across sub-Saharan Africa to measure the true magnitude of artemisinin partial resistance on the continent. MPAG welcomed the reactivation of the subregional networks for monitoring the efficacy of antimalarial drugs in Africa. The WHO malaria leadership was encouraged to increase communication on the urgency of the issue of antimalarial drug resistance with Heads of States of malaria-endemic countries and other stakeholders to accelerate effective and timely action on the ground.

MPAG note on health systems: MPAG noted that, across many of the sessions, the issues of the strength and quality of the health system and health workforce constraints were raised as challenges to implementation of a range of effective malaria control strategies

– from enhanced surveillance to community-based IPTp and RAS. MPAG emphasized that addressing these issues requires application of the rethinking malaria approach involving cross-sectoral collaboration, integration with other disease efforts, workforce strengthening, and recognition that adequately supported and compensated primary health care providers is key to reaching the most underserved and those most at risk.

REFERENCES

1. World malaria report 2022. Geneva: World Health Organization; 2022 (<https://apps.who.int/iris/handle/10665/365169>, accessed 23 April 2023).
2. Tests for glucose-6-phosphate dehydrogenase activity: target product profiles. Geneva: World Health Organization; 2022 (<https://apps.who.int/iris/handle/10665/364485>, accessed 23 April 2023).
3. Vector control products targeting outdoor malaria transmission: preferred product characteristics. Geneva: World Health Organization; 2023 (<https://apps.who.int/iris/handle/10665/366707>, accessed 23 April 2023).
4. Monoclonal antibodies for malaria prevention: preferred product characteristics and clinical development considerations. Geneva: World Health Organization; 2023 (<https://apps.who.int/iris/handle/10665/367044>, accessed 23 April 2023).
5. Malaria chemoprevention: preferred product characteristics. Geneva: World Health Organization; 2023 (<https://apps.who.int/iris/handle/10665/367042>, accessed 23 April 2023).
6. WHO guidelines for malaria, 14 March 2023. Geneva: World Health Organization; 2023 (<https://app.magicapp.org/#/guideline/7089>, accessed 23 April 2023).
7. Vector alert: Anopheles stephensi invasion and spread in Africa and Sri Lanka. Geneva: World Health Organization; 2022 (<https://apps.who.int/iris/handle/10665/365710>, accessed 23 April 2023).
8. Seventeenth meeting of the WHO Vector Control Advisory Group: meeting report, 3–6 October 2022. Geneva: World Health Organization; 2022 (<https://apps.who.int/iris/handle/10665/365654>, accessed 23 April 2023).
9. Strategy to respond to drug resistance in Africa. Geneva: World Health Organization; 2022 (<https://apps.who.int/iris/handle/10665/364531>, accessed 23 April 2023).
10. Global framework for the response to malaria in urban areas. Geneva: World Health Organization; 2022 (<https://apps.who.int/iris/handle/10665/363899>, accessed 23 April 2023).
11. U.S. President’s Malaria Initiative 2021–2026 strategy: end malaria faster. Washington (DC): U.S. President’s Malaria Initiative; 2021 (https://d1u4sg1s9ptc4z.cloudfront.net/uploads/2021/10/10.04Final_USAID_PMI_Report_50851.pdf, accessed 23 April 2023).
12. Guidance on the prioritization of insecticide-treated nets in situations where resources are limited. Geneva: World Health Organization; 2023 (<https://apps.who.int/iris/handle/10665/366406>, accessed 23 April 2023).
13. Data requirements and methods to support the evaluation of new vector control products. Geneva: World Health Organization; 2017 (<https://apps.who.int/iris/handle/10665/259536>, accessed 23 April 2023).

14. Indoor residual surface treatments for malaria transmission control in areas with insecticide-resistant mosquito populations. Geneva: World Health Organization; 2022 (<https://apps.who.int/iris/handle/10665/356901>, accessed on 23 April 2023).
15. Malaria Policy Advisory Committee meeting report (October 2017). Geneva: World Health Organization; 2017 (<https://apps.who.int/iris/handle/10665/259396>, accessed on 23 April 2023).
16. Global technical strategy for malaria 2016–2030, 2021 update. Geneva: World Health Organization; 2021 (<https://apps.who.int/iris/handle/10665/342995>, accessed 23 April 2023).
17. A framework for malaria elimination. Geneva: World Health Organization; 2017 (<https://apps.who.int/iris/handle/10665/254761>, accessed 23 April 2023).
18. Malaria vaccine: WHO position paper – March 2022. Geneva: World Health Organization; 2022 (<https://apps.who.int/iris/handle/10665/352337>, accessed 4 April 2023).
19. Framework for the allocation of limited malaria vaccine supply. Geneva: World Health Organization; 2022 (<https://www.who.int/publications/m/item/framework-for-allocation-of-limited-malaria-vaccine-supply>, accessed 25 April 2023).
20. R21/Matrix-MTM malaria vaccine developed by University of Oxford receives regulatory clearance for use in Ghana. Press release. Oxford: Oxford University; 2023 (<https://www.ox.ac.uk/news/2023-04-13-r21matrix-m-malaria-vaccine-developed-university-oxford-receives-regulatory>, accessed 23 April 2023).
21. Digital solutions for malaria surveillance [website]. In: Global Malaria Programme. Geneva: World Health Organization; 2023 (<https://www.who.int/teams/global-malaria-programme/surveillance/digital-solutions-for-malaria-surveillance>, accessed 23 April 2023).
22. Malaria surveillance assessment toolkit [website]. In: Global Malaria Programme. Geneva: World Health Organization (<https://www.who.int/teams/global-malaria-programme/surveillance/surveillance-system-assessments>, accessed 23 April 2023).
23. Malaria surveillance assessment toolkit: implementation reference guide. Geneva: World Health Organization; 2022 (<https://apps.who.int/iris/handle/10665/361178>, accessed 23 April 2023).
24. Gomes MF, Faiz MA, Gyapong JO, Warsame M, Agbenyega T, Babiker A, et al. Pre-referral rectal artesunate to prevent death and disability in severe malaria: a placebo-controlled trial. *The Lancet*, Volume 373, Issue 9663,557–566. doi: 10.1016/S0140-6736(08)61734-1.
25. World malaria report 2021. Geneva: World Health Organization; 2021 (<https://apps.who.int/iris/handle/10665/350147>, accessed 23 April 2023).
26. WHO recommendations on antenatal care for a positive pregnancy experience. Geneva: World Health Organization; 2016 (<https://apps.who.int/iris/handle/10665/250796>, accessed 25 April 2023).
27. Technical consultation to assess evidence on community-based delivery of intermittent preventive treatment in pregnancy for malaria: report of a virtual meeting, 21–23 June 2022. Geneva: World Health Organization; 2023 (<https://apps.who.int/iris/handle/10665/366329>, accessed on 25 April 2023).
28. WHO guideline on health policy and system support to optimize community health worker programmes. Geneva: World Health Organization; 2018 (<https://apps.who.int/iris/handle/10665/275474>, accessed on 23 April 2023).

29. Seasonal malaria chemoprevention with sulfadoxine-pyrimethamine plus amodiaquine in children: a field guide. Geneva: World Health Organization; 2013 (<https://apps.who.int/iris/handle/10665/85726>, accessed on 23 April 2023).
30. Vector alert: Anopheles stephensi invasion and spread: Horn of Africa, the Republic of the Sudan and surrounding geographical areas, and Sri Lanka: information note. Geneva: World Health Organization; 2019 (<https://apps.who.int/iris/handle/10665/326595>, accessed on 23 April 2023).
31. WHO initiative to stop the spread of Anopheles stephensi in Africa. Geneva: World Health Organization; 2022 (<https://apps.who.int/iris/handle/10665/363318>, accessed on 23 April 2023).
32. World Health Organization, UNICEF/UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases. Global vector control response 2017–2030. Geneva: World Health Organization; 2017 (<https://apps.who.int/iris/handle/10665/259002>, accessed on 23 April 2023).
33. Malaria Threats Map: tracking the spread of biological threats to malaria [website]. In: Global Malaria Programme. Geneva: World Health Organization (<https://www.who.int/teams/global-malaria-programme/surveillance/malaria-threats-map>, accessed 25 April 2023).
34. Thomson R, Parr JB, Cheng Q, Chenet S, Perkins M, Cunningham J. Prevalence of Plasmodium falciparum lacking histidine-rich proteins 2 and 3: a systematic review. Bull World Health Organ. 2020;98(8):558–568F. doi:10.2471/BLT.20.250621.
35. Response plan to pfhrp2 gene deletions. Geneva: World Health Organization; 2019 (<https://apps.who.int/iris/handle/10665/325528>, accessed 25 April 2023).

All documentation related to this meeting can be found at:
<https://www.who.int/news-room/events/detail/2023/04/18/default-calendar/23rd-meeting-of-the-malaria-policy-advisory-group>

All previous MPAC meeting reports can be found here: <https://www.who.int/groups/malaria-policy-advisory-group/meeting-archives>

To sign up for news and latest updates from the WHO Global Malaria Programme, please visit this page: <https://www.who.int/teams/global-malaria-programme/about/previous-issues-of-the-newsletter>

WHO Malaria Policy Advisory Group (MPAG) meeting report, 18–20 April 2023

ISBN 978-92-4-007438-5 (electronic version)

ISBN 978-92-4-007439-2 (print version)

© World Health Organization 2023. Some rights reserved. This work is available under the CC BY-NC-SA 3.0 IGO licence.

This publication contains the report of the Malaria Policy Advisory Group (MPAG) and does not necessarily represent the decisions or policies of WHO.

