

Summary report on the

**Regional meeting of
malaria and vector
control programme
managers from
HANMAT countries**

Djibouti City, Djibouti
9–12 December 2024



**World Health
Organization**

Eastern Mediterranean Region

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1. Introduction

A meeting of malaria and vector control programme managers from member countries of the Horn of Africa Network for Monitoring Antimalarial Treatment (HANMAT) was held in Djibouti City on 9–12 December 2024. It was organized by the WHO Regional Office for the Eastern Mediterranean in collaboration with WHO headquarters and the WHO Regional Office for Africa. The meeting brought together delegates from Djibouti, Ethiopia, Saudi Arabia, Somalia, South Sudan, Sudan and Yemen, as well as experts and international partners, to review progress and challenges in malaria control and elimination across the participating countries.

The objectives of the workshop were to:

- review progress and challenges in malaria control and elimination across HANMAT countries;
- develop country-specific plans for drug resistance monitoring, histidine-rich protein 2 and 3 (HRP2/3) gene deletion management and vector control strategies;
- strengthen cross-border collaboration and data sharing;
- explore the impact of climate change and invasive vectors on vector-borne disease (VBD) control efforts;
- share updates on innovative tools and approaches, such as genetically modified mosquitoes (GMM).

Attending organizations included the Armauer Hansen Research Institute, Baylor University, Centers for Disease Control and Prevention (CDC) Atlanta, Intergovernmental Authority on Development, International Organization for Migration, King Salman Humanitarian Aid & Relief Center, London School of Hygiene & Tropical Medicine (University of London), Naval Medical Research Unit EURAFCENT, UNICEF and University of Liverpool.

The meeting was opened by His Excellency Dr Ahmed Robleh Abdilleh, Minister of Health of Djibouti, who emphasized the growing challenge of the urban malaria vector *Anopheles stephensi*, and highlighted Djibouti's efforts to combat malaria, including partnerships with research institutions to develop new tools for vector control. He called for increased regional collaboration and technical support to achieve malaria elimination.

2. Summary of discussions

Overview of global malaria

Since 2000, malaria interventions have successfully averted 2.2 billion cases and 12.7 million deaths globally. Despite these achievements, progress remains off track for achieving the 2025 and 2030 targets of the Global Technical Strategy for Malaria 2016–2030. In 2023, there were 263 million malaria cases and 597 000 deaths, with Africa accounting for the majority of cases (94%) and deaths (95%). Challenges persist, such as risk of antimalaria drug resistance, insecticide resistance, HRP2/3 gene deletions, and the spread of the invasive vector *An. stephensi*. However, innovations such as malaria vaccines (with 16 countries planning to introduce vaccines by 2024) and new-generation insecticide-treated nets (ITNs) provide hope for burden reduction.

Malaria control and elimination in the Eastern Mediterranean Region

In the WHO Eastern Mediterranean Region, there were 10.2 million estimated malaria cases in 2023, with Sudan, Pakistan and Yemen being the highest burden countries. Notable achievements include Egypt being certified malaria-free in 2024, joining Morocco and the United Arab Emirates. Sudan introduced malaria vaccines in 2024, with plans for national scale-up. However, the Region faces challenges such as biological threats, funding gaps, weak health systems, climate change, humanitarian crises and urbanization. WHO supports capacity-building, outbreak preparedness,

cross-border coordination and resource mobilization to strengthen malaria control across the Region. Additionally, WHO released the first Arabic guidelines to improve their accessibility for health care providers.

Malaria control and elimination in the African Region

Africa remains the epicentre of malaria, accounting for 94% of global cases (233 million) and 95% of deaths (580 000) in 2022. Achievements in the Region include seasonal malaria chemoprevention protecting 49 million children in 2022, up from 0.2 million in 2012, and over 500 000 children being vaccinated with the RTS,S vaccine, with 23 countries planning further rollouts. Cabo Verde was certified malaria-free in 2024, joining Algeria and Mauritius. However, the Region faces challenges such as emerging artemisinin resistance, widespread HRP2/3 deletions, inadequate health care access and disruptions caused by humanitarian crises and climate change. Strategic goals include expanding vector control, strengthening surveillance for drug resistance and vector monitoring, and fostering regional collaborations such as the High Burden to High Impact (HBHI) initiative.

Country presentations

Djibouti, Ethiopia, Saudi Arabia, Somalia, Sudan, South Sudan and Yemen all highlighted significant progress and challenges in their malaria control efforts. Ethiopia and Sudan, both reported significant increase in malaria cases due to extreme weather and ongoing conflict and displacement, particularly in Sudan. Djibouti reported decreasing malaria cases, while Somalia reported reductions in positivity rates. The countries reported challenges with HRP2/3 gene deletions, insecticide resistance and the spread of invasive vectors *An. stephensi* and *Aedes aegypti*, particularly in urban areas with limited resources for integrated vector surveillance and control.

Achievements include Saudi Arabia maintaining zero indigenous cases since 2021 by focusing on imported case management and prevention of re-establishment. The country is now in the process of evaluation for WHO certification. Sudan, the country with the highest malaria burden in the Eastern Mediterranean Region introduced malaria vaccines to targeted high transmission areas with ITN distribution. Mass campaigns for ITN distribution have taken place in South Sudan and Yemen. Integrated community case management was also highlighted by Yemen as an achievement. Despite diverse challenges, all countries demonstrated commitment to strengthening malaria control interventions through innovative strategies and partnerships.

Evidence generation and decision support in the Horn of Africa

The presentation focused on generating real-time evidence to address malaria challenges in the Horn of Africa with focus on *pfHR2/3* gene deletions, *An. stephensi* and antimalarial resistance. Findings indicate a high prevalence of *pfHRP2/3* deletion in Djibouti and Ethiopia, which leads to diagnostic accuracy issues and the invasive *An. stephensi* driving urban malaria outbreaks. Malaria molecular studies and therapeutic efficacy studies (TES) will assess treatment efficacy in these countries. There is a need to enhance diagnostics, update malaria control strategies and integrate TES findings into policy decisions to improve overall malaria case management.

WHO guidelines on diagnostics and radical treatment

Preventing relapse of malaria due to *Plasmodium vivax* and *Plasmodium ovale* is emphasized in the recently-updated WHO guidelines for malaria case management. Glucose-6-phosphate dehydrogenase (G6PD) deficiency is a risk factor for haemolytic anaemia, particularly when malaria patients are exposed to primaquine and tafenoquine. Key updates include integration of near-patient G6PD

testing for safer use of primaquine and tafenoquine and recommendations on the use of advanced diagnostic methods to identify G6PD deficiencies and manage drug safety risks.

Global update on antimalarial drug resistance

The presentation provided an update on global antimalarial drug resistance, with a focus on Africa, and presented strategic interventions to mitigate its impact. Mechanisms of resistance, surveillance methods, geographical distribution and a four-pillar strategy to combat resistance were discussed. Artemisinin-based combination therapies (ACTs) are the main treatment for malaria, and their efficacy is dependent on the efficacy of both components. Artemisinin rapidly lowers the parasite biomass, while the partner drug completes the elimination of the parasites. The term “ACT resistance” should be avoided, using, “artemisinin partial resistance”, “resistance to an ACT partner drug”, or “high failure rate with a specific ACT” instead.

Surveillance methods for monitoring drug efficacy and resistance include: TES, which are the standard for assessing treatment effectiveness; molecular markers, which are used for early detection of resistance mutations; in-vitro and ex-vivo testing, which measure parasite response to drugs; and pharmacokinetics, which ensures that drug levels in the blood are adequate.

Artemisinin partial resistance and resistance to key partner drugs was first detected in the Greater Mekong subregion. Now countries where resistance posed the greatest challenge are close to elimination of *P. falciparum* (Cambodia, Lao People’s Democratic Republic and Viet Nam). Artemisinin partial resistance was detected in Guyana, but appears to have disappeared. However, piperaquine resistance has now developed and dihydroartemisinin-piperaquine cannot be used in some countries. In Africa, artemisinin partial resistance has emerged independently in multiple locations, with some mutations appearing to spread quickly. Reports of

higher-than-expected failure rates with different ACTs, are causing concern over the potential emergence of ACT partner drug resistance.

To combat resistance, a strategy consisting of four pillars has been proposed. The first pillar focuses on strengthening surveillance by expanding and improving surveillance systems, standardizing data collection and enhancing data dissemination. The second pillar aims to regulate drug and diagnostic use by promoting diversified treatment options, strengthening drug quality controls, improving access to quality diagnostics and removing non-recommended monotherapies. The third pillar seeks to limit the spread of resistance by optimizing vector control strategies, improving cross-border malaria management and strengthening preventive measures. The fourth pillar emphasizes research and innovation, including the development of innovative resistance management strategies, identifying high-risk populations for resistance spread and researching new treatment and diagnostic tools.

Countries should conduct assessments to evaluate their resistance status, health system capacities, and the behavioural and social factors influencing treatment adherence and drug misuse. Several factors contribute to resistance, including inadequate vector control, widespread use of antimalarials for non-confirmed cases, overreliance on a few ACTs, circulation of substandard and falsified drugs, and the delayed treatment of recrudescence cases.

WHO is updating its guidelines in 2025 to address resistance management. Improved surveillance, drug policies and cross-border coordination will be crucial in controlling resistance. Continuous monitoring and adaptation of strategies will also be needed to sustain the efficacy of malaria treatments. This approach ensures that policy-makers and health care providers can implement effective strategies to prevent further spread of resistance and maintain the effectiveness of malaria treatment.

Status of therapeutic efficacy studies in HANMAT countries

The TES data from 2016–2020 in HANMAT countries, including Afghanistan, Somalia, Sudan and Yemen, show high treatment success rates for artemether-lumefantrine and dihydroartemisinin-piperaquine in most countries. There were significant gaps in TES data for Somalia and Sudan due to conflict and resource limitations. Security issues, low malaria caseloads and limited local capacity, all hinder study implementation. It is recommended to prioritize TES in neglected regions, reassess the malaria burden and train local staff.

PfHRP2/3 gene deletion monitoring and response

The emergence of *pPfHRP2/3* gene deletions compromises the reliability of rapid diagnostic tests (RDTs) with significant prevalence in the Horn of Africa. Key actions for countries include developing harmonized surveillance protocols, switching to *pfLDH*-based RDTs in locations where HRP2 deletions exceed 5%, strengthening laboratory capacity and integrating molecular diagnostics into routine monitoring. It is essential for countries to align their response plans, map HRP2/3 deletions and introduce next generation RDTs.

Global insecticide resistance and vector control recommendations

Resistance to pyrethroids, organophosphates and carbamates is widespread and commonly detected in the major *Anopheles* and *Aedes* mosquito vectors. Spatial repellent is a new intervention that showed 30% efficacy in reducing malaria infections in trials in Indonesia and Kenya. Other novel vector control interventions include GMM, which is undergoing assessment, and sterile insect techniques that reduce mosquito populations through sterilized males. Strengthening insecticide resistance monitoring, adopting supplementary tools such as spatial repellents, and

accelerating research on novel vector control interventions, are recommended to respond to the emerging insecticide resistance.

Regional vector control challenges and interventions

In burden-reduction countries, the primary malaria vector control intervention is ITNs, distributed in mass campaigns to cover all ages. Indoor residual spraying is mainly implemented in response to outbreaks. However, due to the reduced funding for vector control and insufficient domestic resources, these core interventions target mainly the high-risk transmission areas. In Sudan, the lack of resources and ongoing conflict has led to very limited vector control and due to the continuous population displacement, and no replacement campaigns, people are left unprotected. Climate change, the expansion of the invasive vectors *An. stephensi* and *Ae. aegypti* in urban areas, and insecticide resistance are major challenges in the region that threaten malaria control efforts and increase the risk of malaria and dengue/*Aedes*-borne disease outbreaks where these diseases often overlap. HANMAT has continued to enhance integrated vector surveillance and control in countries, including through capacity-building activities during 2023–2024, with support from the CDC Vector-Borne Disease Network (VecNet) and the Network's regional and international partners.

CDC VecNet initiative

The CDC VecNet aims to enhance regional capacity for vector surveillance and control in resource-limited settings. Key activities include regional training programmes in Africa to prepare for *An. stephensi*, the training of trainers in mosquito identification for dengue and malaria vectors in Oman (2023) and building capacity for detecting and responding to insecticide resistance. The Network aims to increase cross-network exchanges, demonstrate the impact of vector control interventions and expand funding for sustainability.

NAMRU-EURAFCENT vector surveillance efforts

NAMRU-EURAFCENT has ongoing projects in the countries of the Eastern Mediterranean Region. These include supporting vector surveillance and developing distribution and temporal mapping of disease vectors of malaria, dengue and other arboviruses in urbanized areas of Aden and Djibouti City. Future activities include piloting advanced surveillance tools for acute febrile illnesses and incorporating genetic analyses of malaria parasites to guide resistance strategies.

*Genomic investigation into invasive *An. stephensi* in collaboration with Baylor University*

Recent findings provide new insights into the application of genomics for tracking and characterizing the invasive *An. stephensi* and its impact on malaria transmission. Updated analyses of both published and new data on the genetic diversity of *An. stephensi* populations in the Horn of Africa and Yemen continue to reveal distinct genomic structures between western and eastern populations in southern Yemen. These findings further support the connection between the invasive population in the Horn of Africa and that in southern Yemen, with ongoing reports identifying *An. stephensi* hubs associated with malaria outbreaks in Ethiopia.

Recent studies have also highlight the utility of *Plasmodium* DNA in tracing the continental origin of *Plasmodium* detected in *An. stephensi* during outbreaks. Longitudinal genomic and transcriptomic data remain crucial for understanding the mosquito's functional adaptations. Emphasis continues to be placed on strengthening collaboration between entomological and epidemiological sectors to improve monitoring efforts and mitigate the impact of *An. stephensi* on malaria prevalence.

Climate sensitive vector-borne diseases: spatial and temporal distribution of major vector-borne diseases and cholera in Yemen

The project of the National Malaria Control Programme in Aden, Yemen, on climate sensitive vector-borne diseases, conducted in collaboration with the University of Liverpool (United Kingdom) was presented. The spatial and temporal distribution of major VBDs and cholera in southern governorates of Yemen, including the key drivers, was discussed, highlighting the role of climate change in shaping transmission dynamics. The Copernicus Interactive Climate Atlas was introduced, illustrating global warming trends in the region and their upward trajectory. A situational analysis revealed high-risk areas for malaria, mosquito vectors, dengue and cholera. Maps showing both temporal trends and regional variations were presented, indicating the need for tailored surveillance and control strategies, while risk stratification maps highlighted critical climate and environmental factors, such as rainfall, temperature, elevation and ecoregions, that may influence transmission. Co-distribution maps, showing high-risk regions for multiple diseases, and where resources could be maximized, were also discussed. This approach provides a valuable template for other countries to assess and address climate-related risks.

Ecological extents of anopheline vectors in the Middle East and North Africa region

The WHO Regional Office for the Eastern Mediterranean is currently working on a project to create a regional malaria knowledge platform, geo-spatial risk mapping capacity and a community of practice. The project is a collaboration between the University of Oxford, Kenya Medical Research Institute (KEMRI) and WHO, and is funded by the Global Institute for Disease Elimination (GLIDE) based in the United Arab Emirates. The project includes 18 countries/territories in the Middle

East and North Africa, including Algeria, Bahrain, Egypt, Iran (the Islamic Republic of), Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, the occupied Palestinian territory, Oman, Qatar, Saudi Arabia, the Syrian Arab Republic, Tunisia, the United Arab Emirates and Yemen. The project aims to understand the ecological extent of anopheline vectors of malaria and the historical prevalence of malaria infection in the Middle East and North Africa, with the goal of better comprehending the receptive risks for the possible re-introduction of malaria across the region. Geo-coded inventories of anopheline species, historic infection prevalence and GIS Shapefiles of natural and changing malaria extents will form the basis of an Open Access data repository accessible to research institutes and ministries of health in the Middle East and North Africa.

Djibouti Friendly Mosquito Program

The Djibouti Friendly Mosquito Program is a public-private partnership between Djibouti's National Malaria Control Programme, Association Mutualis and Oxitec. A pilot project releases self-limiting "friendly" (genetically engineered) mosquitoes to target the *An. stephensi*, an invasive vector driving urban malaria in Djibouti. It uses GMM with a self-limiting gene (the female offspring of the released males do not survive). The project started with mark-release-recapture studies of wild-type mosquitoes to confirm dispersal patterns and lifespan, enabling targeted GMM releases. The first pilot release occurred in May 2024 in Ambouli (Djibouti). The phase 1 pilot showed promising vector suppression and featured robust community engagement and government alignment fostering local support. Next steps involve expanding the trials and scaling up production to support regional vector control by 2025.

Field visits

On the last day of the meeting, participants had the opportunity to observe examples of Djibouti's approach to malaria case management and vector control during field visits to two key health facilities and vector surveillance and control sites. The latter visit included observing the indoor residual spraying campaign and inspecting the GMM insectary and field GMM trial sites of this new vector control intervention in the country. Strengthening case management requires the availability of second-line treatments and stricter regulation of private sector medicine distribution. While vector control efforts show progress, especially innovative tools such as GMM, they require further investment for sustainability and scaling up. Additionally, ongoing training and capacity-building are crucial for the success of both case management and vector control programmes.

Group discussion

The meeting also included group discussions on developing country-specific plans to monitor malaria interventions for a timely response to emerging and existing biological threats. In a case management group, countries developed plans for drug resistance monitoring through conducting TES and the surveillance and management of HRP2/3 gene deletion. A vector control group focused on developing plans for insecticide resistance monitoring and strengthening integrated vector surveillance and control strategies. Both groups discussed the challenges and explored mechanisms to address these through WHO coordinated support with HANMAT partners and country cross-border collaboration. Participants noted the promising new approaches to malaria control and elimination, including malaria vaccines, anti-malarial treatments and novel vector control tools, and emphasized the importance of mobilizing the funding and technical support needed to implement plans to enhance surveillance, control interventions and capacity-building.

3. Recommendations

Political commitment and funding

1. To ensure sustainable progress towards malaria elimination, there is a critical need to advocate for increased political commitment and long-term funding.
2. Countries should prioritize domestic resource mobilization through targeted advocacy and fund-matching mechanisms with donor agencies.
3. In addition, private institutions and partners should be engaged to diversify funding sources.
4. HANMAT should strengthen its role as a policy advocate to secure sustained financial commitments from governments and stakeholders.

Surveillance and resistance monitoring

5. Surveillance systems need to be strengthened to effectively monitor insecticide and drug resistance, invasive disease vectors and HRP2/3 gene deletions.
6. Cross-border collaboration should be enhanced through bilateral agreements for systematic data sharing and technical cooperation.
7. Resources should be allocated for molecular and genetic surveillance to detect mutations and resistance patterns, to ensure preparedness and response capacity across the Region.

Integrated approaches for vector control

8. An integrated approach to managing invasive vectors and addressing insecticide resistance is essential.
9. Partnerships should be strengthened among health, environmental, and municipal sectors to develop cohesive strategies.
10. Updated integrated vector management plans should include geographic targeting based on malaria case distribution data.

11. Regular monitoring and evaluation of these plans will ensure that interventions are both effective and adaptive to emerging needs.

Intersectoral collaboration

12. Strong intersectoral collaboration is vital to effectively manage all major vector-borne diseases.
13. This requires coordinated efforts across sectors such as health, agriculture, environment, water management, education and the private sector, with an emphasis on strong community engagement.
14. Strengthen collaboration with the private sector to ensure compliance with regulations on the distribution of antimalarial medicines.
15. Joint action plans, regular communication and shared objectives will ensure resources are optimized, and efforts are unified for better outcomes.

Climate change adaptation in VBD strategies

16. Climate-sensitive data must be integrated into malaria and VBD surveillance systems to predict and mitigate the impact of vector habitat changes caused by climate change.
17. Collaboration with environmental and health agencies is crucial to address climate-related risks effectively.
18. Training and capacity-building programmes focusing on climate resilience should be developed to equip stakeholders with the skills needed to adapt their strategies.

Innovation and technology

19. To address the evolving challenges of VBDs, use of innovative tools such as GMM should be explored in selected regions according to WHO recommendations
20. Funding for research and development in diagnostic tools, medicines and vector control interventions should be increased.
21. Cost-benefit and cost-effectiveness analyses should be incorporated into the rollout of innovative technologies to ensure their economic and operational viability.

Community outreach and engagement

22. Community engagement programmes are essential for improving treatment adherence and raising awareness about drug resistance and prevention methods.
23. Community health workers should be trained in using an integrated approach to deliver education, provide health services and support community-based surveillance efforts.
24. Health messaging should be simplified for better understanding at the grassroots level.
25. Field visits and direct engagement with communities should be prioritized to foster trust and participation.

Cross-border collaboration and data sharing

26. To strengthen regional collaboration, regular cross-border meetings should be scheduled to align policies and strategies, starting with Intergovernmental Authority on Development (IGAD) countries.
27. Unified guidelines for the movement of health personnel and data sharing across borders should be developed.

28. A centralized data-sharing platform should be established to facilitate seamless collaboration and provide real-time updates to stakeholders.

Sustained progress and HANMAT coordination

29. The future activities of HANMAT should focus on sustaining the momentum of current efforts.
30. A core group should be established, comprising representatives from Member States, research institutions and academia, to guide HANMAT's activities.
31. Leadership should rotate among member countries to ensure equitable participation, and a dedicated secretariat should be set up to oversee coordination and progress monitoring.

Specific recommendations to WHO

32. Finalize the HANMAT core group terms of reference.
33. Continue to support implementation of HANMAT activities in collaboration with regional and international partners.
34. Support countries in developing entomological surveillance plans for 2025 that include insecticide resistance monitoring, genomic surveillance and strengthening capacity through coordination with international partner institutes.
35. Follow up with partners for possible needed changes to RDTs for Yemen and other countries in the Horn of Africa, when the evidence is available.
36. Support in-country discussions and plans for the process for using multiple first-line therapies for malaria.



World Health Organization
Regional Office for the Eastern Mediterranean
Monazamet El Seha El Alamia Street,
Extension of Abdel Razak El Sanhoury Street
P.O. Box 7608, Nasr City
Cairo 11371, Egypt
www.emro.who.int