**Read Me file: MARC SE-Africa Dashboard: Antimalarial Drug Resistance**

**Introduction**

The regions of Southern and Eastern Africa bear some of the highest global burdens of malaria. Understanding the spatiotemporal changes underlying the emergence of partial antimalarial resistance and how to mitigate it remains paramount in these areas. To empower users in this crucial task, we present the MARC SE-Africa Dashboard, developed by the Mitigating Antimalarial Resistance Consortium for South and East Africa. This dashboard is designed to enhance the capacity of national malaria control programs and stakeholders by providing dynamic updates on components central to data-driven public health responses in 19 malaria-endemic countries, representing 20 profiles.

For more information visit our website (https://www.marcse-africa.org/) or contact us via [marcseafrica@uct.ac.za](mailto:marcseafrica@uct.ac.za?)

**Information on the dashboard and the data presented on this site:**

**Useful links and resources**

For a more in-depth understanding of antimalarial resistance and references to the presented results, we encourage you to explore the country profiles compiled for the 20 malaria-endemic profiles (https://www.marcse-africa.org/downloads). The links below provide access to these resources and more on malaria treatment policies, molecular marker prevalence, literature on the malaria burden per country, and Therapeutic Efficacy Study (TES) outcomes.

* 1. MARC SE-Africa https://www.marcse-africa.org/
  2. MARC SE-Africa country profiles https://www.marcse-africa.org/downloads
  3. WWARN https://www.iddo.org/wwarn/tools-resources/kelch-markers-toolkit
  4. PMI https://www.pmi.gov/country-profiles-2024/
  5. WHO Threat Maps https://apps.who.int/malaria/maps/threats/
  6. World Malaria Report https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2023
  7. MRCSA <https://www.samrc.ac.za/research/centre-and-platforms-office/malaria-research-group>
  8. Roll Back Malaria Partnership to End Malaria Dashboard: https://dashboards.endmalaria.org/dashboard

The dashboard displays four data types to provide an overview of malaria treatment policies, the outcomes of the most recent therapeutic efficacy studies, the prevalence of genetic markers of concern, and the malaria burden at a glance:

1. This dashboard includes 19 malaria-endemic countries in South and East Africa. These countries include Angola, Botswana, Burundi, Comoros, Democratic Republic of Congo, Eswatini, Kenya, Madagascar, Malawi, Mozambique, Namibia, Rwanda, Somolia, South Africa, South Sudan, Tanzania (Mainland), Uganda, Zambia, and Zanzibar (Tanzania). Zanzibar is represented separately from mainland Tanzania due to its unique malaria transmission setting and elimination status.
2. Therapeutic efficacy study (TES) outcomes: Day 28 and Day 42 PCR-corrected and uncorrected results of clinical trials on WHO-recommended antimalarials. This data is visualized on a map using colour-coded markers indicating the study outcome and the location of the study. Green markers represent TES outcomes above 95% efficacy; orange markers indicate outcomes between 90-95%; and red markers signify outcomes below 90%, the WHO-recommended threshold. The map displays the latest results of the most recent TES outcomes for each location. The TES outcomes are set by default to display the latest available results for Artemether-lumefantrine (AL), Day 28 results. However,
3. Prevalence of *Kelch13* mutations: The dashboard presents the geographic distribution and prevalence of WHO-validated and -candidate *Kelch13* (K13) genetic markers associated with (partial) antimalarial resistance. The prevalence of K13 markers per country or region is further illustrated using a colour-coordinated tree map. Markers included results from molecular surveillance published in 2014 and onwards. The K13 prevalence displayed on our dashboard include

* C580Y, P574L, R561H, P553L, I543T, R539T, Y493H, M476I, N458Y, F446I, C469Y, C469F, A675V, P441L, R622I, G625R. A578S and N537S (Not classified as validated or candidate but included due to their widespread prevalence across sub-Sahara Africa)
* Wildtype

Wildtype prevalence is displayed as reported in published literature. Due to the limited alleles reported per study, care should be taken when interpreting the displayed data on K13 wildtype prevalences, as this may be an overestimation of their prevalences and may not refer to wildtype alleles across the entire K13 gene region.

All references are listed and can be retrieved in the GitHub link below.

1. Malaria treatment profiles: The dashboard includes information on the current treatment policies employed in each country. This table includes information on first- and second-line treatment of uncomplicated *P. falciparum* malaria, first- and second-line treatment of severe malaria, prereferral treatment, the percentage of *P. falciparum* amongst infected patients per country, and the treatment policy on *Plasmodium vivax* and *Plasmodium ovale* infections.
2. Reported malaria cases and deaths: The data is displayed using a combined chart illustrating the total number of cases, presented on the y-axis as a column graph, and the total number of reported deaths, presented on the alternative y-axis and visualised as a line graph, per country/region per year on the x-axis. Where inaccurately reported to the WHO Malaria Report 2023, recommendations from the country partners were included, the totals were adjusted, and references are included in the GitHub link.

### The objectives of the development dashboard were as follows:

* **Inform malaria policy and practice at sub-national, national, cross-border, and regional levels:** The dashboard provides actionable insights to guide decision-making and resource allocation at various geographical scales. Cross-border information on the emergence of antimalarial resistance is particularly crucial, as the spread of resistant parasites can quickly undermine the effectiveness of malaria control efforts in neighbouring countries.
* **Identify gaps in evidence and delays in evidence sharing:** The dashboard will highlight areas where data on antimalarial resistance are lacking or outdated, such as dated molecular markers. This will help prioritize research efforts and encourage timely dissemination of findings.
* **Inform inconsistencies between malaria treatment policies and available evidence:** The dashboard will compare the latest evidence on antimalarial resistance with current treatment guidelines, identifying discrepancies and providing a basis for policy updates.
* **Enhance network sharing and encourage data sharing:** The dashboard will serve as a platform to foster collaboration and data sharing among researchers, policymakers, and other regional stakeholders. By building regional trust and providing the necessary technology, the dashboard will facilitate the prompt exchange of information on antimalarial resistance.
* **Enable near-real-time updates and visualized outputs:** The dashboard will incorporate the latest data on the prevalence and geographic distribution of validated and candidate *Kelch13* mutations associated with (partial) artemisinin resistance and TES outcomes. Interactive visualizations allow users to interpret and compare data across countries and over time easily.

**List of abbreviations:**

AL – Artemether-Lumefantrine

DP – Dihydroartemisinin-Piperaquine

PQ – Primaquine

AS-AQ – Artesunate-Amodiaquine

ASAQ – Artesunate-Amodiaquine

ASP – Artesunate-Pyronaridine

AS-PYR – Artesunate-Pyrimethamine

ACT – Artemisinin-based Combination Therapy

IM – Intramuscular

AM – Artemether

QN – Quinine

AS – Artesunate

NA – Not Available

Rectal AS – Rectal Artesunate

For more information on the MARC SE Africa project, visit our website at https://www.marcse-africa.org/ or contact us at marcseafrica@uct.ac.za. The data and full reference list are available via https://github.com/Stephanie-van-Wyk/MARC\_SEA\_dashboard.git.