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LETTER TO THE EDITOR

EVALUATING THE IMPACT OF RAPID DIAGNOSTIC TESTS, VACCINATION, TREATMENT, AND CLIMATE CHANGE ON MALARIA CONTROL IN A CHANGING GLOBAL LANDSCAPE

Emerging challenges and new strategies in global malaria control

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Dear Editor,

despite substantial global endeavours and economic investments, malaria continues to be a major obstacle in modern medicine and the most widespread infectious menace worldwide. The latest World Malaria Report (WMR) 2023, an annual publication by the World Health Organization (WHO), reveals that the number of malaria cases in 2022 rose by 5 million compared to 2021. Nevertheless, there was an 11.000 decrease in the number of deaths compared to the previous year, although the current count of 608.000 is still alarmingly high [1]. In this letter, inspired by Chaudhary et al. [2], we highlight new factors and reports that may affect future projections, as well as environmental and pathogen changes that require decisive responses.

Climate change is a major potential threat. Climate changes affect malaria risk in complex ways. Global warming may reduce malaria-carrying Anopheles mosquitoes. By reducing mosquito breeding sites, drier seasons, often linked to global warming, reduce

malaria transmission. However, recent research highlights the magnitude of the risks associated with this scenario, including the spread of the disease to mountainous regions, shifts in Anopheles mosquito distribution, with an increase in South Africa and China but a decrease in India and Southeast Asia, and transmission in highland areas being extended [3]. Climate change increases Plasmodium and Anopheles larvae development and reproduction. Furthermore, climate-related disasters and poor sanitation increase malaria incidence and epidemics [4].

Pharmacotherapy and chemoprevention are key malaria treatments, but drug resistance threatens their efficacy. Drug resistance threatens, but vaccines offer hope. WHO has approved two malaria vaccines. In October 2021, WHO recommended RTS,S/AS01 (RTS,S) for the prevention of malaria caused by Plasmodium falciparum in children from 5 months old in moderate to high transmission areas. In 2023, WHO recommended R21/Matrix-M, the second vaccine. Both vaccines are safe and effective. In efficacy studies, RTS,S reduced symptomatic malaria risk by 39% and severe malaria risk by 29%, while R21/Matrix-M reduced risk by 75% in countries with high seasonal transmission and 66% in countries with more consistent malaria transmission [5, 6]. Both adjuvant subunit vaccines require three doses and a booster. Given the low availability of RTS,S compared to demand, the introduction of R21 into the medical arsenal could ensure sufficient access to this preventive method for all children living in malaria-endemic areas. The introduction of tafenoquine has improved malaria chemoprophylaxis and relapse prevention. Tafenoquine, like primaquine, eliminates dormant liver stages (hypnozoites) and prevents relapse, but it is usually combined with chloroquine, which targets blood stages. It can prevent malaria caused by Plasmodium vivax or Plasmodium falciparum. Combined with chloroquine, it prevents relapses as well as primaquine. This result was achieved with a single dose of tafenoquine, which is relevant given the challenges of nonadherence to the 14-day primaquine regimen [7, 8].

Advanced malaria detection methods like Rapid Diagnostic Tests (RDTs) have also improved malaria control. From 36% in 2010 to 84% in 2018, sub-Saharan Africa has tested more suspected cases due to the widespread use of cost-effective RDTs. The majority of malaria diagnoses from 2013 to 2019 were made with RDTs [9]. RDTs have limitations, especially in resource-limited settings and early infection. A microfluidic point-of-care (mPOC) immunoassay was developed to quantify *Plasmodium falciparum* histidine-rich protein 2 (PfHRP2) in whole blood to overcome the limitations of traditional tests, which only give binary results and lack the sensitivity to detect many asymptomatic infections. The field-deployable, simple mPOC immunoassay does not require plasma separation and provides

results in 15 minutes via a smartphone app. Two diagnostic modes have been developed to detect PfHRP2 at low (100's pg/mL) and high (1.000's ng/mL) concentrations, making it useful for multiple diagnostic applications, including asymptomatic infection [10].

In light of these evolving circumstances, recent scientific reports advise malaria control caution. Climate change and drug resistance are changing malaria transmission worldwide, so we must constantly adjust our strategies. New malaria vaccines like RTS,S/AS01, and R21/Matrix-M are groundbreaking. Tafenoquine's single-dose regimen and mPOC immunoassay improve treatment and detection. Continued real-world monitoring and malaria control research will reveal their impact.

Article information and declarations

Author contributions

All authors contributed equally to the conception, writing, and revision of this letter to the editor. All authors have read and approved the final version of the manuscript.

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Conflict of interest

The authors declare no conflict of interest.

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