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# Good Practices to Malaria Elimination in Countries from 2016 to 2023: A Systematic Literature Review

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## Abstract

**Context:** One of the key objectives of the WHO's "Global Technical Strategy against Malaria 2016-2030" is to eliminate malaria in at least 30 countries by 2030. However, it has to be said that malaria is progressing dangerously in some of the 21 priority countries, including Burkina Faso, which complicates the achievement of the elimination objectives. **Objective:** The aim of this study was to assess documented good practices that are conducive to malaria intervention and elimination. **Method:** We searched Medline, Cochrane, Hinari, Global index Medicus and Google scholar for relevant studies published between 2016 and 2023, and produced a narrative synthesis to organize and categorize the various interventions. Data quality was assessed using the Dixon-Woods M technique and risk of bias using the Cochrane's ROBINS-I assessment tool. **Result:** A sample of 41 documents was selected to meet our assessment criteria. The 7 good practices conducive to malaria elimination are the use of long-lasting insecticide-treated nets (LLINs), combined interventions, mass drug administration (MDA), chemoprevention of seasonal malaria (CPS), intermittent preventive treatment of malaria (IPT), rapid diagnostic testing, and antimalarial treatments. **Conclusion:** This review has identified good practices conducive to malaria elimination of malaria. However, other innovations such as gene drives and vaccines are interventions which, when combined with these good practices, could enhance the efforts of health programmes in our African countries.

**Keywords**

Malaria, Intervention, Elimination, Control, Treatment, Malaria Control

## 1. Introduction

Malaria is an endemic disease in 83 countries, contributing to about 263 million cases and over 597,000 deaths worldwide in 2023 [1]. Although the epidemiological burden of malaria has been considerably reduced, it remains the world's leading cause of morbidity and mortality. One of the key objectives of the WHO's "Global Technical Strategy against Malaria 2016-2030" is the elimination of malaria in at least 30 countries by 2030. To support this goal, WHO launched the E-2020 initiative in 2017, which brought together 21 countries with the potential to achieve zero cases of malaria by 2030. Burkina Faso is one of the ten most affected countries worldwide (3.4% of cases and 3.2% of deaths worldwide in 2020). The country experienced a 17.3% drop in the incidence rate between 2016 and 2019, from 0.87 to 0.72 per 1000 inhabitants at risk [2]. This trend is particularly significant in Africa, where nearly 94% of deaths are malaria-related (WHO Malaria Report 2024) [3].

To address with the burden of the disease, health authorities in many endemic countries, following WHO guidelines, have implemented several anti-malarial programmes and strategies within health facilities and communities. These include the use of long-lasting insecticidal nets (LLINs), indoor residual spraying (IRS), seasonal malaria chemoprevention (SMC), intermittent preventive treatment (IPT), artemisinin-based combination therapy (ACT), and malaria diagnosis and treatment as measures aimed at reducing morbidity and mortality in the population [4]. Other interventions include malaria vaccines, vector control via drone spraying, epidemiological surveillance, repellents, integrated vector management, and gene drive technology.

These efforts have contributed to a reduction in malaria-related deaths from 805,000 to 569,000 (2000 to 2023) [3]. However, despite this progress, the burden of malaria has remained very high and the rate of has begun to stagnate, jeopardizing the achievement of the 2030 targets. One of the concerns is the development of resistance to antimalarial drugs, which hampers the improvement of antimalarial interventions [5]. Another concern involves political changes affecting antimalarial strategies in terms of funding, governance, innovation and adherence to public health programmes [6].

All these innovations and strategies should be the subject of a comprehensive review. Little is known about these good practices in the scientific literature, yet understanding them could shed light on community, economic and health issues, underlining the need to continue the efforts undertaken by governments and communities who find themselves powerless against this disease.

A number of research studies have been carried out on various malaria-related topics. However, an evaluation of the different interventions, whether they are individual, combined or used as a complement to other strategies, through a systematic review and in comparison, with other existing reviews, will better situate this study within the current body of knowledge. This approach will provide endemic countries with a concrete tool to advance progress in the fight against malaria.

## 2. Methods

The systematic review protocol was registered in PROSPERO under number CRD42024587238.

The review was carried out in accordance with PRISMA guidelines [7]. The primary research question was: What documented good practices are conducive to malaria intervention and elimination?

### 2.1. Inclusion and Exclusion Criteria

The PICO(S) strategy was adopted for this research to formulate a well-defined, clear, targeted and precise research question [8]. This strategy consists of:

**P:** (Population): 'Population of endemic countries; **I:** (intervention): "effective interventions" "Malaria strategy" "malaria prevention" "malaria treatment" "diagnosis of malaria" "malaria elimination" "malaria vaccine" "fight against malaria"; **C** (comparison): "Absence" "ineffectiveness of similar interventions in endemic countries"; **O** (out com): "Reduction" "elimination of indigenous malaria cases"; **S** (setting): "Observational studies", "controlled trials", "qualitative studies", "WHO reports", "existing reviews".

Eligible studies had to meet the following criteria: be a publication detailing elimination strategy in malaria-free countries and their potential adaptation to endemic regions; use a qualitative, quantitative or mixed method; be a study published in peer-reviewed journals or institutional reports (WHO, UNICEF, etc.); be written in English or French; report on the period from 2016 to 2023.

Studies that did not meet the inclusion criteria and articles that focused solely on interventions unrelated to malaria were excluded.

### 2.2. Search Strategy and Study Identification

Two independent investigators (DO, AK) conducted searches across the electronic databases of PubMed, Cochrane, Hinari and Global index Medicus, as well as the grey literature via Google scholar. The search used qualitative, quantitative or mixed methods, and included studies published between 2016 and 2023, aligning with the WHO's call for countries to adopt strategies toward achieving the 2030 goals. In addition, a manual search on each malaria intervention was performed to complete the analysis.

These strategies yielded 2630 articles after removing duplicates. Keywords were applied to titles, abstracts, and full texts during screening. Reading the title to eliminate irrelevant documents was the first step in the selection process. A preliminary set of 284 documents was retained at this stage. Various disagreements regarding inclusion were resolved through discussion among all the investigators. When title and abstract information were insufficient for decision-making, full-text reading was performed to resolve the issue.

Two investigators individually extracted the data from each study meeting the criteria, using standardized forms designed to synthesize the results. A third investigator (HH) was consulted in case of discrepancies. The following data were extracted: Author, Year of publication and study, Country/continent, Type of study, Type of interventions, and Main results (**Table 1**).

### 2.3. Data Collection and Analysis

We used the technique based on narrative synthesis, according to Petticrew and Roberts, to categorize studies according to different interventions and innovative actions in malaria control (**Table 1**) [9].

### 2.4. Determining Document Quality and Risk of Bias

Determination of document quality was borrowed from the National Health Service (NHS) criteria of Dixon-Woods *et al.* (**Table 2**) [10]. Risk of bias was assessed using the ROBINS-I risk-of-bias assessment tool (**Table 3**) [11]. This identified the strengths and weaknesses of the studies, as well as implications for the review's conclusions and recommendations.

## 3. Results

Finally, 41 studies were assessed for their methodological merits and included in the analysis. A flow chart illustrating the selection process is presented below (**Figure 1**).

### 3.1. Descriptive Results of Eligible Studies

At the end of this research, we observed seven good practices (**Table 1**):

- LLINs, observed in 3 studies in Rwanda, Congo and Benin. The studies by Kabera *et al.* reported a 71% reduction in malaria cases [12]. While Accrombessi *et al.* found a 66% reduction in the entomological inoculation rate [14]. This result is attributed to the high coverage of LLINs in the area, and their protective effect in reducing the number of new infections.
- SMC, identified in 4 studies in Mali, Ghana, Uganda and Sudan. Boyce *et al.* observed a 53.4% reduction in the incidence of malaria [30]. This result is similar to that of Molina-de la Fuente *et al.*, who reported a 53% reduction [33]. As for Issiaka *et al.* and Adjei *et al.*, a 66% reduction in morbidity and mortality was observed [31] [32].
- MDA found in 2 studies in Cambodia, Eswatini. The studies by Tripura *et al.* observed no clinical cases of malaria after MDA [38]. Vilakati *et al.* reported a

74% reduction in the incidence of malaria [39]. These results suggest that MDA has had a significant impact on malaria transmission in these regions.

- IPT, observed in 5 studies in Ghana, Cameroon, Malawi, Uganda and Tanzania. These studies reported a treatment efficacy of 95% [28] [29], and a reduction in low birth weight [25] [27].
- RDT, identified in 1 study in India, with a sensitivity of 49.9% and a specificity of 90.4% [40].
- Antimalarial treatments, found in 5 studies. The results of these studies are similar in the treatment group for uncomplicated malaria, with 98% efficacy [41]-[43], and in the severe malaria group, where the cure rate is over 98% [47] [48].
- Combining interventions, identified in 5 studies in Ghana, Uganda, Namibia Thailand and Mozambique. The outcomes of these combinations varied by region, but led to a reduction of malaria incidence ranging from 38% to 75% [18]-[22].

## 3.2. Quality Assessment Results

A total of twenty-seven (27) studies obtained a score of 5/5, nine (9) a score of 4/5 and five (5) a score of 3/5 (**Table 2**).

Nineteen (19) studies had a high risk of bias, seven (7) had a moderate risk and fifteen (15) had a low risk (**Table 3**).

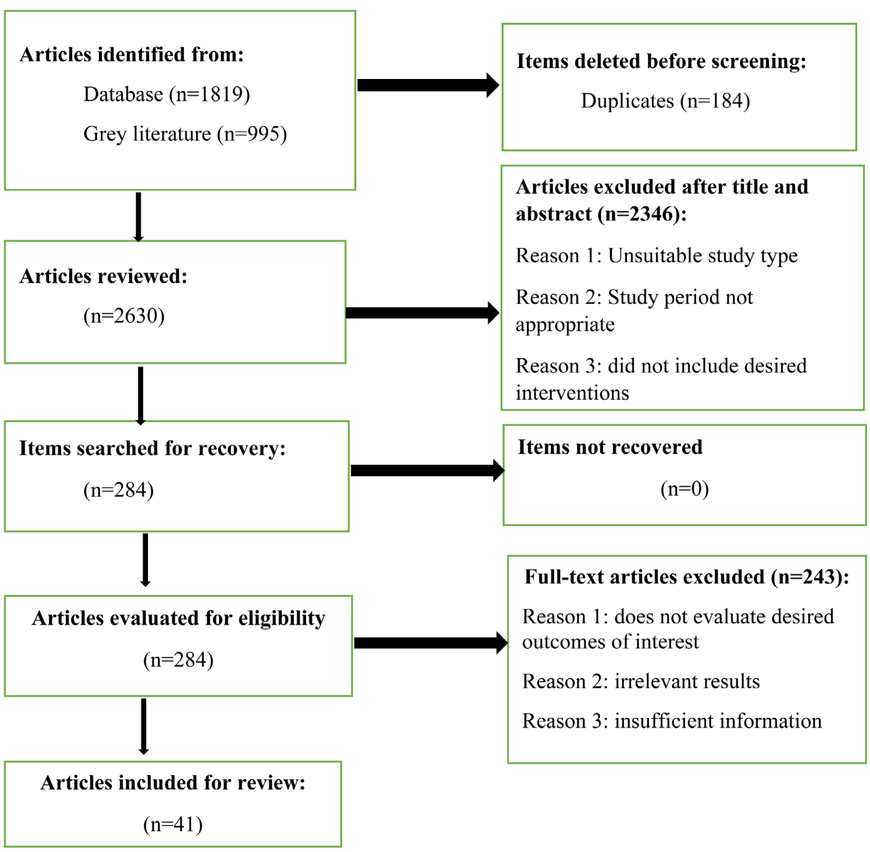


**Figure 1.** Flow chart for the identification and selection of articles included in this review.

**Table 1.** Summary of selected reviews.

| Authors | Year of publication | Year of study | Country/Continent | Type of study | Intervention methods | Main results |
|---|---|---|---|---|---|---|
| Kabera *et al.* [12] | 2023 | 2020 | Rwanda (Africa) | Quantitative study | Long-lasting insecticidal nets (LLINs) | Overall average reduction in malaria cases of 71%, with malaria incidence below 53% for individuals of all ages in the intervention zone. 66% reduction in entomological inoculation rate |
| Kabeya *et al.* [13] | 2023 | 2018-2019 | Congo (Africa) | | | |
| Accrombessi *et al.* [14] | 2023 | 2019-2020 | Benin (Africa) | | | |
| Ngufor *et al.* [15] | 2020 | 2016-2017 | Benin (Africa) | Quantitative study | Indoor residual spraying (IRS) | Bite rate reduced by 72% to 79% from 0 to 4 months and 4 to 6 months post-intervention in people aged 15 and over. Mosquito mortality rate of up to 46% over 12 months |
| Kané *et al.* [16] | 2020 | 2016 | Mali (Africa) | | | |
| Chaumeau *et al.* [17] | 2022 | 2018-2019 | Myanmar (Asia) | | | |
| Alhassan *et al.* [18] | 2022 | 2016 | Ghana (Africa) | Quantitative study | Combining interventions | Reduction in malaria incidence ranging from 38% to nearly 75% for all ages and for children under 5, following the respective use of LLIN + IRS, focal reactive mass drug administration combined with focal reactive vector control and mass drug administration + IRS |
| Echodu *et al.* [19] | 2023 | 2016-2019 | Ouganda (Africa) | | | |
| Hsiang *et al.* [20] | 2020 | 2017 | Namibie (Africa) | | | |
| von Seidlein*et al.* [21] | 2020 | 2017-2018 | Thaïlande (Asia) | | | |
| Chaccour *et al.* [22] | 2021 | 2016-2018 | Mozambique (Africa) | | | |
| Asale *et al.* [23] | 2019 | 2016-2018 | Ethiopie (Africa) | Quantitative study | Integrated vector control | Average rate of nocturnal infectious bites reduced from 0.010 to 0.001 infectious bites per person.<br>Significant reduction in malaria cases from 1162 to 262 |
| McCan *et al.* [24] | 2021 | 2018 | Malawi (Africa) | | | |
| Ampofo *et al.* [25] | 2023 | 2022 | Ghana (Africa) | Quantitative study | IPTg (in pregnant women) | IPTg significantly influenced whether participants were malaria parasite-negative. The crude probability of low birth weight was 59% lower in women who received 3 doses of IPTg. |
| Apinjoh *et al.* [26] | 2022 | 2019-2020 | Cameroun (Africa) | | | |
| Rubenstein *et al.* [27] | 2022 | 2018-2020 | Malawi (Africa) | | | |
| Wallender *et al.* [28] | 2021 | 2014-2017 | Ouganda (Africa) | Quantitative study | IPT in children | Protective effect of 20% in schoolchildren after 12 months of intervention and protective efficacy of 95% every 4 weeks after administration in newborns. |
| Makenga *et al.* [29] | 2023 | 2019 | Tanzanie (Africa) | | | |
| Boyce *et al.* [30] | 2022 | 2018 | Ouganda (Africa) | Quantitative study | SMC | 53% average reduction in the incidence of uncomplicated malaria, with an 84% average reduction in the incidence of severe malaria and a 66% reduction in all-cause mortality after SMC |
| Issiaka *et al.* [31] | 2020 | 2017 | Mali (Africa) | | | |
| Adjei *et al.* [32] | 2022 | 2018-2019 | Ghana (Africa) | | | |
| Molina-de la Fuente *et al.* [33] | 2023 | 2019 | Soudan (Africa) | | | |
| Selvaraj *et al.* [34] | 2020 | 2019 | Burkina Faso (Africa) | Quantitative study | Gene drive | Genetic forcing technology could kill genetically modified mosquitoes before they become established and hinder their development |
| Hoermann *et al.* [35] | 2022 | 2021 | America | | | |
| Agius *et al.* [36] | 2023 | 2016 | Myanmar (Asia) | Quantitative study | Repellents (topical and spatial) | Spatial repellent has a 40.9% protective effect against all infections, and topical repellents have a 33% protective effect against PCR-detectable P. falciparum infections. |
| Syafruddin *et al.* [37] | 2020 | 2016-2018 | Indonésie (Asia) | | | |
| Tripura *et al.* [38] | 2018 | 2017 | Cambodge (Asia) | Quantitative study | Mass drug administration (MDA) | Reduction in the incidence of malaria by up to 74% among the population of the intervention regions, all ages combined. |
| Vilakati *et al.* [39] | 2021 | 2017 | Eswatini (Africa) | | | |
| Shankar *et al.* [40] | 2021 | 2017 | Inde (Asia) | Quantitative study | Rapid diagnostic test (RDT) | RDT showed a sensitivity of 49.9% and a specificity of 90.4%. RDT performance (AUC: 0.65 vs. 0.74; p = 0.001). |
| van der Pluijm *et al.* [41] | 2020 | 2015-2018 | Cambodge, Thaïlande, Vietnam, Myanmar (Asia) | Quantitative study | Treatment of uncomplicated malaria (ACT) | High cure rate estimated at 100% in participants of all ages, with overall efficacy of 98% for artemether-lumefantrine plus amodiaquine in individuals aged 2 to 65. |
| Msellem *et al.* [42] | 2020 | 2017 | Zanzibar (Asia) | | | |
| Moriarty *et al.* [43] | 2020 | 2017-2018 | Congo (Africa) | | | |
| Zhao *et al.* [44] | 2021 | 2019 | Sierra leone (Africa) | Quantitative study | Genetic and entomological monitoring | Monitoring is crucial for identifying vectors infected with malaria parasites, providing new knowledge about the spread of these resistant strains, and determining the various genetic mutations of these parasites. |
| Jacob *et al.* [45] | 2021 | 2020 | Grand Mékong en Chine (Asia) | | | |
| Wolie *et al.* [46] | 2022 | 2016 | Côte d'Ivoire (Africa) | | | |
| Green *et al.* [47] | 2023 | 2018 | Zambie (Africa) | Quantitative study | Treatment of severe malaria with intravenous or rectal artesunate | Reduction in severe malaria from 6.2% to 0.6% after treatment with rectal artesunate in children under 5 years of age. All patients treated with intravenous artesunate 98.2% survived; all deaths were attributed to complications of severe malaria. |
| Abanyie *et al.* [48] | 2021 | 2019-2020 | USA (America) | | | |

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|---|---|---|---|---|---|---|
| Samuels *et al.* [49] | 2022 | 2017-2018 | Ghana et Kenya (Africa) | Quantitative study | RTS, S/AS01 | Protective efficacy of up to 68% after 3 doses of RTS, S, but decreases over time: 68% to 55% over the first 12 months in children aged 5 to 17 months. |
| Asante *et al.* [50] | 2024 | 2021 | Malawi (Africa) | | | |
| Stanton *et al.* [51] | 2021 | 2018-2020 | Malawi (Africa) | Quantitative study | Using drones | The use of drones is effective for precise surveillance, assessing habitat suitability for larvae and/or adult mosquitoes, and implementing interventions. |
| Datoo *et al.* [52] | 2021 | 2019 | Burkina Faso (Africa) | Quantitative study | R21 in Matrix-M adjuvant (phase 2b trial) | Vaccine efficacy was 74% (95% CI 63-82) in group 1 and 77% (67 - 84) in group 2 at 6 months, and 77% (67- 84) in group 1 at 1 year. |

**Table 2.** Quality evaluation results.

| Authors | Scores by domain | | | | | Total |
|---|---|---|---|---|---|---|
| | Are the aims and objectives of the research clearly stated? | Is the research plan clearly specified and adapted to the research goals and objectives? | Do the researchers provide a clear account of the process by which their results were reproduced? | Do the researchers present sufficient data to support their interpretations and conclusions? | Is the analysis method appropriate and sufficiently explained? | |
| Kabera *et al.* | 1 | 1 | 0 | 1 | 0 | 3 |
| Kabeya *et al.* | 1 | 1 | 0 | 1 | 0 | 3 |
| Accrombessi *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Ngufor *et al.* | 1 | 1 | 1 | 1 | 0 | 4 |
| Kané *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Chaumeau *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Alhassan *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Echodu *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Hsiang *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| von Seidlein*et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Chaccour *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Asale *et al.* | 1 | 1 | 1 | 1 | 0 | 4 |
| McCan *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Ampofo *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Apinjoh *et al.* | 1 | 1 | 1 | 0 | 1 | 4 |
| Rubenstein *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Wallender *et al.* | 1 | 1 | 1 | 1 | 0 | 4 |
| Makenga *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Boyce *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Issiaka *et al.* | 1 | 1 | 0 | 1 | 0 | 3 |
| Adjei *et al.* | 1 | 1 | 1 | 0 | 0 | 3 |
| Molina-de la Fuente *et al.* | 1 | 1 | 1 | 1 | 0 | 4 |
| Selvaraj *et al.* | 1 | 1 | 1 | 1 | 0 | 4 |
| Hoermann *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Agius *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Syafruddin *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Tripura *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Vilakati *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Shankar *et al.* | 1 | 1 | 1 | 1 | 0 | 4 |
| van der Pluijm *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Msellem *et al.* | 1 | 1 | 1 | 1 | 0 | 4 |

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| | | | | | | |
|---|---|---|---|---|---|---|
| Moriarty *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Zhao *et al.* | 1 | 1 | 0 | 1 | 0 | 3 |
| Jacob *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Wolie *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Green *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Abanyie *et al.* | 1 | 1 | 1 | 1 | 0 | 4 |
| Samuels *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Asante *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Stanton *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |
| Datoo *et al.* | 1 | 1 | 1 | 1 | 1 | 5 |

**Table 3.** Results of risk of bias assessment.

| Study | D1 | D2 | D3 | D4 | D5 | D6 | D7 | Overall bias |
|---|---|---|---|---|---|---|---|---|
| Kabera *et al.*, 2023 | Moderate | Moderate | Low | Moderate | Low | Serious | Moderate | Serious |
| Kabeya *et al.*, 2023 | Moderate | Moderate | Low | Low | Moderate | Serious | Moderate | Serious |
| Accrombessi *et al.*,2023 | Low | Moderate | Low | Low | Low | Low | Low | Low |
| Ngufor *et al.*, 2020 | Moderate | Low | Low | Low | Low | Moderate | Moderate | Serious |
| Kané *et al.*, 2020 | Moderate | Moderate | Low | Moderate | Low | Serious | Low | Serious |
| Chaumeau *et al.*, 2022 | Low | Low | Low | Low | Low | Moderate | Moderate | Moderate |
| Alhassan *et al.*, 2022 | Moderate | Moderate | Low | Low | Low | Serious | Moderate | Serious |
| Echodu *et al.*, 2023 | Moderate | Moderate | Low | Low | Low | Low | Low | Moderate |
| Hsiang *et al.*, 2020 | Low | Moderate | Low | Low | Low | Low | Low | Low |
| von Seidlein*et al.*, 2020 | Low | Moderate | Low | Low | Low | Moderate | Low | Moderate |
| Chaccour *et al.*, 2021 | Low | Moderate | Low | Low | Low | Moderate | Low | Moderate |
| Asale *et al.*, 2019 | Moderate | Moderate | Low | Low | Low | Serious | Moderate | Serious |
| McCan *et al.*, 2021 | Low | Moderate | Low | Low | Low | Low | Low | Low |
| Ampofo *et al.*, 2023 | Moderate | Moderate | Low | Low | Low | Serious | Moderate | Serious |
| Apinjoh *et al.*, 2022 | Moderate | Moderate | Low | Low | Low | Moderate | Moderate | Serious |
| Rubenstein *et al.*, 2022 | Low | Moderate | Low | Low | Low | Moderate | Low | Moderate |
| Wallender *et al.*, 2017 | Low | Low | Low | Low | Low | Moderate | Low | Low |
| Makenga *et al.*, 2023 | Low | Low | Low | Low | Low | Low | Low | Low |
| Boyce *et al.*, 2022 | Moderate | Moderate | Low | Low | Low | Serious | Moderate | Serious |
| Issiaka *et al.*, 2020 | Moderate | Moderate | Moderate | Low | Low | Serious | Low | Serious |
| Adjei *et al.*, 2022 | Moderate | Moderate | Low | Low | Low | Serious | Moderate | Serious |
| Molina-de la Fuente *et al.*, 2023 | Moderate | Moderate | Low | Low | Low | Serious | Moderate | Serious |
| Selvaraj *et al.*, 2020 | Moderate | Moderate | Low | Low | Low | Low | Low | Moderate |
| Hoermann *et al.*, 2022 | Low | Low | Low | Moderate | Low | Low | Low | Low |
| Agius *et al.*, 2020 | Low | Low | Low | Low | Low | Moderate | Low | Low |
| Syafruddin *et al.*, 2020 | Low | Moderate | Low | Low | Low | Low | Low | Low |
| Tripura *et al.*, 2018 | Low | Low | Low | Low | Low | Moderate | Low | Low |
| Vilakati *et al.*, 2021 | Low | Low | Low | Low | Low | Moderate | Moderate | Moderate |
| Shankar *et al.*, 2021 | Moderate | Moderate | Low | Low | Low | Serious | Moderate | Serious |
| van der Pluijm *et al.*, 2020 | Low | Low | Low | Low | Low | Low | Moderate | Low |
| Msellem *et al.*, 2020 | Moderate | Low | Low | Low | Low | Low | Low | Low |

Continued

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Moriarty *et al.*, 2021 | Low | Low | Low | Low | Low | Low | Moderate | Low |
| Zhao *et al.*, 2021 | Moderate | Moderate | Low | Low | Low | Serious | Moderate | Serious |
| Jacob *et al.*, 2021 | Moderate | Moderate | Low | Low | Low | Serious | Moderate | Serious |
| Wolie *et al.*, 2022 | Moderate | Moderate | Low | Low | Low | Serious | Moderate | Serious |
| Green *et al.*, 2023 | Moderate | Moderate | Low | Moderate | Low | Serious | Moderate | Serious |
| Abanyie *et al.*, 2021 | Moderate | Moderate | Low | Low | Low | Serious | Low | Serious |
| Samuels *et al.*, 2022 | Low | Low | Low | Low | Low | Moderate | Low | Low |
| Asante *et al.*, 2024 | Low | Low | Low | Low | Low | Low | Moderate | Low |
| Stanton *et al.*, 2021 | Moderate | NI | Moderate | Moderate | Low | NI | Moderate | Serious |
| Datoo *et al.*, 2021 | Low | Low | Low | Low | Low | Low | Low | Low |

## 4. Discussion

This review identified seven (7) best practices in malaria control: LLINs, SMC, mass drug administration, IPT, rapid diagnostic testing, antimalarial treatments, and combined interventions. We have also observed other practices and perspectives that can play a crucial role in this fight. In this section, we will examine the impact of each of these interventions, identify their limitations and propose solutions to optimize their effectiveness.

**The use of long-lasting insecticide-treated mosquito nets (LLINs):** This is one of the most effective interventions in the fight against malaria. Kamau *et al.* (2022) and Barker *et al.* (2023) respectively reported a significant protective effect of 47% and a 53% reduction in the incidence of malaria cases after intervention in the population [53] [54]. This could be explained by the fact that LLINs kill or repel mosquitoes, preventing the bites of malaria-vector mosquitoes and reducing the density of mosquito populations. However, their limited lifespan (3 to 5 years), inadequate coverage in inaccessible areas and the emergence of insecticide resistance in mosquitoes hamper their effectiveness [13] [55]. It is therefore necessary to continue investing in research on new-generation LLINs, and to improve supply chains by using, for example, drones or partnerships with local organizations.

**Mass drug administration (MDA):** This shows very promising results in the fight against malaria. Li *et al.* demonstrated the effectiveness of this strategy in their study, reporting an 87.2% reduction in parasitaemia and an 89% reduction in malaria cases in the community after the campaign [56]. This success could be explained by the fact that MDA promotes a rapid reduction in parasite load and provides post-treatment protection through the prophylactic effect of drugs like dihydroartemisinin-piperaquine. Schneider *et al.* (2024), in turn, observed that MDA is only effective between 1 and 3 months after intervention, with a 39% reduction in the incidence of parasitaemia, and little or ineffective beyond the fourth month [57]. This could be attributed to the emergence of drug resistance hindering its efficacy, and to incomplete coverage leading to retransmission of parasites through untreated people. To address these challenges, it is essential to strengthen epidemiological and resistance monitoring, and to alternate drugs to reduce resistance.

**Seasonal malaria chemoprevention (SMC):** SMC has played a major role in malaria control. Cairns *et al*. (2021) and Manga *et al*. (2022) observed a protective efficacy of SPC against malaria of 88% and 89% respectively [58] [59]. However, this strategy is limited by drug resistance, incomplete coverage, and logistical and financial challenges that hinder enrolment and follow-up due to logistical and financial constraints. To overcome these obstacles, it is essential to step up awareness campaigns, optimize distribution logistics to ensure that targeted children receive treatment on time, and strengthen the resistance monitoring system.

**Intermittent preventive treatment of malaria (IPT):** This has played a major role in the control of malaria in pregnant women (IPTg), infants (IPTIn) and children (IPTs). Kamau *et al.* (2022) found that IPTg was associated with a 21% reduction in stillbirths [60]. Similarly, Maiga *et al.* (2022) found a 67% and 55% reduction in the risk of P. falciparum infection after two cycles of full treatment with sulfadoxine-pyrimethamine or amodiaquine plus artesunate in schoolchildren aged 6 to 13 [61]. Indeed, IPTs prevent symptomatic infection by killing parasites as soon as they are introduced into the organism, reinforcing its protection against the disease. However, their effectiveness is limited by drug resistance, incomplete coverage, poor adherence to treatment, as well as financial and logistical constraints. There is a need to reinforce resistance monitoring, step up awareness campaigns, strengthen supply chains to ensure regular distribution, and encourage research into new therapeutic molecules.

**Rapid Diagnostic Test (RDT**): It has played a crucial role in the fight against malaria by rapidly detecting the presence of Plasmodium infection without laboratory equipment, reducing unnecessary treatment. Ruizendaal *et al.* (2017) in Burkina Faso observed a sensitivity of 81.5% and a specificity of 92.1% achievable by community health workers [62]. However, RDT is limited by its lack of accuracy for certain Plasmodium species (vivax) and low-parasitemia infection. It is crucial to develop multi-antigen RDTs to improve its accuracy.

**Antimalarial treatments:** artemisinin-based combination therapy (ACT) and artesunate have played a major role in reducing the burden and transmission of malaria. The results of Shibeshi *et al.* (2021) testify to the efficacy of ACT, with overall cure rates ranging from 92.2% to 97.4% between days 28 and 63 post-intervention in pregnant women [63]. Byakika-Kibwika *et al.* (2018) found that intravenous artesunate required an average of 2 days for complete parasite elimination in children [64]. However, artemisinin drug resistance, non-compliance with treatment and limited access due to high costs hamper its effectiveness. It is crucial to strengthen resistance monitoring, increase access to drugs and explore new treatment prospects.

**Combining interventions:** This approach has shown favorable results in the fight against malaria. The study by Gari *et al*. (2024) revealed a 37% reduction in the incidence rate following the combination of ITN+IDP within households [65]. Similarly Camponovo *et al*. (2019) revealed a possibility of malaria elimination in a simulation on the combination of RTS, S vaccine and MDA [66]. Indeed, this strategy makes it possible to integrate the individual advantages of each intervention while overcoming their individual weaknesses. However, this strategy is limited by the resistance provoked by this combination and the extremely high cost of its implementation. It is therefore necessary to optimize resources by targeting interventions in high-risk regions and periods.

**Other interventions:**

**Integrated Vector Management (IVM):** IVM, through IRS, has played a favorable role in vector control and the control of mosquito populations [23]. This strategy has been implemented in several countries. According to Zhou *et al.* (2022), IRS is associated with lower rates of malaria infection (OR = 0.35, 95% CI: 0.27 - 0.44) [67]. Similarly, Tiedje *et al.*(2022) observed a more than 90% reduction in the monthly rate of entomological inoculation after IRS in participants of all ages [68]. This is because IRS rapidly eliminates infected mosquitoes before they can bite, thereby reducing the risk to individuals. However, this intervention has been abandoned in some African countries due to its extremely costly implementation, the emergence of resistance due to its continuous use, the side effects (respiratory ailments, neurological disorders and developmental delays in infants), as well as its negative impact on the environment after intensive use [69] [70]. The use of drones for malaria surveillance and malaria vector management can reduce costs and strengthen this intervention [49]. Research into new insecticide compounds can also reinforce this strategy.

**The RTS, S vaccine:** This is a new vaccine that has been introduced and has shown favorable results in the fight against malaria. The study by Cairns *et al.* (2022) observed an overall protective efficacy of at least 60% over 6 months in children under 5 years of age after the primary series and the two seasonal booster doses. However, efficacy seems to diminish rapidly beyond 6 months of intervention [71]. This could be explained by the fact that the vaccine exerts a certain selective pressure on the parasite, which can lead to mutations, thus affecting its efficacy. Another reason could be that the vaccine is only effective against clinical malaria (P. falciparum). To maximize its impact, it is necessary to combine it with other antimalarial interventions, and to encourage the development and improvement of antimalarial vaccine formulations.

**Other prospects in the fight against malaria:** Gene drive technology, which modifies the gene in mosquitoes to make them incapable of transmitting the plasmodium parasite, also has enormous potential for reducing disease transmission [37] [38]. Burkina Faso, Mali and Uganda are pioneers in the application of gene drive against malaria mosquito vectors through the Target Malaria project [72]. However, its implementation raises ethical, ecological and social issues. Gene drive is a technology with irreversible effects that requires in-depth studies before implementation, as its introduction could be uncontrollable. Its application raises major questions, particularly about public acceptance and the way in which it will be regulated at international level. Furthermore, it is impossible to predict with certainty whether these mosquitoes will not lead to involuntary mutations that could disrupt the ecosystem, with unforeseen consequences for biodiversity. Finally, this technology may give rise to reticence and concern among certain populations because of cultural, religious or historical beliefs [34].

The R21/Matrix-M vaccine also represents a major advance in the fight against malaria, having demonstrated efficacy of over 75% against malaria [52]. Its implementation may give rise to concern and reluctance among certain populations, influenced by their cultural and religious beliefs. In addition, the introduction of the vaccine may modify the ecology of the plasmodium parasite and lead to resistance [52] [73].

Compared with the systematic reviews by Loeffel *et al.*(2022) and Kim *et al.* (2021) analyzing the impact and effectiveness of malaria interventions [74] [75], This review highlights the impact and importance of these strategies for endemic countries. It emphasizes that most interventions target children under the age of 5, pregnant women and the general population regardless of age. A combination of these interventions can have a significant impact. However, this requires, on the economic level, sufficient and sustainable financial availability to carry out these interventions; active involvement of the local community on the social level to carry out the activities; on the political level, strong political commitment to regulate and support malaria control programmes; and on the environmental level, continuous environmental monitoring to combat resistance.

## 5. Study Limitations

The majority of the studies included are observational, favoring the existence of publication bias, limiting the ability to draw more generalizable conclusions. This underlines the importance of carrying out a meta-analysis to obtain more generalizable results.

## 6. Conclusion

The present study has enabled us to identify and analyze interventions likely to be effective in eliminating malaria. These insights will enable researchers, programme managers, policy-makers and administrators to identify best practices for malaria elimination, with the aim of optimizing the use of available resources.

## Authors' Contributions

All authors cited in this article contributed to the realization of this study and to the drafting of the manuscript.

## Availability of Data and Equipment

All data is accessible to the public. They can be consulted via databases (PubMed, Cochrane, Global index Medicus, Google scholar and Hinari).

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## Conflicts of Interest

The authors declare no conflict of interest.

## References

[1] WHO (2025) Rapport 2024 sur le paludisme dans le monde: Principaux messages 2024. https://cdn.who.int/media/docs/default-source/malaria/world-malaria-reports/world-malaria-report-2024-global-briefing-kit-fre.pdf?sfvrsn=affbbec7_6&download=true

[2] Palu, S. (2024) Fonds Mondial Evaluation des obstacles liés aux communautés, aux droits humains et au genre dans la lutte contre le paludisme à l'aide de Malaria Matchbox Tool au Burkina Faso 2024.

[3] WHO (2024) Rapport 2024 sur le paludisme dans le monde: Données & tendances régionales 2024. https://cdn.who.int/media/docs/default-source/malaria/world-malaria-reports/world-malaria-report-2024-regional-briefing-kit-fre.pdf?sfvrsn=bceac4ae_9&download=true

[4] Bhatt, S. and Weiss, D.J. (2015) L'effet de la lutte antipaludique sur *Plasmodium falciparum* en Afrique entre 2000 et 2015.

[5] Cairns, M.E., Sagara, I., Zongo, I., Kuepfer, I., Thera, I., Nikiema, F., *et al.* (2020) Evaluation of Seasonal Malaria Chemoprevention in Two Areas of Intense Seasonal Malaria Transmission: Secondary Analysis of a Household-Randomised, Placebo-Controlled Trial in Houndé District, Burkina Faso and Bougouni District, Mali. *PLOS Medicine*, **17**, e1003214. https://doi.org/10.1371/journal.pmed.1003214

[6] Cohen, J.M., Smith, D.L., Cotter, C., Ward, A., Yamey, G., Sabot, O.J., *et al.* (2012) Malaria Resurgence: A Systematic Review and Assessment of Its Causes. *Malaria Journal*, **11**, Article No. 122. https://doi.org/10.1186/1475-2875-11-122

[7] Hutton, B., Salanti, G., Caldwell, D.M., Chaimani, A., Schmid, C.H., Cameron, C., *et al.* (2015) The PRISMA Extension Statement for Reporting of Systematic Reviews Incorporating Network Meta-Analyses of Health Care Interventions: Checklist and Explanations. *Annals of Internal Medicine*, **162**, 777-784. https://doi.org/10.7326/m14-2385

[8] Saaiq, M. and Ashraf, B. (2017) Modifying "Pico" Question into "Picos" Model for More Robust and Reproducible Presentation of the Methodology Employed in A Scientific Study. *World Journal of Plastic Surgery*, **6**, 390-392.

[9] Petticrew, M. and Roberts, H. (2006) Systematic Reviews in the Social Sciences. Wiley. https://doi.org/10.1002/9780470754887

[10] Dixon-Woods, M., Cavers, D., Agarwal, S., Annandale, E., Arthur, A., Harvey, J., *et al.* (2006) Conducting a Critical Interpretive Synthesis of the Literature on Access to Healthcare by Vulnerable Groups. *BMC Medical Research Methodology*, **6**, Article No. 35. https://doi.org/10.1186/1471-2288-6-35

[11] Sterne, J.A., Hernán, M.A., Reeves, B.C., Savović, J., Berkman, N.D., Viswanathan, M., *et al.* (2016) ROBINS-I: A Tool for Assessing Risk of Bias in Non-Randomised Studies of Interventions. *BMJ*, **355**, i4919. https://doi.org/10.1136/bmj.i4919

[12] Kabera, M., Mangala, J.N., Soebiyanto, R., Mukarugwiro, B., Munguti, K., Mbituyumuremyi, A., *et al.* (2023) Impact of Pyrethroid Plus Piperonyl Butoxide Synergist-Treated Nets on Malaria Incidence 24 Months after a National Distribution Campaign in Rwanda. *The American Journal of Tropical Medicine and Hygiene*, **109**,

1356-1362. https://doi.org/10.4269/ajtmh.23-0317

[13] Kabeya, T.K., Musasa Kasongo, J.C., Matumba, N.B., Tshibangu, D.I., Garcia-Morzon, L.A. and Burgueno, E. (2023) Impact of Mass Distribution of Long-Lasting Insecticide Nets on the Incidence of Malaria in Lomami, Democratic Republic of Congo (DRC): A Study Based on Electronic Health Record Data (2018-2019). *Pan African Medical Journal*, **45**, Article 89. https://doi.org/10.11604/pamj.2023.45.89.33099

[14] Accrombessi, M., Cook, J., Dangbenon, E., Yovogan, B., Akpovi, H., Sovi, A., *et al*. (2023) Efficacy of Pyriproxyfen-Pyrethroid Long-Lasting Insecticidal Nets (LLINS) and Chlorfenapyr-Pyrethroid LLINS Compared with Pyrethroid-Only Llins for Malaria Control in Benin: A Cluster-Randomised, Superiority Trial. *The Lancet*, **401**, 435-446. https://doi.org/10.1016/s0140-6736(22)02319-4

[15] Ngufor, C., Fongnikin, A., Hobbs, N., Gbegbo, M., Kiki, L., Odjo, A., *et al*. (2020) Indoor Spraying with Chlorfenapyr (A Pyrrole Insecticide) Provides Residual Control of Pyrethroid-Resistant Malaria Vectors in Southern Benin. *Malaria Journal*, **19**, Article No. 249. https://doi.org/10.1186/s12936-020-03325-2

[16] Kané, F., Keïta, M., Traoré, B., Diawara, S.I., Bane, S., Diarra, S., *et al*. (2020) Performance of IRS on Malaria Prevalence and Incidence Using Pirimiphos-Methyl in the Context of Pyrethroid Resistance in Koulikoro Region, Mali. *Malaria Journal*, **19**, Article No. 286. https://doi.org/10.1186/s12936-020-03357-8

[17] Chaumeau, V., Kajeechiwa, L., Kulabkeeree, T., Sawasdichai, S., Haohankhunnatham, W., Inta, A., *et al*. (2022) Outdoor Residual Spraying for Malaria Vector-Control in Kayin (Karen) State, Myanmar: A Cluster Randomized Controlled Trial. *PLOS ONE*, **17**, e0274320. https://doi.org/10.1371/journal.pone.0274320

[18] Alhassan, Y., Dwomoh, D., Amuasi, S.A., Nonvignon, J., Bonful, H., Tetteh, M., *et al*. (2022) Impact of Insecticide-Treated Nets and Indoor Residual Spraying on Self-Reported Malaria Prevalence among Women of Reproductive Age in Ghana: Implication for Malaria Control and Elimination. *Malaria Journal*, **21**, Article No. 120. https://doi.org/10.1186/s12936-022-04136-3

[19] Echodu, D.C., Yeka, A., Eganyu, T., Odude, W., Bukenya, F., Amoah, B., *et al*. (2023) Impact of Population Based Indoor Residual Spraying with and without Mass Drug Administration with Dihydroartemisinin-Piperaquine on Malaria Prevalence in a High Transmission Setting: A Quasi-Experimental Controlled before-and-after Trial in Northeastern Uganda. *BMC Infectious Diseases*, **23**, Article No. 72. https://doi.org/10.1186/s12879-023-07991-w

[20] Hsiang, M.S., Ntuku, H., Roberts, K.W., Dufour, M.K., Whittemore, B., Tambo, M., *et al*. (2020) Effectiveness of Reactive Focal Mass Drug Administration and Reactive Focal Vector Control to Reduce Malaria Transmission in the Low Malaria-Endemic Setting of Namibia: A Cluster-Randomised Controlled, Open-Label, Two-by-Two Factorial Design Trial. *The Lancet*, **395**, 1361-1373. https://doi.org/10.1016/s0140-6736(20)30470-0

[21] von Seidlein, L., Hanboonkunupakarn, B., Jittamala, P., Pongsuwan, P., Chotivanich, K., Tarning, J., *et al*. (2019) Combining Antimalarial Drugs and Vaccine for Malaria Elimination Campaigns: A Randomized Safety and Immunogenicity Trial of RTS,S/AS01 Administered with Dihydroartemisinin, Piperaquine, and Primaquine in Healthy Thai Adult Volunteers. *Human Vaccines & Immunotherapeutics*, **16**, 33-41. https://doi.org/10.1080/21645515.2019.1643675

[22] Chaccour, C., Zulliger, R., Wagman, J., Casellas, A., Nacima, A., Elobolobo, E., *et al*. (2021) Incremental Impact on Malaria Incidence Following Indoor Residual Spraying in a Highly Endemic Area with High Standard ITN Access in Mozambique: Re-

sults from a Cluster-Randomized Study. *Malaria Journal*, **20**, Article No. 84. https://doi.org/10.1186/s12936-021-03611-7

[23] Asale, A., Kussa, D., Girma, M., Mbogo, C. and Mutero, C.M. (2019) Community Based Integrated Vector Management for Malaria Control: Lessons from Three Years' Experience (2016-2018) in Botor-Tolay District, Southwestern Ethiopia. *BMC Public Health*, **19**, Article No. 1318. https://doi.org/10.1186/s12889-019-7606-3

[24] McCann, R.S., Kabaghe, A.N., Moraga, P., Gowelo, S., Mburu, M.M., Tizifa, T., *et al.* (2021) The Effect of Community-Driven Larval Source Management and House Improvement on Malaria Transmission When Added to the Standard Malaria Control Strategies in Malawi: A Cluster-Randomized Controlled Trial. *Malaria Journal*, **20**, Article No. 232. https://doi.org/10.1186/s12936-021-03769-0

[25] Ampofo, G.D., Ahiakpa, A.K. and Osarfo, J. (2023) Interventions for Malaria Prevention in Pregnancy; Factors Influencing Uptake and Their Effect on Pregnancy Outcomes among Post-Natal Women in a Tertiary Facility in the Volta Region of Ghana. *SAGE Open Medicine*, **11**, 1-11. https://doi.org/10.1177/20503121231199653

[26] Apinjoh, T.O., Ntui, V.N., Chi, H.F., Moyeh, M.N., Toussi, C.T., Mayaba, J.M., *et al.* (2022) Intermittent Preventive Treatment with Sulphadoxine-Pyrimethamine (IPTp-SP) Is Associated with Protection against Sub-Microscopic *P. Falciparum* Infection in Pregnant Women during the Low Transmission Dry Season in Southwestern Cameroon: A Semi-Longitudinal Study. *PLOS ONE*, **17**, e0275370. https://doi.org/10.1371/journal.pone.0275370

[27] Rubenstein, B.L., Chinkhumba, J., Chilima, E., Kwizombe, C., Malpass, A., Cash, S., *et al.* (2022) A Cluster Randomized Trial of Delivery of Intermittent Preventive Treatment of Malaria in Pregnancy at the Community Level in Malawi. *Malaria Journal*, **21**, Article No. 195. https://doi.org/10.1186/s12936-022-04216-4

[28] Wallender, E., Ali, A.M., Hughes, E., Kakuru, A., Jagannathan, P., Muhindo, M.K., *et al.* (2021) Identifying an Optimal Dihydroartemisinin-Piperaquine Dosing Regimen for Malaria Prevention in Young Ugandan Children. *Nature Communications*, **12**, Article No. 6714. https://doi.org/10.1038/s41467-021-27051-8

[29] Makenga, G., Baraka, V., Francis, F., Nakato, S., Gesase, S., Mtove, G., *et al.* (2023) Effectiveness and Safety of Intermittent Preventive Treatment with Dihydroartemisinin-Piperaquine or Artesunate-Amodiaquine for Reducing Malaria and Related Morbidities in Schoolchildren in Tanzania: A Randomised Controlled Trial. *The Lancet Global Health*, **11**, e1277-e1289. https://doi.org/10.1016/s2214-109x(23)00204-8

[30] Boyce, R.M., Hollingsworth, B.D., Baguma, E., Xu, E., Goel, V., Brown-Marusiak, A., *et al.* (2021) Dihydroartemisinin-Piperaquine Chemoprevention and Malaria Incidence after Severe Flooding: Evaluation of a Pragmatic Intervention in Rural Uganda. *Clinical Infectious Diseases*, **74**, 2191-2199. https://doi.org/10.1093/cid/ciab781

[31] Issiaka, D., Barry, A., Traore, T., Diarra, B., Cook, D., Keita, M., *et al.* (2020) Impact of Seasonal Malaria Chemoprevention on Hospital Admissions and Mortality in Children under 5 Years of Age in Ouelessebougou, Mali. *Malaria Journal*, **19**, Article No. 103. https://doi.org/10.1186/s12936-020-03175-y

[32] Adjei, M.R., Kubio, C., Buamah, M., Sarfo, A., Suuri, T., Ibrahim, S., *et al.* (2022) Effectiveness of Seasonal Malaria Chemoprevention in Reducing Under-Five Malaria Morbidity and Mortality in the Savannah Region, Ghana. *Ghana Medical Journal*, **56**, 64-70. https://doi.org/10.4314/gmj.v56i2.2

[33] Molina-de la Fuente, I., Sagrado Benito, M.J., Lasry, E., Ousley, J., García, L., González, V., *et al.* (2023) Seasonal Malaria Chemoprevention in a Context of High Presumed Sulfadoxine-Pyrimethamine Resistance: Malaria Morbidity and Molecular

Drug Resistance Profiles in South Sudan. *Malaria Journal*, **22**, Article No. 345. https://doi.org/10.1186/s12936-023-04740-x

[34] Selvaraj, P., Wenger, E.A., Bridenbecker, D., Windbichler, N., Russell, J.R., Gerardin, J., *et al.* (2020) Vector Genetics, Insecticide Resistance and Gene Drives: An Agent-Based Modeling Approach to Evaluate Malaria Transmission and Elimination. *PLOS Computational Biology*, **16**, e1008121. https://doi.org/10.1371/journal.pcbi.1008121

[35] Hoermann, A., Habtewold, T., Selvaraj, P., Del Corsano, G., Capriotti, P., Inghilterra, M.G., *et al.* (2022) Gene Drive Mosquitoes Can Aid Malaria Elimination by Retarding *Plasmodium* Sporogonic Development. *Science Advances*, **8**, eabo1733. https://doi.org/10.1126/sciadv.abo1733

[36] Agius, P.A., Cutts, J.C., Han Oo, W., Thi, A., O'Flaherty, K., Zayar Aung, K., *et al.* (2020) Evaluation of the Effectiveness of Topical Repellent Distributed by Village Health Volunteer Networks against *Plasmodium* Spp. Infection in Myanmar: A Stepped-Wedge Cluster Randomised Trial. *PLOS Medicine*, **17**, e1003177. https://doi.org/10.1371/journal.pmed.1003177

[37] Syafruddin, D., Asih, P.B.S., Rozi, I.E., Permana, D.H., Nur Hidayati, A.P., Syahrani, L., *et al.* (2020) Efficacy of a Spatial Repellent for Control of Malaria in Indonesia: A Cluster-Randomized Controlled Trial. *The American Journal of Tropical Medicine and Hygiene*, **103**, 344-358. https://doi.org/10.4269/ajtmh.19-0554

[38] Tripura, R., Peto, T.J., Chea, N., Chan, D., Mukaka, M., Sirithiranont, P., *et al.* (2018) A Controlled Trial of Mass Drug Administration to Interrupt Transmission of Multidrug-Resistant Falciparum Malaria in Cambodian Villages. *Clinical Infectious Diseases*, **67**, 817-826. https://doi.org/10.1093/cid/ciy196

[39] Vilakati, S., Mngadi, N., Benjamin-Chung, J., Dlamini, N., Dufour, M.K., Whittemore, B., *et al.* (2021) Effectiveness and Safety of Reactive Focal Mass Drug Administration (rfMDA) Using Dihydroartemisinin-Piperaquine to Reduce Malaria Transmission in the Very Low-Endemic Setting of Eswatini: A Pragmatic Cluster Randomised Controlled Trial. *BMJ Global Health*, **6**, e005021. https://doi.org/10.1136/bmjgh-2021-005021

[40] Shankar, H., Singh, M.P., Phookan, S., Singh, K. and Mishra, N. (2021) Diagnostic Performance of Rapid Diagnostic Test, Light Microscopy and Polymerase Chain Reaction during Mass Survey Conducted in Low and High Malaria-Endemic Areas from Two North-Eastern States of India. *Parasitology Research*, **120**, 2251-2261. https://doi.org/10.1007/s00436-021-07125-8

[41] van der Pluijm, R.W., Tripura, R., Hoglund, R.M., Pyae Phyo, A., Lek, D., ul Islam, A., *et al.* (2020) Triple Artemisinin-Based Combination Therapies versus Artemisinin-Based Combination Therapies for Uncomplicated *Plasmodium falciparum* Malaria: A Multicentre, Open-Label, Randomised Clinical Trial. *The Lancet*, **395**, 1345-1360. https://doi.org/10.1016/s0140-6736(20)30552-3

[42] Msellem, M., Morris, U., Soe, A., Abbas, F.B., Ali, A., Barnes, R., *et al.* (2020) Increased Sensitivity of *Plasmodium falciparum* to Artesunate/Amodiaquine Despite 14 Years as First-Line Malaria Treatment, Zanzibar. *Emerging Infectious Diseases*, **26**, 1767-1777. https://doi.org/10.3201/eid2608.191547

[43] Moriarty, L.F., Nkoli, P.M., Likwela, J.L., Mulopo, P.M., Sompwe, E.M., Rika, J.M., *et al.* (2021) Therapeutic Efficacy of Artemisinin-Based Combination Therapies in Democratic Republic of the Congo and Investigation of Molecular Markers of Antimalarial Resistance. *The American Journal of Tropical Medicine and Hygiene*, **105**, 1067-1075. https://doi.org/10.4269/ajtmh.21-0214

[44] Zhao, N., Sesay, I., Tu, H., Yamba, F., Lu, L., Guo, Y., *et al.* (2021) Entomological and

Molecular Surveillance of *Anopheles* Mosquitoes in Freetown, Sierra Leone, 2019. *Frontiers in Public Health*, **9**, Article 649672. https://doi.org/10.3389/fpubh.2021.649672

[45] Jacob, C.G., Thuy-Nhien, N., Mayxay, M., Maude, R.J., Quang, H.H., Hongvanthong, B., *et al.* (2021) Genetic Surveillance in the Greater Mekong Subregion and South Asia to Support Malaria Control and Elimination. *eLife*, **10**, e62997. https://doi.org/10.7554/elife.62997

[46] Wolie, R.Z., Koffi, A.A., Ayuk-Taylor, L., Alou, L.P.A., Sternberg, E.D., N'Nan-Alla, O., *et al.* (2022) Entomological Indicators of Malaria Transmission Prior to a Cluster-Randomized Controlled Trial of a 'Lethal House Lure' Intervention in Central Côte D'ivoire. *Malaria Journal*, **21**, Article No. 188. https://doi.org/10.1186/s12936-022-04196-5

[47] Green, C., Quigley, P., Kureya, T., Barber, C., Chanda, E., Moyo, B., *et al.* (2023) Rectal Artesunate for Severe Malaria, Implementation Research, Zambia. *Bulletin of the World Health Organization*, **101**, 371-380A. https://doi.org/10.2471/blt.22.289181

[48] Abanyie, F., Acharya, S.D., Leavy, I., Bowe, M. and Tan, K.R. (2021) Safety and Effectiveness of Intravenous Artesunate for Treatment of Severe Malaria in the United States—April 2019 through December 2020. *Clinical Infectious Diseases*, **73**, 1965-1972. https://doi.org/10.1093/cid/ciab570

[49] Samuels, A.M., Ansong, D., Kariuki, S.K., Adjei, S., Bollaerts, A., Ockenhouse, C., *et al.* (2022) Efficacy of RTS,S/AS01$_E$ Malaria Vaccine Administered According to Different Full, Fractional, and Delayed Third or Early Fourth Dose Regimens in Children Aged 5-17 Months in Ghana and Kenya: An Open-Label, Phase 2B, Randomised Controlled Trial. *The Lancet Infectious Diseases*, **22**, 1329-1342. https://doi.org/10.1016/s1473-3099(22)00273-0

[50] Asante, K.P., Mathanga, D.P., Milligan, P., Akech, S., Oduro, A., Mwapasa, V., *et al.* (2024) Feasibility, Safety, and Impact of the RTS,S/AS01$_E$ Malaria Vaccine When Implemented through National Immunisation Programmes: Evaluation of Cluster-Randomised Introduction of the Vaccine in Ghana, Kenya, and Malawi. *The Lancet*, **403**, 1660-1670. https://doi.org/10.1016/s0140-6736(24)00004-7

[51] Stanton, M.C., Kalonde, P., Zembere, K., Hoek Spaans, R. and Jones, C.M. (2021) The Application of Drones for Mosquito Larval Habitat Identification in Rural Environments: A Practical Approach for Malaria Control? *Malaria Journal*, **20**, Article No. 244. https://doi.org/10.1186/s12936-021-03759-2

[52] Datoo, M.S., Natama, M.H., Somé, A., Traoré, O., Rouamba, T., Bellamy, D., *et al.* (2021) Efficacy of a Low-Dose Candidate Malaria Vaccine, R21 in Adjuvant Matrix-M, with Seasonal Administration to Children in Burkina Faso: A Randomised Controlled Trial. *The Lancet*, **397**, 1809-1818. https://doi.org/10.1016/s0140-6736(21)00943-0

[53] Kamau, A., Musau, M., Mtanje, G., Mataza, C., Bejon, P. and Snow, R.W. (2022) Long-Lasting Insecticide-Treated Net Use and Malaria Infections on the Kenyan Coast. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, **116**, 966-970. https://doi.org/10.1093/trstmh/trac029

[54] Barker, T.H., Stone, J.C., Hasanoff, S., Price, C., Kabaghe, A. and Munn, Z. (2023) Effectiveness of Dual Active Ingredient Insecticide-Treated Nets in Preventing Malaria: A Systematic Review and Meta-Analysis. *PLOS ONE*, **18**, e0289469. https://doi.org/10.1371/journal.pone.0289469

[55] Loha, E., Deressa, W., Gari, T., Balkew, M., Kenea, O., Solomon, T., *et al.* (2019) Long-Lasting Insecticidal Nets and Indoor Residual Spraying May Not Be Sufficient

to Eliminate Malaria in a Low Malaria Incidence Area: Results from a Cluster Randomized Controlled Trial in Ethiopia. *Malaria Journal*, **18**, Article No. 141. https://doi.org/10.1186/s12936-019-2775-1

[56] Li, G., Zheng, S., Zhang, Z., Hu, Y., Lin, N., Julie, N., *et al*. (2023) A Campaign of Mass Drug Administration with Artemisinin-Piperaquine to Antimalaria in Trobriand Islands. *Preventive Medicine Reports*, **32**, Article 102154. https://doi.org/10.1016/j.pmedr.2023.102154

[57] Schneider, Z.D., Shah, M.P., Boily, M.C., Busbee, A.L., Hwang, J., Lindblade, K.A., *et al*. (2024) Mass Drug Administration to Reduce Malaria Transmission: A Systematic Review and Meta-Analysis. *The American Journal of Tropical Medicine and Hygiene*, **110**, 17-29. https://doi.org/10.4269/ajtmh.22-0766

[58] Cairns, M., Ceesay, S.J., Sagara, I., Zongo, I., Kessely, H., Gamougam, K., *et al*. (2021) Effectiveness of Seasonal Malaria Chemoprevention (SMC) Treatments When SMC Is Implemented at Scale: Case-Control Studies in 5 Countries. *PLOS Medicine*, **18**, e1003727. https://doi.org/10.1371/journal.pmed.1003727

[59] Manga, I.A., Tairou, F., Seck, A., Kouevidjin, E., Sylla, K., Sow, D., *et al*. (2022) Effectiveness of Seasonal Malaria Chemoprevention Administered in a Mass Campaign in the Kedougou Region of Senegal in 2016: A Case-Control Study. *Wellcome Open Research*, **7**, Article 216. https://doi.org/10.12688/wellcomeopenres.18057.2

[60] Kamau, A., Musau, M., Mwakio, S., Amadi, D., Nyaguara, A., Bejon, P., *et al*. (2022) Impact of Intermittent Presumptive Treatment for Malaria in Pregnancy on Hospital Birth Outcomes on the Kenyan Coast. *Clinical Infectious Diseases*, **76**, e875-e883. https://doi.org/10.1093/cid/ciac509

[61] Maiga, H., Opondo, C., Chico, R.M., Cohee, L.M., Sagara, I., Traore, O.B., *et al*. (2022) Overall and Gender-Specific Effects of Intermittent Preventive Treatment of Malaria with Artemisinin-Based Combination Therapies among Schoolchildren in Mali: A Three-Group Open Label Randomized Controlled Trial. *The American Journal of Tropical Medicine and Hygiene*, **107**, 796-803. https://doi.org/10.4269/ajtmh.21-1218

[62] Ruizendaal, E., Schallig, H.D.F.H., Scott, S., Traore-Coulibaly, M., Bradley, J., Lompo, P., *et al*. (2017) Evaluation of Malaria Screening during Pregnancy with Rapid Diagnostic Tests Performed by Community Health Workers in Burkina Faso. *The American Journal of Tropical Medicine and Hygiene*, **97**, 1190-1197. https://doi.org/10.4269/ajtmh.17-0138

[63] Shibeshi, W., Baye, A.M., Alemkere, G. and Engidawork, E. (2021) Efficacy and Safety of Artemisinin-Based Combination Therapy for the Treatment of Uncomplicated Malaria in Pregnant Women: A Systematic Review and Meta-Analysis. *Therapeutics and Clinical Risk Management*, **17**, 1353-1370. https://doi.org/10.2147/tcrm.s336771

[64] Byakika-Kibwika, P., Nyakato, P., Lamorde, M. and Kiragga, A.N. (2018) Assessment of Parasite Clearance Following Treatment of Severe Malaria with Intravenous Artesunate in Ugandan Children Enrolled in a Randomized Controlled Clinical Trial. *Malaria Journal*, **17**, Article No. 400. https://doi.org/10.1186/s12936-018-2552-6

[65] Gari, T. and Lindtjørn, B. (2024) Insecticide-Treated Bed Nets and Residual Indoor Spraying Reduce Malaria in Areas with Low Transmission: A Reanalysis of the Mal-trials Study. *Malaria Journal*, **23**, Article No. 67. https://doi.org/10.1186/s12936-024-04894-2

[66] Camponovo, F., Ockenhouse, C.F., Lee, C. and Penny, M.A. (2019) Mass Campaigns Combining Antimalarial Drugs and Anti-Infective Vaccines as Seasonal Interventions for Malaria Control, Elimination and Prevention of Resurgence: A Modelling

Study. *BMC Infectious Diseases*, **19**, Article No. 920. https://doi.org/10.1186/s12879-019-4467-4

[67] Zhou, Y., Zhang, W., Tembo, E., Xie, M., Zhang, S., Wang, X., *et al*. (2022) Effectiveness of Indoor Residual Spraying on Malaria Control: A Systematic Review and Meta-Analysis. *Infectious Diseases of Poverty*, **11**, Article No. 83. https://doi.org/10.1186/s40249-022-01005-8

[68] Tiedje, K.E., Oduro, A.R., Bangre, O., Amenga-Etego, L., Dadzie, S.K., Appawu, M.A., *et al*. (2022) Indoor Residual Spraying with a Non-Pyrethroid Insecticide Reduces the Reservoir of *Plasmodium falciparum* in a High-Transmission Area in Northern Ghana. *PLOS Global Public Health*, **2**, e0000285. https://doi.org/10.1371/journal.pgph.0000285

[69] Osunkentan, A. and Evans, D. (2015) Chronic Adverse Effects of Long-Term Exposure of Children to Dichlorodiphenyltrichloroethane (DDT) through Indoor Residual Spraying: A Systematic Review. *Rural and Remote Health*, **15**, Article 2889. https://doi.org/10.22605/rrh2889

[70] Namuganga, J.F., Epstein, A., Nankabirwa, J.I., Mpimbaza, A., Kiggundu, M., Sserwanga, A., *et al*. (2021) The Impact of Stopping and Starting Indoor Residual Spraying on Malaria Burden in Uganda. *Nature Communications*, **12**, Article No. 2635. https://doi.org/10.1038/s41467-021-22896-5

[71] Cairns, M., Barry, A., Zongo, I., Sagara, I., Yerbanga, S.R., Diarra, M., *et al*. (2022) The Duration of Protection against Clinical Malaria Provided by the Combination of Seasonal RTS,S/AS01$_E$ Vaccination and Seasonal Malaria Chemoprevention versus Either Intervention Given Alone. *BMC Medicine*, **20**, Article No. 352. https://doi.org/10.1186/s12916-022-02536-5

[72] Pare Toe, L., Barry, N., Ky, A.D., Kekele, S., Meda, W., Bayala, K., *et al*. (2021) Small-Scale Release of Non-Gene Drive Mosquitoes in Burkina Faso: From Engagement Implementation to Assessment, a Learning Journey. *Malaria Journal*, **20**, Article No. 395. https://doi.org/10.1186/s12936-021-03929-2

[73] WHO (2023) Conseils actualisés en matière de vaccination: L'OMS recommande le vaccin R21/Matrix-M pour prévenir le paludisme. https://www.who.int/fr/news/item/02-10-2023-who-recommends-r21-matrix-m-vaccine-for-malaria-prevention-in-updated-advice-on-immunization

[74] Loeffel, M. and Ross, A. (2022) The Relative Impact of Interventions on Sympatric *Plasmodium vivax* and *Plasmodium falciparum* Malaria: A Systematic Review. *PLOS Neglected Tropical Diseases*, **16**, e0010541. https://doi.org/10.1371/journal.pntd.0010541

[75] Kim, S., Luande, V.N., Rocklöv, J., Carlton, J.M. and Tozan, Y. (2021) A Systematic Review of the Evidence on the Effectiveness and Cost-Effectiveness of Mass Screen-and-Treat Interventions for Malaria Control. *The American Journal of Tropical Medicine and Hygiene*, **105**, 1722-1731. https://doi.org/10.4269/ajtmh.21-0325