
Barriers and Enablers to the Uptake of Malaria Vaccines among Caregivers of Eligible Children in Sub-Saharan Africa: A Scoping Review

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ABSTRACT

Background: Malaria remains a major public health challenge in sub-Saharan Africa and continues to disproportionately affect children under five years of age despite ongoing control efforts. The introduction of the RTS,S/AS01 and R21/Matrix-M malaria vaccines represents a major advancement in malaria prevention. However, successful implementation depends not only on vaccine availability and effectiveness but also on caregiver acceptance and uptake. Evidence regarding barriers and facilitators influencing malaria vaccine uptake among caregivers across sub-Saharan Africa remains fragmented. Therefore, this scoping review mapped and synthesized existing evidence on barriers and enablers influencing malaria vaccine uptake among caregivers of eligible children in sub-Saharan Africa and identified areas requiring future policy and research attention.

Methods: A scoping review was conducted following the Joanna Briggs Institute (JBI) methodology and reported according to PRISMA-ScR guidelines. Literature searches were undertaken across PubMed/MEDLINE, Scopus, Embase, Web of Science, and CINAHL, supplemented by grey literature from WHO, UNICEF, PATH, Africa CDC, and GAVI repositories. Eligible studies published in English between January 2015 and May 2025 included quantitative, qualitative, mixed-methods, and selected grey literature studies focusing on caregivers of children eligible for malaria vaccination in sub-Saharan Africa. Data were synthesized using descriptive and thematic analyses and mapped to the COM-B Model, Health Belief Model (HBM), and WHO SAGE Vaccine Hesitancy Matrix.

Results: A total of 386 records were identified, of which 35 studies met the inclusion criteria following screening and eligibility assessment. Studies were conducted across 13 countries in sub-Saharan Africa, with Ghana and Nigeria contributing the largest proportion. Most studies reported high caregiver acceptance of malaria vaccines, with acceptance rates ranging from 59% to 97.7% in 85.7% of included studies. Major barriers to vaccine uptake included socio-cultural factors (religious beliefs, misconceptions, spousal influence), informational barriers (limited awareness and misinformation), economic constraints (transport and affordability concerns), health-system limitations (poor access, stock-outs, long waiting times), perceived vaccine risks, and logistical challenges. Key enablers included trust in healthcare workers, awareness of vaccine benefits, positive previous vaccination experiences, free vaccine provision, strong health-system support, community endorsement, and perceived vaccine effectiveness. Behavioural framework mapping demonstrated that caregiver capability, opportunity, and motivation strongly influenced vaccine uptake decisions.

Conclusion: Malaria vaccine uptake among caregivers in sub-Saharan Africa is shaped by interconnected socio-cultural, economic, informational, and health-system determinants. Although caregiver acceptance is generally high, sustaining uptake requires context-specific strategies that strengthen risk communication, improve access to vaccination services, build trust in health systems, and engage communities. Addressing these barriers while reinforcing existing enablers will be essential to maximize the public health impact of malaria vaccination programmes.

Keywords: Malaria vaccine; RTS,S/AS01; R21/Matrix-M; Vaccine uptake; Caregivers; Sub-Saharan Africa; Scoping review; Vaccine hesitancy.

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1.0 INTRODUCTION

Malaria remains one of the most significant public health challenges globally despite decades of intensive control efforts. The disease continues to disproportionately affect low- and middle-income countries, particularly those in sub-Saharan Africa, where environmental, socioeconomic, and health-system factors sustain high levels of transmission. According to the World Health Organization (WHO), an estimated 282 million malaria cases and approximately 610,000 malaria-related deaths occurred globally in 2024, with the WHO African Region accounting for approximately 95% of the global burden.¹ Children under five years continue to bear the greatest burden of disease and mortality, accounting for nearly three-quarters of all malaria deaths in the African Region.² Although considerable progress was achieved in reducing malaria morbidity and mortality during the early years of the twenty-first century, recent gains have slowed considerably. Emerging challenges including insecticide resistance, antimalarial drug resistance, climate change, population growth, humanitarian crises, and persistent funding gaps have threatened malaria control efforts across endemic countries.¹ In many African countries, malaria remains a leading cause of outpatient attendance, hospital admissions, school absenteeism, childhood morbidity, and mortality. The economic consequences are equally substantial, resulting in increased household healthcare expenditures, reduced labour productivity, and impediments to socioeconomic development. Consequently, there is increasing recognition that existing malaria control interventions alone may be insufficient to achieve global malaria elimination targets, thereby necessitating complementary preventive approaches such as vaccination.^{1,2}

The development of a malaria vaccine has long been regarded as a major scientific and public health priority. However, the complex life cycle of the *Plasmodium* parasite and its ability to evade host immune responses have historically hindered vaccine development. Following decades of research, the RTS,S/AS01 vaccine became the first malaria vaccine recommended by WHO in 2021 for use among children living in areas of moderate-to-high *Plasmodium falciparum* transmission.³ Subsequently, WHO recommended the R21/Matrix-M vaccine in 2023, making it the second malaria vaccine approved for widespread use among children in endemic settings.⁴ These landmark achievements have introduced a new era in malaria prevention and have expanded the portfolio of interventions available for malaria control. Both RTS,S/AS01 and R21/Matrix-M vaccines target the circumsporozoite protein of *Plasmodium falciparum* and have demonstrated significant effectiveness in reducing clinical malaria episodes, severe malaria, hospital admissions, and mortality among young children. Evidence from clinical trials and implementation studies indicates that malaria vaccines provide additional protection when integrated with existing malaria control measures such as insecticide-treated nets, indoor residual spraying, seasonal malaria chemoprevention, and prompt diagnosis and treatment.³

A major milestone in malaria vaccine implementation was the WHO-coordinated Malaria Vaccine Implementation Programme (MVIP), which commenced in 2019 across Ghana, Kenya, and Malawi. Through this programme, nearly two million children received at least one dose of the RTS,S vaccine. Evaluation findings demonstrated that the vaccine was feasible to deliver through routine immunization systems, exhibited a favourable safety profile, and significantly reduced severe malaria, hospitalizations, and childhood mortality.⁵ These findings provided critical evidence supporting WHO recommendations for broader malaria vaccine deployment across endemic countries. The recommendation of the R21/Matrix-M vaccine further strengthened global malaria prevention efforts by addressing anticipated supply limitations associated with RTS,S. Clinical evidence suggests that R21 provides substantial protection against malaria and can be produced at scale, thereby improving vaccine availability for countries with high malaria burden.⁶ As a result, several African countries, including Nigeria, Ghana, Cameroon, Benin, Liberia, Sierra Leone, and others, have initiated plans for malaria vaccine introduction or scale-up within their national immunization programmes.

Despite the availability of effective malaria vaccines, successful implementation depends not only on vaccine efficacy and supply but also on acceptance and uptake among target populations. Vaccine uptake is a complex behavioural phenomenon influenced by multiple interacting factors operating at individual, interpersonal, community, and health-system levels. Evidence from childhood immunization programmes demonstrates that vaccine availability alone does not guarantee utilization. Rather, caregivers' perceptions regarding vaccine safety, effectiveness, necessity, accessibility, and trustworthiness significantly influence vaccination decisions.⁷ Caregivers are central decision-makers regarding childhood vaccination in most African settings. Their decisions are often shaped by knowledge and awareness of vaccines, perceived susceptibility of children to disease, perceived benefits and risks of vaccination, trust in healthcare providers, social influences, cultural beliefs, religious perspectives, previous vaccination experiences, and exposure to misinformation.^{8,9} Concerns regarding vaccine safety, fear of adverse events following immunization, uncertainty regarding vaccine effectiveness, and misconceptions surrounding newly introduced vaccines have been identified as important contributors to vaccine hesitancy across several African countries.^{8,9}

The growing influence of social media and informal communication channels has further complicated vaccine acceptance efforts. Misinformation and rumours regarding vaccine safety, infertility, hidden agendas, and adverse effects have been shown to undermine confidence in vaccination programmes. These concerns are particularly relevant for malaria vaccines because they represent a relatively recent addition to childhood immunization schedules, and many caregivers may have limited prior knowledge regarding their benefits and safety profiles.¹⁰ Health-system factors also play a critical role in determining vaccine uptake. Accessibility of health facilities, vaccine availability, adequacy of healthcare workforce, cold-chain infrastructure, waiting times, transportation costs, service quality, and communication between healthcare workers and caregivers can either facilitate or impede

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vaccine utilization.⁷ Studies conducted in several African settings have shown that caregivers are more likely to vaccinate their children when vaccination services are convenient, affordable, reliable, and delivered by trusted healthcare providers. Conversely, vaccine stock-outs, long travel distances, indirect costs, and poor interactions with health personnel may discourage vaccine uptake and completion of recommended vaccine schedules.^{7,9}

Understanding the factors that influence malaria vaccine uptake is particularly important because both RTS,S and R21 vaccines require multiple doses to achieve optimal effectiveness. Failure to initiate or complete vaccination schedules may substantially reduce vaccine impact and compromise efforts to reduce malaria-related morbidity and mortality. Consequently, identifying barriers and facilitators to vaccine uptake is essential for informing policy, strengthening immunization programmes, designing effective communication strategies, and maximizing public health benefits. Although several studies have investigated malaria vaccine acceptance and uptake across sub-Saharan Africa, the available evidence remains fragmented across countries, populations, and implementation contexts. Furthermore, the rapid expansion of malaria vaccine programmes following WHO recommendations has generated new evidence that has not been comprehensively synthesized. Therefore, a scoping review is warranted to systematically map existing evidence on barriers and enablers influencing malaria vaccine uptake among caregivers of eligible children in sub-Saharan Africa and to identify research gaps requiring further investigation.

2.0 METHODS

2.1 Study Design

This study employed a scoping review design to map, categorize, and systematically synthesize empirical evidence regarding the barriers and enablers to malaria vaccine uptake among primary caregivers of eligible children in sub-Saharan Africa. A scoping review framework was chosen over a traditional systematic review due to the exploratory nature of the research questions and the need to comprehensively evaluate heterogeneous study designs (including quantitative cross-sectional surveys, qualitative focus groups, longitudinal cohorts, and experimental designs) across multiple nations. The methodology of this review was guided by the Joanna Briggs Institute (JBI) Manual for Evidence Synthesis and is reported in strict accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines.

2.2 Eligibility Criteria

Studies were screened and selected based on the Population, Concept, and Context (PCC) framework recommended for scoping reviews:

- **Population (P):** Primary caregivers (including biological mothers, fathers, grandparents, and legal guardians) of children eligible for malaria vaccination (typically aged 3 months to 5 years old). Studies focusing exclusively on health workers, program managers, or policymakers without distinct, extractable data for primary caregivers were excluded.
- **Concept (C):** Behavioural, structural, socio-cultural, economic, informational, logistical, or health system-related barriers and enablers affecting caregiver intention, vaccine acceptance, willingness to pay, initial uptake, or full schedule completion of malaria vaccines. The scope was restricted to vaccines approved, prequalified, or actively piloted in sub-Saharan Africa (specifically RTS,S/AS01 and R21/Matrix-M).
- **Context (C):** National, regional, or community health settings within sub-Saharan African countries, encompassing urban, rural, semi-rural, or peri-urban locations.
- **Study Types:** Primary, peer-reviewed empirical research utilizing quantitative, qualitative, or mixed-methods approaches, as well as authoritative grey literature reports from major international public health institutions. Systematic reviews, theoretical protocols, editorials, and conference abstracts lacking full-text data were excluded.
- **Language and Temporal Restrictions:** To ensure contemporary relevance to active malaria vaccine rollouts and implementation pilots, the selection was limited to primary studies published in the English language between January 2015 and May 2025.

2.3 Information Sources and Search Strategy

A comprehensive, systematic literature search was executed across five major electronic bibliographic databases: PubMed/MEDLINE, Scopus, Embase, Web of Science, and CINAHL. To minimize publication bias and capture programmatic data, a targeted search for grey literature was conducted using the institutional repositories and official websites of global health organizations, including UNICEF, the World Health Organization (WHO), PATH (Program for Appropriate Technology in Health), Africa CDC, and GAVI, the Vaccine Alliance.

Search strings were constructed using a combination of Medical Subject Headings (MeSH) terms, open-text keywords, truncations (*), and Boolean operators (AND/OR) optimized for each database structure. The core search components comprised variations of the following domains:

1. *Population:* "caregiver*", "parent*", "mother*", "guardian*", "father*".
2. *Intervention:* "malaria vaccine*", "RTS,S*", "Mosquirix", "R21*", "Matrix-M*".

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3. *Outcomes*: "barrier*", "enabler*", "facilitator*", "hesitance*", "accept*", "uptake", "willingness to pay".
4. *Geography*: "sub-Saharan Africa", "Nigeria", "Ghana", "Kenya", "Malawi", "Tanzania", "Mali", "Togo", "Burundi", "Uganda", "Mozambique", "Guinea", "Sierra Leone", "Ethiopia".

(The complete, reproducible search string executed for each electronic database is provided in Appendix A).

2.4 Study Selection and Screening

All records retrieved from the database and registry searches (n = 386) were exported into EndNote reference management software, and duplicate items (n = 122) were automatically and manually removed. The remaining 264 unique records underwent a rigid, two-stage screening process:

1. **Title and Abstract Screening**: Titles and abstracts were independently evaluated by reviewers against the predetermined eligibility criteria. A total of 204 records were excluded during this phase.
2. **Full-Text Assessment**: The remaining 60 records were sought for retrieval, and their full texts were thoroughly evaluated for final inclusion. Twenty-five (25) reports were excluded with documented reasons, including wrong context, missing primary caregiver populations, or lack of accessible primary full-text data.

Discrepancies during the screening phases were resolved through consensus or consultation with a third senior reviewer, yielding a final sample of 35 studies for synthesis. The search selection flow is mapped into a standard PRISMA flow chart (Figure 3.1).

2.5 Data Extraction

Data extraction was executed using a standardized, pre-piloted data extraction form developed in Microsoft Excel. To ensure accuracy, the extraction sheet categorized data points into structural and thematic variables, including:

- **Bibliometric and Geographical Data**: Lead author, publication year, country of origin, and study setting (rural, urban, mixed, semi-rural).
- **Methodological Characteristics**: Study design, data collection timeframe, sample size, type of data source (primary vs. secondary), target child age, and vaccine type evaluated (RTS,S/AS01, R21/Matrix-M, or non-specified).
- **Key Review Outcomes**: Quantitative or narrative vaccine acceptance and intent rates, specific identified barriers, specific identified enablers, and behavioral or implementation frameworks referenced.

2.6 Synthesis of Results and Framework Analysis

The extracted evidence was aggregated and analysed using an integrated descriptive and thematic framework approach.

- **Descriptive Analysis**: Frequencies and percentages were used to summarize study metadata, geographic disaggregation, publication timelines, and quantitative ranges of caregiver vaccine acceptance.
- **Thematic Analysis**: Textual data regarding obstacles and facilitators were extracted and processed via ATLAS.ti qualitative analysis software using an inductive-deductive approach. Codes were clustered into six primary operational domains: socio-cultural, economic, informational, health system-related, logistical, and perceived vaccine risks/benefits.
- **Theoretical Mapping**: To provide structural public health utility, the finalized thematic barriers and enablers were formally mapped against three validated health behavior frameworks:
 1. *The COM-B Model*: Evaluating individual Capability, external Opportunity, and intrinsic Motivation interacting to produce behavioral outcomes.
 2. *The Health Belief Model (HBM)*: Categorizing caregiver decisions based on Perceived Susceptibility, Severity, Benefits, Barriers, Cues to Action, and Self-Efficacy.
 3. *The WHO SAGE Vaccine Hesitancy Matrix*: Organizing reasons for delay or refusal into Contextual influences, Individual and Group influences, and Vaccine- or Vaccination-specific issues.

3.0 RESULTS

3.1 Study Selection

The literature search identified 386 records from electronic databases and grey literature sources. Following the removal of 122 duplicate records, 264 studies were screened based on titles and abstracts. A total of 204 records were excluded during screening. Sixty full-text articles were assessed for eligibility, of which 25 were excluded due to lack of full text, wrong context, wrong concept, or inappropriate study population. Ultimately, 35 studies met the inclusion criteria and were included in this scoping review. The 35 included studies were published between 2015 and 2025 and were conducted across 13 countries in Sub-Saharan Africa. Ghana and Nigeria accounted for the largest proportion of studies, contributing 12 and 10 studies respectively. Other represented countries included Kenya, Tanzania, Malawi, Mali, Ethiopia, Uganda, Mozambique, Togo, Guinea, Sierra Leone, and Burundi. Most studies employed cross-sectional designs, while a smaller number used qualitative, longitudinal, and mixed-methods approaches. Study settings included urban, rural, semi-rural, and mixed locations. Sample sizes ranged from 7 to 5,502 participants. The majority of studies focused on primary caregivers, particularly mothers and parents of children younger than five years.

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3.2 Geographic Distribution of Studies

The geographic distribution of studies demonstrated a concentration of malaria vaccine uptake research in West and East Africa. Ghana and Nigeria emerged as the most frequently studied countries, followed by Kenya and Tanzania.

3.3 Temporal Trends in Research

Research output on malaria vaccine uptake increased substantially over the review period. Isolated studies were identified between 2015 and 2020, followed by a gradual increase from 2021 onward. Research activity expanded considerably in 2023 and 2024 and reached its peak in 2025. This trend coincides with increased policy attention, pilot implementation program, and the introduction of newer malaria vaccines such as R21/Matrix-M.

3.4 Barriers to Malaria Vaccine Uptake

The review identified several recurrent barriers to malaria vaccine uptake among caregivers. These barriers were categorized into socio-cultural, informational, economic, and health-system factors.

Table 3.1: Barriers to Malaria Vaccine Uptake Among Caregivers in Sub-Saharan Africa

Thematic Category	Specific Barriers	COM-B Model Mapping	HBM Model Mapping	WHO Hesitancy Matrix Mapping
Socio-Cultural Barriers	Cultural and religious beliefs, Spousal refusal, Misconceptions, Misinformation about the vaccine schedule, Perception that malaria can be treated with medicine	Motivation, Capability, Opportunity	Perceived Barriers	Individual & Group Influences, Contextual Influences, Vaccine-specific Issues
Economic Barriers	Unaffordability of the vaccine, Concerns about vaccine cost, Low income, Cost of travel, Inability to pay for the vaccine	Opportunity, Motivation	Perceived Barriers	Contextual Influences, Vaccine-specific Issues
Informational Barriers	Lack of awareness about the vaccine and its schedule, Miscommunication regarding vaccine doses, Lack of education, Fear of side effects due to misinformation, Misunderstanding of the vaccine's efficacy	Capability, Motivation, Opportunity	Perceived Barriers	Individual & Group Influences, Contextual Influences, Vaccine-specific Issues
Health System Barriers	Difficulty in accessing vaccination sites, Health worker strikes, long waiting times at vaccination clinics, Poor health worker attitudes, Stockouts and unavailability of vaccines	Opportunity, Capability, Motivation	Perceived Barriers	Contextual Influences, Individual & Group Influences
Perceived Vaccine Risk	Fear of adverse side effects, Concern about vaccine safety, Fear of new vaccines, Distrust in the vaccine's effectiveness	Motivation, Capability	Perceived Susceptibility, Perceived Barriers	Vaccine-specific Issues, Individual & Group Influences
Logistical Barriers	Distance to health facility, Lack of transportation, Unreliable vaccine supply, competing life responsibilities (home, farming), Missed visits due to personal events	Opportunity, Motivation, Capability	Perceived Barriers	Contextual Influences, Individual & Group Influences

3.5 Enablers of Malaria Vaccine Uptake

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Several factors facilitated malaria vaccine uptake among caregivers. Trust in healthcare workers and health authorities was one of the most frequently reported enablers. Positive interactions with healthcare providers increased confidence in vaccine safety and effectiveness.

Table 3.2 Enablers to Malaria Vaccine Uptake Among Caregivers in Sub-Saharan Africa

Thematic Category	Specific Enablers	COM-B Model Mapping	HBM Model Mapping	WHO Hesitancy Matrix Mapping
Socio-Cultural Enablers	Community trust in local leadership, social networks influence (Neighbour/community approval), Tribal acceptance of vaccination (Belonging to a certain tribe)	Motivation, Opportunity	Perceived Benefits, Self-Efficacy	Individual & Group Influences, Contextual Influences
Economic Enablers	Caregiver employment, Willingness to pay, Free vaccine provision, Inconvenience that comes with treating malaria	Opportunity, Motivation	Perceived Benefits, Self-Efficacy	Contextual Influences, Vaccine-specific Issues
Informational Enablers	Awareness of malaria vaccine, Knowledge of vaccine benefits, Positive past experiences with vaccination, Information from health workers and media, Higher education levels	Capability, Opportunity	Perceived Benefits, Self-Efficacy	Contextual Influences, Individual & Group Influences
Health System Enablers	Free healthcare services, Provision of transport support, Strong healthcare system, Consistent health worker engagement, Health education campaigns, Satisfaction with service rendered during RTS,S/AS01 pilot phase	Opportunity, Motivation	Perceived Benefits, Cues to Action	Contextual Influences, Individual & Group Influences
Perceived Vaccine Effectiveness	Perceived high effectiveness of vaccine, Fewer malaria cases observed post-vaccination, Trust in vaccine based on prior positive vaccine experiences	Motivation, Capability	Perceived Benefits, Perceived Susceptibility	Individual & Group Influences, Vaccine-specific Issues

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Logistical Enablers	Good transport access to health facilities, Proximity to healthcare centers, Availability of vaccines, Efficient vaccine supply chain	Opportunity, Capability	Perceived Benefits	Contextual Influences, Vaccine-specific Issues
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Table 3.3 Intent/Acceptance of Malaria Vaccine

Acceptance Level	Definition	No. of Studies (%)	Acceptance range (%)	Countries
High	≥50% acceptance or described as “majority willing”	30 (85.7%)	59%-97.7%	Ghana (10), Nigeria (10), Kenya (3), Tanzania (3), Malawi (2), Mali, Burundi, Guinea, Sierra Leone, Uganda, Togo, Mozambique, Ethiopia
Low	<50% acceptance or described as “minority willing”	2 (5.7%)	20%-32.3%	Togo, Ethiopia
Not Reported	-	3 (8.6%)	-	Ghana(2),Kenya

*Percentages may not total 100 due to rounding.

*Note that there were 4 multi-country studies with regional disaggregation

3.6 Thematic Synthesis Using Behavioral Frameworks

Application of behavioral frameworks revealed that vaccine uptake was influenced by caregiver capability, opportunity, and motivation. Knowledge and awareness improved psychological capability, while healthcare access and social support enhanced opportunity. Perceived benefits, trust, and confidence in vaccines strengthened motivation.

The Health Belief Model demonstrated that perceptions of susceptibility to malaria, disease severity, benefits of vaccination, and barriers such as safety concerns significantly influenced caregiver decision-making. Similarly, the WHO Vaccine Hesitancy Matrix highlighted the contribution of individual, contextual, and vaccine-specific factors to vaccine acceptance and hesitancy.

4.0 DISCUSSION

This scoping review synthesized evidence on the barriers and enablers influencing malaria vaccine uptake among caregivers of eligible children in sub-Saharan Africa. The review found generally high levels of caregiver acceptance of malaria vaccines across most included studies, although uptake was influenced by a complex interplay of socio-cultural, informational, economic, health-system, and logistical factors. These findings suggest that while the introduction of RTS,S/AS01 and R21/Matrix-M vaccines has been met with considerable enthusiasm in many settings, sustained uptake will require interventions that address both individual and systemic determinants of vaccination behaviour.

One of the most notable findings of this review was the consistently high level of malaria vaccine acceptance reported across the majority of studies. Acceptance rates exceeding 50% were documented in most countries, with some studies reporting willingness to vaccinate above 90%. This finding is consistent with evidence indicating that caregivers in malaria-endemic regions generally recognize the substantial burden of malaria and are receptive to interventions that can protect their children from infection and severe disease.¹⁻³ The high acceptance observed may also reflect increasing awareness generated through pilot implementation programmes and national vaccine introduction initiatives. Findings from the Malaria Vaccine Implementation Programme in Ghana, Kenya, and Malawi similarly demonstrated favourable community perceptions and acceptance of the RTS,S vaccine when delivered through routine immunization systems.⁵ Despite these encouraging levels of acceptance, socio-cultural barriers emerged as important determinants of vaccine uptake. Cultural and religious beliefs, spousal influence, misconceptions about vaccination, and perceptions that malaria can be adequately treated without vaccination were frequently reported across studies. Similar findings

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have been documented in childhood immunization programmes throughout sub-Saharan Africa, where vaccination decisions are often influenced by family members, community leaders, and prevailing social norms rather than individual caregivers alone.^{7,8} These findings highlight the importance of adopting community-centred approaches that engage religious leaders, traditional authorities, and other influential stakeholders in malaria vaccine promotion. Community endorsement may be particularly important in addressing misconceptions and fostering confidence in newly introduced vaccines.

Informational barriers also featured prominently across the reviewed studies. Lack of awareness regarding malaria vaccines, poor understanding of vaccination schedules, misinformation about vaccine safety, and uncertainty regarding vaccine effectiveness were common obstacles to uptake. These findings are consistent with previous evidence showing that inadequate health literacy and misinformation contribute significantly to vaccine hesitancy in low- and middle-income countries.^{7,8} The rapid dissemination of inaccurate information through social media and informal communication networks has further complicated vaccine acceptance efforts.¹⁰ Given that malaria vaccines remain relatively new in many countries, caregivers may be particularly susceptible to misinformation regarding safety and effectiveness. Strengthening health education campaigns, improving risk communication, and providing accurate information through trusted channels may therefore be critical to improving vaccine uptake and completion of recommended vaccination schedules. Concerns regarding vaccine safety and adverse events following immunization constituted another major barrier identified in this review. Fear of side effects, concerns about the safety of newly introduced vaccines, and doubts regarding vaccine effectiveness were frequently associated with vaccine hesitancy. Similar concerns have been reported across studies examining acceptance of other childhood vaccines and more recently COVID-19 vaccines.^{8,10} According to the WHO Strategic Advisory Group of Experts (SAGE) on Immunization, confidence in vaccine safety remains one of the most important determinants of vaccine acceptance globally.¹¹ Building and sustaining public trust will therefore require transparent communication regarding vaccine safety profiles, effectiveness data, and post-introduction monitoring outcomes. Healthcare workers have a particularly important role in this regard, as caregivers often rely on them as trusted sources of vaccine information.

Health-system and logistical barriers were also commonly reported across the included studies. Distance to vaccination centres, transportation difficulties, long waiting times, vaccine stock-outs, and poor interactions with healthcare providers were identified as major impediments to uptake. These findings align with broader immunization literature demonstrating that physical accessibility and quality of service delivery significantly influence vaccination behaviour.⁷ Even when caregivers are willing to vaccinate their children, challenges related to access and service availability may hinder vaccine initiation or completion. This is especially important for malaria vaccines, which require multiple doses to achieve optimal protection. Ensuring reliable vaccine supply chains, reducing missed opportunities for vaccination, and improving the quality of caregiver-provider interactions will be essential for maximizing vaccine coverage and programme effectiveness.

Economic factors also influenced vaccine uptake. Although malaria vaccines are largely expected to be delivered through publicly funded immunization programmes, indirect costs such as transportation expenses, lost income, and time away from work were reported as barriers in several studies. Similar observations have been made in studies of childhood immunization uptake across low-resource settings, where indirect costs often discourage utilization of preventive health services.⁷ These findings suggest that policymakers should consider strategies that reduce financial burdens on caregivers, including outreach vaccination services, community-based delivery approaches, and integration of malaria vaccination into existing child health programmes.

The review further identified several important enablers of malaria vaccine uptake. Trust in healthcare workers and health authorities emerged as one of the most consistently reported facilitators. Caregivers who received information from trusted healthcare providers were more likely to perceive malaria vaccines as safe, effective, and beneficial. This finding supports previous research demonstrating the central role of healthcare workers in influencing vaccination decisions and promoting vaccine confidence.^{8,9} Other important facilitators included awareness of vaccine benefits, positive previous experiences with childhood immunization, community support, perceived effectiveness of the vaccine, and satisfaction with healthcare services. These findings suggest that strengthening routine immunization platforms and leveraging existing trust in vaccination programmes may enhance malaria vaccine uptake across endemic settings.

The application of behavioural frameworks provided additional insight into the factors influencing caregiver decision-making. The COM-B model demonstrated that vaccine uptake is shaped by caregiver capability through knowledge and awareness, opportunity through healthcare access and social support, and motivation through trust and perceived benefits. Similarly, the Health Belief Model highlighted the influence of perceived susceptibility to malaria, perceived severity of disease, perceived benefits of vaccination, and perceived barriers such as safety concerns. The WHO SAGE Vaccine Hesitancy Matrix further illustrated how contextual, individual, and vaccine-specific factors interact to influence vaccination behaviour. Collectively, these frameworks reinforce the need for multifaceted interventions that address behavioural, social, and structural determinants simultaneously.

5.0 LIMITATIONS

This review provides important evidence to support ongoing malaria vaccine implementation efforts across sub-Saharan Africa. However, several limitations should be acknowledged. The review was restricted to English-language publications and may have

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excluded relevant studies published in other languages. Additionally, most included studies employed cross-sectional designs, limiting causal interpretation of identified factors. Nevertheless, the review provides a comprehensive synthesis of current evidence and identifies key areas for policy action and future research.

6.0 CONCLUSION

Malaria vaccine uptake among caregivers in sub-Saharan Africa is influenced by a complex interplay of individual, socio-cultural, economic, and health-system factors. Strengthening risk communication, improving access to vaccination services, engaging community leaders, and building trust in health systems are essential to improve vaccine acceptance and uptake. Future implementation strategies should adopt context-specific approaches that address identified barriers while leveraging existing facilitators.

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APPENDIX A

ELECTRONIC DATABASE SEARCH STRATEGIES AND BOOLEAN STRINGS

Database / Repository	Search Date	Search Fields Evaluated	Specific Field Filters Applied	Reproducible Boolean Search String / Search Query
PubMed / MEDLINE (via NCBI)	May 24, 2025	Medical Subject Headings [Mesh], Title/Abstract [tiab]	<ul style="list-style-type: none"> • Publication Date: 2015/01/01 to 2025/05/24 • Language: English 	((("Caregivers"[Mesh] OR caregiver*[tiab] OR parent*[tiab] OR mother*[tiab] OR father*[tiab] OR guardian*[tiab] OR "Mothers"[Mesh] OR "Parents"[Mesh]) AND ("Malaria Vaccines"[Mesh] OR "malaria vaccine"*[tiab] OR "RTS,S"[tiab] OR "RTS,S/AS01"[tiab] OR "Mosquirix"[tiab] OR "R21"[tiab] OR "Matrix-M"[tiab] OR "R21/Matrix-M"[tiab]) AND ("Vaccine Hesitancy"[Mesh] OR barrier*[tiab] OR enabler*[tiab] OR facilitator*[tiab] OR hesitanc*[tiab] OR accept*[tiab] OR uptak*[tiab] OR "willingness to pay"[tiab] OR "Patient Acceptance of Health Care"[Mesh]) AND ("Africa South of the Sahara"[Mesh] OR "sub-Saharan Africa"[tiab] OR "Nigeria"[tiab] OR "Ghana"[tiab] OR "Kenya"[tiab] OR "Malawi"[tiab] OR "Tanzania"[tiab] OR "Mali"[tiab] OR "Togo"[tiab] OR "Burundi"[tiab] OR "Uganda"[tiab] OR "Mozambique"[tiab] OR "Guinea"[tiab] OR "Sierra Leone"[tiab] OR "Ethiopia"[tiab]))
Scopus (via Elsevier)	May 24, 2025	Title, Abstract, and Keywords (TITLE-ABS-KEY)	<ul style="list-style-type: none"> • Publication Year: > 2014 • Language: English 	(TITLE-ABS-KEY (caregiver* OR parent* OR mother* OR father* OR guardian*) AND TITLE-ABS-KEY ("malaria vaccine*" OR "RTS,S" OR "Mosquirix" OR "R21" OR "Matrix-M") AND TITLE-ABS-KEY (barrier* OR enabler* OR facilitator* OR hesitanc* OR accept* OR uptak* OR "willingness to pay") AND TITLE-ABS-KEY ("sub-Saharan Africa" OR nigeria OR ghana OR kenya OR malawi OR tanzania OR mali OR togo OR burundi OR uganda OR mozambique OR guinea OR "Sierra Leone" OR ethiopia)) AND PUBYEAR > 2014 AND (LIMIT-TO (LANGUAGE , "English"))
Embase (via Elsevier)	May 24, 2025	Emtree Terms /exp, Title/Abstract :ti,ab	<ul style="list-style-type: none"> • Publication Years: 2015–2025 • Language: English 	('caregiver'/exp OR 'caregiver':ti,ab OR 'parent':ti,ab OR 'mother':ti,ab OR 'father':ti,ab OR 'guardian':ti,ab) AND ('malaria vaccine'/exp OR 'malaria vaccine':ti,ab OR 'rts,s':ti,ab OR 'mosquirix':ti,ab OR 'r21':ti,ab OR 'matrix-m':ti,ab) AND ('vaccine hesitancy'/exp OR 'barrier':ti,ab OR 'enabler':ti,ab OR 'facilitator':ti,ab OR 'hesitanc':ti,ab OR 'accept':ti,ab OR 'uptak':ti,ab OR 'willingness to pay':ti,ab) AND ('africa south of the sahara'/exp OR 'sub-saharan africa':ti,ab OR 'nigeria':ti,ab OR 'ghana':ti,ab OR 'kenya':ti,ab OR 'malawi':ti,ab OR 'tanzania':ti,ab OR 'mali':ti,ab OR 'togo':ti,ab OR 'burundi':ti,ab OR 'uganda':ti,ab OR 'mozambique':ti,ab OR 'guinea':ti,ab OR 'sierra leone':ti,ab OR 'ethiopia':ti,ab) AND [2015-2025]/py AND [english]/lim
Web of Science Core Collection (via Clarivate)	May 24, 2025	Topic (TS), evaluating Title, Abstract, Keywords, Keywords Plus	<ul style="list-style-type: none"> • Publication Years: 2015–2025 • Language: English • Document Type: Articles, Early Access 	TS=(caregiver* OR parent* OR mother* OR father* OR guardian*) AND TS=("malaria vaccine*" OR "RTS,S" OR "Mosquirix" OR "R21" OR "Matrix-M") AND TS=(barrier* OR enabler* OR facilitator* OR hesitanc* OR accept* OR uptak* OR "willingness to pay") AND TS=("sub-Saharan Africa" OR Nigeria OR Ghana OR Kenya OR Malawi OR Tanzania OR Mali OR Togo OR Burundi OR Uganda OR Mozambique OR Guinea OR "Sierra Leone" OR Ethiopia)

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CINAHL (via EBSCOhost)	May 24, 2025	All Text fields (TX)	<ul style="list-style-type: none"> • Publication Dates: 2015/01/01 to 2025/05/24 • Language: English 	TX (caregiver* OR parent* OR mother* OR father* OR guardian*) AND TX ("malaria vaccine*" OR "RTS,S" OR "Mosquirix" OR "R21" OR "Matrix-M") AND TX (barrier* OR enabler* OR facilitator* OR hesitanc* OR accept* OR uptak* OR "willingness to pay") AND TX ("sub-Saharan Africa" OR Nigeria OR Ghana OR Kenya OR Malawi OR Tanzania OR Mali OR Togo OR Burundi OR Uganda OR Mozambique OR Guinea OR "Sierra Leone" OR Ethiopia)
Grey Literature Repositories (WHO IRIS, UNICEF, PATH, GAVI, Africa CDC)	May 24, 2025	Institutional publication indexes, title registries, site-wide search engines	<ul style="list-style-type: none"> • Publication Years: 2015–2025 • Language: English 	Targeted string phrase querying (manual index check): 1. "malaria vaccine" AND caregiver AND (barriers OR hesitancy) 2. "RTS,S" AND "R21" AND acceptance AND "Africa" 3. "malaria immunization" AND uptake AND parents