Review

China's Malaria R&D Innovations: A Scoping Review from 2013–2023

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ABSTRACT

Malaria remains a major global health challenge. Understanding the research progress of the potential innovative tools is important for malaria elimination. This scoping review aims to explore China's research and development (R&D) advances from 2013–2023 in addressing the current challenges and contributing to global malaria elimination. Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR), this review searched the English and Simplified Chinese data sources from five databases. A total of 11,112 English articles and 2,944 Chinese articles were retrieved. After screening, 44 English and 13 Chinese articles were included. Key advancements were identified in three domains: vector control, pathogen screening and diagnosis, and prevention and treatment. Innovations in vector control include studies such as the use of *Serratia* strains and symbiont-mediated RNAi approaches to block malaria transmission. Advances in pathogen screening and diagnosis feature biosensor development, AI monitoring technologies, and novel amplification gene and nucleic acid detection technologies. In prevention and treatment, artemisinin-based combination therapies (ACTs) remain a cornerstone, with additional progress in industrial pharmaceuticals and technologies already in field and semi-field-testing stages. This review underscores the importance of leveraging China's R&D capacity to meet global challenges. To maximize impact, we call for global attention to strengthening international collaboration with China in malaria R&D to accelerate the commercialization, regulatory approval, and large-scale deployment of innovations.

Malaria, one of the 'Big Three' infectious diseases, contributed 249 million cases and 608,000 deaths to the global disease burden in 2022, with the WHO African Region bearing a disproportionately high share (*1*). Recent years have witnessed innovative advancements in malaria control that offer new hope for elimination. The RTS,S/AS01 malaria vaccine now provides additional protection for children living in endemic areas (*2*–*3*), while modern malaria rapid diagnostic tests (RDTs) have significantly improved in sensitivity and specificity, delivering fast and reliable results (*2*). Additionally, emerging engineering technologies that deploy transgenic methods against mosquitoes, such as gene drive, show potential to modify mosquito populations to reduce their reproductive capacity and transmission ability, though these remain in experimental stages (*4*). However, these advancements face significant challenges. The RTS,S/AS01 vaccine demonstrates compromised efficacy, highlighting the need for more robust vaccines (*5*). Widespread *pfhrp2* gene deletions compromise RDT reliability (*6*), while emerging drug resistance to artemisinin-based combination therapy (ACT) and mosquito resistance to insecticides driven by evolving vector behaviors (*7*) present ongoing threats. Ecological concerns regarding gene drive technologies further complicate implementation (*8*). These challenges, combined with longstanding impediments such as limited service delivery capacity, insufficient operational expertise, and inadequate laboratory infrastructure in endemic areas, underscore the critical need for continued innovation in malaria control to achieve global elimination.

Malaria has historically been one of China's most serious health challenges. In the 1940s, China reported over 30 million malaria cases annually (*9*). Nevertheless, China has achieved remarkable progress: zero local transmission cases since 2016 and World Health Organization (WHO) certification as malaria-

free in 2021. China's success in combating malaria can be attributed to a comprehensive range of prevention and control strategies, including strong government commitment to science, evidence-based interventions, and financial support; the establishment of a robust and adaptive surveillance and response system; and continuous capacity building alongside demand-oriented scientific research (*10*). The 1-3-7 strategy — developed by the National Malaria Elimination Program in 2010 and extensively implemented in early 2012 — has been recognized as critical to China's malaria elimination. This strategy refers to reporting malaria cases within one day, confirming and investigating cases within three days, and implementing appropriate responses to prevent further transmission within seven days (*11*).

In parallel, China has made significant strides in malaria-related research and product development (*12*). The discovery of artemisinin, originating from "Project 523" in 1967 and later earning Professor Tu Youyou the Nobel Prize in Physiology or Medicine in 2015, revolutionized malaria treatment globally (*13*). ACTs, endorsed by WHO as first-line and second-line treatments for malaria, have saved millions of lives (*14*). Beyond artemisinin, China's research progress in other innovative products is also noteworthy, including insecticide-treated nets (ITNs) for preventing mosquito bites (*15*), genetically modified mosquitoes for transmission control (*16*), the PfCP-2.9 blood-stage vaccine for malaria, which has entered clinical studies, and additional vaccine candidates in various R&D stages (*17*).

Despite growing international recognition of China's malaria elimination achievements, there remains a lack of systematic, evidence-based documentation, particularly regarding advances in diagnosis and vector control. This gap hinders further innovation and limits the global application of China's contributions. While the Malaria Eradication Research Agenda (malERA) emphasizes the importance of R&D to interrupt transmission (*18*), the increasing global malaria burden highlights the need for more effective tools and strategies. Given these challenges and the limited literature summarizing China's malaria innovation from a global health perspective, this scoping review aims to provide a comprehensive overview of malaria R&D in China from 2013 to 2023, identifying progress, gaps, and opportunities to contribute to global malaria elimination efforts.

METHODOLOGY

Study Design

This study was meticulously designed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist (*19*) to ensure methodological rigor and international generalizability. We implemented a pilot review phase where two reviewers jointly screened approximately 20 publications during in-person and online meetings under the guidance of an experienced reviewer. Following this initial screening, the team conducted collaborative discussions to critically evaluate outcomes and make necessary adjustments to the screening and data extraction protocol before proceeding to the full scoping review.

Search Strategies

Our review incorporated search strategies encompassing both English and Simplified Chinese data sources to comprehensively capture emerging innovation information. English data sources included PubMed (https://www.ncbi.nlm/nih.gov/pubmed/), Web of Science (https://www.webofscience.com/), and ScienceDirect (https://www.sciencedirect.com), while Chinese data sources comprised local databases including China National Knowledge Infrastructure (CNKI, https://www.cnki.net/) and Wanfang (https://www.wanfangdata.com.cn/). The specific search strategies employed for each database are presented in Table 1. To address potential meaning discrepancies arising from English-Chinese language translation, two independent researchers conducted reverse translation verification. Translation references for keywords used in the Chinese literature search strategy are provided in Supplementary Table S1 (available at https://weekly.chinacdc.cn/). The final literature search was completed in December 2023.

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria were developed through two rounds of internal discussions among researchers. Initially, we defined innovation products in malaria based on the framework identified by Chibi et al. (*20*): technology and device developments in surveillance, microplanning, prevention, diagnosis, and treatment of malaria. Subsequently, we established our specific inclusion and exclusion criteria, which are detailed in Table 2.

TABLE 1. Search strategies applied in the databases.

Database	Search time	Key words	Article type	Publication time range
PubMed	2023.12.2	(Malaria [title] OR malaria [Mesh] OR plasmodium [title] OR anopheles [title] OR artemisinin [title] OR quinine [title]OR vector [title] OR parasite [title])AND (control [title] OR product* [title] OR technolog*[title] OR prevention[title] OR vaccin*[title] OR screening [title] OR diagnosis [title] OR treatment [title] OR rehabilitation [title] OR recovery [title] OR medicine [title] OR biology* [title] OR pathway [title] OR mechanism [title] OR novel [title] OR drug* [title] OR residual spraying [title] OR potential [title] OR efficacy [title])AND (China [all fields] OR Chinese [all fields])	All	2013–2023
Web of Science	2023.12.2	AB=((Malaria OR plasmodium OR anopheles OR artemisininOR quinine OR vector OR parasite)AND (control OR product* OR technolog* OR prevention OR vaccin* OR screening OR diagnosis OR treatment OR rehabilitation OR recovery OR medicine OR biology* OR pathway OR mechanism OR novel OR drug* OR residual spraying OR potential OR efficacy)AND (China OR Chinese))	All	2013–2023
ScienceDirect	2023.12.2	Term: "control" OR "product" OR "products" OR "technology" OR "technologies" OR "prevention" OR "vaccine" OR "vaccines" OR "vaccination" OR "screening" OR "diagnosis" OR "treatment" OR "rehabilitation" OR "recovery" OR "medicine" OR "biology" OR "pathway" OR "mechanism" OR "novel" OR "drug" OR "drugs" OR "residual spraying" OR "potential" OR "efficacy" AND TI:"Malaria" OR "plasmodium" OR "anopheles" OR "artemisinin" OR "quinine" OR "vector" OR "parasite" Find articles with these terms:"China" OR "Chinese"	Research Articles	2013–2023
CNKI	2023.12.2	((TI='疟疾') OR (TI='疟原虫') OR (TI='蚊') OR (TI='青蒿素') OR (TI='奎宁') OR (TI='寄生虫')) AND ((TI='控制') OR (TI='产品') OR (TI='技术') OR (TI='预防') OR (TI='疫苗') OR (TI='筛查') OR (TI='诊断') OR (TI='治疗') OR (TI='康复') OR (TI='药物') OR (TI='生物') OR (TI='通道') OR (TI='机制'))	Academic Study	2013–2023
Wanfang	2023.12.2	题名或关键词:((疟疾 OR 疟原虫 OR 蚊 OR 青蒿素 OR 奎宁) AND (控制 OR 产品 OR 技术 OR 预防 OR 疫苗 OR 筛查OR诊断 OR治疗OR康复 OR药物OR生物OR通道OR机制))	All	2013–2023

TABLE 2. Inclusion and exclusion criteria of the scoping review.

Category	Inclusion	Exclusion
Language	English and Chinese	Languages other than English and Chinese
Author affiliation information	At least one of the first or corresponding authors' primary (first listed) affiliation is an institute located in China	None of the first or corresponding authors' primary affiliation is an institute located in China
Accessibility	Open access	Limited access
Study design	Empirical studies: Observational studies (clinical trials, cohort, case–control, cross-sectional, case-crossover, ecologic, case series, case reports) assessing the effectiveness of certain interventions; Health technology Assessment (HTA) studies qualitative studies; reviews (systematic, scoping) and meta-analyses. Non – empirical studies: (e.g., commentary, some of the editorial pieces, erratum etc.)	Study of animals, cells, or other non-human subjects Basic research at genetic or molecular levels without field or semi-field experimental data; Development of analytical tools or strategies; clinical guidelines and interpretation of them; causal inference studies to identify risk factors; Non – empirical studies: (e.g., commentary, some of the editorial pieces, erratum etc.)
Objective	To introduce or examine an innovative malaria product satisfying the definition*	Other objectives than introducing or examining an innovative malaria product satisfying the definition*
Result	Result of the study should expose the application information of the product.	No focus on the product or no expose of the product application information.
Study time	2013 to 2023	Before 2013 or after 2023

* The definition: technology and device developments in surveillance, microplanning, prevention, diagnosis, and treatment of malaria (*20*).

Quality Assessment

Critical appraisal checklists developed by the Joanna Briggs Institute (JBI), an international research organization specializing in evidence-based healthcare, were utilized for quality assessment of the studies, including Diagnostic Test Accuracy Studies, Quasi-Experimental Studies, and Case Reports (*21*–*23*). For each study meeting the inclusion criteria, the corresponding critical appraisal aligned with its study design was applied to evaluate quality. Two independent researchers conducted the data inclusion-exclusion process using EndNote X9 (Clarivate, Philadelphia, USA) before submitting the individual checklist outcomes for each study to the entire research

team for final inclusion-exclusion determination.

Data Analysis

Evidence charting and synthesis were performed in accordance with the 2020 updated scoping review methodological guidelines by the JBI team (*24*). For included studies, evidence charting focused on a) the major research institution of the first author or corresponding author, b) the innovative products introduced in the study, c) the nationality of the participating institutes, d) the major challenges and opportunities, e) the study language, and f) research progress. During the evidence synthesis process, we categorized the data into clusters of prevention, diagnosis, and treatment based on the definition of malaria product innovation from Chibi, Wasswa, Ngongoni, Baba and Kalu (*20*). Two researchers conducted evidence extraction and data charting using Microsoft Excel 2016 (Microsoft Corp., Redmond, WA, USA).

RESULTS

Description of Included Studies

A total of 11,112 English articles were retrieved, including 1,311 from PubMed, 7,102 from Web of Science, and 2,699 from ScienceDirect. After removing 269 duplicates, 10,615 articles were excluded based on title and abstract review. Full-text review led to the exclusion of 151 articles that did not meet inclusion criteria, 27 articles with unavailable full texts, and 1 article duplicated in Chinese literature. Following JBI quality assessment, 5 papers were rejected due to inadequate experimental design. Ultimately, 44 English articles were included in the final analysis.

For Chinese literature, 2,944 relevant articles were retrieved, including 1,275 from Wanfang and 1,669 from CNKI. After removing 362 duplicates, 2,468 articles were excluded based on title and abstract review. Full-text review led to the exclusion of 91 articles that did not meet inclusion criteria and 8 articles with unavailable full texts. One article published in both Chinese and English was included only in its Chinese version. Following JBI quality assessment, 2 papers were rejected due to inadequate experimental design. Ultimately, 13 Chinese articles were included in the final analysis.

Annual Distribution of Chinese and English Publications

Figure 2 illustrates the annual distribution of Chinese and English publications from 2013 to 2023. The number of English publications consistently exceeded Chinese publications throughout the study period. From 2017 to 2023, English publications maintained relative stability at approximately six publications per year. In contrast, Chinese publications were fewer in number and showed greater fluctuations.

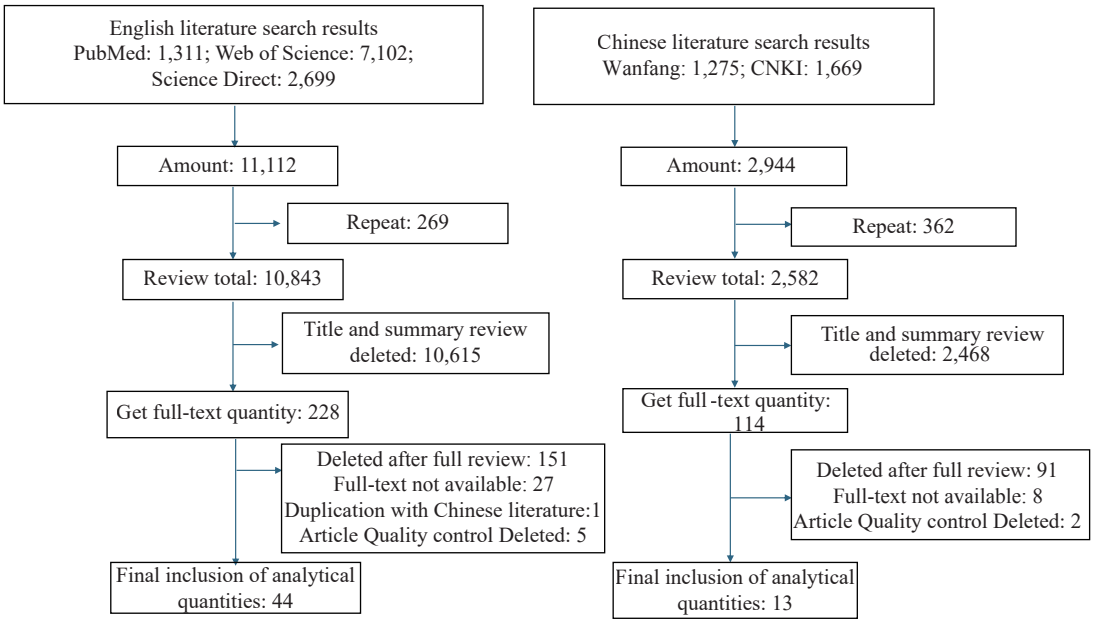

FIGURE 1. Screening process and results of literature review.

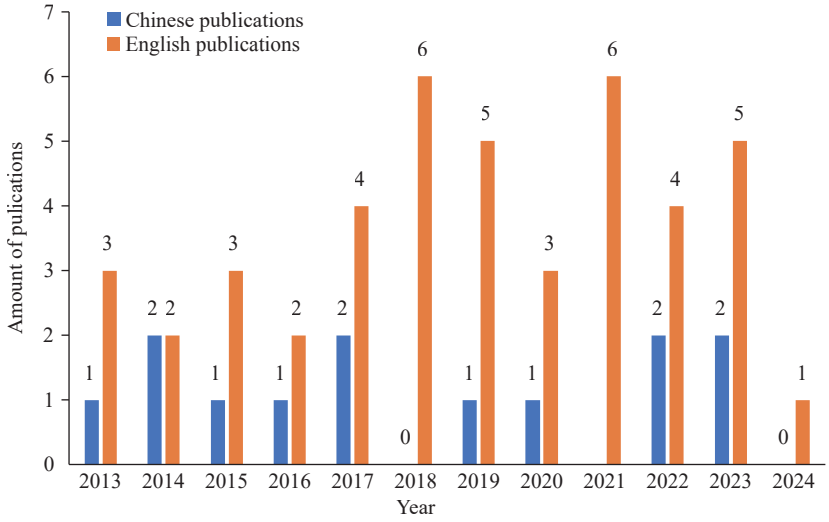

FIGURE 2. Distribution of publications by year.

English publications peaked in 2018 and 2021 with six entries each, followed by a slight decline while maintaining stability. Chinese publications remained scattered across other years with only one or two entries annually. The predominance of English publications in both quantity and yearly consistency suggests either greater international attention to the research topic or a more globally oriented approach to disseminating research outcomes.

Affiliated Institutions and Collaborators

The affiliated institutions in China conducting malaria research primarily include universities, research institutes, hospitals, disease control centers, and enterprises. Among the publications reviewed, 36 had first or corresponding authors from universities, 12 from research institutes, 9 from hospitals, 3 from disease control centers, and 2 from firms, with 3 from other enterprises or institutions.

In our literature review, 37 articles represented collaborations exclusively among Chinese institutions (11 in Chinese and 26 in English), while 10 involved collaborations with the United States and 2 with Pakistan. Additional collaborative research was conducted with institutions in Australia, Sweden, France, Germany, Italy, Colombia, India, Gabon, Niger, Sierra Leone, and Iraq.

Applicable Technologies in Malaria Prevention, Diagnosis, and Treatment

Based on our research review, malaria control technologies primarily focus on three key areas: vector control, pathogen screening and diagnosis, and prevention and treatment. For detailed information regarding specific Malaria R&D innovations, their development stages, and other related information mentioned in these results, please refer to the Supplementary Table S1. Significant advancements have been achieved in each area, as detailed below:

Vector control Research on vector control primarily focuses on larval control and adult mosquito interventions. In larval control, two published studies have examined Capture and Ligation Probe-PCR (CLIP-PCR) and recombinase-mediated constant temperature amplification (RAA). For adult mosquito control, Professor Sibao Wang's team has conducted two studies on *Serratia* strains (Y1 and J1) isolated from field-caught female *Anopheles sinensis* from China, assessing their effect on *Plasmodium* development in *An. stephensi*, as well as the symbiont-mediated RNAi (smRNAi) approach. Additionally, Professor He Qi's team has investigated the efficacy of *Zanthoxylum acanthopodium* essential oil as a vector control agent.

Pathogen screening and diagnosis In the area of pathogen screening and diagnosis, we categorize advancements into instrument innovation, technological innovation, and analytical method innovation.

Instrument innovation primarily focuses on biosensor Development, such as the Portable Microfluidic Aptamer-Tethered Enzyme Capture (APTEC) Biosensor for Malaria Diagnosis, which detects changes in red blood cell and platelet parameters in patients with malignant malaria.

Technological Innovation encompasses AI monitoring, software and big data integration, and

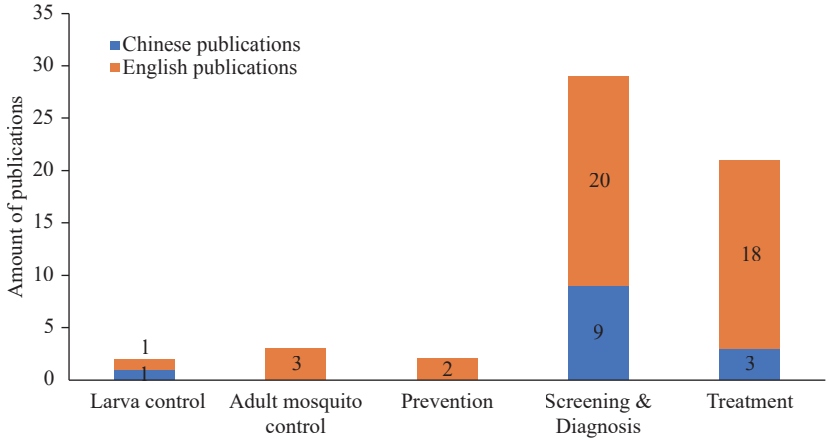

FIGURE 3. Prevention and treatment phases cited by literature.

platform construction. The University of Hong Kong has developed whole genome sequencing and big data analysis technology for *Plasmodium falciparum*, establishing a genome polymorphism database and variation and evolution analysis model.

Analytical method innovation represents significant progress beyond traditional pathogen screening methods that relied on blood films and malaria antigen detection. Currently, there are 8 advancements in staining malarial parasites and serological detection, alongside 20 new amplification gene, nucleic acid, and protein detection technologies.

Prevention and treatment Artemisinin-based combination therapy, currently the most important weapon in the global fight against malaria, is the first-line antimalarial treatment vigorously promoted by the World Health Organization. Among the treatment and prevention advancements identified, 8 (57.1%) are related to artemisinin. Currently, 15 technologies have progressed to field and semi-field testing stages. Additionally, 11 advancements have been made in industrial pharmaceuticals.

Through this literature review, we found that malaria research in China is primarily conducted by universities, with major international collaborations involving institutions in the United States, Europe, and Australia. Research efforts concentrate on pathogen screening and diagnosis, with several technologies having advanced to field and semi-field testing stages.

DISCUSSION

This scoping review identified key innovations in China's malaria-related R&D across three domains: vector control, diagnostic technologies, and prevention and treatment.

Significance and Potential of China's Innovations

Despite global progress in malaria R&D, significant gaps persist in addressing drug and insecticide resistance, RDT sensitivity, cost-effectiveness, and detection of asymptomatic cases (*25*–*30*). China's R&D trends offer promising solutions to these challenges and complement global efforts, with many innovations focused on improving the sensitivity, cost-effectiveness, and accessibility of malaria interventions. Non-chemical vector control methods, including the smRNAi approach and the use of *Zanthoxylum acanthopodium* essential oil, provide alternatives that reduce dependence on insecticides (*31*). These environmentally sustainable approaches can mitigate the rise of insecticide resistance, particularly in regions where traditional methods have become less effective (*32*). Additionally, China's advancements in vector control, such as CLIP-PCR technology, enhance the precision and efficiency of vector management, enabling more targeted interventions in areas with diverse *Anopheles* species. In diagnostics, aptamer-mediated diagnostic systems and AI-based platforms for analyzing thin-blood smears address critical shortcomings of existing tools. These technologies potentially offer higher sensitivity, rapid results, and simpler application in field conditions. By making malaria diagnostics more accessible and affordable, these advancements show promise for strengthening surveillance systems and ensuring timely treatment. China has also made significant contributions to next-generation malaria vaccines by enhancing the

immunogenicity of *Plasmodium* antigens and developing novel vaccine candidates. In drug delivery and chemoprevention, China's innovations include novel delivery systems such as lipid emulsions for intravenous administration of artemisinin and other antimalarial drugs (*33*). These systems improve drug absorption and address challenges in treating severe malaria and multidrug-resistant strains.

Promoting China's R&D to Accelerate Global Malaria Elimination

Globally, malaria R&D has been supported by robust funding mechanisms, partnerships, and the application of innovations in malaria-endemic regions. In contrast, China faces limited R&D partnerships, funding mechanisms, and global application of innovative tools. In terms of partnerships, global efforts often emphasize collaborations with private enterprises and international organizations through public-private partnerships (PPPs). These collaborations have driven the rapid translation of innovations into field applications. In China, however, partnerships with private enterprises remain underdeveloped, limiting the scalability and deployment of novel tools. Regarding funding mechanisms, most of China's malaria R&D relies on domestic funding, such as the National Natural Science Foundation of China (NSFC). International funding mechanisms such as the Bill & Melinda Gates Foundation (BMGF) and PATH are currently supporting China's malaria R&D and their application to malaria-endemic regions. Nevertheless, there remains a substantial funding gap for China's malaria R&D. In terms of application of China's innovative malaria products, the country's malaria-free status makes it difficult for researchers to find suitable fields for applying their products domestically. Applying these products in malaria-endemic regions outside China would be an alternative, but insufficient funding and lack of local partners and experience, including unfamiliarity with foreign regulations and additional coordination requirements, restricts their global impact. These factors inhibit China's R&D from contributing effectively to global malaria elimination efforts.

To maximize the global impact of China's malaria-related R&D, the following strategies should be considered. First, strengthening partnerships with international organizations, such as the WHO, Global Fund, and the Roll Back Malaria Partnership. These partnerships can not only ensure China's innovations are aligned with global health priorities, but also help to refine existing technologies and ensure their successful deployment in malaria-endemic regions, ultimately facilitating faster uptake of Chinese innovations on the global stage. Second, developing close collaboration with local research institutions and government agencies such as malaria programmes. China's innovations must be adapted to local contexts in malaria-endemic regions. Collaboration with local institutions, malaria programmes, and health authorities will ensure solutions developed in China are accessible and culturally appropriate (*34*). Third, increased investment and PPPs in translational research are needed to bridge the gap between laboratory research and field implementation. This includes support for clinical trials, regulatory approvals, and the commercialization of products. Promoting policies that foster collaboration between research institutions, government agencies, and private enterprises is essential to accelerate the development and deployment of malaria-related products (*35*). Fourth, streamlining the process for regulatory approvals of China's malaria innovations. Collaborations with WHO and other international, regional, and local health organizations such as the African Medicines Agency (AMA), can facilitate the approval of malaria-related products in various markets, ensuring their widespread use (*20*,*36*–*37*). Fifth, capacity building should be delivered within local health systems for healthcare workers, researchers, and policymakers during the implementation of these innovations. This will not only ensure that new technologies are used effectively, but also support local malaria programmes in strengthening their ability to achieve elimination goals (*38*). Lastly, the competencies of those engaging in China's global malaria efforts should also be strengthened to ensure a smooth translation and application of China's domestic products and expertise to foreign contexts (*39*–*40*). Improved global health competencies will promote trust with local counterparts and facilitate the adaptation of products and technologies.

This scoping review has several limitations. Firstly, we only searched the peer-reviewed literature and did not include grey literature from government, institutional, and enterprise websites. This omission could result in missed information, particularly from companies. Our previous investigations have shown that many Chinese companies do not publish their technologies unless collaborating with research entities. Secondly, although we used an appraisal checklist to

assess the quality of the publications, we were unable to evaluate the effectiveness of the identified advancements. Lastly, the final literature search was conducted at the end of 2023, which may limit the timeliness of the findings.

CONCLUSION

China's malaria R&D offers innovative solutions to global challenges. Advancements in non-chemical vector control, diagnostics, and vaccines demonstrate China's potential to complement global malaria elimination efforts. To maximize impact, we call for global attention to strengthening international collaboration with China in malaria R&D to accelerate the commercialization, regulatory approval, and large-scale deployment of innovations.

Conflicts of interest: No conflicts of interest.

Funding: Supported by the Bill and Melinda Gates Foundation (INV-061480) and the National Key R&D Program of China (grant number 2024YFC2309900).

doi: 10.46234/ccdcw2025.105

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Submitted: February 28, 2025
Accepted: April 28, 2025
Issued: May 02, 2025

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SUPPLEMENTARY MATERIAL

SUPPLEMENTARY TABLE S1. China's Malaria R&D Innovations Identified in This Scoping Review (2013–2023).

Stage of control	Year of publication	Language	Affiliation	Study type	Product or technology	Phase of the study
Adult mosquito control	2018	English	University	Experimental	Zanthoxylum acanthopodium essential oil	Laboratory
	2019	English	University	Observational	Two Serratia strains (Y1 and J1) isolated from field-caught female *Anopheles sinensis* from China and assessed their effect on *Plasmodium* development in *An. Stephensi*	Laboratory
	2023	English	University	Experimental	Symbiont-mediated RNAi (smRNAi) approach	Laboratory
Screening and diagnosis	2013	English	University	Observational	Sandwich RNA hybridization assay	Laboratory
	2013	English	University	Experimental	*Plasmodium vivax* aldolase-specific monoclonal antibodies	Laboratory
	2014	Chinese	Research institute	Observational	The small subunit ribosomal ribonucleic acid gene amplified by nested polymerase chain reaction for the diagnosis of three-day *Plasmodium* infection	Field
	2014	English	Research institute	Observational	The Wondfo Rapid diagnostic Kit (Pf-HRP2/PAN-pLDH)	Laboratory
	2014	Chinese	Hospital	Observational	A highly sensitive visual closed-tube detection method for *Plasmodium falciparum* based on Loop-mediated Isothermal Amplification (LAMP) technology	Laboratory
	2015	Chinese	Hospital	Observational	SYBR Green Real-time PCR	Laboratory
	2015	English	University	Experimental	The immunogenicity of HRP 2 exon II and the novel monoclonal antibodies (mAbs) against HRP 2 for Point-of-Care Test (POCT)	Laboratory
	2017	Chinese	CDC	Observational	Parallel diagnosis composed of thick blood smears and rapid *Plasmodium* detection (RDT)	Laboratory
	2017	English	University	Observational	The LAMP assay with the primer set PF3D7_1253300-5	Laboratory
	2017	English	University	Observational	A rapid antibody-free diagnostic method of malaria infection with *Plasmodium falciparum* and *Plasmodium vivax* in whole blood with Surface-enhanced Raman Spectroscopy using Nanostructured Gold Substrate	Semi-Field
	2018	English	University	Observational	A Portable Microfluidic Aptamer-Tethered Enzyme Capture (APTEC) Biosensor for Malaria Diagnosis.	Laboratory
	2018	English	University	Observational	A novel aptamer-based electrochemical biosensor (aptasensor) for malaria detection by impedance. Spectroscopy, through the specific recognition between a highly discriminatory DNA aptamer and its target *Plasmodium falciparum* lactate dehydrogenase (PfLDH).	Laboratory
	2018	English	University	Observational	Aptamer-mediated *Plasmodium*-specific diagnosis of malaria	Laboratory
	2019	English	Hospital	Observational	Mindray BC-6800 hematology analyzer	Laboratory
	2019	Chinese	University	Observational	nABPs obtained by recombinant expression and purification using genetic engineering technology, and a colloidal gold immunochromatography detection method	Laboratory
	2020	Chinese	Research institute	Observational	Loop-mediated isothermal amplification technology for capture and connection	Laboratory
	2020	English	University	Observational	A novel fluorescence probe of *Plasmodium vivax* lactate dehydrogenase based on adenosine monophosphate protected bimetallic nanoclusters	Laboratory
	2022	Chinese	Hospital	Observational	Changes of red blood cell and platelet parameters in patients with malignant malaria	Field
	2022	English	University	Observational	The novel LAMP assay based on the *P. falciparum* actin I gene	Semi-Field
	2022	English	University	Observational	Multi-section Capture and Ligation Probe PCR (mCLIP-PCR).	Semi-Field
	2022	Chinese	Other	Observational	A group of primer pairs with better amplification effects; The amplification of the entire RAA system could be completed in 20 minutes at 37 ℃ using the best primer pairs.	Laboratory
	2022	English	Other	Experimental	An assay using recombinase-aided amplification (RAA) and a lateral-flow dipstick (LFD) (RAA-LFD) to detect the 18S ribosomal RNA gene of *Plasmodium* species	Laboratory

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Stage of control	Year of publication	Language	Affiliation	Study type	Product or technology	Phase of the study
Screening and Diagnosis	2022	English	Research institute	Observational	The mμLAMP detection system: a new detection system, i.e., multiplex microfluidic loop-mediated isothermal amplification (mμLAMP) array, was developed to provide a convenient, rapid and economical detection system for malaria diagnosis.	Laboratory
	2023	Chinese	Hospital	Observational	The blood cell histogram of the BC-5300 blood cell analyzer combined with blood smear microscopy to detect *Plasmodium*	Semi-Field
	2023	English	Research institute	Observational	AIDMAN: An AI-based object detection system for malaria diagnosis from smartphone thin-blood smear images	Semi-Field
	2023	English	Hospital	Observational	A rapid multiplex assay of human malaria parasites by digital PCR	Semi-Field
	2023	English	CDC	Experimental	An Innovative Point-of-Care Rapid Diagnostic Test for the identification of imported malaria parasites in China	Field
	2023	English	University	Observational	A simple alkaline lysis method for DNA extraction from blood samples on filter paper.	Laboratory
	2024	English	University	Observational	A field-applicable, ultrasensitive malaria diagnostic tool based on CRISPR-Cas13a for the detection of *P. falciparum* in whole blood samples	Laboratory
Larva control	2015	English	University	Observational	Capture and Ligation Probe-PCR (CLIP-PCR)	Laboratory
	2016	Chinese	Other	Observational	Recombinant enzyme-mediated isothermal amplification RAA technology	Laboratory
Prevention	2015	English	University	Observational	The discovery of a novel virulence factor of *P. falciparum*, a TatD-like DNase (PfTatD) that is expressed primarily in the asexual blood stage and is likely utilized by the parasite to counteract NETs.	Laboratory
	2016	English	University	Experimental	The cryptic epitopes of different antigens in the sporozoite and liver stages of *Plasmodium falciparum* to increase their immunogenicity without changing T cell antigen receptor (TCR)-peptide binding specificity	Laboratory
Treatment	2013	Chinese	Hospital	Experimental	Artesunate combined with CVVH treatment	Field
	2013	English	University	Observational	Novel Selective and Potent Inhibitors of Malaria Parasite Dihydroorotate Dehydrogenase: Dihydrothiophenone Derivatives	Laboratory
	2014	English	University	Observational	Endoperoxide polyketides from a Chinese Plakortis simplex	Laboratory
	2016	English	University	Experimental	Prototypes of lateral flow dipstick assays	Field
	2017	English	University	Observational	Inosine monophosphate dehydrogenase (IMPDH), an important target for antimalarial drug discovery	Laboratory
	2017	English	University	Observational	The component in A. annua extracts (MAE) leading to enhanced antiplasmodial potency of QHS via regulation of its metabolism	Laboratory
	2017	Chinese	Hospital	Experimental	The efficacy of acupuncture combined with artemisinin-based drugs in the treatment of malaria	Field
	2018	English	University	Observational	The supplementation of L-Arg may be a promising adjunctive therapy to reduce malaria-associated mortality in endemic areas. susceptibility to parasite synchronously by regulating host immune responses against P.y17XL, producing better outcomes for malaria infection	Laboratory
	2018	English	University	Experimental	Lipid emulsions for intravenous co-delivery of artemether and lumefantrine in severe malaria treatment	Laboratory
	2019	English	University	Observational	Identified a novel series of dual inhibitors through fragments assembly	Laboratory
	2019	English	Research institute	Observational	4-Aryl pyrrolidines as a novel class of orally efficacious antimalarial agents	Laboratory
	2019	English	University	Experimental	Overexpression of AaPIF3	Semi-Field
	2020	English	University	Observational	A series of artemisinin-sulfonamide hybrids (1–16)	Laboratory
	2020	English	University	Observational	Drug Repurposing of Quisinostat to Discover Novel *Plasmodium falciparum* HDAC1 Inhibitors with Enhanced Triple-Stage Antimalarial Activity and Improved Safety	Laboratory

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Stage of control	Year of publication	Language	Affiliation	Study type	Product or technology	Phase of the study
Treatment	2021	English	Research institute	Experimental	Naphthoquine-Azithromycin Coformulation	Field
	2021	English	Hospital	Observational	Employed comparative genomics analysis and identified parasite-infected erythrocyte-specific protein 2 (PIESP2) to be a CM-related protein; further experimental investigations found that PIESP2 is an immunogenic protein	Laboratory
	2021	English	University	Observational	PfDXR inhibitors with improved pharmacology/safety	Laboratory
	2021	English	Research institute	Observational	The identification of a *Plasmodium*-blocking symbiotic bacterium, *Serratia ureilytica* Su_YN1	Laboratory
	2021	English	University	Observational	An HMFN-based delivery system with considerable antimalarial efficacy	Laboratory
	2021	English	University	Experimental	Heparin-decorated nanostructured lipid carriers of artemether-protoporphyrin IX-transferrin combination for therapy of malaria	Laboratory
	2023	Chinese	CDC	Experimental	The treatment of vivax malaria in children with Wumei Pills combined with Compound dihydroartemisinin Tablets and primaquine regimens	Field