Okereke *et al. Malaria Journal* (2025) 24:412
https://doi.org/10.1186/s12936-025-05656-4

Malaria Journal

REVIEW

Open Access

Mobile app-based malaria surveillance and vector control integration: a scoping review of evidence from endemic settings

Promise Udohchukwu Okereke[1,2,3,4,5*], Obumneme Wisdom Okereke[1,4], Benedicta Oluwafisayomi Ogunyinka[6], Scholarstica Itohan Aluele[6], Rukayat Aderonke Tiamiyu[6], Mobolaji Alexander Afolabi[6], Chukwuemeka Victor Umeh[7], Emmanuel Uchechukwu Nwibo[8], Solomon Nnanyelugo Ibekwe[1,2], Andrew Chukwuemeka Ogbu[9], Emmanuel Onyekachukwu Okwor[8], Chigozie Cindy Onwurah[3] and Nzubechukwu Ogamba[2,9]

Abstract

Background Effective malaria surveillance is critical for timely and targeted vector control, especially in endemic settings approaching elimination. In recent years, mHealth technologies have emerged as promising tools to improve case detection, reporting efficiency, and spatial targeting of interventions. However, the extent to which mobile-app-based surveillance systems are integrated with vector control strategies remains unclear. This scoping review aimed to synthesize existing evidence on the implementation of mobile-based malaria surveillance platforms and assess their role in supporting or enhancing vector control interventions.

Methods Following the PRISMA-ScR framework, a comprehensive search was conducted across PubMed, Web of Science, EMBASE (via Ovid) and Google Scholar for studies published between 2010 and 2024. Eligible studies reported on the use of mHealth for malaria surveillance with direct or inferred linkage to vector control activities such as indoor residual spraying (IRS), long-lasting insecticidal nets (LLINs), or larval source management. A total of 152 articles were identified, of which 20 met the inclusion criteria after screening and full-text review. Data were extracted and thematically analysed across five domains: timeliness, integration, community engagement, challenges, and policy alignment.

Results Mobile surveillance systems such as MCBR (Myanmar), SOCH and MCS (India), and MRRS (Zambia) significantly improved the timeliness of case reporting and enabled more precise vector control responses. GIS-enabled tools supported hotspot identification and real-time intervention planning. Community-based platforms like Fever-Tracker enhanced case detection and local engagement. However, challenges such as poor internet access, low digital literacy, and limited national policy integration impeded sustainability and scalability. Only a few platforms were institutionalized within national malaria strategies.

Conclusion Mobile-app-based malaria surveillance platforms offer substantial potential to accelerate elimination goals when integrated with vector control strategies. Success depends on interoperability, community participation, and long-term policy support. Future efforts should prioritize the institutionalization of these tools within national health systems and explore adaptive models for deployment in resource-constrained settings.

*Correspondence:
Promise Udohchukwu Okereke
promise.okereke.240740@unn.edu.ng
Full list of author information is available at the end of the article

Keywords Malaria surveillance, Mobile health, mHealth, Vector control, Mobile apps, Scoping review, Endemic regions

Background

Malaria continues to be a leading public health concern, particularly in sub-Saharan Africa where transmission intensity, weak health infrastructure, and vector and drug resistance combine to create complex epidemiological challenges. According to the World Health Organization (WHO) World Malaria Report 2023, an estimated 249 million malaria cases and 608,000 deaths occurred globally in 2022, with approximately 94% of cases and 95% of deaths concentrated in the WHO African Region [1, 2].

The global strategy to eliminate malaria has emphasized prevention through vector control interventions such as using long-lasting insecticidal nets (LLINs) and indoor residual spraying (IRS), coupled with effective case management [3]. However, these interventions are only as effective as the surveillance systems that guide them. Surveillance systems are tasked with detecting outbreaks, monitoring resistance, evaluating programme impact, and informing resource allocation [4, 5]. Weak surveillance contributes to underreporting, delays and misalignment of interventions—ultimately undermining elimination efforts [6, 7].

In response, mobile health (mHealth) technologies have emerged as a promising avenue for improving malaria surveillance. The WHO defines mHealth as the use of mobile and wireless technologies to support the achievement of health objectives [5]. Mobile-based surveillance platforms allow frontline health workers to collect, transmit, and analyse case data in real-time, increasing the precision and speed of outbreak response and control efforts [8]. Several countries, including Zambia, India, and Myanmar, have piloted or implemented such systems with promising results [8–10]. It is also important to note that while many mHealth applications have demonstrated value for case detection and epidemiological surveillance, few directly incorporate modules for vector control interventions such as IRS or LLIN distribution, highlighting a critical gap in the digital ecosystem [6, 9].

Despite their promise, mHealth platforms are often implemented in isolation from vector control programmes, or national health systems, reducing their long-term impact and scalability. Moreover, few studies systematically examine how mobile surveillance data are integrated into targeted vector control interventions, such as focal IRS, larval source management, or community mobilization. Understanding these linkages is critical for advancing toward malaria elimination in resource-constrained settings [11, 12].

This scoping review aims to synthesize evidence on mobile-app-based malaria surveillance systems and assess how they inform or enhance targeted vector control interventions. Specifically, the review seeks to answer the question: "*What is known from the existing literature about the implementation and impact of mobile-app-based malaria surveillance systems on targeted vector control interventions in endemic settings?*".

Methods

Study design

This scoping review was conducted in accordance with the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) guidelines. It aims to map the body of literature related to mobile-based malaria surveillance tools and their interaction with vector control efforts. Because this scoping review did not involve human participants, institutional review board (IRB) approval were not required.

Eligibility criteria

Inclusion criteria

This scoping review included peer-reviewed studies published between 2010 and 2025 that described or evaluated the implementation, feasibility, or outcomes of mobile health (mHealth) or mobile-app-based systems for malaria surveillance and/or vector control. Eligible studies included: (i) Implementation experiences of digital or mobile-based malaria surveillance systems, (ii) quantitative, qualitative, or mixed-methods evaluations of such systems, (iii) theoretical frameworks or models describing best practices in digital malaria surveillance and (iv) studies reporting direct or indirect linkages between surveillance and vector control (e.g., use of case data for LLIN/IRS targeting or environmental sanitation).

Exclusion criteria

Studies were excluded if they focused solely on laboratory, experimental, or molecular surveillance unrelated to digital or vector control applications (e.g., resistance genetics). Opinion pieces, commentaries, and studies lacking malaria- or vector-control-relevant data were also excluded.

During synthesis, inclusion criteria were iteratively refined, as recommended in PRISMA-ScR, to ensure comprehensive coverage of relevant evidence. This process allowed inclusion of studies that, while primarily surveillance-focused, presented clear implications for vector control decision-making.

Information sources and search strategy

Searches were conducted on PubMed, Web of Science, EMBASE (via OVID) and Google Scholar using key terms such as "mobile app," "malaria surveillance," "vector control," and "malaria elimination." The search also involved manual screening of reference lists from relevant articles to identify additional studies. The search primarily targeted mHealth that supported case surveillance with explicit or inferred linkages to vector control interventions (IRS, LLIN, larval management).

Selection process

Studies were included if they either integrated epidemiological surveillance with vector control components, or that demonstrated clear application of digital tools to guide vector control interventions. Purely entomological surveillance tools without such linkage were excluded.

For the purpose of this review, *vector control integration* was defined broadly as any direct or indirect linkage between malaria surveillance and vector control interventions. This included systems that directly recorded vector control coverage or activities (e.g., IRS or LLIN campaigns), systems that used surveillance data to inform vector control planning or response, mHealth tools supporting community-level vector management, environmental sanitation, or entomological monitoring aligned with malaria programmes and/or interoperable national platforms where case surveillance data were used for vector control decision-making.

A total of 162 records were identified through systematic searches. After removal of 18 duplicates, 144 articles remained which was subjected to initial screening of titles and abstracts and 101 articles removed. Full texts of 43 articles were assessed, out of which 25 met the inclusion criteria. The selection process is illustrated in the PRISMA-ScR flow diagram in Fig. 1 [13].

Data extraction and charting

As shown in Table 1, a structured data extraction form was used to systematically collect information, including authors, year, and country, description of the mobile app/system, surveillance and reporting capabilities, linkage to vector control interventions, and reported outcomes and limitations. Two reviewers independently extracted the data, with discrepancies resolved through consensus.

Synthesis of results

The findings were analysed using thematic synthesis, which grouped the results into key themes, including the timeliness and accuracy of reporting, integration with vector control strategies, community engagement and acceptability, technological and operational challenges, and sustainability and policy integration. This approach allowed for a comprehensive understanding of the studie's results.

Results

Overview of included studies

A total of 25 studies met the inclusion criteria and were included in this scoping review. These studies were conducted across a range of malaria-endemic settings including Myanmar, India, Indonesia, Zambia, Kenya, USA, Ethiopia, Nigeria, Ghana, Uganda, Tanzania and Cape Verde. The selected studies encompassed evaluations of mobile-based malaria surveillance platforms, pilot implementations, feasibility assessments, and reviews of programmatic applications in the context of vector control. Most studies emphasized how these mobile tools functioned within national or district-level health systems, with some including modeling approaches to predict long-term impact. As shown in Table 1, common tools featured in the studies included the *Malaria Case-Based Reporting (MCBR)* system in Myanmar, *SOCH* and *MoSQuIT* in India, *Malaria Control System (MCS)* in Mangaluru, *FeverTracker*, and Zambia's *Malaria Rapid Reporting System (MRRS)*. Others focused on mobile-supported IRS programmes, SMS-driven community alert systems, and mobile-assisted environmental sanitation coordination.

As illustrated in Fig. 2, nine of the 25 studies (36%) demonstrated direct integration of surveillance and vector-control activities, nine (36%) reported partial linkages, and seven (28%) focused exclusively on surveillance or strategic frameworks. Figure 3 shows the regional distribution, with six global frameworks and the highest country-level contributions from India (4) and Kenya (3).

Timeliness and accuracy of surveillance reporting

Several studies highlighted the transformative impact of mobile-based surveillance tools in improving the timeliness and precision of malaria case reporting. In Myanmar, the MCBR app was credited with enabling health workers to report cases within 24 h, significantly reducing the lag between diagnosis and national-level response [8]. India's SOCH platform also demonstrated enhanced accountability and data accuracy by supporting frontline health workers in recording field-level case details, treatment initiation, and stock monitoring through handheld devices [9]. Similarly, in Indonesia, Hasyim et al. [11], found that an Android-based surveillance system facilitated faster and more complete data entry by healthcare workers in remote districts, streamlining coordination between district and national malaria programmes.

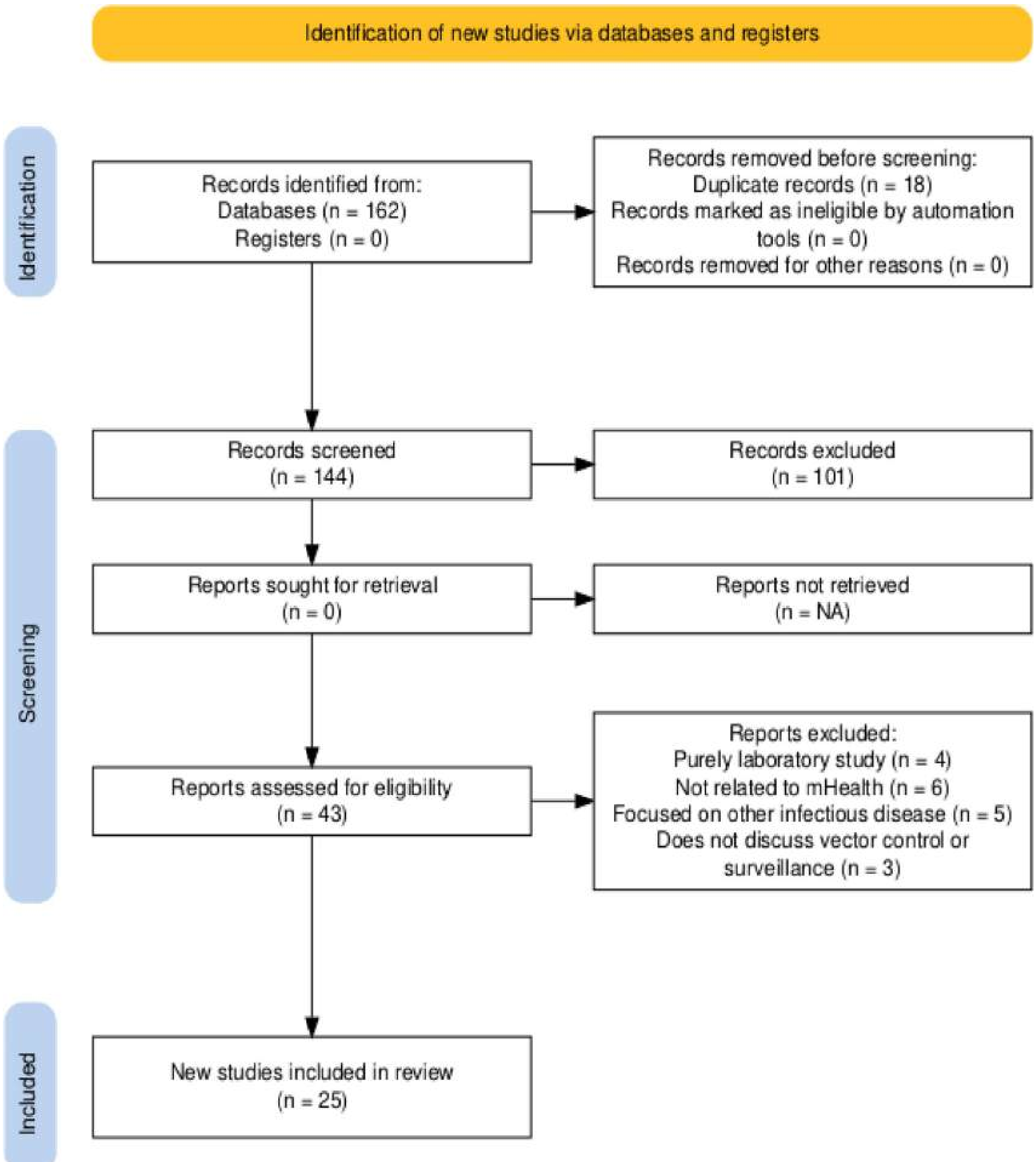

Fig. 1 PRISMA-ScR flow diagram showing the study selection process

Other examples include the GIS-enabled *MCS system* in Mangaluru, which captured real-time data on confirmed cases and enabled early tracking of treatment status. The programme's implementation was associated with a measurable reduction in malaria incidence over time [17]. Likewise, *FeverTracker*, a community-facing application piloted in northeastern India, allowed real-time reporting of febrile illnesses with GPS tagging, supporting active case detection and early intervention [19]. The *MoSQuIT* platform also demonstrated promising

Table 1 Summary of included studies on mobile-app-based malaria surveillance and vector control integration (n = 25)

Citation	Country/region	Platform/tool	Functionality	Key outcomes	Limitations	Vector control linkage
WHO (2023) [2]	Global	World malaria report	Annual surveillance analytics	Provides baseline policy and burden estimates	Not empirical data	No
WHO (2019) [5]	Global	HBHI framework	Targeted digital response strategy	Supports stratified surveillance	Not intervention-specific	No
Hemingway et al. (2016) [4]	Global	Strategic policy tools	mHealth convergence framework	Defines digital–policy integration	Limited field-level validation	No
Moonen et al. (2020) [14]	Global	Feasibility framework	mHealth readiness for elimination	Outlines key integration principles	Theoretical scope	No
Lourenço et al. (2019) [15]	Global	Surveillance systems landscaping	Global review of malaria surveillance performance	Identified critical system gaps and readiness for elimination	Variable data quality and reporting standards across regions	Partial – informs strategic VC planning
Sturrock et al. (2015) [7]	Global	Elimination tools	Surveillance for elimination stages	Reinforces need for VC–surveillance linkage	Requires strong national systems	Partial
Takala-Harrison et al. (2019) [16]	SE Asia	Resistance surveillance apps	Genomic resistance tracking	Real-time data sharing	Complex implementation	No
Baliga et al. (2021) [17]	India	MCS App	GIS-enabled surveillance & response	Reduced incidence post-digitization	High implementation cost	Yes – hotspot-driven IRS/LLIN
Rajvanshi et al. (2021) [9]	India	SOCH App	Surveillance, HR & logistics management	Improved accountability and timeliness	Limited national scale-up	Partial – LLIN/IRS logistics
Patgiri et al. (2022) [18]	India (Border areas)	MoSQuIT	Cross-border malaria reporting	Improved response tracking	Connectivity issues	Partial – focal IRS/LLIN response
Bhowmick et al. (2023) [19]	India	FeverTracker	Community reporting of febrile illness	Enhanced community participation	User training required	No direct – informs mobilization
Oo et al. (2020) [8]	Myanmar	MCBR	Case-based mobile reporting	24-h notification improvement	Digital literacy barriers	Yes – targeted IRS/LLIN
Hasyim et al. (2022) [11]	Indonesia	Custom Android App	Digital case surveillance	Faster input & rural usability	Connectivity constraints	No
Zambia NMEC (2020) [10]	Zambia	MRRS	Weekly case reporting system	Improved national LLIN/IRS targeting	Scaling challenges	Yes – national LLIN/IRS planning
Hamainza et al. (2014) [20]	Zambia	CHW Mobile Reporting	Community-level surveillance	Improved data completeness and VC planning	Some entry inconsistencies	Yes – IRS/LLIN targeting
Githinji et al. (2014) [21]	Kenya	SMS reporting system	Health worker malaria case reporting	Improved timeliness of reports	Variable phone access	Partial – informed IRS prioritization
Soti et al. (2015) [22]	Kenya	Electronic data app	Field data capture for malaria	Improved completeness and accuracy	Network dependency	Yes – guided IRS planning
Ng'ang'a et al. (2019) [23]	Kenya	Community-embedded app	Participatory malaria & IVM surveillance	Strengthened community uptake	Weak feedback systems	Yes – integrated vector mgmt. (IVM)
Mekasha et al. (2020) [24]	Ethiopia	IRS-SMS Alert System	Household spraying alerts	Improved IRS compliance	Low mobile coverage	Yes – IRS campaign linkage
Asiimwe et al. (2011) [25]	Uganda	SMS-based open-source tool	Remote malaria monitoring	Faster reporting and confirmation	Connectivity constraints	Partial – focal IRS/LLIN coordination
Mponzi et al. (2025) [26]	Tanzania	MozzWear App	Community mosquito-sound recording	Increased citizen participation	Need for sustained incentives	Yes – community vector monitoring
Agyemang-Badu et al. (2023) [27]	Ghana	SMS alert coordination	Environmental & vector-control alerts	Improved community engagement	Limited device access	Yes – community vector reduction

Table 1 (continued)

Citation	Country/region	Platform/tool	Functionality	Key outcomes	Limitations	Vector control linkage
Mbunge et al. (2024) [28]	Zimbabwe	Mobile health service model	Health service coordination	Strengthened local malaria service delivery	Scalability challenges	Partial – policy-level VC linkage
Scherr et al. (2016) [29]	Multi-country	Mobile imaging + cloud system	Diagnostic imaging and reporting	Automated detection & mapping	Needs stable connectivity	Partial – supports hotspot targeting

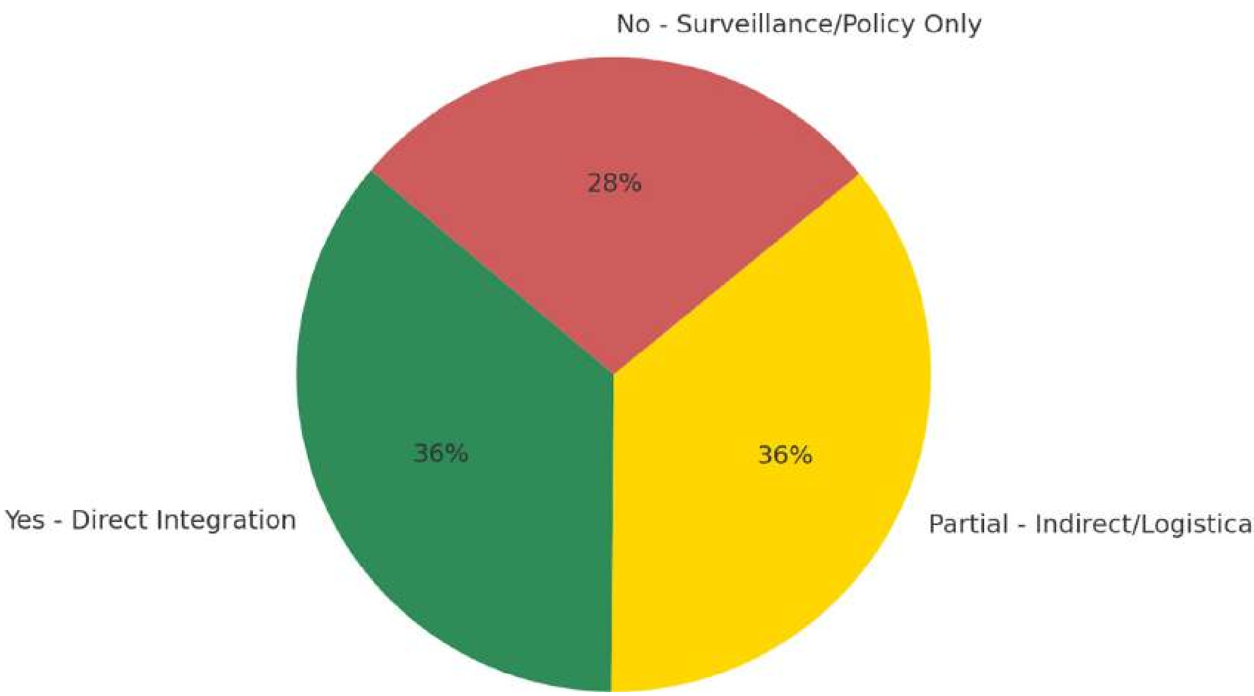

Fig. 2 Degree of vector-control integration among the 25 included studies. Nine (36%) demonstrated direct integration, nine (36%) partial integration, and seven (28%) addressed surveillance or strategic frameworks without explicit vector-control linkage

improvements in surveillance efficiency in India's border regions, although its utility was hindered by synchronization delays and network issues [18]. In Zambia, the introduction of MRRS, a mobile-enabled system that supplemented the Health Management Information System (HMIS), improved the frequency and granularity of malaria data collection, replacing monthly paper reports with weekly digital updates [10].

Integration with vector control interventions

To strengthen the quantitative assessment in line with recent recommendations by Lourenço et al., 2019, all included systems were classified by their degree of vector control integration [15]. As shown in Fig. 2, nine of the included studies (36%) demonstrated direct integration of surveillance and vector-control activities, nine (36%) exhibited partial linkage through logistical or policy mechanisms, and seven (28%) focused exclusively on surveillance or strategic frameworks without explicit vector-control components.

Figure 3 illustrates the geographical distribution, showing that global and multi-country studies accounted for 24% of the total, while the largest national contributions were from India (16%), Kenya (12%), and the Southeast Asia region (12%).

Community engagement and app usability

Engaging local communities in the surveillance process was shown to be critical for both app adoption and vector control success. Studies from India, Kenya, and Sri Lanka emphasized how participatory design and education campaigns increased both App uptake and the effectiveness of intervention measures. The *FeverTracker* App in India involved community volunteers and frontline

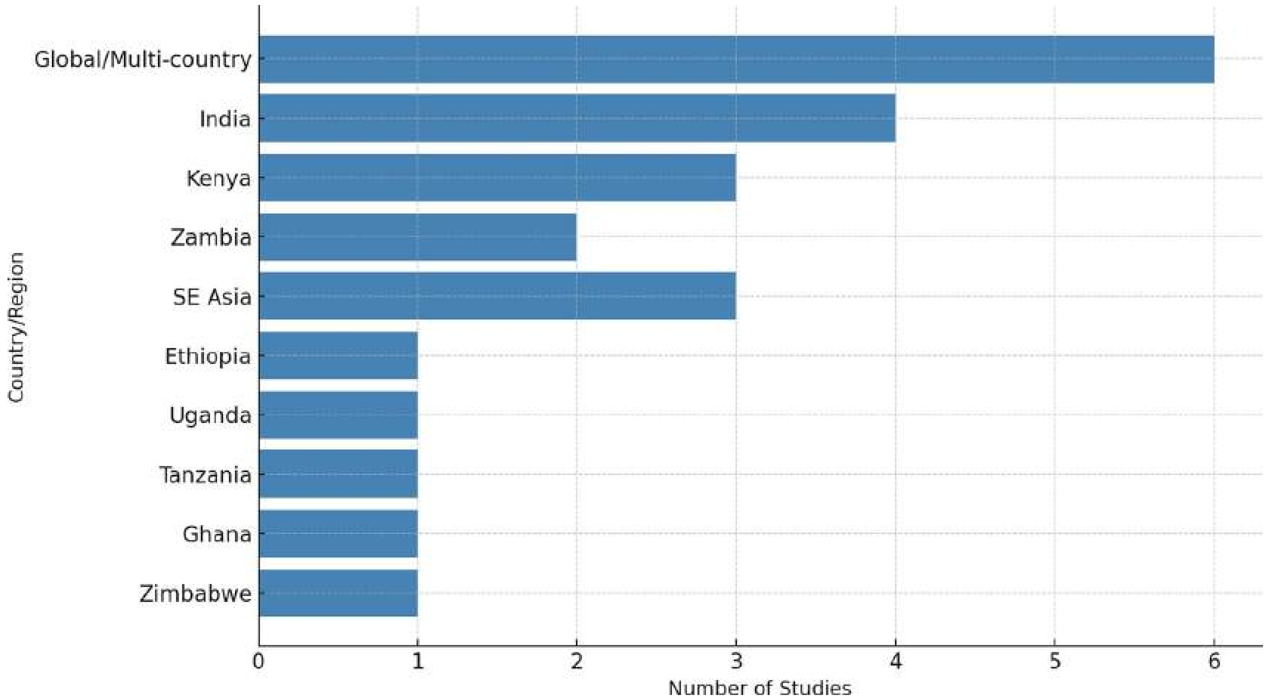

Fig. 3 Geographic distribution of the 25 included studies. Six studies (24%) described global or multi-country frameworks, while India (16%), Kenya (12%), and Southeast Asia (12%) accounted for the largest shares among endemic-country analyses

health workers in its pilot testing, which contributed to improved compliance with case reporting protocols and increased public trust in the health system [19].

In Kenya, Ng'ang'a et al. [23], reported that embedding mobile surveillance tools into integrated vector management (IVM) initiatives significantly enhanced community ownership and participation. In Ethiopia, the use of mobile phones to send text alerts about IRS spraying schedules resulted in higher household participation and acceptance [24]. Cape Verde's successful malaria-free certification campaign was supported by mobile-based community surveillance structures that enabled residents to report vector hotspots and fever cases in real time, reinforcing government response capacity [12]. The predominance of studies from South and East Asia reflects both population burden and rapid adoption of national digital health information platforms such as DHIS2 and country-specific mobile systems.

Implementation barriers and operational challenges

Despite the evident benefits, multiple studies identified persistent technical, infrastructural, and systemic barriers. Poor internet connectivity was frequently cited, especially in rural or remote settings, limiting the real-time syncing of surveillance data [11, 18]. In Myanmar, health workers reported difficulty using the MCBR app due to limited digital literacy, resulting in inconsistent data entry and underreporting [8]. Similar usability challenges were echoed in studies from India and Ghana, where weak feedback loops, battery limitations, and device attrition reduced reporting consistency [27].

Sustainability was another cross-cutting concern. While Zambia's MRRS and India's MCS have received ongoing government support, other systems such as SOCH and MoSQuIT remained donor-funded pilots with no clear scale-up strategy [9, 18]. Furthermore, several studies observed that even when high-quality surveillance data were collected, they were not always integrated into national health planning systems, limiting their use for strategic decision-making [4, 6].

Policy alignment and national integration

Some countries have begun to institutionalize mobile surveillance tools within broader national malaria control strategies. Zambia's MRRS is now embedded in its national Malaria Elimination Strategic Plan [10]. India's MCS platform, initially launched as a municipal project in Mangaluru, is now operational across several districts and supports the National Vector Borne Disease Control Programme [17]. In contrast, other tools such as *FeverTracker* and *SOCH*, despite strong local impact, have yet to be formally integrated at national scale.

Cape Verde and Algeria's malaria-free certification campaigns leveraged mobile-based community surveillance to support WHO protocols for elimination [6, 12]. However, as highlighted by Musoke et al. [6], the lack of standardized digital reporting frameworks across LMICs limits comparability, scaling, and institutional uptake of mHealth tools.

Discussion

Overview of key findings

This scoping review identified 25 studies examining mobile-app-based malaria surveillance systems and their degree of integration with vector-control activities across endemic settings. Approximately one-third (36%) of studies demonstrated direct integration between surveillance and vector-control decision-making, another 36% showed partial or indirect linkage, mainly through logistics, supply chain, or health workforce coordination, and 28% focused solely on surveillance or policy analytics without explicit vector-control components The predominance of hybrid integration models indicates that many national malaria programmes remain in transition from siloed digital reporting toward fully unified systems that connect epidemiological, entomological, and intervention data streams (Fig. 2). Similar trends have been noted in WHO's High Burden to High Impact (HBHI) framework and in recent surveillance modernization efforts in endemic countries [2, 5].

The current findings align with prior digital-health assessments demonstrating that most malaria-endemic countries have prioritized case-based surveillance digitization before pursuing complete integration with vector-control datasets [4, 14, 15]. Similar conclusions were reported in analyses of DHIS2-based modules in Zambia, India, and Kenya, which showed that while mobile reporting improved data timeliness, interoperability with vector-control planning tools remained limited [17, 20–22]. These experiences echo WHO's global surveillance recommendations, which encourage joint analysis of case data and intervention coverage for adaptive malaria control [2, 5].

Despite such policy momentum, the evidence base remains uneven: high-burden regions often rely on fragmented mHealth pilots or isolated electronic registers [9, 10, 19], while few have achieved comprehensive integration of LLIN, IRS, or larval-management data into national surveillance dashboards. Recent studies highlight this digital divide between epidemiological and vector-control systems, emphasizing the need for standardized data-sharing protocols [11, 15, 29].

Timeliness and accuracy of reporting

Across settings, mHealth consistently improved the speed and accuracy of malaria case notification. In Myanmar, case reporting within 24 h increased following adoption of the Mobile Case-Based Reporting (MCBR) system [8]. Similar gains were observed in Zambia's *Malaria Rapid Reporting System* and *CHW Mobile Reporting* platforms, where weekly submissions enhanced data completeness and reduced backlog [10, 20]. Indian systems such as SOCH and MCS demonstrated notable gains in accountability and real-time mapping of hotspots [9, 17].

However, accuracy occasionally suffered from digital-literacy barriers, network instability, and limited data validation in remote areas [11, 18, 23]. These findings mirror WHO's observation that data timeliness has improved faster than accuracy in the digital surveillance transition [2, 5].

Integration with vector-control strategies

Integration depth varied widely. Direct-integration studies, notably in Zambia [10, 20], Ethiopia [24], and India [9, 17], linked surveillance outputs with vector-control actions such as IRS or LLIN distribution, leading to more targeted interventions. Partial-integration models, such as Kenya's *MoSQuIT* and Ghana's SMS-based sanitation alerts, supported logistics and planning without direct operational linkage [22, 27]. Pure surveillance tools such as WHO frameworks and Moonen et al. 2020 nonetheless provided policy scaffolds for integration [2, 4, 5, 14].

These gradients confirm that integration is not binary but progressive, ranging from data sharing to operational coupling. They also highlight the opportunity to embed entomological and intervention layers within existing DHIS2 or IHIP infrastructures for adaptive vector-control decision-making.

Community engagement and acceptability

Several studies emphasized community participation as a determinant of sustainability. Participatory systems, such as *FeverTracker* in India [19], *MozzWear* in Tanzania [26], and community-embedded Apps in Kenya [23], enhanced local ownership, trust, and prompt reporting. SMS-based tools in Uganda [25] and Ghana [27] enabled rural populations to report environmental and vector-related risks despite limited connectivity.

Conversely, inadequate feedback mechanisms and insufficient user training reduced sustained engagement [11, 23, 27]. These experiences reaffirm that technology adoption depends on sociocultural alignment and ongoing capacity-building at the community level.

Implementation challenges

Despite their promise, several challenges limited effectiveness. Digital literacy issues hindered the use of MCBR in Myanmar [8], while MoSQuIT and Apps in Indonesia suffered from poor internet coverage and synchronization delays [18]. Others like SOCH and FeverTracker remained pilot projects with limited scalability due to funding or system integration constraints [9, 19]. Technological constraints including unstable networks, device shortages, and inconsistent data standards, were recurrent barriers [9, 11, 18, 19, 22]. Interoperability between surveillance and vector-control databases remains limited, often due to fragmented software ecosystems and weak national e-health governance [4, 15, 17]. Operationally, pilot initiatives such as MCS and MoSQuIT achieved localized success but struggled with national scalability and maintenance costs [9, 17, 22]. The lack of standardized metadata structures further hampers cross-country comparability of outcomes.

Addressing these barriers will require unified digital architectures, open-source interoperability, and dedicated financing for system upkeep beyond donor-funded cycles.

Toward institutional integration

Only a few tools, such as Zambia's MRRS and MCS in India, have been embedded into national malaria programmes [10, 17]. Others showed strong local effectiveness but lacked clear policy uptake mechanisms. Shomuyiwa et al. [12] demonstrated how national adoption of mobile-supported surveillance contributed to Cape Verde's WHO malaria-free certification, underscoring the value of institutional commitment and cross-sectoral integration. These findings align with broader perspectives in digital epidemiology, which emphasize the need for spatiotemporal integration of surveillance and intervention data [15].

Strengths and limitations

This scoping review provides one of the most comprehensive syntheses to date on mobile-app-based malaria surveillance and its integration with vector-control interventions. By systematically reviewing 25 studies across multiple endemic settings, it captures both empirical evidence and conceptual frameworks, offering a holistic understanding of how digital technologies are transforming malaria surveillance ecosystems. The inclusion of studies spanning national programmes, community-based tools, and global policy frameworks enhances external validity and provides a comparative perspective across regions and technological maturities.

A key strength lies in the use of an expanded inclusion criterion that accommodated quantitative, qualitative, and theoretical contributions. This approach allowed mapping of diverse evidence, ranging from country-level implementation experiences in India, Zambia, and Kenya to community-driven innovations such as MozzWear in Tanzania and FeverTracker in India. The review also applied PRISMA-ScR guidance to ensure methodological transparency and clearly documented the degree of integration across all included studies.

However, several limitations must be acknowledged. The studies reviewed were heterogeneous in design, indicators, and digital maturity, which limited the ability to perform direct comparisons or aggregate metrics. Many were pilot or donor-supported projects with short observation periods, resulting in scarce data on sustainability, interoperability, or long-term health outcomes. Furthermore, publication and language bias are likely, as only English-language peer-reviewed papers were included, potentially underrepresenting local and governmental implementations in non-English-speaking endemic countries.

Finally, the lack of standardized definitions for "mHealth," "digital surveillance," and "vector-control integration" across studies complicated synthesis. Variations in scope, from basic data capture to fully integrated decision-support platforms, made it necessary to interpret integration contextually rather than uniformly. These constraints highlight the need for harmonized frameworks and open-access reporting standards to improve comparability and accelerate the transition toward fully interoperable digital malaria surveillance systems.

Recommendations

Institutionalize mobile surveillance platforms

Governments in endemic countries should move beyond pilot phases and adopt mobile-based surveillance systems into their national malaria strategic plans. Systems like MRRS (Zambia) and MCS (India) demonstrate that such tools can be scaled and maintained when aligned with policy and resource flows. Only 2 of 25 systems (MRRS in Zambia, MCS in India) have been scaled into national programmes, showing a need for wider institutional adoption.

Integrate surveillance data into real-time vector control decision-making

Mobile tools must be linked to vector control operations, including IRS, LLIN distribution, and environmental interventions. It was seen that about 7 of 25 systems linked surveillance directly to IRS, LLIN, or larval management, demonstrating the feasibility of full integration. Without this, case detection remains isolated from response. Integrated decision dashboards with geospatial mapping should be a priority.

Prioritize community engagement and digital literacy

Training and community ownership are vital. Programs like FeverTracker and those in Sri Lanka, Ethiopia, and Kenya illustrate how community integration boosts both surveillance data quality and intervention uptake.

Address technological barriers through offline functionality and device equity

Mobile platforms must function in low-connectivity areas. Offline data capture and asynchronous syncing are essential features. Poor connectivity was a limiting factor in over half the studies, highlighting the need for offline-first systems. Governments and donors must also invest in durable, accessible devices for frontline workers.

Encourage multisectoral collaboration and cross-border data sharing

Elimination requires cross-border data sharing; few systems addressed this gap. Malaria does not respect borders. Mobile platforms should be interoperable with neighbouring health systems and capable of supporting cross-border surveillance, especially in conflict zones or migratory regions.

Fund long-term implementation research

Future research should focus on evaluating cost-effectiveness, long-term impact on malaria incidence, and adaptation across varying ecological and health system contexts. Ministries of Health and academic partners should collaborate to generate evidence on real-world outcomes.

Conclusion

This scoping review synthesized evidence from 19 studies on mobile-app-based malaria surveillance platforms and their integration with targeted vector control interventions in endemic settings. The findings suggest that mHealth tools hold strong potential to enhance the timeliness, accuracy, and coordination of malaria surveillance and vector control activities. However, broader institutional adoption, sustainable financing, and technical interoperability remain essential for realizing their full impact.

Moreover, surveillance systems that are coupled with community engagement—as demonstrated in FeverTracker, MoSQuIT, and participatory models from Kenya and Cape Verde—show improved adoption and effectiveness. These results echo previous global evaluations, which emphasize that the utility of surveillance tools is maximized only when data are not only collected but acted upon through operationally responsive vector control.

However, challenges persist. Many programmes remain pilot-based and lack long-term sustainability plans or institutional integration. Technical limitations such as weak connectivity, digital illiteracy, and infrastructure gaps hinder broader deployment. The absence of standardized frameworks for integrating mobile surveillance data into national malaria dashboards continues to limit strategic coordination and policy feedback loops.

Abbreviations

EMS	Environmental management strategies
GIS	Geographic information system
HBHI	High burden to high impact
HMIS	Health management information system
IRS	Indoor residual spraying
IVM	Integrated vector management
LLIN	Long-lasting insecticidal net
LMIC	Low- and middle-income country
MCBR	Malaria case-based reporting
MCS	Malaria control system
MoSQuIT	Mobile surveillance quest using information technology
MRRS	Malaria rapid reporting system
mHealth	Mobile health
SMS	Short message service
SOCH	Solution for community health-workers
WHO	World Health Organization

Author contributions

PUO and BOO conceptualized the study. All authors wrote the first and final drafts. All authors read and approved the final manuscript.

Funding

There was no funding received for this study.

Data availability

The datasets generated and/or analysed during the current study are not publicly available due to participant confidentiality, but are available from the corresponding author, Dr. Promise Udohchukwu Okereke, on reasonable request (email: promise.okereke.240740@unn.edu.ng).

Declarations

Ethics approval and consent to participate

Not applicable as this is a review article.

Competing interests

The authors declare no competing interests.

Author details

[1]Faculty of Dentistry, College of Medicine, University of Nigeria, Enugu, Nigeria. [2]Youth Health Action Network (YOHAN Research Institute), Enugu, Nigeria. [3]University College Hospital, Ibadan, Nigeria. [4]Ideal Dental Foundation International, Abuja, Nigeria. [5]Global Leadership in Dentistry and Sciences, Washington DC, USA. [6]Faculty of Nursing, College of Medicine, University of Ibadan, Ibadan, Nigeria. [7]Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, UK. [8]Belgorod State National Research University, Belgorod, Russia. [9]Faculty of Medical Sciences, College of Medicine, University of Nigeria, Enugu, Nigeria.

Received: 24 May 2025 Accepted: 29 October 2025
Published online: 19 November 2025

References

1. Li J, Docile HJ, Fisher D, Pronyuk K, Zhao L. Current status of malaria control and elimination in Africa: epidemiology, diagnosis, treatment, progress and challenges. J Epidemiol Glob Health. 2024;14:561–79.
2. WHO. Malaria policy advisory group (MPAG) meeting report, 18–20 April 2023. Geneva, World Health Organization; 2023.
3. Akinwale OD, Okereke PU, Akinbowale BT, Awosanya FO, Abdulsalam BO, Akintola AB, et al. Assessing the effectiveness of current malaria control

strategies in Nigeria: a systematic review and meta-analysis. Int J Med Health Dev. 2025 (preprint).
4. Hemingway J, Shretta R, Wells TN, Bell D, Djimdé AA, Achee N, et al. Tools and strategies for malaria control and elimination: what do need to achieve a grand convergence in malaria? PLoS Biol. 2016;14:e1002380.
5. WHO. RBM Partnership to End Malaria. High burden to high impact: a targeted malaria response. Geneva, World Health Organization, 2019.
6. Musoke D, Atusingwize E, Namata C, Ndejjo R, Wanyenze RK, Kamya MR. Integrated malaria prevention in low-and middle-income countries: a systematic review. Malar J. 2023;22:79.
7. Sturrock HJ, Roberts KW, Wegbreit J, Ohrt C, Gosling RD. Tackling imported malaria: an elimination endgame. Am J Trop Med Hyg. 2015;93:139.
8. Oo WH, Thu KM, Cutts JC, Htike W, Win KM, Oo MC, et al. Sustainability of a mobile phone application-based data reporting system in Myanmar's malaria elimination program: a qualitative study. BMC Med Inform Decis Mak. 2021;21:285.
9. Rajvanshi H, Jain Y, Kaintura N, Soni C, Chandramohan R, Srinivasan R, et al. A comprehensive mobile application tool for disease surveillance, workforce management and supply chain management for Malaria Elimination Demonstration Project. Malar J. 2021;20:91.
10. Zambia National Malaria Elimination Centre (ZNMEC). National Malaria Monitoring & Evaluation Plan 2022–26. [Internet]. Ministry of Health, Lusaka, Zambia; 2021. Available from: https://static1.squarespace.com/static/58d002f017bffcf99fe21889/t/63bd16278c8d0e551501511b/1673336371825/NMEC+Monitoring+and+Evaluation+Plan_2022-2026_Final+SIGNED.pdf
11. Hasyim H, Heroza RI, Misnaniarti M, Idris H, Maharani FE, Dale P. Malaria surveillance information system using an Android mobile phone: a qualitative study in Lahat District, South Sumatra Province, Indonesia. Malays J Med Health Sci. 2024;20:62–70.
12. Shomuyiwa DO, Okesanya OJ, Okon II, Ekerin O, Manirambona E, Lucero-Prisno IIIDE. Cabo Verde's malaria-free certification: a blueprint for eradicating malaria in Africa. J Taibah Univ Med Sci. 2024;19:534.
13. Haddaway NR, Page MJ, Pritchard CC, McGuinness LA. *PRISMA2020* : An R package and shiny app for producing PRISMA 2020-compliant flow diagrams, with interactivity for optimised digital transparency and open synthesis. Campbell Syst Rev. 2022;18:e1230.
14. Moonen B, Cohen JM, Tatem AJ, Cohen J, Hay SI, Sabot O, et al. A framework for assessing the feasibility of malaria elimination. Malar J. 2010;9:322.
15. Lourenço C, Tatem AJ, Atkinson PM, Cohen JM, Pindolia D, Bhavnani D, et al. Strengthening surveillance systems for malaria elimination: a global landscaping of system performance, 2015–2017. Malar J. 2019;18:315.
16. Takala-Harrison S, Jacob CG, Arze C, Cummings MP, Silva JC, Dondorp AM, et al. Independent emergence of artemisinin resistance mutations among *Plasmodium falciparum* in Southeast Asia. J Infect Dis. 2015;211:670–9.
17. Baliga BS, Baliga S, Jain A, Kulal N, Kumar M, Koduvattat N, et al. Digitized smart surveillance and micromanagement using information technology for malaria elimination in Mangaluru, India: an analysis of five-year post-digitization data. Malar J. 2021;20:139.
18. Patgiri SJ, Gohain GG, Goswami SK, Bhattacharyya DR, Debnath SHD, Panat L, et al. Development and on-field deployment of a mobile-based application 'MoSQuIT' for malaria surveillance in international border districts of Northeast India—challenges and opportunities. Int J Environ Res Public Health. 2022;19:2561.
19. Bhowmick IP, Chutia D, Chouhan A, Nishant N, Raju PLN, Narain K, et al. Validation of a mobile health technology platform (FeverTracker) for malaria surveillance in India: development and usability study. JMIR Form Res. 2021;5:e28951.
20. Hamainza B, Killeen GF, Kamuliwo M, Bennett A, Yukich JO. Comparison of a mobile phone-based malaria reporting system with source participant register data for capturing spatial and temporal trends in epidemiological indicators of malaria transmission collected by community health workers in rural Zambia. Malar J. 2014;13:489.
21. Githinji S, Kigen S, Memusi D, Nyandigisi A, Wamari A, Muturi A, et al. Using mobile phone text messaging for malaria surveillance in rural Kenya. Malar J. 2014;13:107.
22. Soti DO, Kinoti SN, Omar AH, Logedi J, Mwendwa TK, Hirji Z, et al. Feasibility of an innovative electronic mobile system to assist health workers to collect accurate, complete and timely data in a malaria control programme in a remote setting in Kenya. Malar J. 2015;14:430.
23. Ng'ang'a PN, Aduogo P, Mutero CM. Strengthening community and stakeholder participation in the implementation of integrated vector management for malaria control in western Kenya: a case study. Malar J. 2021;20:155.
24. Mekasha W, Daba C, Malede A, Debela SA, Gebrehiwot M. The need for strengthening health information dissemination toward indoor residual spraying for malaria prevention in malarious area of Ethiopia. Front Public Health. 2022;10:913905.
25. AsiimC, Gelvin D, Lee E, Amor YB, Quinto E, Katureebe C, et al. Use of an innovative, affordable, and open-source short message service–based tool to monitor malaria in remote areas of Uganda. Am J Trop Med Hyg. 2011;85:26.
26. Mponzi WP, Dam R, Msaky D, Mwalugelo Y, Sinka M, Kiskin I, et al. "Fighting against malaria is everyone's concern": a randomized control trial assessing the role of incentives for encouraging local communities to record and upload mosquito sounds using the MozzWear application. Malar J. 2025;24:295.
27. Agyemang-Badu SY, Awuah E, Oduro-Kwarteng S, Dzamesi JYW, Dom NC, Kanno GG. Environmental management and sanitation as a malaria vector control strategy: a qualitative cross-sectional study among stakeholders, Sunyani Municipality, Ghana. Environ Health Insights. 2023;17:11786302221146890.
28. Mbunge E, Millham RC, Sibiya MN, Takavarasha Jr S. Leveraging mobile phones to improve malaria healthcare service delivery in Buhera rural communities: implications for practice and policy. Behav Inf Technol. 2024;1–14.
29. Scherr TF, Gupta S, Wright DW, Haselton FR. Mobile phone imaging and cloud-based analysis for standardized malaria detection and reporting. Sci Rep. 2016;6:28645.

Publisher's Note