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Effects of Integrated Referral Information Systems on Maternal Survival-Related Outcomes and Referral Performance: A Focused Systematic Review of SISRUTE-Like Maternal Referral Interventions

Erni Suryani Wongso¹, Zulvayanti², Hardi Sursiano³
^{1,2,3} Universitas Padjadjaran, West Java, Indonesia
 Email correspondensi : Ernisuryani5999@gmail.com

Track Record Article Accepted: Published:	<i>Abstract</i> <i>Despite the importance of prompt referral for maternal survival, there is a lack of conclusive evidence about the efficacy of integrated or mobile referral information systems in improving clinically significant maternal outcomes. Ultimately, we aim to compile data showing if referral treatments for mothers, similar to SISRUTE, enhance outcomes related to maternal survival and the efficacy of referrals. A focused systematic review was conducted using Scopus and PubMed to look for English-language records published between 2000 and 2025. The search followed the rationale of PRISMA 2020. By intentionally excluding all maternal referral studies, this review focuses on well-established digital, mobile, or information-based strategies for referring pregnant women. Six full-text papers were considered for the primary synthesis after deduplication and screening. The included studies represented a total of four countries: Iraq, Liberia, Ghana, and Uganda. Interventions included phone conversations prior to referral, a referral platform based on WhatsApp, and the Mobile Obstetric Referral Emergency System (MORES), which was occasionally augmented with triage conducted by midwives. The evidence strongly supported the idea of enhancing the process. In Uganda, prereferral phone calls were associated with lower adverse maternal-fetal outcomes (adjusted odds ratio [aOR] 0.22, 95% CI 0.09-0.44). In Ghana, the median response time on the WhatsApp platform was 17 minutes, and a receiving hospital was identified in 82.7% of posted cases. In Liberia, MORES plus midwife-led triage reduced the median decision-to-incision interval by 117.5 minutes and increased the odds of cesarean delivery within 75 minutes (aOR 11.75, 95% CI 1.32-104.54). Direct evidence for maternal mortality reduction was insufficient. SISRUTE-like maternal referral interventions appear most effective for strengthening communication, triage, preparedness, and emergency timeliness rather than for demonstrating direct mortality reduction. Their contribution to maternal survival is most plausibly indirect and depends on transport, receiving-facility readiness, and implementation support</i> Keyword: <i>maternal referral, digital health, e-referral, obstetric emergency, mHealth, triage, maternal survival.</i>
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INTRODUCTION

Maternal mortality remains a persistent marker of health-system inequity, especially where women with obstetric complications depend on rapid access to comprehensive emergency obstetric care. The WHO says maternal mortality is still too high, and most fatalities occur in low- and lower-middle-income countries (World Health Organization, 2025).

In these situations, the referral channel is not a minor administrative concern. It is often* the practical link between first contact care and life-saving treatment. Even when women do manage to go to a formal healthcare facility, their outcomes can be poorer due to communication breakdowns, incomplete documentation, poor transportation

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coordination, and unprepared receiving facilities, according to long-standing studies on maternal referrals (Daniels & Abuosi, 2020; Ofosu et al., 2021; Avoka et al., 2022; Ameyaw et al., 2022; Mengist et al., 2024; Harahap et al., 2021). Qualitative and process-mapping studies in Ghana and Ethiopia have identified issues such as insufficient information, ineffective feedback loops, poor coordination between referring and receiving facilities, and uncertainty regarding service readiness in referral systems (Daniels & Abuosi, 2020; Ofosu et al., 2021; Mengist et al., 2024). A sub-Saharan African systematic study, despite methodological flaws, indicated that referral decision-making, communication, and feedback could enhance emergency obstetric referrals (Avoka et al., 2022).

More people recommend digital health for cooperation. A 2023 WHO research found digital initiatives could do more than replace paper forms (World Health Organization, 2023). They can help with provider communication, care coordination, data visibility, and health system administration. Electronic and mobile interventions can improve service utilization, antenatal attendance, follow-up, and some maternal-newborn indicators, but the evidence is inconsistent and often focuses on mHealth in general or antenatal care rather than emergency referral pathways (Ameyaw et al., 2024). Further study is needed to assess the effects of diverse digital interventions on emergency referral pathways and develop best practices for equitable access to these technologies for all populations. Addressing these gaps allows stakeholders to use digital health solutions to improve maternal and neonatal health worldwide (Knop et al., 2024; Kachimanga et al., 2024; Kirwa et al., 2025; Mohamed et al., 2025; Shartyanie et al., 2025; Ngwenya et al., 2025).

This difference is important for systems like SISROUTE. Structured prereferral phone notifications, messaging-based referral platforms, mobile obstetric emergency systems, and interconnected triage tools are all examples of practical solutions that strive to make referral pathways more clear, responsive, and accountable. Nonetheless, the current literature often amalgamates three disparate lines of evidence: firstly, research that employs non-digital methods to elucidate referral obstacles; secondly, studies that delineate prototype applications in the developmental phase; and thirdly, studies that document variations in referral efficacy stemming from established intervention studies. It remains challenging to evaluate the influence of digital maternal referral systems on survival-related outcomes without clarifying* these streams.

This review therefore focuses deliberately on mature digital, mobile, or information-based maternal referral interventions analogous to SISROUTE-like systems. The review asks

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whether these interventions improve maternal survival-related outcomes and referral effectiveness, and which contextual factors appear to shape their success or failure.

METHODS

2.1 Review design and reporting framework

This study was structured as a targeted systematic review and is presented in accordance with PRISMA 2020 guidelines (Page et al., 2021). Narrative synthesis was specified as the main analytic approach because the final evidence base was heterogeneous in intervention architecture, study design, outcome definitions, and implementation maturity (Paré & Kitsiou, 2017). A formal protocol was not prospectively registered, which is acknowledged as a limitation of the present review.

2.2 Eligibility criteria

Studies were eligible if they involved pregnant, intrapartum, or postpartum women; obstetric emergency referrals; or health workers managing maternal referrals, and if they evaluated a digital, mobile, or information-based referral intervention. Eligible interventions included structured prereferral phone communication, WhatsApp-based referral systems, digital referral platforms, and mobile obstetric emergency systems. Outcomes of interest were maternal survival-related outcomes, maternal-fetal adverse outcomes, referral timeliness, communication, coordination, treatment preparedness, or implementation feasibility directly linked to referral effectiveness. Studies focused only on non-digital referral barriers, prototype development without meaningful implementation evidence, or non-maternal referral populations were excluded from the main synthesis.

2.3 Information sources and search strategy

Searches were completed in Scopus and PubMed for English-language records published between 1 January 2000 and 31 December 2025. The search strategy combined four concept blocks: maternal or obstetric population; referral or transfer processes; digital or mobile referral interventions; and survival-related or referral-effectiveness outcomes. Scopus records were refined to article and review records and PubMed results were filtered to English-language publications within the defined period. The completed search rounds yielded 37 Scopus records and 19 PubMed records for final export and screening.

2.4 Selection process, data extraction, and quality appraisal

After deduplication, records were screened by title and abstract against predefined criteria. Full texts of potentially relevant records were then reviewed against the stricter digital-

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systems scope used for the main synthesis. Data extraction captured country, design, setting, sample, intervention features, comparator framework, outcomes, key findings, implementation insights, and major limitations. Design-appropriate critical appraisal was conducted using JBI qualitative and quasi-experimental logic, supplemented by a structured appraisal of feasibility and observational process studies.

2.5 Synthesis approach

The main synthesis was restricted to mature digital or mobile maternal referral interventions that provided empirical evidence on referral effectiveness or closely related maternal outcomes. One Indonesian maternal referral app paper and one Malawian radio-network communication study were retained as contextual studies for Discussion only. They informed interpretation of digital maturity and transport bottlenecks, but were not counted as effectiveness studies in the main synthesis.

RESULTS

3.1 Study selection

The database searches yielded 56 records (37 from Scopus and 19 from PubMed). After the removal of 14 duplicates, 42 unique records underwent title and abstract screening. Thirty records were excluded as clearly outside the strict review scope. Twelve full texts were reviewed in detail. Six studies met the criteria for the primary synthesis. Six additional full texts were excluded from the primary synthesis because they represented broader non-digital communication interventions, development-focused application studies without evaluative effectiveness data, or contextual/background papers without eligible intervention-effect estimates. Two of these excluded studies were retained for narrative contextual discussion only and were not counted as included studies in the primary synthesis.

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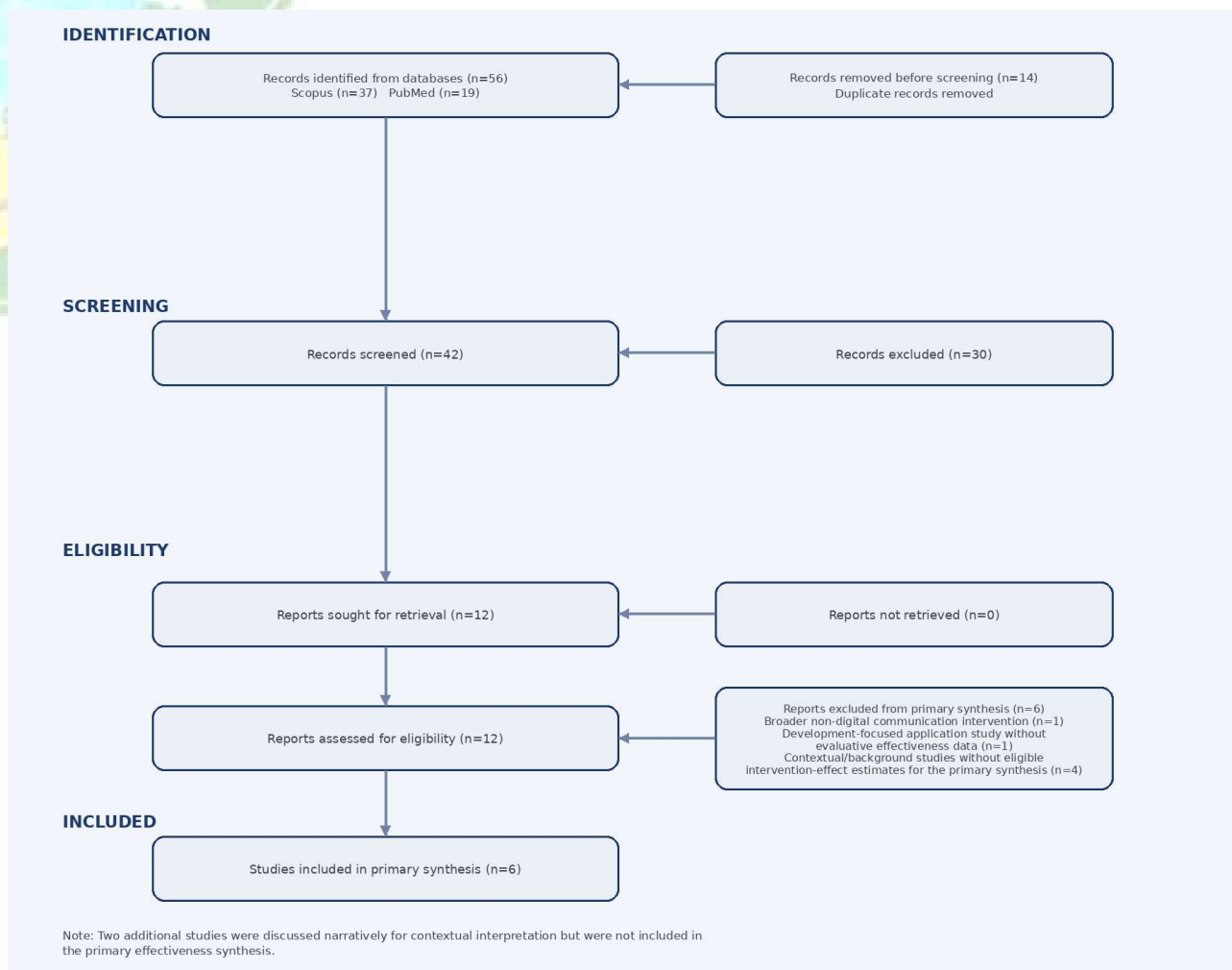


Figure 1. PRISMA 2020 flow diagram for identification, screening, eligibility assessment, and inclusion of studies in the primary synthesis.

3.2 Characteristics of included studies

The six main-synthesis studies were conducted in Liberia (n=3), Ghana (n=1), Uganda (n=1), and Iraq (n=1). Four studies used quantitative designs, including quasi-experimental, pre-post, and feasibility analyses, while two used qualitative implementation-oriented designs. The dominant intervention models were prereferral phone communication, WhatsApp-based referral coordination, and the Mobile Obstetric Referral Emergency System (MORES), with one Liberian study combining MORES with a midwife-led triage package (Kanyesigye et al., 2022; Owen et al., 2022; Lee et al., 2024; Reynolds et al., 2024; Lee et al., 2025; Relyea et al., 2021).

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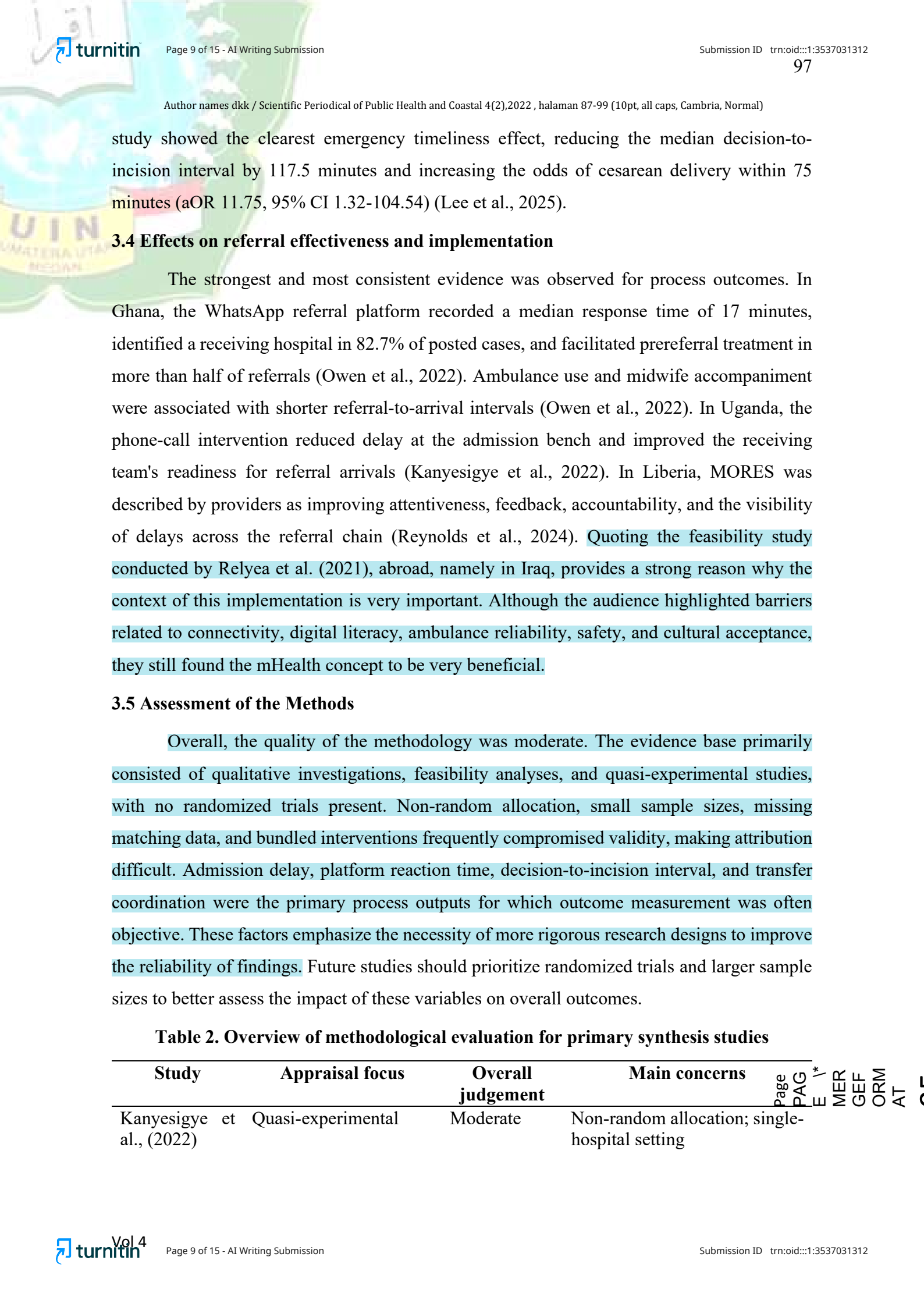
Table 1. Main-synthesis studies included in the review.

Study	Country	Design	Intervention	Main outcomes
(Kanyesigye et al., 2022)	Uganda	Quasi-experimental	Prereferral phone call communication	Adverse maternal-fetal outcomes; admission delay
(Owen et al., 2022)	Ghana	Feasibility study	WhatsApp referral communication platform	Response time; receiving hospital identification; prereferral treatment; referral-to-arrival time
(Lee et al., 2024)	Liberia	Pre-post study	MORES across rural health facilities and referral hospitals	Transfer time, cesarean delivery; newborn vigor
(Reynolds et al., 2024)	Liberia	Qualitative implementation study	MORES implementation assessment	Usability; coordination; accountability; transfer process perceptions
(Lee et al., 2025)	Liberia	Quasi-experimental	MORES plus midwife-led triage	Decision-to-incision interval; timely emergency cesarean delivery
(Relyea et al., 2021)	Iraq	Qualitative feasibility study	Prospective mHealth referral concept	Feasibility; acceptability; implementation barriers and facilitators

3.3 Effects on maternal survival-related outcomes

Direct evidence that digital maternal referral systems reduce maternal mortality was insufficient. None of the six main studies provided a robust mortality effect estimate, and one of the strongest quantitative studies reported no maternal deaths during the observation period, which made direct mortality evaluation impossible (Lee et al., 2025). The main evidence therefore concerns survival-related proxy outcomes and adverse maternal-fetal outcomes rather than mortality itself.

Even so, the quantitative studies provided several clinically meaningful signals. In Uganda, prereferral phone communication was associated with fewer adverse maternal-fetal outcomes and remained protective in adjusted analysis (aOR 0.22, 95% CI 0.09-0.42) (Kanyesigye et al., 2022). In Liberia, the network-wide MORES pre-post study suggested higher odds of cesarean delivery and better newborn vigor at endline, although transfer time itself did not improve significantly (Lee et al., 2024). The MORES plus midwife-led triage



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study showed the clearest emergency timeliness effect, reducing the median decision-to-incision interval by 117.5 minutes and increasing the odds of cesarean delivery within 75 minutes (aOR 11.75, 95% CI 1.32-104.54) (Lee et al., 2025).

3.4 Effects on referral effectiveness and implementation

The strongest and most consistent evidence was observed for process outcomes. In Ghana, the WhatsApp referral platform recorded a median response time of 17 minutes, identified a receiving hospital in 82.7% of posted cases, and facilitated prereferral treatment in more than half of referrals (Owen et al., 2022). Ambulance use and midwife accompaniment were associated with shorter referral-to-arrival intervals (Owen et al., 2022). In Uganda, the phone-call intervention reduced delay at the admission bench and improved the receiving team's readiness for referral arrivals (Kanyesigye et al., 2022). In Liberia, MORES was described by providers as improving attentiveness, feedback, accountability, and the visibility of delays across the referral chain (Reynolds et al., 2024). Quoting the feasibility study conducted by Relyea et al. (2021), abroad, namely in Iraq, provides a strong reason why the context of this implementation is very important. Although the audience highlighted barriers related to connectivity, digital literacy, ambulance reliability, safety, and cultural acceptance, they still found the mHealth concept to be very beneficial.

3.5 Assessment of the Methods

Overall, the quality of the methodology was moderate. The evidence base primarily consisted of qualitative investigations, feasibility analyses, and quasi-experimental studies, with no randomized trials present. Non-random allocation, small sample sizes, missing matching data, and bundled interventions frequently compromised validity, making attribution difficult. Admission delay, platform reaction time, decision-to-incision interval, and transfer coordination were the primary process outputs for which outcome measurement was often objective. These factors emphasize the necessity of more rigorous research designs to improve the reliability of findings. Future studies should prioritize randomized trials and larger sample sizes to better assess the impact of these variables on overall outcomes.

Table 2. Overview of methodological evaluation for primary synthesis studies

Study	Appraisal focus	Overall judgement	Main concerns
Kanyesigye et al., (2022)	Quasi-experimental	Moderate	Non-random allocation; single-hospital setting

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Owen et al., (2022)	Feasibility and process analysis	Moderate	No concurrent control for all outcomes; process metrics dominate
Lee et al., (2024)	Preliminary and subsequent study	Moderate	Before-and-after design; limited attribution; incomplete matched records
Reynolds et al., (2024)	Qualitative assessment	Moderate to high	Transferability limited; perception-based outcomes
Lee et al., (2025)	Quasi-experimental	Moderate	Bundled intervention; modest sample; no mortality events
Relyea et al., (2021)	Qualitative viability	Moderate	Feasibility-focused; no direct effectiveness estimate

DISCUSSION

This targeted research found that process outcomes, not maternal mortality reductions, are the best predictors of success for maternal referral initiatives like SISROUTE. The most rigorous Liberian study found that digital or phone-based referral systems improved communication, readiness, and the time between decision-making and emergency cesarean section in Uganda, Ghana, and Liberia (Kanyesigye et al., 2022; Owen et al., 2022; Lee et al., 2024; Reynolds et al., 2024; Lee et al., 2025). Digital maternal referral programs organize and activate emergency obstetric care, however they have not reduced mortality. This lends credence to mechanical reasoning. Such solutions can help healthcare staff respond faster and communicate better, improving patient outcomes, especially in emergencies where mothers and infants need prompt treatment. As research progresses, their long-term effects on mother health and survival in these regions must be assessed.

Several previous studies, such as Ameyaw et al., (2024), Knop et al., (2024), Kachimanga et al., (2024), Kirwa et al., (2025), Mohamed et al., (2025), Shartyanie et al., (2025), and Ngwenya et al., (2025) emphasize the benefits of mHealth and digital maternal care on service utilization, continuity, and care processes. However, they also emphasize that there is no direct evidence of severe maternal outcomes and the importance of contextual factors. To provide a better understanding of the overall existing literature, this review focuses on referral pathway therapy. Reducing this evidence base makes it more rational, albeit less extensive. With the existence of more specific methods focused on certain routes, researchers are able to demonstrate a clearer relationship between interventions and outcomes, thereby helping to create more individualized care plans.

One of the most important things we've learned is the difference between the benefits of communication and the limits on trip time. The Ghana WhatsApp platform and the Ugandan

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prereferral phone intervention enhanced the information environment of referral care; however, both initiatives failed to eliminate structural barriers related to transportation and receiving-facility capacity (Kanyesigye et al., 2022; Owen et al., 2022). The MORES pre-post research in Liberia enhanced certain variables concerning mothers and newborns; however, it did not demonstrate a significant reduction in the transfer time between facilities (Lee et al., 2024). These findings indicate that digital referral systems can enhance internal clinical timeliness and preparedness; however, they cannot independently resolve issues such as insufficient ambulance services, poor road conditions, fuel shortages, or capacity limitations.

Liberian evidence is thorough and relevant because it includes implementation methodologies and downstream clinical indicators. The MORES implementation study (Reynolds et al., 2024) found that after one year of use, providers reported increased prehospital transfer, attentiveness, feedback, and accountability. This study illustrates why the quantitative findings are plausible. Following this, the quasi-experimental decision-to-incision study demonstrates what the mechanism may entail in practice when combined with midwife-led triage: women were able to achieve emergency cesarean sections in a shorter amount of time (Lee et al., 2025). Even if the studies are observational, this layered pattern gives more proof that the benefits that have been found are not only technical things.

Although still relying on offline communication and lacking strong evidence that the SISROUTE program is successful, the article on maternal referral applications in Indonesia shows that the SISROUTE digital referral program is possible, supported by two additional contextual studies that clarify this better (Indriani et al., 2020). The study of the Malawian radio network, although not directly related to digital platforms, indicated that improved communication does not necessarily lead to expedited referrals when ambulance logistics are inadequate (Lungu & Ratsma, 2007). These contextual studies collectively corroborate the overriding claim that communication technologies are vital yet insufficient. The referral structure around it still decides how much clinical value may be gained.

For policy and practice, maternal referral tools should be straightforward, compatible with current procedures, and linked to triage and escalation alternatives. Low-resource areas may prefer messaging or phone solutions because they use familiar technologies. But support for implementation is important: training, network reliability, escalation mechanisms, accountability for the receiving hospital, and transportation arrangements are all still very important for effectiveness. From a systems point of view, the digital platform is better thought of as one part of a larger emergency obstetric pathway than as a separate solution.

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The article also suggests future research topics. We require more thorough quasi-experimental studies with longer periods, exact referral delay and treatment timeliness criteria, and complete outcome assessments.

CONCLUSIONS

Integrated, digital, or mobile maternal referral treatments that are equivalent to SISROUTE-like systems are the most effective in improving communication, preparedness, and the timeliness of emergency treatment, according to the full-text data that is currently available. The process outcomes that have been documented as having the greatest benefits are those that involve a reduction in admission delays, a faster response to referrals, enhanced coordination, and shorter intervals between decision and incision.

The claim that these techniques effectively reduce maternal mortality is not supported by sufficient evidence at this time because there is not enough concrete evidence to support the claim. So, the claim has to be looked into more. The notion that a computer-based maternal referral system indirectly enhances maternal survival may represent the most credible interpretation. These tools help women find their way through emergency pathways in a way that is both safer and more efficient, as long as transportation, triage, and the readiness of receiving facilities are all working.

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