Effects of Digital Maternal Referral Systems on Referral Performance and Maternal Survival-Related Outcomes: A Systematic Review

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Abstract

Timely maternal referral is essential for emergency obstetric care, but the effectiveness of digital maternal referral systems in improving referral performance and maternal survival-related outcomes remains uncertain. This systematic review synthesized evidence on digital, mobile, or information-based referral interventions that have core functions comparable to those of integrated referral systems such as SISRUTE. Scopus and PubMed were searched for English-language records published from 1 January 2000 to 31 December 2025. The review followed PRISMA 2020 guidance. Eligible studies involved pregnant, intrapartum, or postpartum women, obstetric emergency referrals, or health workers managing maternal referrals, and evaluated implemented digital or mobile referral interventions. Studies limited to non-digital referral barriers, prototype development without evidence of implementation, or non-maternal referral populations were excluded. Owing to heterogeneity in design, interventions, and outcomes, narrative synthesis was conducted. Six studies from Uganda, Ghana, Liberia, and Iraq were included in the primary synthesis. Evidence for a reduction in direct maternal mortality was insufficient. However, digital referral interventions were associated with improved process and survival-related proxy outcomes, including lower adverse maternal-fetal outcomes, faster referral response, better identification of receiving hospitals, improved preparedness, and shorter decision-to-incision intervals for emergency cesarean delivery. The most consistent benefits were observed in communication, triage, coordination, and treatment timeliness. Digital maternal referral systems appear to be more strongly supported as tools for improving referral performance than as interventions with proven direct effects on mortality. Their potential contribution to maternal survival is most plausibly indirect and depends on transport, receiving-facility readiness, clinical triage, and implementation support.

Keywords: Digital Health, E-Referral, Maternal Referral, Maternal Survival, Mhealth, Obstetric Emergency, Triage

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 World Health Organization estimated that about 260,000 women died during and following pregnancy and childbirth in 2023, with approximately 92% of all maternal deaths occurring in low- and lower-middle-income countries. (World Health Organization, 2025). In such settings, the referral channel is not a minor administrative process; it is often the practical link between first-contact care and life-saving treatment.

Even when women reach a formal healthcare facility, referral failure can continue through communication breakdowns, incomplete documentation, poor transportation

coordination, weak feedback loops, and unprepared receiving facilities (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 insufficient information, ineffective feedback, poor coordination between referring and receiving facilities, and uncertainty about service readiness as recurring weaknesses in maternal referral systems (Daniels & Abuosi, 2020; Ofosu et al., 2021; Mengist et al., 2024). A systematic review of emergency obstetric referral interventions in sub-Saharan Africa similarly highlighted referral decision-making, communication, and feedback as important areas for improvement (Avoka et al., 2022).

Digital health is increasingly promoted to strengthen provider communication, care coordination, data visibility, and health-system administration. The WHO classification of digital health interventions indicates that digital tools can support communication between providers, referrals, decision support, and health-system management rather than merely replacing paper records. (World Health Organization, 2023). Evidence from broader mHealth and digital maternal-care reviews suggests improvements in service utilization, antenatal attendance, follow-up, and selected maternal-newborn indicators, but the evidence remains inconsistent and often focuses on general mHealth or antenatal care rather than emergency referral pathways. (Ameyaw et al., 2024; 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 distinction is important for Indonesia's Sistem Informasi Rujukan Terintegrasi (SISRUTE). The Indonesian Ministry of Health describes SISRUTE as an online integrated referral information system that supports competency-based referrals across health facilities, provides referral information for individual health services, and includes maternal and neonatal referral menus. (Kementerian Kesehatan Republik Indonesia, 2023). For this review, systems comparable to SISRUTE are not assumed to be identical to the Indonesian platform. Rather, they are defined by core functional similarity: the use of digital, mobile, or information-based communication to connect referring and receiving facilities, transmit referral information, support response or triage, improve coordination, and make referral timeliness more visible.

The research gap is therefore specific. Previous literature has often combined three distinct evidence streams: non-digital studies describing referral barriers, development-stage application papers without evaluative implementation evidence, and implemented digital or mobile referral interventions reporting referral performance or maternal survival-related outcomes. Because these streams are frequently mixed, it remains difficult to determine whether implemented digital maternal referral systems actually improve referral performance

and whether any survival-related benefit is direct or indirect. This review addresses that gap by synthesizing empirical evidence from mature digital, mobile, or information-based maternal referral interventions and asking whether they improve maternal survival-related outcomes, referral effectiveness, and implementation processes.

METHODS

This study was designed as a systematic review and reported in accordance with PRISMA 2020 guidance (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, and this is acknowledged as a limitation.

Studies were eligible if they involved pregnant, intrapartum, or postpartum women, obstetric emergency referrals, or health workers managing maternal referrals, and if they evaluated or implemented digital, mobile, or information-based referral interventions. Eligible interventions included structured prereferral phone communication, WhatsApp-based referral coordination, digital referral platforms, mobile obstetric emergency systems, and digital triage-support tools. Outcomes of interest were maternal survival-related outcomes, maternal-fetal adverse outcomes, referral timeliness, communication, coordination, treatment preparedness, triage, or implementation feasibility directly linked to referral effectiveness.

Studies were excluded from the primary synthesis if they focused only on non-digital referral barriers, described prototype development without meaningful implementation evidence, addressed non-maternal referral populations, or did not provide empirical information on referral effectiveness or closely related maternal outcomes. This criterion avoids the logical contradiction of excluding maternal referral studies in general; the review excluded only studies that did not meet the digital maternal referral intervention scope.

Searches were completed in Scopus and PubMed for English-language records published between 1 January 2000 and 31 December 2025. The final search strategy combined four concept blocks: maternal or obstetric population, referral or transfer process, digital or mobile referral intervention, and survival-related or referral-effectiveness outcome. 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 export and screening.

The Scopus search string was: TITLE-ABS-KEY ((maternal OR obstetric OR pregnancy OR pregnant OR postpartum OR intrapartum) AND (referral OR transfer OR "emergency referral" OR "interfacility transfer") AND (digital OR electronic OR e-referral OR mHealth OR mobile OR phone OR WhatsApp OR "information system" OR "referral system") AND (mortality OR survival OR outcome* OR delay OR timeliness OR "decision-to-incision" OR coordination OR communication OR triage).

The PubMed search strategy was developed by combining keywords related to maternal and obstetric care, referral and transfer systems, digital health technologies, and patient outcomes. Specifically, the search included terms such as maternal, obstetric, pregnancy, pregnant, postpartum, and intrapartum to capture the target population; referral, transfer, emergency referral, and interfacility transfer to identify referral-related processes; digital, electronic, e-referral, mHealth, mobile, phone, WhatsApp, and information system to represent digital health interventions; and mortality, survival, outcomes, delay, timeliness, triage, and coordination to capture relevant health and system outcomes. These terms were searched within the title and abstract fields and combined using Boolean operators (AND/OR) to maximize the retrieval of relevant studies examining the use of digital technologies in maternal referral systems and their impact on referral processes and outcomes.

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-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 logic and checklists for quasi-experimental and qualitative studies, supplemented by a structured appraisal of feasibility and observational process studies where no single JBI checklist exactly matched the design (Joanna Briggs Institute, 2024). The appraisal emphasized clarity of cause-effect or phenomenon of interest, comparability of groups or credibility of qualitative data, reliability of outcome measurement, appropriateness of analysis, and transferability of findings.

The primary synthesis was restricted to implemented digital or mobile maternal referral interventions that provided empirical evidence on referral effectiveness or closely related maternal outcomes. One Indonesian maternal referral application paper and one Malawian radio-network communication study did not meet the primary effectiveness criteria but were retained as contextual papers. They were used only to interpret implementation context, digital

maturity, and transport constraints; they were not counted as included primary-synthesis studies and did not determine the main effectiveness conclusions.

Due to heterogeneity in intervention type, design, outcome definition, and implementation context, a meta-analysis was not feasible. The synthesis, therefore, grouped findings narratively into maternal survival-related outcomes, referral performance outcomes, and implementation or contextual mechanisms.

RESULTS

The database searches yielded 56 records, including 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 review scope. Twelve full texts were assessed in detail. Six studies met the criteria for 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 the excluded studies were retained for contextual discussion only.

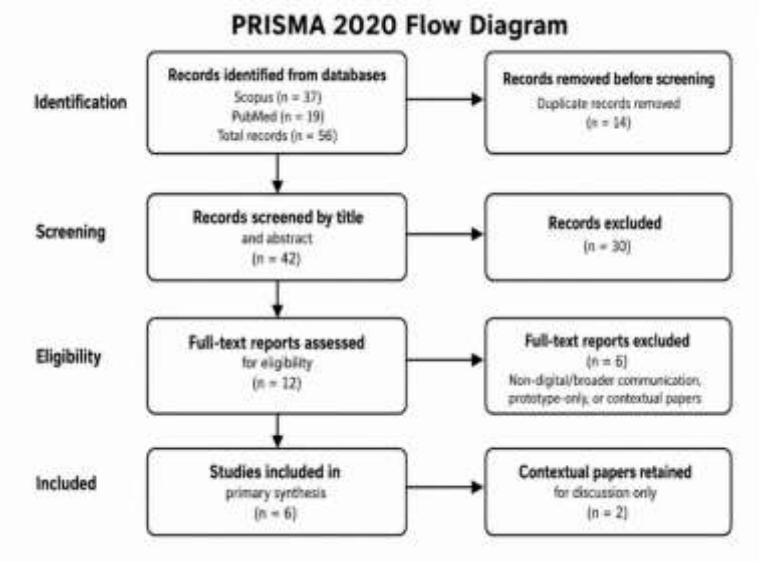

Figure 1. PRISMA 2020 flow diagram for identification, screening, eligibility assessment, and inclusion of studies in the primary synthesis

Characteristics of included studies

The six primary 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 intervention models included prereferral phone communication,

WhatsApp-based referral coordination, the Mobile Obstetric Referral Emergency System (MORES), and a prospective mHealth referral concept. (Kanyesigye et al., 2022; Owen et al., 2022; Lee et al., 2024; Reynolds et al., 2024; Lee et al., 2025; Relyea et al., 2021).

The main outcome column in Table 1 can be read in two groups. Survival-related outcomes included adverse maternal-fetal outcomes, cesarean delivery indicators, newborn vigor, decision-to-incision interval, and timely emergency cesarean delivery. Referral performance outcomes included admission delay, platform response time, receiving-hospital identification, prereferral treatment, referral-to-arrival time, usability, coordination, accountability, and implementation feasibility.

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

Effects on maternal survival-related outcomes

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

The quantitative studies nevertheless provided clinically relevant 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 0.09-0.44) (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 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).

The strongest and most consistent evidence was observed for referral 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. In Uganda, the prereferral 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 visibility of delays across the referral chain (Reynolds et al., 2024). In Iraq, stakeholders viewed an mHealth obstetric referral concept as feasible and potentially useful, while also identifying barriers related to connectivity, digital literacy, ambulance reliability, safety, and cultural acceptability (Relyea et al., 2021). These findings indicate that referral technologies were most consistently linked to communication, response, coordination, and preparedness rather than direct mortality change.

Overall, methodological quality was moderate. The evidence base consisted primarily of quasi-experimental, pre-post, feasibility, and qualitative implementation studies, with no randomized trials. Common concerns included non-random allocation, small or modest sample sizes, limited control of confounding, incomplete matched data, bundled interventions, and perception-based outcomes. Outcome measurement was stronger for objective process indicators such as admission delay, platform response time, decision-to-incision interval, and transfer coordination. The small number of eligible studies (n = 6) should therefore be interpreted as an important limitation of the review.

Table 2: Detailed JBI-based methodological appraisal of primary-synthesis studies

Study	JBI/appraisal focus	Criteria adequately met	Criteria with concern	Overall judgment	Implication for synthesis
(Kanyesigye et al., 2022)	Quasi-experimental	Clear intervention-outcome direction; comparable referral population; objective	Non-random allocation; single-hospital setting; residual confounding possible	Moderate	Included as quantitative evidence for adverse maternal-fetal and admission-delay outcomes,

Study	JBI/appraisal focus	Criteria adequately met	Criteria with concern	Overall judgment	Implication for synthesis
		adverse outcome and delay measures; adjusted analysis reported			interpreted cautiously
(Owen et al., 2022)	Feasibility/process study	Clear intervention description; objective platform metrics; relevant process outcomes; implementation detail available	No concurrent control for all outcomes; process metrics dominate; clinical endpoint evidence is limited	Moderate	Included as process-effectiveness evidence for response time, receiving-hospital identification, and referral coordination
(Lee et al., 2024)	Pre-post study	Implemented MORES intervention; before-and-after comparison; relevant obstetric referral outcomes.	Limited attribution due to pre-post design; incomplete matched records; transfer time not significantly improved	Moderate	Included for network-level referral and clinical process signals, not treated as definitive causal evidence
(Reynolds et al., 2024)	Qualitative implementation study	Clear phenomenon of interest; appropriate qualitative design; provider perspectives directly linked to implementation; credible themes on coordination and accountability	Transferability limited to rural Liberia; perception-based outcomes; cannot estimate effectiveness.	Moderate to high	Used to explain mechanisms behind quantitative findings and identify implementation requirements
(Lee et al., 2025)	Quasi-experimental	Clear intervention package; objective decision-to-incision outcome; relevant emergency cesarean endpoint; comparative analysis reported	Bundled intervention with midwife-led triage; modest sample; no maternal mortality events; wide confidence interval	Moderate	Included as the strongest timeliness evidence, but interpreted as a bundled digital-plus-triage effect
(Relyea et al., 2021)	Qualitative feasibility study	Clear feasibility focus; stakeholder perspectives; barriers and	No direct effectiveness estimate; hypothetical/prospective intervention; context-	Moderate	Used for feasibility and implementation interpretation rather than a

Study	JBI/appraisal focus	Criteria adequately met	Criteria with concern	Overall judgment	Implication for synthesis
		facilitators relevant to adoption and implementation	specific security and cultural issues		direct effectiveness conclusion

DISCUSSION

This review found that digital maternal referral systems are more strongly supported for improving referral performance than for demonstrating direct reductions in maternal mortality. The available evidence from Uganda, Ghana, and Liberia suggests that digital or phone-based referral interventions can strengthen communication, receiving-facility preparedness, triage, accountability, and emergency treatment timeliness (Kanyesigye et al., 2022; Owen et al., 2022; Lee et al., 2024; Reynolds et al., 2024; Lee et al., 2025). However, the evidence does not yet establish a direct mortality-reduction effect.

This finding aligns with broader digital maternal health literature. Previous reviews have reported benefits of mHealth and digital maternal-care interventions for service utilization, continuity, follow-up, and care processes, while also noting that evidence on severe maternal outcomes is limited and context-dependent (Ameyaw et al., 2024; Knop et al., 2024; Kachimanga et al., 2024; Kirwa et al., 2025; Mohamed et al., 2025; Shartyanie et al., 2025; Ngwenya et al., 2025). By focusing specifically on referral pathway interventions, this review narrows the evidence base but provides a clearer interpretation: the most plausible pathway to maternal survival is indirect, operating through better information transfer, earlier clinical preparation, and faster emergency response.

A key interpretation is the distinction between communication benefits and transport constraints. The Ghana WhatsApp platform and the Ugandan prereferral phone intervention improved the information environment of referral care, but neither eliminated structural barriers related to ambulance availability, road conditions, fuel, or receiving-facility capacity (Kanyesigye et al., 2022; Owen et al., 2022). Similarly, the MORES pre-post study in Liberia improved several maternal and newborn indicators but did not show a significant reduction in interfacility transfer time (Lee et al., 2024). Digital referral systems can therefore improve clinical timeliness and preparedness, but they cannot independently solve logistical and capacity bottlenecks.

The Liberian evidence is particularly informative because it links implementation experience with downstream clinical indicators. The qualitative MORES assessment reported improved prehospital transfer, attentiveness, feedback, and accountability after one year of use

(Reynolds et al., 2024). The subsequent quasi-experimental study showed how a mobile-based referral system combined with midwife-led triage could shorten decision-to-incision intervals for emergency cesarean delivery (Lee et al., 2025). Although the studies are observational, this layered pattern strengthens the plausibility that digital referral systems work best when embedded in a broader clinical escalation and triage pathway.

The Indonesian SISRUTE context is relevant not because the reviewed interventions are identical to SISRUTE, but because they share core system functions. SISRUTE is designed to support online, competency-based referrals across health facilities, provide referral information, and include maternal and neonatal referral menus (Kementerian Kesehatan Republik Indonesia, 2023). The evidence in this review suggests that systems with these functions are most likely to improve communication, response time, coordination, and preparedness. At the same time, the review cautions that SISRUTE or comparable digital referral systems should not be expected to reduce maternal mortality by technology alone. Their clinical value depends on transport readiness, receiving-facility capacity, trained users, triage protocols, and accountability mechanisms.

For policy and practice, digital maternal referral tools should be simple, interoperable with existing workflows, and linked to triage, escalation, and transport arrangements. Messaging or phone-based solutions may be practical in low-resource settings because they use familiar technologies, but implementation support remains essential. Training, network reliability, clear referral response standards, audit and feedback, and coordination with ambulance services are necessary for converting faster communication into safer maternal outcomes.

This review has several limitations. The primary synthesis included only six studies, and the designs were heterogeneous. The lack of randomized trials, the limited number of countries, differences in outcome definitions, and the absence of robust mortality estimates restrict causal inference. Due to heterogeneity in intervention architecture, design, and outcomes, meta-analysis was not feasible. Future research should use stronger quasi-experimental or randomized designs, where ethical and feasible, apply standardized referral-delay and treatment-timeliness metrics, report maternal and neonatal outcomes more completely, and evaluate how digital referral platforms interact with transport, triage, and facility readiness.

CONCLUSIONS

Digital, mobile, and information-based maternal referral systems are most consistently supported as tools for improving referral performance. The clearest documented benefits involve faster referral response, improved communication, better identification of receiving facilities, greater preparedness, stronger coordination, and shorter intervals between decision and emergency treatment.

At present, evidence is insufficient to conclude that these systems directly reduce maternal mortality. The most credible interpretation is that digital maternal referral systems may contribute indirectly to maternal survival by making emergency referral pathways safer, more coordinated, and more timely. Their effectiveness depends on the surrounding referral system, especially transport availability, clinical triage, receiving-facility readiness, trained users, and implementation support.

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