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Community-Based and mHealth Technology Approaches for Early Detection of Pregnancy Risks: A Scoping Review

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ABSTRACT

Pregnancy-related risks remain a major determinant of maternal morbidity and mortality, particularly in low- and middle-income countries. Delays in identifying high-risk conditions contribute to an increase in complications that could actually be prevented through early detection. Community-based approaches integrated with digital technology and mobile health (mHealth) have the potential to improve early detection by expanding service reach and enabling continuous monitoring. This study aims to map community-based and digital/mHealth interventions for the early detection of pregnancy risks. The study employs a scoping review design using the Joanna Briggs Institute (JBI) approach and is reported in accordance with the PRISMA-ScR guidelines. A literature search was conducted in PubMed, ScienceDirect, Wiley, and EBSCO for publications from 2020 to 2025. A total of 9 studies that met the inclusion criteria were analyzed thematically. The results showed a variety of interventions, including community-based screening supported by mHealth applications and clinical decision support systems (CDSS), combined with the involvement of community actors. The most frequently identified risks included anemia, hypertension, and preeclampsia. Key outcomes included increased antenatal care visits, early detection of complications, and more timely referrals. Key success factors included the capacity of community health workers, ease of use of technology, and support from the health system. The integration of community-based approaches and digital technology has the

potential to strengthen systems for the sustainable early detection of pregnancy risks.

Keywords
Community-Based Interventions
Early Detection
Maternal Health
mHealth
Pregnancy Risks

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Introduction

Maternal mortality remains a key indicator of health system performance, particularly in maternal health services. The burden of maternal mortality remains high, especially in low- and middle-income countries, even though many causes can be prevented through risk identification, referrals, and timely management [1]. This situation underscores the importance of strengthening early detection of pregnancy risks starting at the level of care closest to pregnant women.

Early detection of pregnancy risks includes recognizing warning signs, assessing risk factors, monitoring the mother's condition, and following up on referrals. Its implementation still faces barriers such as limited geographic access, disparities in the distribution of health care workers, low utilization of antenatal care (ANC) services, and varying levels of readiness in referral systems. Various interventions to improve the utilization of maternal health services in low- and middle-income countries have shown that community-based approaches, mHealth, and facility-based interventions can complement one another across the continuum of care [2].

Community-based approaches can expand the reach of maternal health services through the involvement of community health workers (CHWs), health volunteers, home visits, families, and community leaders. CHWs can support education, early risk identification, monitoring, and connecting pregnant women with ANC and referral services. Evidence shows that CHW interventions can improve knowledge of and utilization of ANC, particularly when CHWs work in collaboration with clinical services; however, their success depends on training, supervision, system support, and the community context [3], [4].

At the same time, digital technologies such as mobile health (mHealth) and clinical decision support systems (CDSS) have the potential to strengthen the role of these communities. Technology can facilitate data collection, more systematic screening, monitoring, algorithm-based decision-making, and referral communication. Several reviews indicate that mHealth has the potential to increase the utilization of ANC in low- and middle-income countries, although the magnitude of the impact may vary depending on the type of intervention and the implementation context [5], [6], [7].

Nevertheless, the available evidence remains scattered across various types of technologies, outcomes, and service contexts. Some studies focus on direct communication with pregnant women, while others emphasize technological support for health workers or community health workers (CHWs). In addition, there are still gaps regarding how digital technologies are integrated with community-based approaches, primary care, referral systems, and the sociocultural needs of users [8], [9], [10].

Therefore, this scoping review aims to map community-based and digital technology/mHealth approaches for the early detection of pregnancy risks. This review identifies intervention models, the functions of digital technology, community actors, the types of risks detected, reported outcomes, as well as factors related to acceptability, feasibility, and implementation. This mapping is expected to serve as a foundation for the development of community-digital interventions appropriate to the context of maternal health care.

Materials and Methods

A. Research Design

This study aims to gain a comprehensive understanding of the application of community-based approaches integrated with digital technology and mobile health (mHealth) in the early detection of pregnancy risks. This review synthesizes various findings from the scientific literature to describe patterns of intervention implementation across different contexts, particularly within health systems in low- and middle-income countries. The study focuses not only on intervention outcomes but also on the implementation process, variations in strategies, and challenges encountered in the field.

This study used a scoping review to map the evidence on community-based approaches and mHealth technologies for the early detection of pregnancy risks. The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines [11]. The methodological approach drew on the framework developed by Arksey and O'Malley [12] further refined by Levac et al. [13] and was informed by the JBI guidance for scoping reviews [14].

The scoping review was conducted in several main stages, including the identification of research questions, a search for relevant literature, the selection of studies based on inclusion criteria, data extraction, and the analysis and synthesis of findings [13], [15]. These stages aim to produce a systematic and transparent literature review that describes the development of community-based and digital/mHealth interventions.

The choice of the scoping review method was based on the complexity of the topic, which is multidimensional and heterogeneous, with a wide variety of interventions and research designs. This method allows for the inclusion of various types of evidence and provides a

comprehensive overview of the development of concepts, implementation, and research directions in the field of maternal health [13], [15].

The research question in this study is: How are community-based approaches supported by or integrated with digital technology/mHealth applied in the early detection of pregnancy risks among pregnant women? This question serves as the basis for exploring the form of the intervention, the types of technology used, the involvement of community actors and health workers, the pregnancy risks detected, the resulting outcomes, and the factors influencing the implementation of the intervention.

B. Inclusion Criteria

The included studies encompass quantitative, qualitative, mixed-methods, implementation, and program evaluation research involving pregnant women and addressing early detection, screening, monitoring, risk assessment, warning signs, or referrals related to pregnancy risks.

Studies may focus on community-based approaches, digital technology/mHealth, or a combination of both. Community components include health cadres, community health workers (CHWs), home visits, community groups, community surveillance, or community-linked primary care services.

Studies were excluded if they were review articles, meta-analyses, editorials, commentaries, or other publications that did not present primary data. Studies conducted entirely in hospitals or specialized outpatient clinics without a documented community or primary care component were also excluded. Only English-language articles published between 2020 and 2025 were included.

For studies recruited or conducted through hospital facilities, eligibility was determined based on the full text of the article. Such studies were retained only if they included a clear community or primary health care component relevant to the review's objectives. Inclusion decisions and reasons for exclusion at the full-text stage were recorded and presented in Supplementary Table S3.

D. Information Sources and Search Strategies

A systematic literature search was conducted via PubMed, ScienceDirect, Wiley Online Library, and EBSCOhost on December 26, 2025. The search date, search fields, search strategy, filters used, and the number of articles retrieved from each database were recorded and presented in Supplementary Table S1. The search strategy primarily focused on the concepts of pregnancy or maternal health, community-based approaches and community health workers, pregnancy risks or complications, as well as early detection, screening, or risk assessment. The term "digital health technology" or "mHealth" was not consistently applied as a separate search term across all databases. Therefore, the results of this review should be understood as a mapping of studies at the intersection of community-based approaches,

pregnancy risk detection, and digital components identified during the selection process, rather than as a fully comprehensive search for all mHealth interventions.

The PubMed search used the following filters: "last 5 years," free full text, clinical trial, multicenter study, observational study, English, humans, and female. The ScienceDirect search was limited to publications from 2020 to 2025. The Wiley search was limited to Open Access articles from the past five years. On EBSCOhost, no additional filters were recorded in the search history.

E. Study Selection

The initial search yielded 550 articles from PubMed, 2,639 articles from ScienceDirect, 65 articles from Wiley Online Library, and 14 articles from EBSCOhost. A total of 1,473 articles were then imported into Rayyan for reference management, duplicate removal, and screening.

Because the number of search results from several databases was quite large, a preliminary screening of the search results was conducted before importing them into Rayyan. The preliminary screening was based on the relevance of the titles and abstracts to the review's focus—namely, pregnancy, pregnancy risks, community-based approaches, early detection, and maternal health—as well as the availability of full-text articles. Articles that were clearly irrelevant to the review's focus or did not meet the full-text availability requirement were not progressed to the import stage.

From the initial search results, all 550 articles from PubMed were imported into Rayyan. Of the 2,639 search results from ScienceDirect, 900 articles that met the initial screening criteria were downloaded. From the 65 search results from Wiley Online Library, 18 articles were selected through the initial screening, while from the 14 results from EBSCOhost, 5 articles were selected through the same procedure. Thus, a total of 1,473 articles were imported into Rayyan for duplicate removal and formal screening.

A total of 17 duplicate articles were removed, leaving 1,456 articles for title and abstract screening. The titles and abstracts were screened based on inclusion and exclusion criteria by Mayvita Nabila Kurniadi. Articles that potentially met the criteria were then obtained in full text and evaluated using the same criteria.

The PRISMA-ScR flowchart presents the complete study selection process. Of the 98 full-text articles evaluated, 89 were excluded due to inappropriate outcomes (n = 61), irrelevant research context (n = 8), inappropriate study design (n = 10), irrelevant intervention type (n = 4), unavailable research results (n = 1), inappropriate population (n = 1), publication type not meeting criteria (n = 1), or a hospital or specialist care setting without documented community or primary care components (n = 3). A total of 9 studies met the inclusion criteria and were included in the scoping review.

F. Data Extraction and Synthesis

Data from each study that met the criteria were extracted by Mayvita Nabila Kurniadi using a structured data extraction form. The information extracted included authors and year, country, study design, setting, participant characteristics, sample size, intervention characteristics, community actors, digital health components, assessed pregnancy risks, outcomes, and implementation factors. The extracted data were then reviewed and discussed with Asri Hidayat and Dhesi Ari Astuti by comparing them with the full-text articles. Any discrepancies or unclear information were resolved through discussion until consensus was reached before thematic synthesis was conducted.

The extracted data were summarized descriptively and synthesized thematically. The thematic synthesis used both inductive and deductive approaches to identify recurring patterns related to intervention models, the functions of digital technology or mHealth, community actors, detected pregnancy risks, reported outcomes, acceptability, feasibility, implementation barriers, and the health system context.

G. Critical Appraisal of Included Studies

Methodological quality assessments were conducted to describe the strengths and limitations of the included evidence and to support a cautious interpretation of the results. JBI Critical Appraisal Tools were selected based on the design of each study. The JBI Checklist for Analytical Cross-Sectional Studies was used for J1 and J4, while the JBI Checklist for Randomized Controlled Trials was used for J2, J3, J5, J6, J7, J8, and J9. Each study was assessed using the relevant JBI checklist, with response options of “Yes,” “No,” “Unclear,” or “Not Applicable” for each item.

The initial assessment was conducted by Mayvita Nabila Kurniadi. The assessment results were then reviewed and discussed with Asri Hidayat and Dhesi Ari Astuti against the full-text articles. Any discrepancies in assessment or unclear methodological information were resolved through discussion until a consensus was reached.

The results of the appraisal were used to describe the methodological strengths and limitations of each study and to aid in the interpretation of the synthesis results. Critical appraisal was not used as an automatic basis for excluding studies. Details of the checklist used, the assessment results for each item, and a summary of methodological limitations are presented in Supplementary Table S2.

Results

A. Selected Studies

Nine studies met the inclusion criteria for this scoping review. The studies originated from India, Ethiopia, Ghana, Bangladesh, Pakistan, Mozambique, and Nigeria. This distribution

indicates that community-based and digital/mHealth approaches are primarily implemented in low- and middle-income countries.

In terms of research design, most studies used experimental approaches—primarily randomized controlled trials and cluster randomized controlled trials—to evaluate the effectiveness of community-based and digital interventions. Other studies employed cross-sectional designs and process evaluations linked to randomized controlled trials to describe implementation factors and the context in which the interventions were carried out.

We assessed the methodological quality of the included studies using the Joanna Briggs Institute (JBI) Critical Appraisal Tools appropriate to the study design. The appraisal results were used to describe the methodological strengths and limitations of each study in interpreting the synthesis results; the appraisal was not used as an automatic basis for excluding studies. Details of the appraisal results are presented in Supplementary Table S2.

All included studies were then categorized and mapped according to their characteristics, intervention models, technologies used, detected pregnancy risks, and reported outcomes. In addition, the analysis also included the identification of enabling factors and barriers to the implementation of interventions at the community level. A summary of the data extraction results is systematically presented in Table 1 as a basis for further thematic analysis.

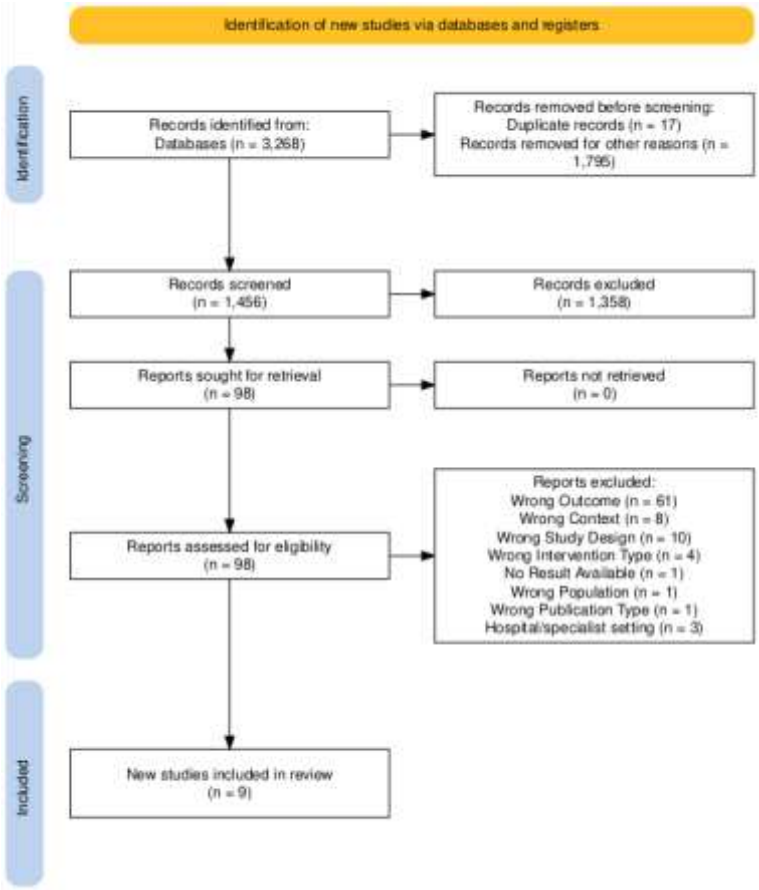


Fig. 1. PRISMA-ScR flow diagram

Table 1. Characteristics of included studies

No	Title, Authors, Year	Country	Research Design	Participants/ Sample
1	Prevalence of high-risk pregnancy among pregnant women enrolled in the PMSMA program – Parajapati et al., 2022 [23]	India	Cross-sectional	400 pregnant women in the second and third trimesters
2	Partnering faith leaders with community health workers increases the use of antenatal care and facility-based delivery services in Ethiopia: A cluster-randomized trial – Guthrie et al., 2021 [16]	Ethiopia	Cluster Randomized Controlled Trial	18 health centers
3	Evaluation of a package of continuum-of-care interventions for improved maternal, newborn, and child health outcomes and service coverage in Ghana – Shibanuma et al., 2021 [17]	Ghana	Cluster Randomized Controlled Trial	2,970 mother-child pairs
4	Determinants of the use of antenatal and delivery care at the community level in the , rural Bangladesh – Pervin et al., 2021 [24]	Bangladesh	Cross-sectional	3,293 mothers
5	EMBRACE intervention to improve the continuum of care in maternal and newborn health in Ghana – Kikuchi et al., 2021 [18]	Ghana	Hybrid cluster RCT (effectivenes–implementation)	>21,000 mothers and infants
6	Community-level interventions for preeclampsia (CLIP) in Pakistan: A cluster randomized controlled trial – Qureshi et al., 2020 [21]	Pakistan	Cluster Randomized Controlled Trial	39,417 pregnancies
7	Community-level interventions for preeclampsia (CLIP) in Mozambique: A cluster randomized controlled trial – Sevene et al., 2020 [22]	Mozambique	Cluster Randomized Controlled Trial	15,123 pregnancies
8	A Mobile Clinical Decision Support System for High-Risk Pregnant Women in Rural India (SMARThealth Pregnancy): Pilot Cluster Randomized Controlled Trial – Nagraj et al., 2023 [19]	India	Pilot cluster RCT (mixed methods)	200 pregnant women
9	The ability and safety of community-based health workers to safely initiate life-saving therapies for preeclampsia in Ogun State, Nigeria: An analysis of 260 community treatments with $MgSO_4$ and/or methyldopa– Adepoju et al., 2021 [20]	Nigeria	RCT – Process Evaluation (CLIP)	8,790 pregnant women

Nine studies met the inclusion criteria for this scoping review. The studies were conducted in India, Ethiopia, Ghana, Bangladesh, Pakistan, Mozambique, and Nigeria, with a variety of research designs, including cross-sectional studies, randomized controlled trials, cluster randomized controlled trials, and process evaluations associated with randomized controlled

trials. Most of the studies used an experimental approach, particularly cluster randomized controlled trials.

Table 2. Intervention characteristics and key findings

No	Focus/Intervention	Data Collection	Key Findings
1	Identification of the prevalence and risk factors for PMSMA	Interviews using a semi-structured questionnaire; SPSS analysis	HRP prevalence: 40.5%; anemia and hypertension are the dominant risk factors; maternal education is significantly associated with HRP
2	Strengthening ANC and childbirth care through community–facility collaboration	Routine health facility data; difference-in-difference analysis	ANC collaboration significantly increases facility-based deliveries and ANC coverage
3	Improving the effectiveness of the maternal–newborn continuum of care	Household surveys; HDSS; mixed-effects regression	COC completion increased significantly; >28 weeks was the pri mary outcome
4	Identification of factors influencing the use of ANC and delivery at health facilities	Postpartum interviews	Age, parity, education, and socioeconomic status influence service utilization
5	Evaluation of the implementation of the ANC-based EMBRACE program	Survey; monitoring of health facilities and personnel	ANC completion rates increased significantly; the intervention can be adopted and sustained within the national system
6	Evaluation of the impact of CLIP on maternal and infant outcomes	Survey; verbal autopsy	System stability; optimal effect with ≥8 contacts
7	Evaluation of CLIP on morbidity and mortality	Household survey; MHEALTH; regression analysis	Primary outcomes showed no significant reduction; ≥8 visits were associated with maternal outcomes
8	Mobile-based clinical decision support system for high-risk pregnancies	Clinical measurements; FGDs; interviews	The app was deemed acceptable; it improves risk detection and management
9	Safety evaluation of task-sharing for preeclampsia treatment	mHealth data; POM; descriptive analysis	No serious adverse effects were found; CHWs can initiate MgSO4 and/or methyldopa

Based on the characteristics of the interventions and key findings, the included studies revealed three main patterns: strengthening community-based services, utilizing digital technology/mHealth, and strengthening the detection and management of pregnancy risks.

Table 3. Data mapping/thematic synthesis.

Theme	Subtheme	Reference Number
Community-Based–Digital Intervention Model	Integrated community education	[16], [17]
	Community-Based Home Visits	[18], [19], [20]
	Continuum of Care (CoC) Package	[17], [18]
	Community Pre-Eclampsia Package	[21], [22]
	Hybrid community–digital model	[21]
Types of Digital/mHealth Technologies and Their Functions	Mobile Clinical Decision Support System (CDSS)	[19]
	mHealth PIERS / POM	[20], [21], [22]
	Digital-Supported Referral	[21]
	Community Health Workers (CHW)	[16], [20]

Theme	Subtheme	Reference Number
Community and Digital Actors	Faith leaders	[16]
	Women's groups	[22]
	Families	[22]
	Digital actors	[19]
Types of Pregnancy Risks Detected	General obstetric risks	[16], [17]
	Risks related to labor preparedness	[17], [22]
	Pregnancy-Induced Hypertension Risk	[21]
	Anemia Risks	[19], [23]
	Perinatal risks	[17], [18]
Intervention Outcomes	Behavioral and Knowledge Outcomes	[16], [17]
	Service Utilization	[16], [24]
	Continuum of Care	[17], [18]
	Neonatal Clinical Outcomes	[18], [22]
	Maternal Mortality	[21], [22]
	Digital Implementation Outcomes	[19]
Acceptability, Feasibility, and Implementation	CHW Acceptability	[19]
	Training needs	[19], [20]
	Technical barriers	[19]
Social Determinants and System Context	Maternal Education	[23], [24]
	Socioeconomic Status	[24]
	Social and Religious Norms	[16], [22]
	Family support	[22]
	Availability of facilities	[18], [22]
	Referral system	[17], [21]
	Digital integration	[19]

B. Community-Based Digital Intervention Model

The included studies showed that community–digital interventions combined community engagement, health education, pregnancy-risk screening, referral support, and digital technologies to facilitate early detection and follow-up [16], [17]. The home visit strategy enables continuous monitoring, early risk identification, and the strengthening of continuity of maternal care, which is generally integrated into the continuum of care (CoC) approach [18], [19], [20]. In the context of specific risks such as preeclampsia, the CLIP program demonstrates that screening, monitoring, and referral can be effectively carried out at the community level through the involvement of community health workers (CHWs)[21], [22]. The integration of digital technologies, such as mobile apps and clinical decision support systems (CDSS), further strengthens this model by improving screening accuracy and the consistency of clinical decision-making. This hybrid community–digital model also strengthens the connection between community services and the formal health system [21].

C. Digital Technology/mHealth and Its Functions

The use of mobile clinical decision support systems (CDSS) assists community health workers (CHWs) in risk screening and algorithm-based decision-making, thereby improving the consistency of clinical practices and user acceptance [19]. The integration of technology into community interventions, such as the CLIP program, enhances risk identification and supports task-shifting in health care [20], [21], [22].

D. Community and Digital Actors

Community health workers (CHWs) are key actors in education, screening, monitoring, and referral in digital community-based interventions, thereby expanding the reach of maternal health services[16], [20] . Technological support, such as mobile apps and clinical decision support systems (CDSS), enhances CHWs' capacity and the consistency of clinical decision-making[16] . The role of social actors in the community, including community leaders, also contributes to shaping health norms and behaviors that influence the utilization of maternal health services[16] . Additionally, family and social environment factors influence service utilization and referral decisions [19], [22].

E. Types of Pregnancy Risks Detected

Digital community-based interventions can detect various pregnancy risks through routine monitoring and improved preparedness for childbirth[16], [17], [22]. The primary focus is on gestational hypertension and preeclampsia, supported by digital technology [20], [21]. In addition, these interventions also include the detection of anemia, maternal–perinatal complications, and maternal health risks on an ongoing basis through the postpartum period, demonstrating comprehensive detection coverage throughout the pregnancy cycle [18], [19], [23].

F. Intervention Outcomes

Community-based digital interventions consistently improve the knowledge and behaviors of pregnant women, as well as their utilization of antenatal care (ANC) and delivery services at health facilities [16], [17], [24]. In addition, there has been an increase in the completion of the continuum of care, reflecting improved access to and continuity of maternal services [17], [18]. However, the impact on reducing maternal mortality has not been consistent, indicating a gap between improved risk detection and the health system's response [18], [21], [22].

G. Acceptability, Feasibility, and Implementation

Community-based digital interventions demonstrate high levels of acceptability and feasibility and enhance the capacity and confidence of community health workers (CHWs) in clinical practice [19], [20].

H. Social Determinants and System Context

The effectiveness of community-based digital interventions is influenced by social determinants—such as education, economic status, and family support—that affect the utilization of maternal health services [16], [22], [23], [24]. In addition, the readiness of the health system—including facilities, referral systems, and service integration—determines the extent to which early detection can yield optimal clinical outcomes [18], [19], [21].

Discussion

In various low- and middle-income countries, community-based approaches integrated with digital technology/mHealth show potential for improving the early detection of pregnancy risks. These approaches leverage the role of the community and technological innovations to expand the reach of screening, monitoring, and referrals for pregnant women [16], [19], [21], [22]. These findings are consistent with a recent systematic review indicating that mHealth interventions have the potential to increase the utilization of antenatal care (ANC), facility-based deliveries, and postnatal care in low- and middle-income countries. However, the magnitude of the impact depends on the type of intervention, access to technology, service readiness, and the context of implementation [25], [26].

The findings of this review indicate that the interventions implemented were not one-size-fits-all but rather included health education, home visits, risk screening, strengthening the continuum of care, and digital technology-based monitoring. This diversity suggests that community-digital approaches can be adapted to local contexts and available service capacities [16], [17], [18], [19].

Most interventions focus on a continuum-of-care approach, meaning that services do not end with risk detection but continue through monitoring and referral. Studies in Ghana have shown improvements in the continuity of maternal care and service utilization; however, the impact on maternal mortality is not always evident in the short term [10], [11]. The CLIP programs in Pakistan and Mozambique have also demonstrated that screening, monitoring, and referral for preeclampsia risk can be implemented at the community level through the involvement of community health workers [21], [22].

Community health workers (CHWs) are a central element in many of the interventions analyzed. CHWs play a role in education, screening, monitoring, and serving as liaisons with the health system. In a study in Nigeria, trained CHWs were able to safely initiate life-saving treatment for cases of preeclampsia within the framework of a supervised program [20] .The involvement of religious leaders alongside CHWs in Ethiopia also increased the utilization of antenatal and delivery services at health facilities[16]. Experience implementing the PIERS on the Move app in Mozambique shows that ease of use and perceived benefits can increase CHW acceptance, although operational challenges such as battery life and field conditions still need to be anticipated [27].

From a technological perspective, the use of mHealth and clinical decision support systems (CDSS) contributes to consistency in screening and decision-making at the community level. Mobile applications help healthcare workers conduct risk screenings more systematically and have demonstrated good user acceptance in the context of primary care in rural India [19]. Findings from other reviews also indicate that CDSS in maternal care have the

potential to support consistency in decision-making. However, these benefits depend on the system's alignment with workflows, data quality, and the service context in which it is used [28]. The success of mHealth implementation is also influenced by acceptance among healthcare workers and users, ease of use, organizational support, resource availability, connectivity, and alignment with the local social and cultural context [29].

The interventions analyzed indicate that a digital-community approach can be used to identify various pregnancy risks, including anemia, hypertension in pregnancy or preeclampsia, and general obstetric risks. The breadth of these risks demonstrates the approach's potential to support a more systematic assessment of maternal risk [19], [20], [21], [22], [23].

Most studies show improvements in process outcomes, such as utilization of antenatal care, continuity of care, screening, and referral of high-risk cases. However, the impact on reducing maternal mortality has not been consistent. These findings underscore that early detection must be accompanied by an adequate referral system, facility readiness, and continuity of care in order to produce clinical impact [17], [18], [21], [22].

In addition to health system factors, social determinants also influence the success of implementation. Education, socioeconomic status, and family support are associated with the utilization of maternal health services [23], [24]. On the other hand, the readiness of health facilities, the strength of the referral system, and the integration of services across levels determine whether early detection can be followed up in a timely manner [17], [18], [21], [22].

Overall, the findings of this review confirm that community-based approaches enhanced by digital technology hold great potential for improving the early detection of pregnancy risks. However, successful implementation does not solely depend on technological innovation, but also on the integration of health systems, the readiness of human resources, and the ability to adapt to social and cultural contexts.

Policy and Practice Implications

The findings of this scoping review indicate that integrating community-based approaches with digital technology/mHealth could be considered to strengthen the early detection of pregnancy risks in primary health care. From a policy perspective, strengthening the role of community health workers (CHWs) can be supported through standardized training, ongoing supervision, and clear governance frameworks for screening and referrals at the community level.

The development of digital technologies, such as mHealth and clinical decision support systems (CDSS), must be aligned with existing primary care workflows and referral systems. Integration with health management information systems (HMIS) should be considered to support data utilization, referral communication, and continuity of care. Such development

requires a digital health strategy that integrates human resources, organizational structures, financing, and technological infrastructure [30]. In antenatal care, these adjustments may include the standardization of data elements, workflows, and decision-support logic that remain aligned with clinical recommendations [31].

From a practical perspective, the implementation of interventions must be adapted to the local context, including sociocultural conditions, the involvement of families and community leaders, the readiness of health workers, and the availability of infrastructure. A user-centered approach is essential to ensure ease of use and the alignment of technology with user needs. Infrastructure readiness, network availability, follow-up mechanisms, and strategies for sustaining user engagement must be considered from the planning stage to ensure the technology can be used sustainably [32]. Technology development must involve healthcare workers and users as end-users from the design stage, including through workflow mapping, data requirement definition, and system adaptation to primary care conditions [33]. The design characteristics of the intervention and implementation strategies must also be tailored to user needs to ensure consistent use of mHealth [34].

Strengthening the referral system and ensuring the readiness of health facilities remain crucial so that early detection can be followed by a timely response. Digital technology should be positioned as a tool to support the strengthening of the health system, not as a substitute for health workers, primary care, or well-functioning referral facilities [35].

Overall, the community-digital approach has the potential to be one of the supporting strategies for strengthening maternal health services. Its success requires policy integration, health system readiness, human resource strengthening, and adaptation to the local context.

Conclusion

This scoping review indicates that community-based approaches integrated with digital technology/mHealth have the potential to support the early detection of pregnancy risks in low- and middle-income countries. The involvement of community health workers, community-based interventions, and digital technology can expand service coverage, support risk identification, and facilitate referrals. However, improvements in early detection have not consistently been accompanied by improvements in clinical outcomes, particularly a reduction in maternal mortality. The effectiveness of these interventions depends on the readiness of the health system, including the referral system, facility capacity, and service continuity. In addition, contextual factors—such as sociocultural conditions, literacy, infrastructure availability, and policy support—also influence the success of implementation. Therefore, community-digital approaches need to be designed adaptively and integrated into the broader health system. Overall, the combination of community-based and digital technology

approaches is a promising strategy for strengthening maternal health services, but it requires a responsive system to ensure optimal impact.

Limitations

This review has several limitations that should be considered when interpreting the results. First, only nine studies were included, so the findings may not represent the full range of community-based and digital/mHealth interventions across various contexts. Second, all of the included studies were from low- and middle-income countries. Therefore, generalizing the findings to high-income countries should be done with caution due to differences in health systems, infrastructure, and resource capacity. Third, the heterogeneity of research designs, types of interventions, implementation contexts, and outcomes limit direct comparisons across studies, particularly when assessing the impact on clinical outcomes such as maternal mortality. Fourth, reporting limitations in some studies—including details on implementation and contextual factors—may limit the depth of analysis. Additionally, the potential for publication bias cannot be ruled out, as studies with positive results are more likely to be published. Fifth, the terms "digital technology" or "mHealth" were not consistently used as separate search terms across all databases. This situation means that relevant digital health or mHealth studies may go unidentified if they do not include the terms "community," "pregnancy risks," or "early detection" in their titles or abstracts. Therefore, the findings of this review should be interpreted as a mapping of the evidence available within the search strategy used, rather than as a comprehensive overview of all digital interventions for maternal health. Nevertheless, this review provides an initial overview of digital-community interventions for the early detection of pregnancy risks and identifies key gaps for future research and policy.

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Conflict of Interest

The authors declare that there are no conflicts of interest in this study.

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Supplementary Materials

Table S1. Database search strategies

Database	Search Date	Search Field/ Scope	Search String	Filters Used	Initial results	Articles imported into Rayyan
PubMed	December 26, 2025	Specific fields not recorded in search history	(pregnan* OR maternal) AND (community OR "community-based" OR "community health worker*" OR "lay health worker*" OR "women* group*") AND (risk OR "danger sign*" OR complication* OR "high-risk")	Last 5 years; free full text; clinical trial; multicenter study; observational study; English; humans; female	550	550
ScienceDirect	December 26, 2025	General search	community-based early detection of pregnancy risk	Publication years 2020–2025	2,639	900
Wiley Online Library	December 26, 2025	Anywhere	("community-based" OR "community health worker" OR "women's groups" OR	Open Access; Last 5 Years	65	18

Database	Search Date	Search Field/ Scope	Search String	Filters Used	Initial results	Articles imported into Rayyan
			"community participation") AND ("pregnancy risk" OR "high-risk pregnancy" OR "obstetric risk" OR "danger signs") AND ("early detection" OR "screening" OR "risk identification")			
EBSCOhost	December 26, 2025	All Databases (3); specific fields not recorded	("Community Health Workers"[MeSH] OR community-based OR "women's groups") AND ("Pregnancy Complications"[MeSH] OR "high-risk pregnancy" OR "danger signs") AND ("Early Diagnosis"[MeSH] OR screening OR "risk assessment") AND (screen* OR identif* OR "danger sign*")	No additional filters were recorded	14	5
Total					3,268	1,473

Note: Articles imported into Rayyan were selected based on an initial screening of title and abstract relevance to the review's focus and the availability of the full text. Subsequently, duplicate removal and formal screening were performed using Rayyan.

Table S2. JBI critical appraisal

Study code	Authors, year	Study Design	JBI Checklist Used	Summary of methodological appraisal
J1	Prajapati et al., 2022 [23]	Analytical cross-sectional	JBI Checklist for Analytical Cross-Sectional Studies	The study met most of the JBI criteria. The main limitations were the absence of a strategy to control for confounding factors and a lack of explanation regarding measurement reliability. However, the study's objectives and main results remain relevant for describing the prevalence of high-risk pregnancies.
J2	Guthrie et al., 2021 [16]	Cluster randomized controlled trial	JBI Checklist for Randomized Controlled Trials	The study has strong internal validity and statistical analysis, particularly because it uses registry-based objective outcomes and a difference-in-difference analysis appropriate for cluster RCTs. The main limitations relate to the reporting of allocation concealment and blinding.
J3	Shibanuma et al., 2021 [17]	Cluster randomized controlled trial	JBI Checklist for Randomized Controlled Trials	The study demonstrates good methodological quality with a low to moderate risk of bias. Limitations are primarily found in the blinding domain, but the cluster RCT design still supports

Study code	Authors, year	Study Design	JBI Checklist Used	Summary of methodological appraisal
				the reliability of the evidence regarding community-based approaches and improvements in maternal health services.
J4	Pervin et al., 2021 [24]	Analytical cross-sectional	JBI Checklist for Analytical Cross-Sectional Studies	The study has a clear definition of outcomes, adequate control of confounding factors, and appropriate statistical analysis. The main limitation is the cross-sectional design, which does not allow for causal conclusions.
J5	Kikuchi et al., 2021 [18]	Hybrid effectiveness-implementation cluster RCT	JBI Checklist for Randomized Controlled Trials	The study has good internal and statistical validity, supported by objective outcomes, a large sample size, and intention-to-treat analysis. Limitations are primarily related to blinding and allocation concealment.
J6	Qureshi et al., 2020 [21]	Cluster randomized controlled trial	JBI Checklist for Randomized Controlled Trials	The study has good methodological quality, a large sample size, and robust statistical analysis. The lack of a significant effect on the primary outcome is likely related to the readiness of facility services, rather than primarily to weaknesses in the study design.
J7	Sevene et al., 2020 [22]	Cluster randomized controlled trial	JBI Checklist for Randomized Controlled Trials	The study features objective outcome measures and robust statistical analysis. The lack of a significant effect on the primary outcome is likely influenced by contextual factors and the quality of facility services.
J8	Nagraj et al., 2023 [19]	Pilot cluster randomized controlled trial	JBI Checklist for Randomized Controlled Trials	The study demonstrates good quality as a pilot RCT, with transparent reporting and reliable outcomes. This study was not designed to test definitive clinical effectiveness, but it provides strong evidence regarding the feasibility and acceptability of the intervention.
J9	Adepoju et al., 2021 [20]	Process evaluation linked to an RCT	JBI Checklist for Randomized Controlled Trials	The study is of good quality for assessing safety and feasibility, but it is not a comparative effectiveness study. The study is relevant for describing task-shifting, the use of mHealth, and the safety “ ” of community health workers’ interventions in the management of preeclampsia.

Note: Each study was assessed using the JBI Critical Appraisal Tool appropriate for its study design. Responses to each item were recorded as “Yes,” “No,” “Unclear,” or “Not Applicable.” The assessment results were used to describe the methodological strengths and limitations of the studies, not as an automatic basis for excluding studies from the review.

Table S3. Eligibility Reconciliation

Study Code	Setting described in the study	Community or primary care component	Audit decision	Reason for decision
J8	Primary health centers in India; screening and app use are conducted by ASHA	Yes. ASHA serves as community health workers and are linked to primary health centers.	Retained	The study meets the criteria for community and primary care and uses a mobile clinical decision support system for pregnancy risk screening.
J9	Eleven hospitals in the Netherlands; blood pressure and symptom monitoring are performed by patients at home via SAFE@home.	There are no documented components involving community health workers, community groups, home visits by community health workers, or primary care services.	Excluded	Hospital-based study; self-monitoring at home does not in itself indicate the implementation of a community-based or primary care intervention.
J11	Three hospital networks and 23 service locations in the United States; cardiovascular risk screening is integrated into the EHR.	No community or primary care components were documented.	Excluded	The study is a hospital- and EHR-based quality-improvement initiative without clear community involvement.
J12	Participant recruitment took place at the Jinnah Postgraduate Medical Center, Karachi; the study explored needs and preferences regarding telemonitoring.	No community-based or primary care interventions have been implemented and evaluated.	Excluded	Hospital-based user needs studies; studies that have not evaluated the implementation of community interventions or primary care services.

Note: Studies with a hospital setting were included only if the full-text article documented clear and relevant involvement of the community or primary health care services that aligned with the review's objectives.

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