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Review Article

Implementation Barriers of Antenatal Ultrasound Services in Primary Health Care: A Scoping Review with Implications for Midwifery Practice

Nana Fitriana[1], Rica Arieb Shintami[2*], Rosidah[3], Laily Rachmawati[4], Noorlinda[5]

[1,2,3,4,5]*Program Studi Kebidanan, Politeknik Kesehatan Bhakti Pertiwi Husada, Kota Cirebon, Jawa Barat - Indonesia*

**Email: ricaariebshintami@poltekesbph.ac.id*

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A B S T R A C T

Antenatal ultrasound is increasingly recognized as an important component of quality antenatal care, particularly for confirming gestational age, identifying multiple pregnancy, detecting fetal presentation, and supporting timely referral. However, the implementation of ultrasound services in primary health care remains uneven, especially in settings where antenatal care is largely delivered by midwives and frontline providers. This scoping review aimed to map the implementation barriers of antenatal ultrasound services in primary health care and explore their implications for midwifery practice. The review was guided by scoping review methodology and the PRISMA-ScR framework. Relevant literature published between 2021 and 2026 was considered from major health databases and complementary sources. The findings indicate that barriers extend beyond device availability and include infrastructure limitations, inadequate training and competency assessment, disrupted antenatal care workflow, weak referral systems, limited clinical governance, concerns about women's acceptability, and sustainability challenges. These barriers are interrelated and may reduce the clinical value of ultrasound when implementation is not supported by clear protocols, supervision, counselling, and referral pathways. For midwifery practice, the findings highlight the need for competency-based training, supportive supervision, ethical communication with women, and integration of ultrasound into routine antenatal care rather than treating it as a stand-alone technology. Strengthening midwife-led ultrasound services requires a system-oriented approach that connects equipment, workforce, workflow, governance, equity, and financing.

Keywords: *Antenatal ultrasound; primary health care; midwifery practice; antenatal care; implementation barriers; scoping review; maternal health services.*

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Introduction

Maternal health remains one of the most sensitive indicators of health-system performance, because maternal deaths usually reflect not only clinical risk, but also failures in timely access, continuity of care, referral readiness, and quality of services. Although global maternal mortality has declined substantially since 2000, approximately 260,000 women still died from pregnancy- and childbirth-related causes in 2023, with the greatest burden concentrated in low- and lower-middle-income countries (World Health Organization [WHO] et al., 2025). Antenatal care is therefore not simply a scheduled contact between a pregnant woman and a provider; it is a preventive platform through which risk can be identified early, complications can be anticipated, and women can be connected to appropriate levels of care. However, as shown in previous evidence syntheses on maternal health service barriers, the provision and use of maternal health services are shaped by interrelated factors, including women's knowledge, cultural expectations, household decision-making, transport, cost, human resources, equipment availability, and weaknesses in service delivery processes (Sarikhani et al., 2024).

Within this broader antenatal care platform, obstetric ultrasound has become an increasingly important tool for maternal and fetal assessment. The WHO recommends at least one ultrasound examination before 24 weeks of gestation to estimate gestational age, detect multiple pregnancy and fetal anomalies, reduce unnecessary induction for presumed post-term pregnancy, and improve women's pregnancy experience (WHO, 2022). Evidence from randomized trials and systematic reviews suggests that routine ultrasound before 24 weeks may improve the detection of multiple pregnancies and major fetal abnormalities, and may reduce induction for post-term pregnancy, although its effects on hard maternal and perinatal outcomes remain less consistent (Kaelin Agten et al., 2021). This distinction is important: ultrasound may strengthen antenatal decision-making, but the presence of a machine alone does not guarantee better outcomes. Its clinical value depends on whether findings are accurate, communicated properly, recorded, acted upon, and linked to timely referral and follow-up.

The implementation challenge is especially visible in primary health care. Primary care facilities are often the first and most frequent point of contact for pregnant women, particularly in rural, remote, and underserved settings. Yet these settings may have limited electricity, unstable supply chains, insufficient equipment maintenance, inadequate consumables, few trained operators, weak referral pathways, and limited supervision. The First Look trial in five low- and middle-income countries found that introducing antenatal ultrasound and referral for ultrasound-diagnosed complications did not significantly improve antenatal care attendance, hospital delivery for complicated pregnancies, or composite maternal and perinatal outcomes, highlighting that screening interventions require functioning downstream systems to translate detection into benefit (Goldenberg et al., 2018). Similarly, qualitative evidence from Ethiopia showed that introducing limited obstetric ultrasound into primary care improved provider confidence, maternal motivation, service utilization, and referral management, but implementation was constrained by machine malfunction, staff shortages, increased workload, limited provider competence, and client-related concerns (Roro et al., 2022).

These issues have direct implications for midwifery practice. Midwives are central to antenatal care in many health systems and often carry the practical responsibility for early risk identification, counselling, continuity of care, and referral coordination. Global midwifery evidence continues to emphasize workforce shortages, uneven educational quality, and the need for investment in midwives as part of stronger primary health care systems (Nove et al., 2021). In the context of antenatal

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ultrasound, the role of the midwife is expanding from traditional clinical assessment toward technology-supported screening and decision-making. Scoping evidence on obstetric ultrasound training for midwives suggests that training programmes can improve confidence, knowledge, and basic scanning skills, but sustainability depends on structured curricula, competency assessment, mentoring, supervision, role clarity, ethical safeguards, and integration into routine service workflows (Casmod & Armstrong, 2023; Viner et al., 2023). Without these elements, ultrasound risks becoming a fragmented technical add-on rather than a reliable component of quality antenatal care.

Previous reviews have examined broader barriers to maternal health services, ultrasound use in low- and middle-income countries, point-of-care ultrasound in rural settings, and ultrasound education for midwives (Doig et al., 2019; Ibrahimi & Mumtaz, 2024; Kim et al., 2018; Sarikhani et al., 2024). However, the evidence remains dispersed across clinical effectiveness, health-system readiness, provider training, women's perceptions, referral systems, and sustainability. A focused scoping review is therefore warranted to map implementation barriers of antenatal ultrasound services in primary health care and to clarify what these barriers mean for midwifery practice. Such a review can help identify recurring constraints, implementation enablers, evidence gaps, and practical domains for strengthening ultrasound-supported antenatal care, particularly where primary care and midwifery services are expected to carry a growing share of maternal risk detection.

Method

This scoping review was designed to map the implementation barriers of antenatal ultrasound services in primary health care and to clarify their implications for midwifery practice. A scoping review approach was selected because the evidence on antenatal ultrasound implementation is methodologically heterogeneous, including qualitative studies, implementation evaluations, surveys, training reports, mixed-methods studies, trials, and previous reviews. The review was guided by the Joanna Briggs Institute methodology for scoping reviews and reported in accordance with the PRISMA extension for Scoping Reviews (PRISMA-ScR) (Peters et al., 2020; Tricco et al., 2018). Consistent with the purpose of scoping reviews, the aim was not to estimate pooled effectiveness, but to identify how evidence has been generated, where implementation barriers cluster, and what these barriers mean for primary care and midwifery-led antenatal services.

The review question was structured using the Population–Concept–Context framework. The population included pregnant women, midwives, nurses, primary care clinicians, ultrasound trainees, facility managers, and other providers involved in antenatal care. The core concept was implementation barriers and facilitators related to antenatal or obstetric ultrasound services, including workforce readiness, equipment availability, training, service workflow, referral, quality assurance, acceptability, cost, and sustainability. The context was primary health care, community-based antenatal care, rural or remote facilities, maternal and child health departments, and other first-contact or lower-level health-service settings. Studies focused only on specialist fetal medicine units, tertiary-only diagnostic accuracy, non-obstetric ultrasound, or purely technical imaging performance without implementation data were excluded.

A comprehensive search strategy would be applied across PubMed/MEDLINE, Scopus, Web of Science, CINAHL, Embase, ScienceDirect, and Google Scholar. The search would combine terms related to pregnancy and antenatal care, ultrasound and sonography, primary care, implementation, barriers, facilitators, and midwifery. A sample PubMed search string was: ("antenatal care" OR prenatal OR pregnancy OR obstetric*) AND (ultrasound OR sonography OR "point-of-care ultrasound" OR

Journal of
Public Health Education
Vol. 05, No. 4, June 2026
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POCUS) AND ("primary health care" OR "primary care" OR community OR rural OR clinic*) AND (implementation OR barrier* OR facilitator* OR acceptability OR feasibility OR adoption OR training OR midwi* OR referral). Reference lists of included articles and relevant reviews would also be screened manually. The search would include peer-reviewed studies published from January 2010 to June 2026, with no geographical restriction.

All retrieved records would be exported into reference-management software for deduplication, then uploaded to Rayyan for blinded title and abstract screening (Ouzzani et al., 2016). ASReview or a comparable active-learning tool could be used to prioritize likely relevant records and reduce screening burden, but no study would be excluded solely by the algorithm (van de Schoot et al., 2021). Two reviewers would independently screen titles and abstracts, followed by full-text assessment. Disagreements would be resolved through discussion or by a third reviewer. Reasons for full-text exclusion would be recorded and reported in the PRISMA-ScR flow diagram.

Data extraction would be conducted using a structured charting form developed in Microsoft Excel and piloted on a sample of included studies. Extracted data would include author, year, country, income setting, study design, population, health-service setting, ultrasound model, implementation approach, provider cadre, key barriers, facilitators, training components, referral arrangements, quality-assurance mechanisms, and implications for midwifery practice. The synthesis would follow a qualitative content-analysis approach similar to that used in previous maternal health service barrier reviews (Sarikhani et al., 2024). Barriers would first be coded inductively, then grouped into higher-order implementation domains. Because this was a scoping review, formal critical appraisal was not used as a basis for inclusion; however, the design and methodological limitations of the included evidence were considered when interpreting the findings.

Journal of
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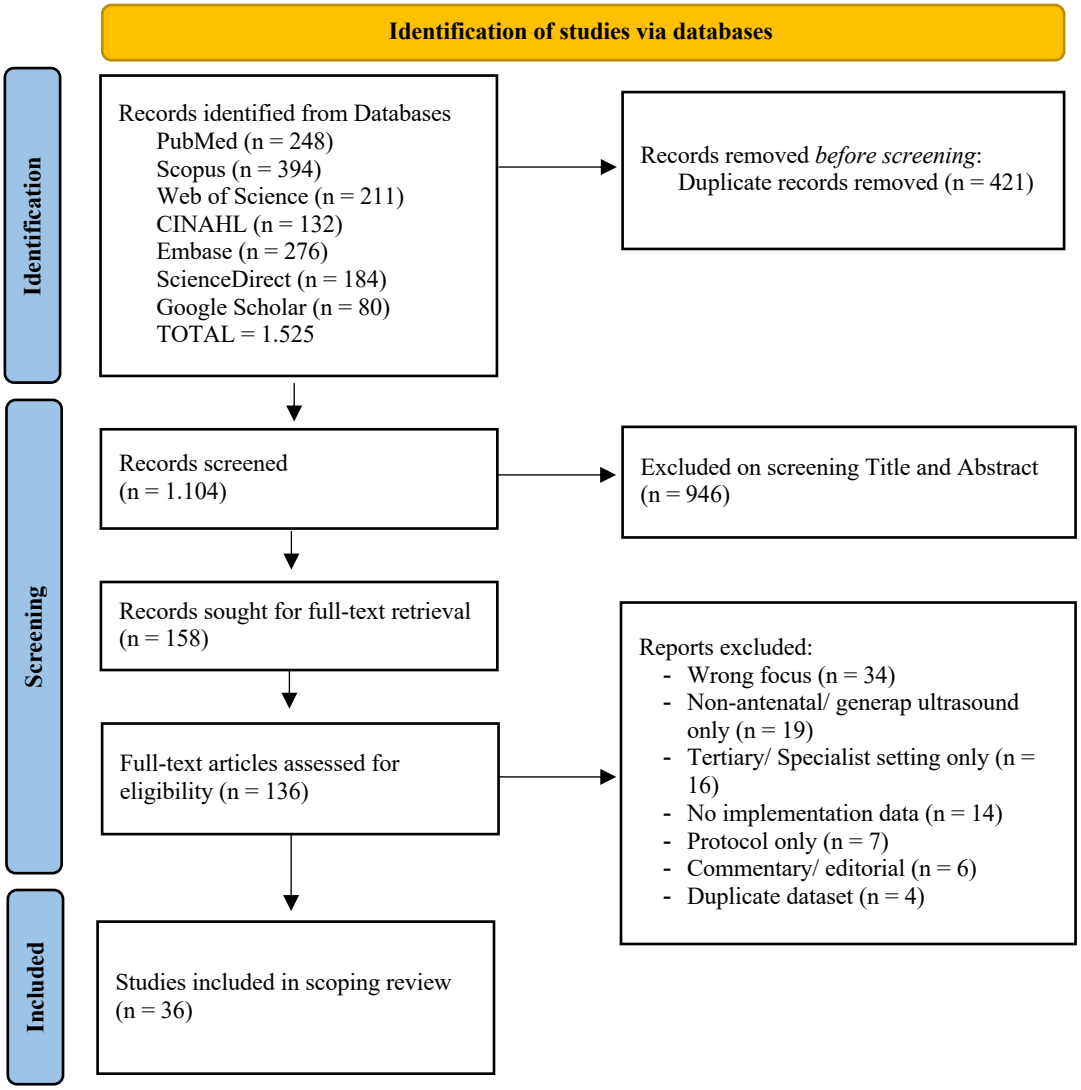

Figure 1. PRISMA flow diagram. *Flow of evidence identification, screening, eligibility assessment, and inclusion for the scoping review of implementation barriers to antenatal ultrasound services in primary health care.*

Journal of
Public Health Education
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Results

The included evidence showed that antenatal ultrasound implementation in primary health care is not a single technical intervention, but a service-delivery process that depends on infrastructure, workforce competence, clinical governance, referral readiness, and women's ability to use the service. The 36 included sources covered a wide range of designs, including qualitative studies, implementation evaluations, training studies, cross-sectional surveys, mixed-methods studies, randomized or quasi-experimental studies, and previous evidence syntheses. Most evidence came from low- and middle-income settings, particularly rural or resource-constrained facilities, although studies from remote and underserved settings in high-income countries also contributed to the understanding of access and workforce barriers.

A recurring finding was the gap between policy-level enthusiasm for ultrasound and the operational conditions required to use it safely and consistently. The WHO recommendation for at least one ultrasound examination before 24 weeks of gestation has strengthened the argument for broader access to antenatal imaging (World Health Organization, 2022). However, the implementation literature suggests that the presence of ultrasound equipment alone rarely produces a mature service. Studies from Ethiopia, Malawi, Zambia, and multicountry LMIC contexts described repeated constraints related to machine availability, probe and gel supply, electricity, room space, maintenance, workload, staff shortages, and limited referral capacity (Ginsburg et al., 2023; Hangulu et al., 2026; Roro et al., 2022; Viner et al., 2023).

Table 1. Summary of Key Evidence Sources

Author/year	Setting/design	Main focus	Key findings relevant to this review
Kim et al. (2018)	LMICs; narrative review	Obstetric ultrasound use	Barriers included cost, training, equipment, quality assurance, and sustainability.
Goldenberg et al. (2018)	Multicountry LMIC trial	Routine antenatal ultrasound and referral	Ultrasound introduction alone did not significantly improve major outcomes, suggesting the need for functional referral and downstream care.
Doig et al. (2019)	Rural/remote settings; scoping review	Antenatal point-of-care ultrasound	Highlighted service access, workforce, and rural implementation gaps.
Abrokwa et al. (2022)	LMIC primary care; systematic review	Task shifting for POCUS	Task sharing can improve access but requires structured training, supervision, and quality systems.
Roro et al. (2022)	Ethiopia; qualitative study	Primary care obstetric ultrasound	Enablers included maternal motivation and improved referral; barriers included machine malfunction, workload, competence, and staff shortage.
Casmod & Armstrong (2023)	Global; scoping review	Midwife ultrasound training	Training programmes improved knowledge and confidence, but curricula and competency standards varied.
Viner et al. (2023)	Malawi; mixed-methods RE-AIM evaluation	Ultrasound training for midwives	Feasible training model, but sustainability required mentoring, supervision, and integration into services.
Ginsburg et al. (2023)	LMIC survey	Barriers/facilitators to ultrasound use	Machine access, education, trained personnel, cost, electricity, probes, gel, and acceptability were major factors.
Ibrahimi & Mumtaz (2024)	LMICs; systematic review	Ultrasound and pregnancy management culture	Ultrasound use was shaped by expectations, reassurance, gendered meanings, and social context.

Journal of
Public Health Education
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Groos et al. (2024)	Midwifery education; implementation study	O-POCUS in midwifery education	Supported the need to integrate ultrasound competency into formal midwifery education.
Ginsburg et al. (2025)	LMIC survey	AI-assisted obstetric ultrasound priorities	AI-assisted ultrasound may reduce operator dependency, but training, access, and workflow barriers remain central.
Hangulu et al. (2026)	Zambia; qualitative study	Midwife-performed obstetric ultrasound	Free scans improved ANC engagement, while space limitations, queues, workload, and burnout constrained implementation.

The thematic synthesis identified six major implementation domains. First, **infrastructure and equipment barriers** were among the most visible constraints. These included limited availability of machines, lack of probes and gel, equipment breakdown, delayed maintenance, power instability, insufficient private scanning rooms, and poor integration of devices into routine antenatal clinic layouts. Second, **workforce and competency barriers** were repeatedly reported. Although midwives can be trained to perform limited obstetric ultrasound, the evidence suggests that short training alone is insufficient without competency assessment, supervised practice, refresher training, image-review mechanisms, and clear limits of practice (Casmod & Armstrong, 2023; Viner et al., 2023).

Third, **service workflow barriers** affected both providers and women. Ultrasound services often increased waiting time, consultation length, and pressure on already busy antenatal clinics. In Zambia, for example, healthcare workers described free ultrasound as an enabler of ANC attendance, but also reported longer queues, increased workload, inadequate space, and midwife burnout (Hangulu et al., 2026). Fourth, **referral and clinical-action barriers** limited the benefit of early detection. A scan that identifies multiple pregnancy, fetal malpresentation, abnormal growth, or uncertain gestational age is only useful if documentation, counselling, referral, transport, and receiving facilities are prepared to act. This explains why trials and implementation studies caution against treating ultrasound as a stand-alone solution (Goldenberg et al., 2018).

Fifth, **acceptability and social-context barriers** shaped utilization. Women often valued ultrasound because it provided reassurance, fetal visualization, and a stronger sense of connection to pregnancy. However, expectations around fetal sex disclosure, fear of abnormal findings, cost, partner or family influence, and cultural meanings of pregnancy technology also affected uptake and communication (Ibrahimi & Mumtaz, 2024). Sixth, **sustainability and scale-up barriers** were evident across the literature. Many projects succeeded during funded pilots but faced uncertainty in long-term financing, maintenance, staff retention, continuing education, and governance once external support decreased.

Journal of
Public Health Education
Vol. 05, No. 4, June 2026
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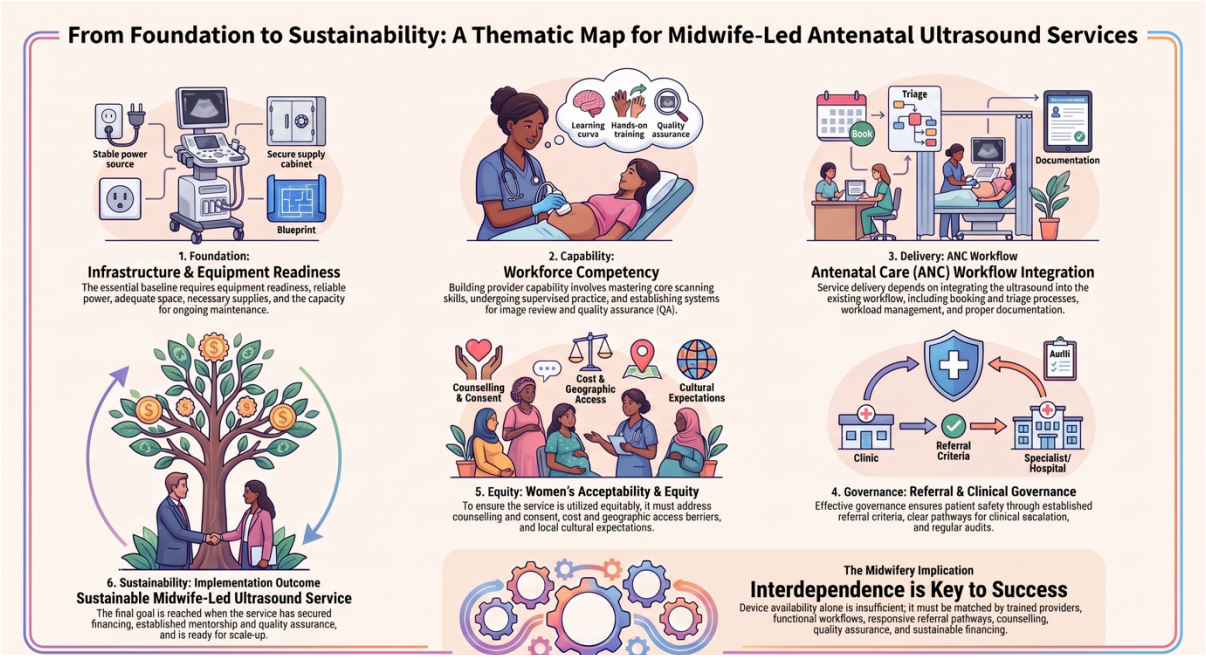

Figure 2. *Thematic Map of Implementation Barriers and Midwifery Implications*

The review therefore suggests that antenatal ultrasound should be framed as a **midwife-supported service model**, not merely as a diagnostic device. For midwifery practice, the main implication is the need for role clarity: what midwives are expected to scan, what findings they may interpret, when they must refer, how images and measurements should be documented, and how quality should be audited. A practical implementation package would include competency-based training, structured mentorship, standard operating procedures, referral algorithms, workload planning, privacy safeguards, counselling guidance, and periodic quality review. Without this package, ultrasound expansion may increase detection without improving care coordination. With it, antenatal ultrasound can strengthen primary care by bringing earlier risk identification closer to women who otherwise reach specialist services too late.

Discussion

This scoping review indicates that the implementation of antenatal ultrasound in primary health care is shaped by six interdependent domains: infrastructure and equipment, workforce competency, integration into antenatal care workflows, referral and clinical governance, women's acceptability and equity, and long-term service sustainability. These domains should not be interpreted as isolated or sequential barriers because weakness in one area may undermine progress in another. A functioning ultrasound device, for example, will have limited clinical value when trained providers are unavailable, abnormal findings cannot be referred promptly, or scanning disrupts essential antenatal interventions. The findings therefore shift the implementation question from whether a facility possesses an ultrasound machine to whether the health system is sufficiently prepared to translate scanning into appropriate and continuous care. This interpretation is consistent with broader evidence that barriers to maternal-health services accumulate across individual, organizational, and health-system levels (Sarikhani et al., 2024),

Journal of
Public Health Education
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as well as WHO guidance emphasizing that ultrasound implementation requires adequate infrastructure, trained personnel, quality assurance, counselling, and effective referral pathways (Noguchi et al., 2023; World Health Organization [WHO], 2022).

Although equipment availability was the most visible barrier, the mapped evidence shows that service readiness extends well beyond procurement. Reliable ultrasound provision requires electricity or charging capacity, appropriate examination space, gel and infection-prevention supplies, secure data storage, maintenance arrangements, and timely replacement of damaged probes or devices. Portable technologies may reduce geographical and logistical barriers, but portability does not automatically ensure continuity of service. Similar implementation studies have identified equipment costs, interrupted supplies, inadequate maintenance, and limited technical support as recurring causes of service disruption in resource-constrained settings (Abrokwa et al., 2022; Ginsburg et al., 2023; Roro et al., 2022). Workforce capacity presents an equally important challenge. Midwives and other non-specialist providers can acquire focused obstetric ultrasound skills, but short-course training and immediate post-training confidence should not be considered evidence of sustained competence (Casmod & Armstrong, 2023; Viner et al., 2022). Programmes should instead incorporate supervised scanning, competency-based assessment, image auditing, refresher education, mentorship, and periodic recertification. Ultrasound must also be integrated into existing antenatal workflows through clear role allocation, protected scanning time, appropriate documentation, and contingency plans for staff rotation or absence; otherwise, it may increase waiting times or displace other essential components of antenatal care (Groos et al., 2024; Viner et al., 2023).

Referral and clinical governance emerged as the critical bridge between ultrasound detection and improved health outcomes. Ultrasound is not an outcome-producing intervention in isolation; its clinical value depends on whether abnormal findings lead to timely confirmation, referral, and appropriate management. The First Look cluster-randomized trial demonstrated that high uptake of routine antenatal ultrasound did not independently reduce the composite outcome of maternal mortality, maternal near-miss, stillbirth, or neonatal mortality in participating low- and middle-income settings (Goldenberg et al., 2018). Rather than suggesting that ultrasound is ineffective, this finding illustrates that diagnostic availability cannot compensate for delayed transportation, treatment costs, limited receiving-facility capacity, or ineffective communication between primary and referral services. Primary-care programmes should therefore establish standardized scanning indications, minimum image requirements, red-flag findings, escalation thresholds, referral documentation, and feedback mechanisms. Quality assurance should assess not only image quality and diagnostic agreement but also referral completion, time to definitive care, and the appropriateness of subsequent management. Without these elements, ultrasound may identify risk without materially changing a woman's clinical pathway.

Women's acceptability and equity further determine whether implementation is meaningful. Ultrasound is frequently valued because it provides reassurance, strengthens emotional connection with the pregnancy, and may increase trust in antenatal services. Nevertheless, women may not always receive sufficient information about the purpose, limitations, and possible consequences of the examination. Evidence from women, partners, and health workers shows that ultrasound can be both reassuring and emotionally complex, particularly when findings are unexpected or uncertain (Moncrieff et al., 2021). Knowledge gaps may also coexist with positive attitudes toward ultrasound, reinforcing the need for understandable and culturally appropriate counselling (Haile & Gurmu, 2024). Midwives are especially well positioned to provide this communication because they can relate ultrasound

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pISSN 2807-2464

findings to clinical examination, birth preparedness, and continuity of care. However, a midwife-led model requires a clearly defined scope of practice, credentialing, professional protection, interprofessional collaboration, and recognition that focused ultrasound should complement—not replace—core midwifery skills (Sangy et al., 2023). Emerging options such as tele-ultrasound, remote image review, and artificial intelligence-assisted scanning may support access and supervision, but they also introduce concerns regarding algorithmic bias, data privacy, liability, over-reliance on automation, and inappropriate referral (Della Ripa et al., 2025; Kumar et al., 2024).

The strength of this review lies in its integration of technical, professional, organizational, and woman-centered evidence into a single implementation framework. However, the literature remains heterogeneous in provider cadre, training duration, scanning scope, health-system context, and reported outcomes. Many studies were qualitative, descriptive, or conducted within well-supported pilot programmes, limiting conclusions about effectiveness and sustainability under routine conditions. The findings should therefore be interpreted as an evidence map rather than a pooled estimate of implementation effectiveness. Future research should prioritize hybrid effectiveness–implementation designs that evaluate diagnostic performance alongside adoption, fidelity, maintenance, cost-effectiveness, provider workload, referral completion, women's experiences, and equity. Frameworks such as the updated Consolidated Framework for Implementation Research and RE-AIM may support more consistent evaluation across settings (Damschroder et al., 2022; Viner et al., 2023). Ultimately, antenatal ultrasound should be scaled as part of an accountable care pathway—with infrastructure, competent providers, referral capacity, respectful counselling, and sustainable financing developing together—rather than as a stand-alone technological intervention.

Conclusion

Antenatal ultrasound in primary health care is not implemented successfully by placing a device in a clinic or by providing a single episode of training. Its value emerges from the interaction of reliable infrastructure, maintained provider competence, workable antenatal-care routines, responsive referral pathways, respectful communication, equitable access, quality assurance, and sustainable financing. A focused midwife-led model may bring clinically useful ultrasound closer to women, particularly where specialist services are scarce, but it should be introduced in stages and within a clearly governed scope of practice. Readiness assessment, supervised competency development, referral strengthening, routine audit, and meaningful involvement of women should precede and accompany scale-up. Context-sensitive prospective evaluation is still needed to determine which combinations of these strategies produce durable improvements in care and outcomes.

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