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Antenatal point-of-care ultrasound in low- and middle-income countries: a systematic review

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Abstract

Objective: To identify, evaluate, and synthesise reported applications of antenatal point-of-care ultrasound (POCUS) in low- and middle-income countries (LMICs).

Design: Systematic review done in accordance with PRISMA 2020 and prospectively registered with PROSPERO (CRD42023410005).

Methods: We searched EMBASE, CINAHL, The Cochrane Library, Global Health Library, MEDLINE, PubMed, and Web of Science Core Collection from inception to Dec 12, 2024. POCUS was defined as focused ultrasonographic imaging performed and interpreted in real time by the treating provider. We included peer-reviewed original studies reporting antenatal POCUS use in LMICs, with no restriction on study design, publication date, or language. Methodological quality was assessed with the Mixed Methods Appraisal Tool (MMAT), and reported applications were mapped by trimester usingInternational Society of Ultrasound in Obstetrics and Gynaecology (ISUOG) guidance to identify evidence gaps.

Results: The search identified 6012 records, of which 30 studies were included. Studies were conducted in 17 countries, 68% in Africa. Most used quantitative designs; four were qualitative. Five studies evaluated machine learning or artificial intelligence for gestational age estimation, fetal presentation, or placental location. The most commonly reported POCUS applications were gestational age determination (23/30), placental location (20/30), fetal presentation (19/30), cardiac activity (17/30), biometry (15/30), fetal number (14/30), and amniotic fluid volume (13/30). By trimester, gestational age was the most frequently reported application throughout; cardiac activity predominated in the first trimester, placental location in the mid-trimester, and fetal presentation in the third trimester. Methodological quality was generally high, with only one study receiving more than one domain rating of “No” or “Cannot Tell”.

Conclusions: Antenatal POCUS in LMICs is being used primarily for focused obstetric assessments that can alter triage and referral. Evidence for broader applications, downstream clinical outcomes, and health-system integration remains limited. AI-enabled ultrasound could expand access, but clinical value will depend on training, governance, and referral capacity.

1. INTRODUCTION

1.1 Background

Maternal and perinatal mortality remain concentrated in low- and middle-income countries (LMICs), where most deaths are preventable with timely access to high-quality care (1–4). Obstetric conditions such as fetal malpresentation, multiple pregnancy, ectopic pregnancy, and placenta previa contribute substantially to maternal and perinatal morbidity and mortality, particularly when diagnosis is delayed (5). Reducing these outcomes requires interventions that improve access to acceptable, effective antenatal care within functioning health systems (6).

The WHO recommends one ultrasound scan before 24 weeks of gestation as part of routine antenatal care (7). Ultrasound can establish viability, confirm multiple pregnancy, estimate gestational age, identify placental location, and detect major fetal anomalies, thereby informing referral and clinical management. In many LMIC settings, however, implementation remains uneven because of infrastructure, workforce, and cost constraints (8–12).

Point-of-care ultrasound (POCUS) refers to focused ultrasonographic imaging performed and interpreted in real time by the treating clinician to answer a specific clinical question (9). Its defining feature is not portability alone, but a model of care in which image acquisition and interpretation occur at the bedside, distinct from comprehensive sonography undertaken by specialist operators. This distinction is especially relevant in LMICs, where decentralisation of diagnostic capacity and task-shifting to mid-level providers may expand access to clinically useful imaging (13, 14).

POCUS may offer a pragmatic route to improving access because focused examinations generally require less infrastructure, time, and operator expertise than comprehensive obstetric ultrasound (8, 15). However, safe use depends on appropriate training, supervision, and referral pathways; otherwise, ultrasound can contribute to misdiagnosis, inappropriate intervention, or false reassurance (10, 11, 16).

A 2016 systematic review of portable ultrasound in LMICs identified only three obstetric studies and highlighted potential effects on clinical decision-making (15). Since then, handheld devices have proliferated, primary-care implementation has expanded, and artificial intelligence (AI)-enabled acquisition and interpretation have emerged.

An updated synthesis is therefore needed to define current antenatal applications of POCUS, the cadres using it, and the principal evidence gaps. We aimed to identify, evaluate, and synthesise reported uses of antenatal POCUS in LMICs.

2. METHODS

This systematic review was organised using the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement guidelines and organised using PRISMA-2020 Checklist (17). The protocol was registered prospectively on PROSPERO, an international database of prospectively registered systematic reviews, with registration number CRD42023410005.

2.1. Eligibility criteria

The review question was developed using the PICO (Population, Intervention, Comparison, Outcome) search strategy for developing mixed methods research questions (18). For this review, POCUS was defined as focused ultrasonographic imaging performed and interpreted in real time by the treating provider. We included peer-reviewed original studies reporting antenatal POCUS applications in LMICs, as defined by the World Bank (19). We excluded studies limited to comprehensive ultrasonography, studies from high-income countries, and studies focused solely on training curricula, echocardiography, or Doppler sonography. Telemedicine and remote-interpretation studies were excluded unless acquisition was undertaken as a focused POCUS examination. No restrictions were applied by study design, language, or publication date. **Supplementary** Tables **S1-S2** provide the full PICO Strategy and Eligibility Criteria.

2.2. Search strategy

Using the PICO search strategy, domains were identified to guide the search strategy to include the participants (participants in antenatal care in LMICs), the intervention (antenatal point-of-care ultrasound) and outcomes (uses of antenatal point-of-care ultrasound).

We searched EMBASE, CINAHL, The Cochrane Library, Global Health Library, MEDLINE, PubMed, and Web of Science Core Collection from inception to Dec 20, 2022, and updated the search on May 16, 2023, and Dec 12, 2024. The MEDLINE strategy was developed with a health sciences librarian and translated for other databases using the Polyglot Search Translator (20). No language or date limits were applied. We also performed Google Scholar searches and screened reference lists for additional eligible studies. An example PubMed strategy is provided in **Supplementary Table S4.** Full search strategies for all databases are available from the authors on request.

2.3. Data selection and extraction

Records were exported to Endnote 20 and deduplicated, then uploaded to Covidence (21). Two reviewers independently screened titles and abstracts, followed by full texts, against the eligibility criteria (22). Reasons for exclusion at full-text review were recorded. Disagreements were resolved by discussion between AY and AS, with a third reviewer consulted when required.

Data extraction was performed by the principal investigator and independently verified by a second reviewer (AS). The following variables were extracted from included studies: study aim, study design, setting, ultrasound device, operator, and timing of use, as well as reported antenatal POCUS applications and other relevant outcomes (**Supplementary Table S3**). Data were extracted into a Microsoft Excel Spreadsheet. The extraction form was piloted on 10% of included studies to assess usability and consistency. Because the review included multiple study designs, outcomes ranged from quantitative variables to qualitative themes.

2.4. Data synthesis

We used descriptive statistics and narrative synthesis because substantial heterogeneity in study design, outcomes, and reporting precluded meta-analysis. The primary outcome was reported antenatal POCUS application, mapped to ISUOG guidance for first-trimester, mid-trimester, and third-trimester obstetric ultrasound (23–25). Although these guidelines were not developed for

POCUS and included studies did not necessarily report findings by trimester, they provided a pragmatic framework for identifying areas of alignment and evidence gaps.

2.5. Methodological quality assessment

Two reviewers (AY and RMS) independently assessed methodological quality using the Mixed Methods Appraisal Tool (MMAT) (26). The MMAT is designed for reviews including qualitative, quantitative, and mixed-methods studies and rates each domain as “Yes”, “No”, or “Cannot Tell”. Disagreements were resolved by discussion. **Supplementary Table S5** summarises the tool.

3. RESULTS

3.1. Study selection

The search identified 6012 records. After removal of 2652 duplicates and exclusion of 3210 records at title and abstract screening and 120 at full-text review, 30 studies were included in the final synthesis. Figure 1 shows the PRISMA flow diagram.

3.2 Study characteristics

The 30 included studies and their characteristics are summarised in Table 1. Most studies were quantitative (n = 26), with four qualitative studies; no mixed-methods or randomised controlled trials were identified.

Table 1
Characteristics of Selected Studies

First Author	Study Design	Country	Setting	Ultrasound Device	Operator	Timing	Uses
Abawollo et al. (2022) (40)	Retrospective cross-sectional study	Ethiopia	Health centres	VScan	*Novice*: Mid-level healthcare providers	1st, 2nd, 3rd trimester	Pregnancy confirmation, cardiac activity, gestational age, biometry, fetal presentation, placenta location, amniotic fluid volume (AFV)
Adler et al. (2008)(41)	Observational feasibility study	Tanzania	Refugee camp health posts	Sonosite Titan	*Novice*: Physicians and mid-level practitioners	1st, 2nd, 3rd trimester	Pregnancy confirmation, cardiac activity, fetal number, gestational age
Argaw et al. (2022)(42)	Qualitative	Ethiopia	Health centres	VScan	*Novice*: Midwives	1st, 2nd, 3rd trimester	Pregnancy confirmation, cardiac activity, gestational age, biometry, fetal presentation, placenta location, AFV
Arroyo et al. (2022)(43)	Training and validation of a deep learning algorithm	Peru	Health Centre	Mindray DP-10	*Novice*	3rd trimester	Gestational age, fetal presentation, placenta location
Bruns et al. (2015)(44)	Prospective cross-sectional study	Brazil	Emergency obstetric ultrasound service	VScan	*Skilled*: Ultrasound specialists in obgyn and/or fetal medicine	1st trimester	Pregnancy confirmation, cardiac activity, ectopic pregnancy
Crispín Milart et al. (2016)(45)	Observational study	Guatemala	Patient homes located in rural areas	USB probe attached to a computer	*Novice*: Nurses	1st, 2nd, 3rd trimester	Cardiac activity, fetal number, gestational age, biometry, fetal presentation, placenta location, AFV
Crispín Milart et al. (2019)(46)	Explanatory and positivist case study	Guatemala	Patient homes located in rural areas	USB probe attached to a computer	*Novice*: Nurses	1st, 2nd, 3rd trimester	Cardiac activity, fetal number, biometry, fetal presentation, placenta location
Dalmacion et al. (2018) (47)	Cross-sectional study	Philippines	Urban and rural health clinic sites	VScan	*Novice*: Doctors, nurses, and midwives	2nd trimester	Cardiac activity, fetal number, fetal presentation,

First Author	Study Design	Country	Setting	Ultrasound Device	Operator	Timing	Uses
							placenta location, AFV
Gomes et al. (2022)(48)	Prospective study	Zambia	NR	Butterfly IQ	*Novice*: Midwives	2nd and 3rd trimester	Gestational age, fetal presentation
Greenwold et al. (2014) (49)	Prospective cohort population study	Mozambique	Health centres	Sonosite M-Turbo	*Novice*: Nurses and clinical officer	1st, 2nd, 3rd	Cardiac activity, gestational age, fetal number, fetal presentation, placenta location, fetal anomalies, uterine fibroids
Kawooya et al. (2015) (50)	Pragmatic comparative study	Uganda	Health centres	LOGIQe (solar powered)	*Novice*: Midwives	1st, 2nd, 3rd	Fetal number, biometry placenta location, AFV, fetal anomalies
Kim et al. (2023)(51)	Qualitative study	Nepal	Rural health centre	NR	*Novice*: Skilled birth attendants	1st, 2nd, 3rd	Pregnancy confirmation, cardiac activity, gestational age, biometry, estimated fetal weight, placenta location, AFV, fetal anomalies
Kimberly et al. (2010) (52)	Observational study	Zambia	District hospital and rural health centres	Sonosite 180	*Novice*: Midwives	1st, 2nd, 3rd	Cardiac activity, fetal number, gestational age (BPD FL), biometry, fetal presentation, placenta location
Kodaira et al. (2020) (53)	Single-centre, prospective observational study	Sierra Leone	Tertiary maternity referral hospital	Smartphone-based device	*Novice*: Junior doctors	1st, 2nd, 3rd	Pregnancy confirmation, cardiac activity, fetal number, gestational age (BPD), biometry, fetal presentation, placenta location, AFV, ectopic, retroplacental hematoma
Koech et al. (2022)(54)	Qualitative feasibility study	Kenya	Public health facilities	Wireless probe and tablet.	*Novice*: Nurses and clinical officer	1st, 2nd, 3rd	Gestational age

First Author	Study Design	Country	Setting	Ultrasound Device	Operator	Timing	Uses
Kozuki et al. (2016)(55)	Feasibility and validation study	Nepal	Patient homes located in rural areas	Sonosite Nanomaxx	*Novice*: Midwives	3rd trimester	Cardiac activity, fetal number, fetal presentation, placenta location
Lourenco et al. (2020) (56)	Prospective study	Brazil	Primary health care units	Sono-Site Titan	*Skilled*: Physicians	2nd trimester	Gestational age
Mbonyizina et al. (2019) (57)	Prospective cohort study	Rwanda	Referral and large district maternity hospital	Sonosite M-Turbo	NR	Third Trimester	Maternal abdominal ascites
Mulowooza et al. (2021) (58)	Quasi-experimental pre-post intervention study	Uganda	District hospital maternity unit	Mindray DP-10	*Novice*: Midwives, doctors and nurses	Third trimester	Cardiac activity, fetal number, biometry, fetal presentation, placenta location, AFV
Nathan et al. (2017) (59)	Observational study	Democratic Republic of Congo, Guatemala, Kenya, Pakistan, and Zambia	Health centres	GE Logiq E ultrasounds	*Novice*: Midwives, nurses, radiographers, medical officers	1st, 2nd, 3rd trimester	Cardiac activity, fetal number, gestational age, biometry, fetal presentation, placenta location, AFV, fetal anomalies, cervical length
Pokaprakarn et al. (2022) (60)	Training, validation and testing of a deep learning algorithm	Zambia	NR	ButterflyIQ	*Novice*: Midwives	1st, 2nd, 3rd	Gestational age
Santos et al. (2021)(61)	Intervention study	Uganda	Primary health centres	Mindray DP-10	*Novice*: Midwives	3rd trimester	Cardiac activity, fetal number, biometry, fetal presentation, placenta location, AFV
Shah et al. (2009)(62)	Cross sectional study	Rwanda	Rural district hospitals	Sonosite Micromaxx	*Novice*: physicians and mid-level practitioners	1st, 2nd, 3rd	Gestational age, fetal presentation, placenta location
Stringer et al. (2024) (63)	Prospective diagnostic accuracy study	Zambia	District health centre	ButterflyIQ	*Novice*	2nd and 3rd	Gestational age
Swanson et al. (2014) (64)	Prospective study	Uganda	Health centres	GE Logiq E ultrasounds	*Novice*: Midwives	1st, 2nd, 3rd	Cardiac activity, fetal number, gestational age, biometry,

First Author	Study Design	Country	Setting	Ultrasound Device	Operator	Timing	Uses
							fetal presentation, placenta location, AFV
Tefera et al. (2024)(65)	Qualitative descriptive study	Ethiopia	Rural health centres	NR	*Novice*: Midwives	1st, 2nd, 3rd	Cardiac activity, fetal number, gestational age, fetal presentation, placenta location, AFV, cervical length
Van den Heuvel et al. (2019)(66)	Validation study	Ethiopia	Hospital	SonoAce R3	*Skilled*: Sonographer	2nd and 3rd trimester	Gestational age
Vyas et al. (2018)(67)	Investigational study	Panama	Mobile clinic	Sonosite M-Turbo	*Novice*: Medical students from USA	2nd and 3rd	Gestational age (BPD, HC), biometry, fetal presentation, placenta location, AFV
Wanjiku et al. (2023) (68)	Non-inferiority test	Kenya	NR	Butterfly IQ	Skilled: Healthcare providers	1st, 2nd, 3rd	Cardiac activity, gestational age (CRL), biometry, fetal presentation, placenta location
Wylie et al. (2013)(69)	Observational cohort study	Malawi	Antenatal care clinic	Sonosite	Novice: Mid-level providers and nurse	1st, 2nd, 3rd	Gestational age, biometry

The studies were conducted across 17 countries spanning Africa, Central America, South America, and Asia. The majority were based in sub-Saharan Africa, with representation from 10 African countries. Additional studies were conducted in Guatemala and Panama (Central America), Brazil and Peru (South America), and Nepal, the Philippines, and Pakistan (Asia). The geographical distribution of studies is illustrated in Fig. 2.

3.2. Study setting

Most studies were conducted in health centres (n = 15) and hospitals (n = 6). Three studies were conducted in patient homes, and single studies were conducted in an emergency obstetric unit, a refugee camp, and a mobile clinic. Setting was not reported in three studies.

3.3. POCUS devices and operators

Sonosite was the most frequently reported ultrasound device (n = 10), followed by VScan (n = 4). Mindray and Butterfly IQ devices were each reported in three studies. Two studies used USB probe systems, and three reported LOGIQ devices. Single studies used a smartphone-based device or a wireless probe connected to a tablet. Device type was not reported in two studies.

POCUS operators were described in all but one study. The majority of studies reported use by novice or mid-level providers, including nurses, midwives, clinical officers, and junior doctors (n = 25). Skilled operators, such as physicians or sonographers

with formal ultrasound training, were reported in four studies. The predominance of novice operators reflects the decentralised implementation of POCUS and aligns with global task-shifting strategies aimed at expanding diagnostic capacity in primary care settings.

3.4. Methodological quality assessment

The included studies comprised qualitative (n = 4), quantitative non-randomised (n = 21), and quantitative descriptive designs (n = 5). Overall, methodological quality was generally high according to MMAT criteria. All studies clearly stated their research questions and collected data appropriate to address those questions. Among quantitative non-randomised studies, 10 (48%) did not clearly report whether confounders were accounted for in the design or analysis. Only one study reported uncertainty regarding participant representativeness.

Greater variation in methodological quality was observed among quantitative descriptive studies, with one study scoring negatively in three domains related to measurement appropriateness, nonresponse bias, and statistical analysis. All four qualitative studies were judged to be of high methodological quality. The detailed risk-of-bias assessment is presented in **Supplementary Materials Table S6**.

3.5. POCUS uses

A wide range of antenatal POCUS applications was identified. Study aims included evaluating clinical impact (n = 10), implementation feasibility (n = 10), validation against traditional ultrasound (n = 4), validation of artificial intelligence (AI) or machine learning models (n = 5), and implementation of AI-enabled POCUS (n = 1). The frequency of reported POCUS uses is illustrated in Fig. 3.

The majority of studies reported more than one use (24/30). The most frequently reported use of POCUS was gestational age determination (23/30 studies), followed by placental location assessment (20/30) and fetal presentation (19/30). Cardiac activity assessment was reported in 17 studies, fetal number in 14 studies, and amniotic fluid volume (AFV) measurement in 13 studies. Pregnancy confirmation through identification of intrauterine pregnancy was reported in six studies. Screening for fetal anomalies was reported in four studies, although specific anomalies were not consistently described. Cervical length and ectopic pregnancy were each reported in two studies. Less frequently reported uses included identification of fibroids, estimation of fetal weight, detection of antepartum maternal ascites, and retroplacental haematoma.

Biometry was reported in 15 studies but was not consistently accompanied by specification of the anatomical parameters measured. When studies explicitly reported gestational age estimation or estimated fetal weight (EFW) derived from these measurements, these were recorded as separate applications of POCUS. Several studies, however, reported biometry without specifying either the measurements obtained or their clinical purpose.

3.6 Uses by ISUOG Guidelines

The International Society of Ultrasound in Obstetrics and Gynaecology (ISUOG) provides practice recommendations for routine obstetric ultrasound examinations. These recommendations categorise assessments by trimester: first (11–14 weeks), mid-trimester (18–24 weeks), and third trimester (32–34 weeks). A detailed mapping of reported POCUS uses according to ISUOG recommendations is presented in Table 3. Figure 4 illustrates the distribution of antenatal POCUS applications across trimesters, with trimesters represented in the inner circle and specific uses in the outer circle. The relative size of each outer segment reflects the frequency of reported use among included studies.

In the first trimester, the most frequently reported application was gestational age estimation (n = 16), followed by cardiac activity assessment (n = 13), biometry (n = 12), and assessment of fetal number (n = 11). No studies reported first-trimester assessment of adnexal structures or placental appearance using POCUS.

In the mid-trimester, gestational age estimation remained the most commonly reported application (n = 21), followed by placental location (n = 18), cardiac activity (n = 13), biometry (n = 13), fetal number (n = 12), and amniotic fluid volume (AFV) measurement (n = 12). No studies reported use of POCUS for fetal movement assessment, detailed fetal anatomy evaluation, placental appearance, umbilical cord assessment, or ovarian cyst identification during this period.

In the third trimester, gestational age estimation (n = 21), fetal presentation (n = 18), and placental location (n = 18) were the most commonly reported applications. Cardiac activity (n = 15), biometry (n = 15), fetal number (n = 12), and AFV measurement (n = 12) were also commonly reported. Estimated fetal weight was reported in one study.

Table 3
POCUS Uses by ISUOG Guidelines

ISUOG Guidelines		Reported POCUS Uses*	Reported Uses
First Trimester	Gestational Age	Gestational Age	16
	Assessment of viability	Cardiac Activity	13
	Biometry	Biometry	12
	Fetal number	Fetal Number	11
	Intrauterine pregnancy	Pregnancy Confirmation	6
	Fetal Anatomy	Fetal Anomalies	4
	Intrauterine pregnancy	Ectopic	2
	Fibroids	Fibroids	1
	Hematoma	Hematoma	1
	Adnexa	NR*	0
	Placenta Appearance	NR	0
Mid-trimester	Gestational Age	Gestational Age	21
	Placenta location	Placenta location	18
	Cardiac activity	Cardiac activity	13
	Biometry	Biometry	13
	Fetal number	Fetal Number	12
	AFV	AFV	12
	Cervical length	Cervical length	2
	Fibroids	Fibroids	1
	Fetal movement	NR	0
	Fetal anatomy	NR	0
	Placenta appearance	NR	0
	Umbilical Cord	NR	0
	Ovarian cysts	NR	0
Third trimester	Gestational Age	Gestational Age	21
	Fetal Presentation	Fetal Presentation	18
	Placenta location	Placental Location	18
	Fetal viability	Cardiac Activity	15
	Biometry	Biometry	15
	Fetal Number	Fetal Number	12
	AFV	AFV	12
	Fetal Anomalies	Fetal Anomalies	4
	Fetal Growth	Estimated fetal weight	1
	NR	Fibroids	1

⁎NR: Not reported as a POCUS use in the selected studies

4. DISCUSSION

In this review, we identified a substantial body of evidence on the use of antenatal POCUS in LMICs, particularly in sub-Saharan Africa. We identified 30 studies reflecting this growing evidence base. Across studies, antenatal POCUS was used primarily for focused assessments with immediate implications for triage and referral, including gestational age, placental location, fetal presentation, cardiac activity, fetal number, and amniotic fluid volume (27). This pattern is clinically coherent. Accurate gestational age underpins timing of antenatal interventions and identification of preterm or growth-restricted pregnancies (28, 29), whereas recognition of placenta previa, malpresentation, fetal demise, or multiple pregnancy can alter monitoring, place of birth, and referral pathways.

Compared with a 2016 review of portable ultrasound in LMICs, which included only three pregnancy-focused studies, these findings indicate a marked increase in the availability and uptake of antenatal POCUS over time (15). Reports from rural African settings suggest that mid-level providers can use obstetric ultrasound to detect such conditions earlier and support decision-making in lower-resourced environments (30, 31).

A notable finding was the consistent use of POCUS by novice or mid-level providers, supporting task-shifting models for obstetric imaging [32,33]. However, the evidence base is not yet sufficient to infer effects on hard maternal or perinatal outcomes. Despite the growing body of literature, the evidence base remains largely composed of feasibility, validation, and implementation studies. No randomised controlled trials were identified, relatively few studies examined downstream outcomes beyond diagnostic accuracy, and confounding was incompletely addressed in many non-randomised studies. The current literature therefore supports feasibility and diagnostic utility more strongly than clinical effectiveness. Thus, while methodological quality was generally high according to MMAT criteria, the predominance of observational designs limits causal inference regarding clinical impact.

The consistent reporting of POCUS being operated by novice users and mid-level providers (nurses and midwives) in the majority of studies is a crucial finding. This demonstrates the feasibility of task-shifting and the potential of POCUS to enable frontline health workers to perform focused examinations and enhance antenatal clinical decision-making (32).

This finding strengthens the case for focused POCUS models in primary care, but it also reinforces the need for structured training, ongoing supervision, and clear referral pathways (32).

Mapping studies to ISUOG guidance highlighted both alignment and gaps. Reported use clustered around high-yield focused assessments, especially gestational age and viability in early pregnancy and placental location and fetal presentation later in gestation. By contrast, first-trimester adnexal assessment and mid-trimester fetal anatomy, placental appearance, umbilical cord assessment, and fetal movement were rarely or never reported (33, 34). This pattern probably reflects deliberate restriction of scope within training programmes, which may be appropriate for safety and feasibility, but it also underscores the need to define scope-of-practice boundaries explicitly when POCUS is introduced into routine antenatal care.

Implementation challenges are central to interpretation of these findings. Scaling POCUS requires more than device procurement and training. Sustainable implementation depends on reliable electricity, maintenance, consumables, supervision, quality assurance, and reliable referral pathways. Detecting high-risk conditions without accessible referral capacity may create ethical and practical challenges. Moreover, few included studies reported cost data, despite important budgetary implications for constrained health systems (35, 36).

In a recent desk review of low-cost (defined as <$10,000) portable ultrasound systems for obstetric use in low-resource settings, Ranger et al. (2024) estimated the price for a portable ultrasound device to range from $700 to $10,000 (35). Integrating a new technology into a health system involves not only direct costs of purchasing the device, training staff, performing maintenance and supplying consumables, but also the opportunity costs associated with diverting funds and health worker time from other critical interventions (36).

AI enabled ultrasound is an important emerging theme. Included studies evaluated AI for gestational age estimation, fetal presentation, and placental localisation, suggesting potential to reduce operator dependency and assisting novice providers in decentralised settings. Broader evidence synthesising AI-based gestational age estimation has demonstrated promising diagnostic performance across diverse contexts; however, much of this work has been conducted in research environments, with limited evidence on routine implementation within LMIC health systems (37).

Emerging qualitative research further highlights that the successful deployment of AI-enabled POCUS extends beyond technical accuracy (38). Stakeholders have expressed optimism regarding improved access to antenatal diagnostics and enhanced provider confidence, while also raising concerns about reliability, overreliance on automated outputs, regulation, and integration within existing care pathways (37–39). AI-enabled POCUS is therefore best viewed as an adjunct to trained providers and functioning maternal health systems. Successful deployment will therefore depend on health-system readiness, including governance, training, maintenance, and integration within referral pathways.

This review has strengths, including prospective registration, PRISMA-based methods, comprehensive searching without language or date restrictions, and dual review for screening, extraction verification, and quality appraisal. The inclusion of diverse study designs (qualitative, quantitative, and mixed methods) provides a more holistic understanding of POCUS use, encompassing not only clinical outcomes but also implementation challenges and opportunities. Limitations include exclusion of studies focused solely on training curricula, Doppler alone, specialist echocardiography, and remote interpretation as these were considered outside the scope. Inconsistent reporting of biometric parameters and the need to map heterogeneous studies to trimester-based ISUOG categories that were not used by original authors limit direct comparability across studies and likely underestimate the full scope of obstetric ultrasound use in LMICs. Greater standardisation in reporting biometric parameters and intended clinical applications would improve comparability across future studies. Despite these limitations, largely reflecting the underlying primary studies, this review represents the most comprehensive and up-to-date synthesis of antenatal POCUS use in LMICs to date.

5. CONCLUSION

Antenatal POCUS in LMICs is already being used for a range of focused obstetric assessments, most commonly gestational age determination, placental localisation, and fetal presentation. Its frequent use by novice and mid-level providers suggests that task-shifted models are feasible and could expand access to essential imaging in resource-constrained settings.

However, the current evidence base is weighted towards feasibility and diagnostic studies, with limited evidence on maternal and perinatal outcomes, cost-effectiveness, and long-term system integration. Future research should prioritise pragmatic evaluations of clinical impact, implementation, equity, and sustainability, including the role of AI-enabled systems within referral-ready maternal health services.

POCUS should therefore be implemented as a complementary component of antenatal care within resilient health systems, not as a standalone technological solution.

Abbreviations

ANC
Antenatal Care
EPMM
Ending Preventable Maternal Mortality
LMICs
Low- and middle-income countries
MMAT
Mixed Methods Appraisal Tool
PICO
Population, Intervention, Comparison, Outcome
POCUS

Point-of-care ultrasound
PRISMA
Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SDGs
Sustainable Development Goals
WHO
World Health Organization

Declarations

Ethics approval and consent to participate

Not applicable. This study is a systematic review of published literature and did not involve human participants or require ethical approval.

Consent for publication

Not applicable.

Competing interests

Completed disclosure of interest forms are available to view online as supporting information.

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Author Contribution

A.Y. and A.S. contributed to conceptualisation and methodology. A.Y. conducted the investigation and wrote the original draft of the manuscript. A.S. and R.M.S. contributed to the investigation. R.M.S. prepared Figure 4. N.R. contributed to conceptualisation and methodology. J.H. and A.T.P. contributed to conceptualisation and methodology, supervised the study, and reviewed and edited the manuscript. All authors reviewed and approved the final manuscript.

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Data Availability

All data generated or analysed during this study are included in this published article and its supplementary information files. Additional data are available from the corresponding author on reasonable request.

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Figures

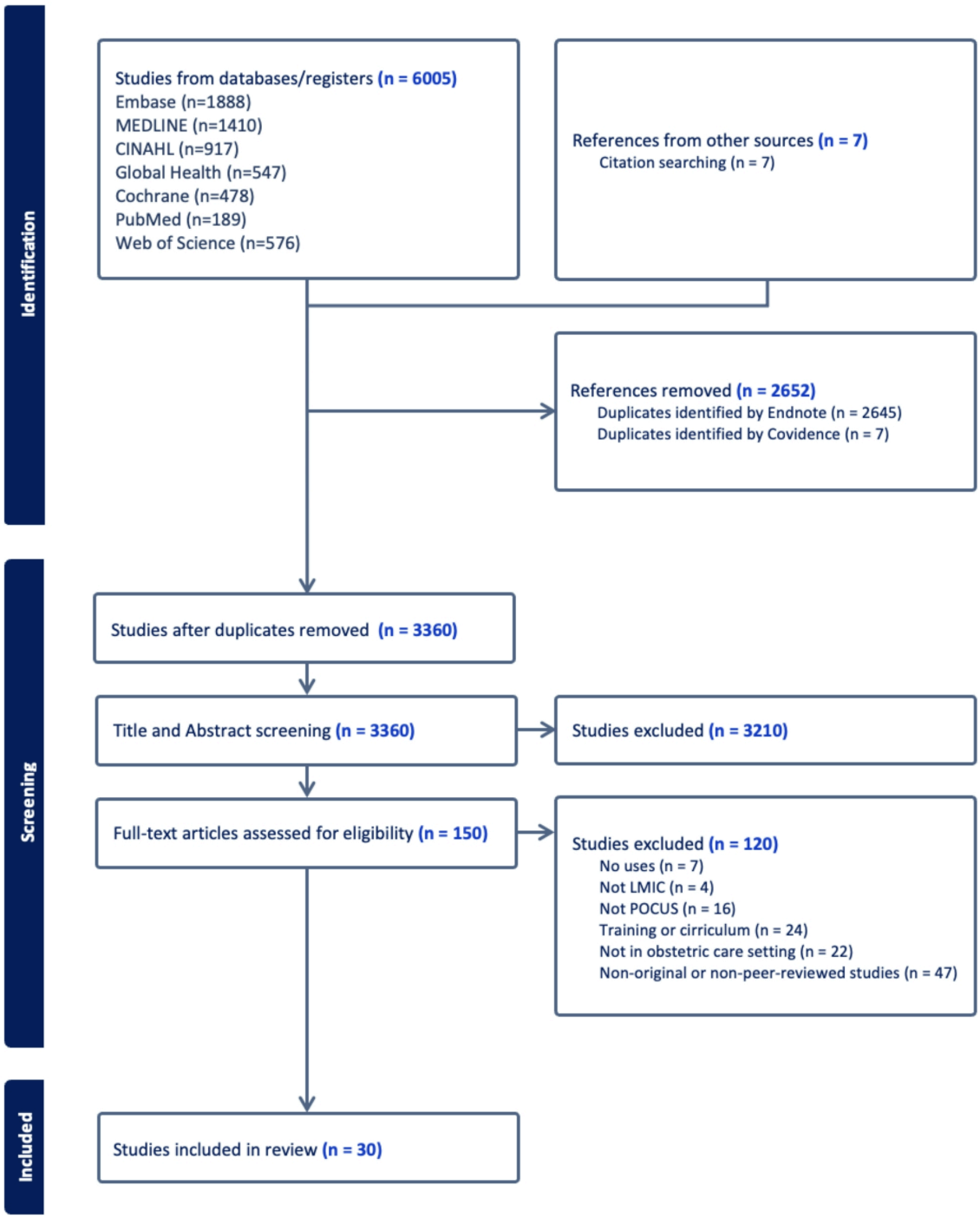

Figure 1

PRISMA flow diagram of study selection

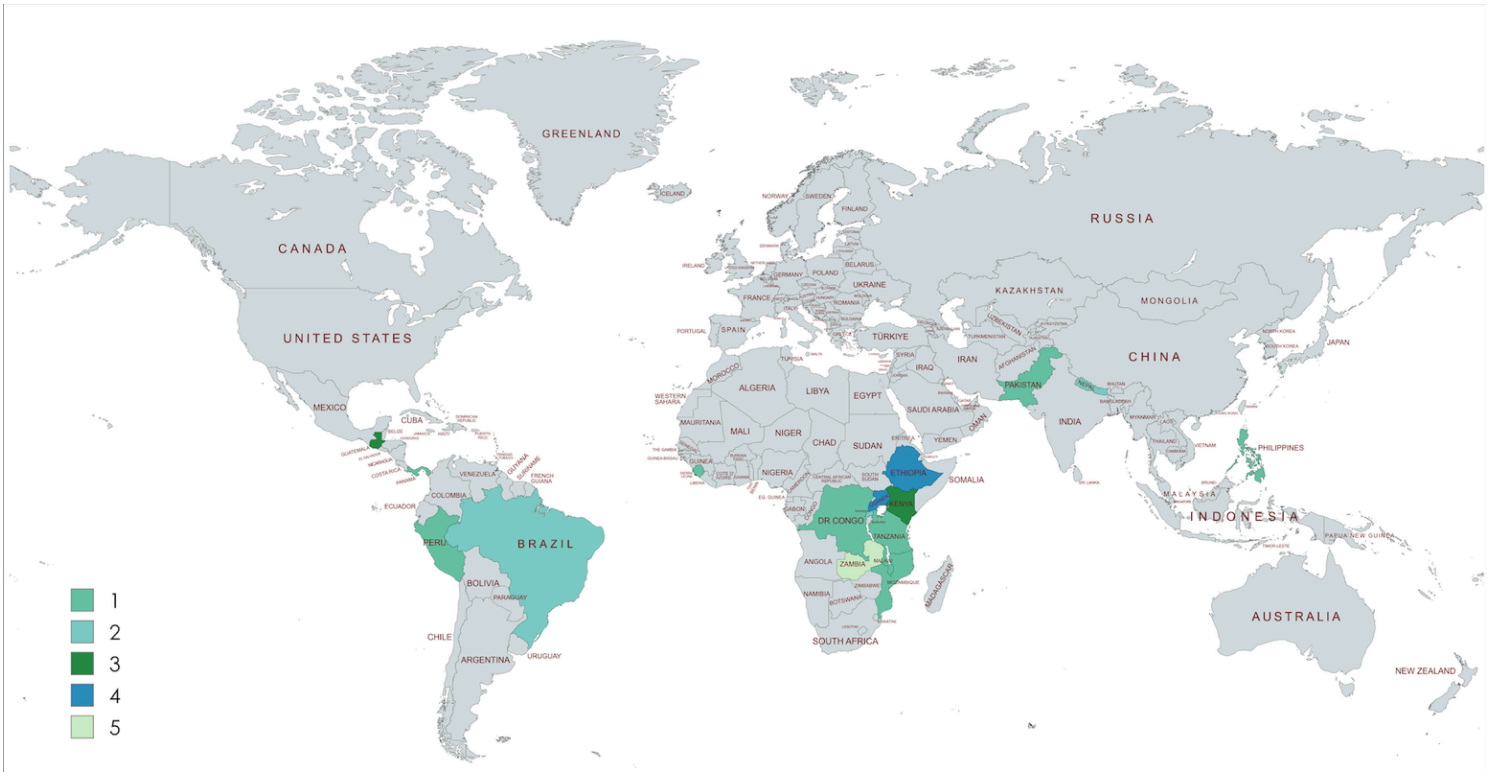

Figure 2

Number of studies by country

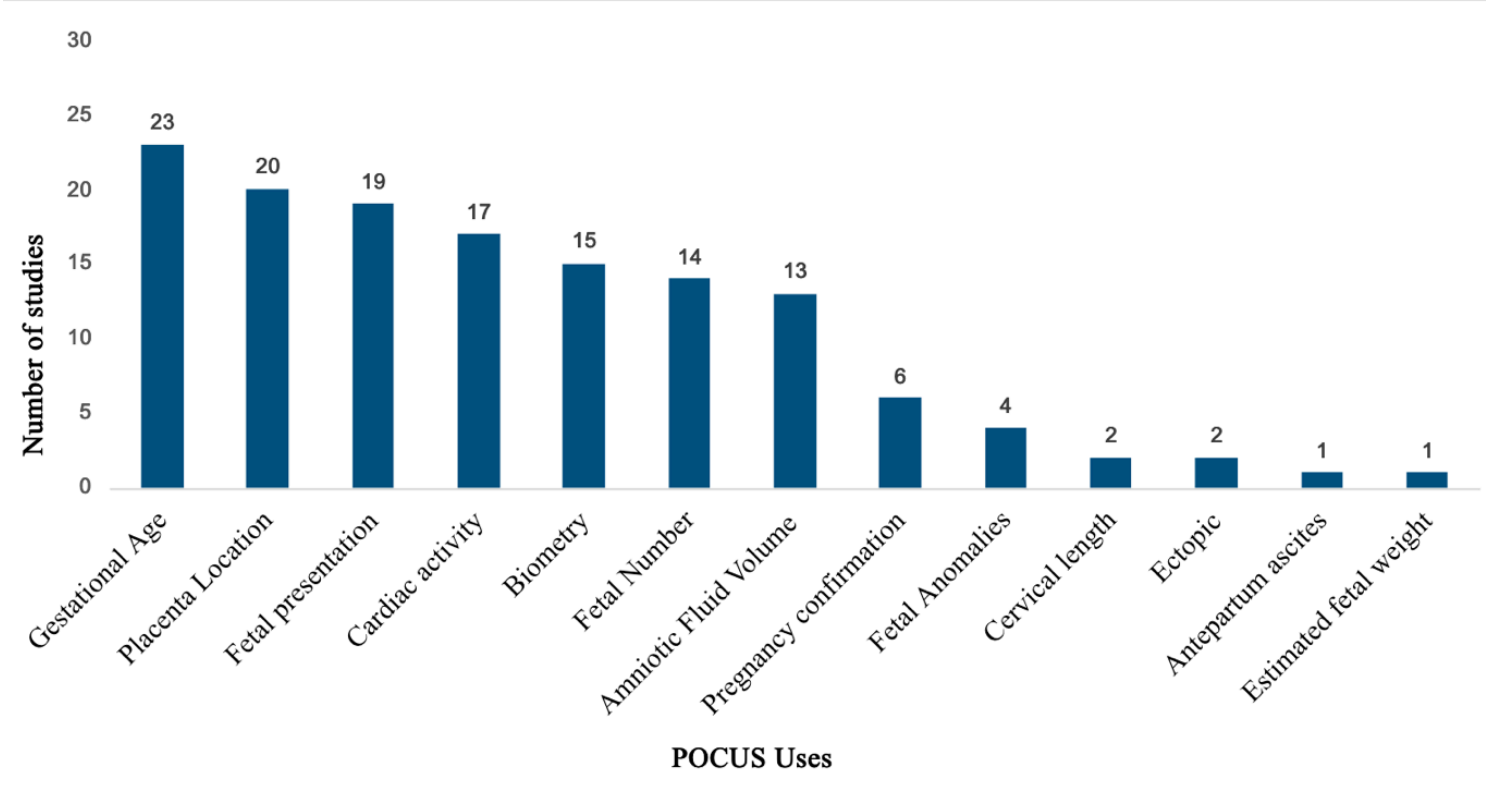

Figure 3

Frequency of Reported Antenatal POCUS Uses

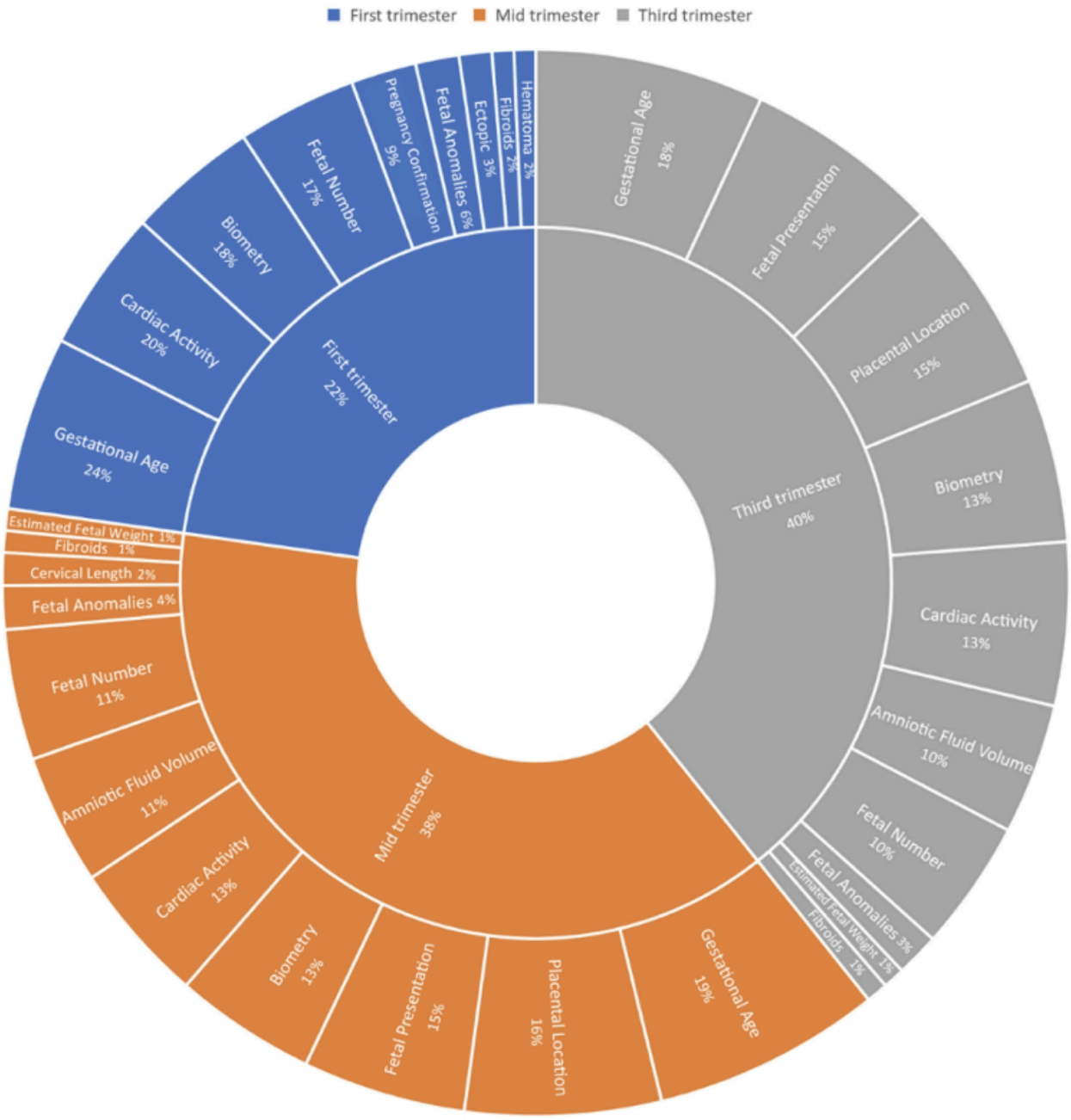

Figure 4

In the chart, the inner circle represents pregnancy trimesters, while the outer circle represents the different uses of POCUS. The size of each segment in the outer circle reflects the frequency of reported uses across all included studies. The chart indicates both the percentage of uses across trimesters in the inner circle and percentage of uses within each trimester in the outer circle.

Supplementary Files

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- POCUSLMICsSystematicReviewSupplementary.docx