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AI and Telehealth for Maternal Healthcare in Remote Areas of Indonesia: An Integrative Review

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ABSTRACT

Background: Indonesia continues to face one of the highest maternal mortality ratios in Southeast Asia, with the burden falling disproportionately on remote and archipelagic regions, where access to skilled birth attendants, referral systems, and obstetric facilities remains limited. Artificial intelligence (AI) and telehealth have been proposed as complementary strategies to reduce access and quality gaps.
Objective: This integrative review examines how artificial intelligence (AI) and telehealth technologies influence access to and quality of maternal healthcare services in remote areas of Indonesia.
Methods: This review followed Whittemore and Knafl's five-stage integrative review framework. Literature published between 2015 and 2026 was retrieved from academic databases including PubMed, Embase, Garuda journals. Eligible sources addressed telehealth, telemedicine, mobile health, or AI-based clinical decision support in maternal, antenatal, or obstetric care in Indonesia.
Findings: Sixteen studies met the inclusion criteria. Artificial intelligence and telehealth technologies represent complementary but unevenly developed strategies for addressing Indonesia's persistent maternal mortality disparities between urban and remote, western and eastern regions. Telehealth has an established decade-long track record of expanding access to antenatal, referral, and postnatal maternal healthcare in rural and remote Indonesian settings, contingent on infrastructure, workforce readiness, and policy support.
Conclusion: AI and telehealth technologies have meaningful, although geographically uneven, potential to improve maternal healthcare access and quality in remote area Indonesia. Requiring investment in connectivity infrastructure, workforce digital competency, interoperable data system and privacy-protective data systems, and locally validated AI models.

Keywords: artificial intelligence; telehealth; maternal healthcare; remote areas; Indonesia

INTRODUCTION

Maternal mortality remains one of the most sensitive indicators of health system performance and social inequity. Globally, an estimated 287,000 women died from pregnancy- and childbirth-related causes in 2020, with nearly 95% of these deaths occurring in low- and lower-middle-income countries (Rachmawati et al., 2026). Indonesia's maternal mortality ratio (MMR) has declined over recent decades but remains among the highest in the ASEAN region, with an estimated 249 maternal deaths per 100,000 live births for 2016–2020, well above the Sustainable Development Goal target of 70 per 100,000 live births by 2030(Idris et al., 2025)

The persistence of high maternal mortality in Indonesia cannot be understood without reference to the country's geography. As an archipelago of more than 17,000 islands, Indonesia exhibits some of the starkest intranational disparities in health facility access in the world; the average distance to a hospital has been reported to differ by roughly sixtyfold between Java, where facilities are dense, and Sulawesi, where they are sparse (Syairaji et al., 2024). Regions such as Nusa Tenggara, Maluku, and Papua consistently report

maternal mortality rates more than double the national average, a pattern attributed to sparse population distribution, lower socioeconomic status, weaker referral infrastructure, and chronic shortages of obstetric specialists and midwives (Suparji et al., 2024; UNFPA Indonesia, 2012). Rural residence has been associated with a measurably higher risk of maternal death relative to urban residence in national census-based analyses (Utomo et al., 2025), and antenatal care (ANC) coverage remains systematically less complete outside urban centers (Idris et al., 2025).

Telehealth, broadly defined as the use of telecommunications technology to deliver clinical consultation, monitoring, education, and referral support at a distance, has expanded rapidly across Indonesia's health sector over the past decade, accelerated by the COVID-19 pandemic (Nugraheni et al., 2024). In parallel, artificial intelligence (AI) and machine learning (ML) methods are increasingly being applied to maternal health problems worldwide, including risk stratification for pre-eclampsia and gestational diabetes, triage support, and predictive analytics built on routinely collected clinical data. Because many of these AI approaches rely on low-cost, non-invasive input variables, they have been promoted as particularly well-suited to low-resource settings where laboratory and specialist capacity is limited (Alfaki Ahmed et al., 2025).

Despite growing enthusiasm, the evidence base connecting AI and telehealth specifically to maternal health outcomes in remote Indonesian settings remains fragmented across disciplines, including public health, informatics, midwifery, and health policy, and across study designs ranging from randomized trials to descriptive implementation reports and grey literature. An integrative review methodology is therefore appropriate, as it permits the inclusion of diverse research designs (experimental, non-experimental, and theoretical or policy-oriented literature) to generate a more complete picture of a complex, emerging phenomenon than a design-restricted systematic review (Whittemore & Knafl, 2005).

1.1 Aim and Review Questions

This integrative review aims to synthesize the available literature on the impact of AI and telehealth technologies on the access to and quality of maternal healthcare services in remote areas of Indonesia. Specifically, it addresses three questions:

(1) How are telehealth technologies used to improve access to maternal healthcare in geographically remote Indonesian settings?

(2) What is the evidence for AI-based tools to improve the quality and safety of maternal care, particularly for risk prediction and clinical decision support?

(3) What structural, technological, and sociocultural barriers condition the effectiveness of these technologies, and what are the implications for policy and future research?

MATERIALS AND METHODS

This review followed the five-stage integrative review methodology described by Whittemore and Knafl: problem identification, literature search, data evaluation, data analysis, and presentation (Whittemore & Knafl, 2005). This design was selected rather than a systematic review because it accommodates heterogeneous study types, including quantitative, qualitative, mixed-methods, and policy or grey literature, which is necessary given the still-emerging and interdisciplinary nature of AI and telehealth applications in Indonesian maternal health. Reporting was informed, where applicable, by relevant items of the PRISMA 2020 statement (search strategy transparency and a documented selection process (Page et al., 2021), consistent with the recommended practice for integrative reviews, which currently have no dedicated PRISMA extension.

2.1 Problem Identification

The phenomenon of interest was defined as the intersection of (a) AI or telehealth/telemedicine/mHealth technologies and (b) maternal, antenatal, obstetric, or reproductive healthcare, situated in (c) remote, rural, underserved, or archipelagic settings, with Indonesia as the primary geographic focus. Comparable low- and middle-income country (LMIC) settings were included for contextual and comparative purposes where direct Indonesian evidence was limited.

2.2 Literature Search

A structured search was conducted across health literature sources; including PubMed, Embase, and Garuda journals. Search terms combined variants of "telehealth," "telemedicine," "telemidwifery," "mHealth," "artificial intelligence," and "machine learning," with "maternal health," "antenatal care," "obstetric," "pre-

eclampsia," "remote," "rural," and "Indonesia." The reference lists of key reviews were hand-searched for additional relevant sources.

2.3 Data Evaluation and Inclusion Criteria

Sources were included if they (a) addressed telehealth/telemedicine or AI applications relevant to maternal, antenatal, or obstetric health; (b) were set in Indonesia or offered directly transferable evidence from comparable LMIC/archipelagic or rural contexts; and (c) were published between 2015 and 2026, reflecting the period of accelerated digital health adoption. Studies were included if they met the following criteria: the full text was accessible, they could be from any publication year, they used an empirical research methodology (regardless of design), they were published in English (regardless of the province of origin), and they addressed the maternal healthcare. Studies were excluded if they were not available in English, did not report empirical research, did not address maternal healthcare, or if the results did not separate out data on pregnant women or from other groups of participants included in the study.

2.4 *Data Evaluation and Data Analysis*

In the data evaluation stage, the quality of studies was reviewed and agreed by two researchers, using the Mixed Meth-odds Appraisal Tool (MMAT) (Hong et al., 2018). The MMAT allows researchers to evaluate validity and reliability of quantitative and qualitative study designs. It has been previously used in integrative and systematic reviews (Delgado et al., 2017) and found to be robust. All studies met at least 2 of the five quality criteria for individual methodologies. Twelve studies met all five criteria. Total scores are included in Table 1, with scores ranging from ∗ if 1 criterion met to ∗∗∗∗∗ if all five criterion were met. In the data analysis stage, information from the included studies was tabulated (see Table 1) and findings summarized according to which review question they answered. During the data analysis phase, information from the included studies was organized into tables (refer to Table 1), and the findings were summarized based on the specific review questions they addressed. Given the diversity of the studies, with minimal overlap in research questions, methods, or measures, data integration was not feasible. The data were tabulated and compared, with common themes identified. The plausibility of the analysis was evaluated by the research team, which consisted of researchers with backgrounds in midwifery nursing. The findings are presented initially as a summary of study characteristics, followed by their relation to the review questions.

RESULTS AND DISCUSSION

In total 86 papers were identified from the searches and reviewed in full by two researchers. The search outcome is presented in Prisma flowchart. 16 papers were included in the final review.

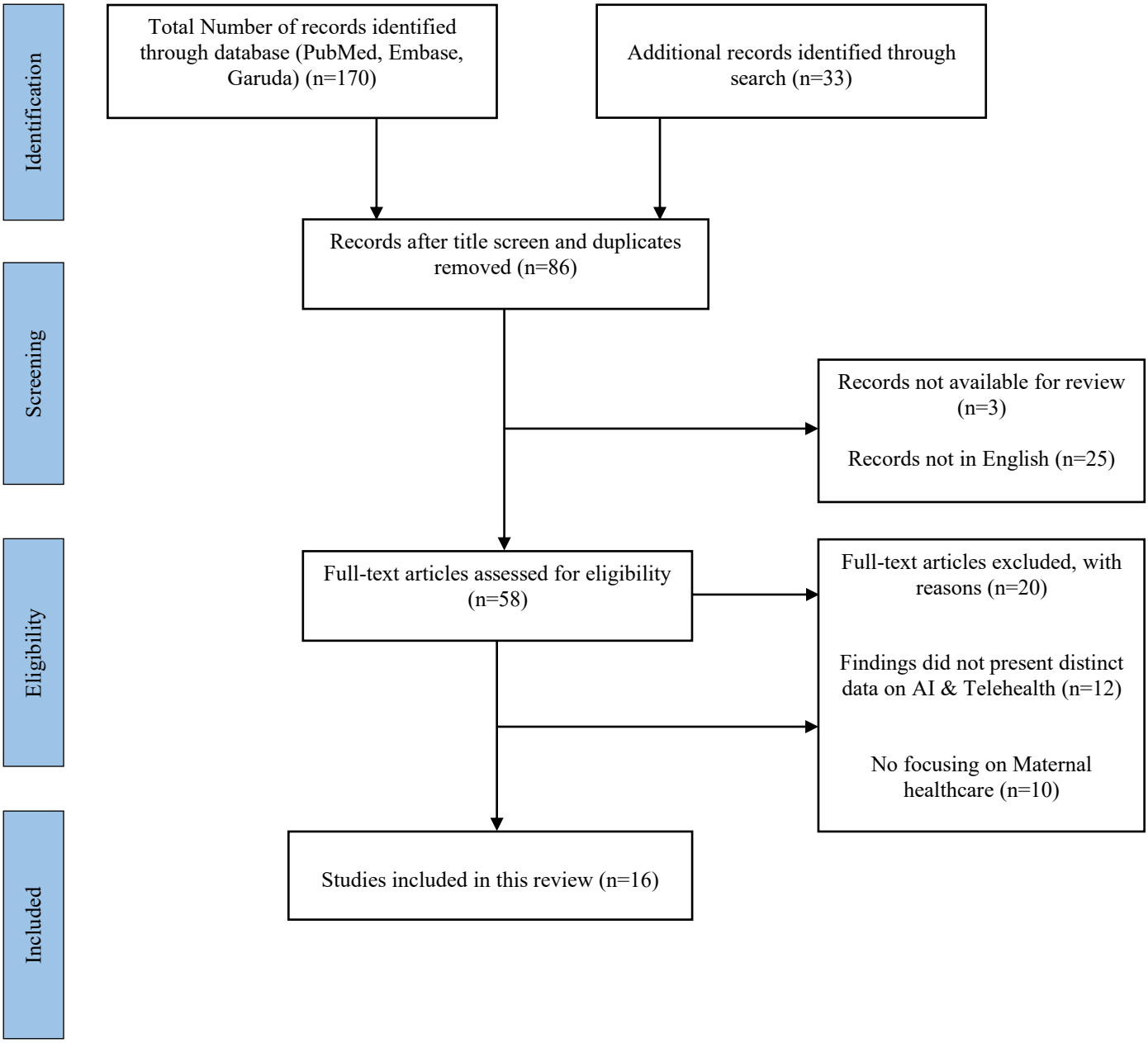


Figure 1. Prisma flow diagram

3.1 Types of Study

Study characteristics are summarized in Table 1, of the eight qualitative studies, five used descriptive approach (Delmaifanis et al., 2023; Desmawati & Hanifah, 2025; Priambodo et al., 2026; Roza et al., 2025; Susanti et al., 2025); one (Gayatri et al., n.d.) phenomelogical study; one used participatory research techniques and code-sign principles (Ekawati et al., 2023) and one used case study (Mujtahidah et al., 2026). Eight quantitative papers, five described quasi eksperimental case-control study(Faujiah & Raraswati, 2025; Hartanto, 2024; Hernawati et al., 2025; Marfuah et al., 2025; Tridiyawati et al., 2025), two used cross-sectional study (Mulyati et al., 2023; Susanti et al., 2022)and one described cross sectional surveys (Hikmah et al., 2025)

How are telehealth technologies used to improve access to maternal healthcare in geographically remote Indonesian settings?

Manifested through mHealth applications, tele midwifery platforms, and instant-messaging-based communication (chat, video calls, WhatsApp, SMS)—have been widely employed to improve access to maternal healthcare in geographically remote and resource-limited settings across Indonesia. The findings can be organized into the following themes.

1. Range of telehealth modalities employed

Structured consultation applications such as "Guide Me" offer chat, video call, appointment scheduling, and educational reading features for pregnant women at Community Health Centers in Pamulang, Banten (Desmawati & Hanifah, 2025). Instant-messaging platforms (WhatsApp, SMS, Facebook) were used by midwives across multiple Indonesian regions during the COVID-19 pandemic for remote consultation, particularly via WhatsApp groups and video calls for postpartum monitoring (Gayatri et al., n.d.). Standardized telemidwifery platforms/consultation systems were reported to have a significant positive effect on maternal satisfaction among 150 respondents (pregnant and postpartum mothers) ($\beta = 0.486$; $p = 0.000$; $R^2 = 0.302$) (Hikmah et al., 2025). Community readiness for rural telehealth adoption was assessed among 65 pregnant women in Bandung Regency, with overall readiness categorized as high (61.5%) for prenatal telehealth (Mulyati et al., 2023). Competency-based mHealth for midwives (iPosyandu Bidan) was developed to support continuity of care from pregnancy through childbirth, newborn care, and the postpartum period, incorporating semi-automatic telemidwifery (chatbot) features and cohort reporting (Susanti et al., 2022).

Signal disruption emerged as the most consistent cross-study theme, affecting both formal application users (as with "Guide Me") and informal midwife–patient communication via WhatsApp (Gayatri et al., n.d.). This suggests that limitations in telecommunications infrastructure across many parts of Indonesia including areas not formally classified as "remote "remain a fundamental structural constraint. This is consistent with the Technology Acceptance Model, in which Perceived Ease of Use is a key determinant of technology acceptance: when network stability is compromised, the perceived usefulness of telehealth services correspondingly declines, as reflected in recurring informant complaints about needing to redial after dropped video calls.

2. Improved accessibility and service efficiency

Across all five studies, telehealth consistently improved accessibility to antenatal care (ANC), particularly for women living far from health facilities. The appointment-scheduling feature was reported to reduce waiting times at health facilities (Desmawati & Hanifah, 2025)while service accessibility recorded the highest mean score (4.12, categorized as high) among all variables examined in the quantitative telemidwifery study (Hikmah et al., 2025)Midwives across three Indonesian regions also reported that virtual care enabled pregnant women to consult at any time without spatial or temporal constraints, especially when in-person visits were restricted during the pandemic (Gayatri et al., n.d.)

3. User satisfaction and technology acceptance

A qualitative study of six pregnant women found high satisfaction across all application features, including response speed and information clarity, although technical disruptions during video calls were noted (Desmawati & Hanifah, 2025) This finding aligns with the Technology Acceptance Model (TAM), whereby Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) were identified as the primary determinants of user acceptance and satisfaction with telemidwifery services (Desmawati & Hanifah, 2025; Hikmah et al., 2025).

4. Readiness as a prerequisite for adoption

The rural Bandung Regency study found that maternal readiness for prenatal telehealth was significantly associated with education level ($p = 0.028$) and income ($p = 0.002$), while age and occupation showed no significant relationship (Mulyati et al., 2023). Nevertheless, most respondents already possessed adequate foundational digital capacity: 100% had internet access, 81.5% owned a personal mobile phone, and 70.8% demonstrated high navigation capability with information technology.

While telehealth demonstrably improved service accessibility and rural community readiness was found to be relatively high (Hikmah et al., 2025; Mulyati et al., 2023) the significant association between education,

income, and telehealth readiness signals a potential digital divide that could widen rather than narrow existing disparities in maternal care access if left unaddressed. Women with lower education and income levelsgroups epidemiologically most vulnerable to maternal complications—isk being left behind in telehealth uptake. This concern is corroborated by (Gayatri et al., n.d.) who found that some pregnant women in CHC catchment areas lacked mobile phones or internet access altogether, meaning that WhatsApp-group-based communication methods used by midwives may inadvertently exclude the most vulnerable population.

5. Infrastructure and digital literacy barriers

All studies consistently identified signal disruption and unstable internet connectivity as the primary barrier, particularly affecting video call features (Desmawati & Hanifah, 2025; Gayatri et al., n.d.). Midwives also reported additional challenges, including pregnant women lacking mobile phones or phone credit, insufficient program socialization leading to low utilization, and limited human resources, which constrained the provision of online consultation services at the hospital level (Gayatri et al., n.d.)

6. Role and competency readiness of midwives

A study of 373 midwives in West Java found that competency in early detection of risk complications during pregnancy, childbirth, newborn care, and the postpartum period was the most needed area (84.99% of respondents) to be integrated into mHealth design. Midwives further expressed a need for education menus, training modules, and telemidwifery features combining chatbot and direct communication (Susanti et al., 2022). This underscores that telehealth effectiveness depends not only on patient readiness but equally on the digital competency and readiness of healthcare providers.

Table 1. Study Overview and Characteristic

Study	Year	Province	Study aim	Design and methods	Participants	Key findings	Limitations	Quality Score	Research question
Delmaifanis	2023	Jakarta	This Study aimed to analyze the need for mHealth development for pregnant women and health workers to provide quality ANC services	A qualitative study - Descriptive	3 pregnant women, 1 doctor, 6 midwives	The main theme found was the opportunity to use mHealth in ANC services at the Health centers. pregnant women need faster service, service officers need convenience in administrative tasks	Small convinience sample	***	2
Desmawati	2025	Banten	This study aims to evaluate the impact of the “Guide Me” app on pregnant women’s satisfaction with antenatal care. By assessing the satisfaction levels of women using the app for ANC, the study seeks to determine the effectiveness of this digital health service in improving their overall satisfaction with the care provided.	A qualitative study - Descriptive	6 pregnant women, participants was being in the second and third trimester of pregnancy.	the “Guide Me” app offers a valuable opportunity to improve the quality and accessibility of antenatal care (ANC) services for pregnant women, especially those living in rural areas or with limited access to healthcare facilities	Technological challenges, particularly related to signal interference, which leads to inconsistent communication during consultations.	*****	1
Ekawati	2023	Special Region of Yogyakarta	to adopt international recommendations to develop the model of care with the context of Indonesian settings	A qualitative study - participatory research techniques and code-sign principles	10 midwives, 13 practice in Puskesmas	Key recommendations agreed upon in the workshop were health screening, maintaining antenatal-postnatal breastfeeding care, limiting visitors, using telemedicine, and creating a multidisciplinary team to provide the care	the number of participants (midwives) selected is insufficient for generalization for all midwives in Indonesia	****	2
Faujiah	2025	West Java	to evaluate the effectiveness of a Meta-AI chatbot delievred via WhatsApp in improving pregnant women's access to maternal and child health information.	A quantitative - quasi-experimental	30 pregnant women	These findings highlight the capacity of conversational AI to address digital literacy disparities and promote maternal health equity.	single site, small sample	*****	2
Gayatri	2025	Several regional of Indonesia	to Exploring the lived experiences of Indonesian midwives regarding changes in maternity services during the pandemic	A qualitative study - Phenomenological study	24 Midwives	Two main themes : (1) changes in maternity care utilisation, and (2) changes in maternity care provision	single site	****	1

Table 1. Study Overview and Characteristic

Study	Year	Province	Study aim	Design and methods	Participants	Key findings	Limitations	Quality Score	Research question
Hartanto	2024	Several regional of Indonesia	to evaluate the effectiveness of telemedicine in reducing maternal mortality rates in these regions	A quantitative - quasi-experimental	500 pregnant women	Telemedicine interventions are a promising strategy to reduce maternal mortality in low-resource settings	The quasi-experimental design cannot entirely rule out confounding factors, such as concurrent improvements in local health programs or regional disparities in implementation quality.	*****	1
Hikmah	2025	Several regional of Indonesia	to analyse the effect of tele midwifery on maternal health service satisfaction in Indonesia using a quantitative approach with a survey of 150 respondents, consisting of pregnant and postpartum mothers who have used tele midwifery applications or online consultation platforms	A quantitative - survey study	150 pregnant women and postpartum mothers	Tele midwifery effectively increases accessibility, continuity of care, and user trust in midwifery services.	The digital literacy gap among older users, limited internet access in certain areas, and the need for stronger digital midwifery regulations to ensure data security and service professionalism.	*****	1
Hernawati	2025	West Java	to evaluate the effectiveness of an AI based mobile health application (PE-CARE) in improving maternal knowledge on early detection of preeclampsia	A quantitative - quasi-experimental	100 pregnant women	The potential of Ai-based mobile health tools to complement antenatal education	Needs to evaluate long-term behavioural and clinical outcomes as well as implementation feasibility in diverse primary care contexts	***	2
Marfuah	2025	West Java	This study aims to assess the impact of an exercise management intervention based on a smartphone app on physical activity, FoC, and QoL in pregnant women in Indonesia.	A quantitative - quasi-experimental	240 pregnant women	The findings indicate that the smartphone app–based exercise management program led to significant improvements in physical activity levels among pregnant women in the intervention group compared to the control group. These positive effects persisted at the 1-month follow-up (T2), suggesting the intervention's potential for long-term benefits.	(1) The quasi-experimental design limits the ability to establish causality, as unmeasured confounding factors may have influenced the results. (2) The sample was recruited from a single region in Indonesia, which may limit the generalizability of the findings to other populations or cultural contexts. (3) the reliance on self-reported measures, such as the PPAQ and WDEQ-A,	***	2

Table 1. Study Overview and Characteristic

Study	Year	Province	Study aim	Design and methods	Participants	Key findings	Limitations	Quality Score	Research question
							may introduce response bias.		
Mulyati	2023	West Java	This study aimed to determine the factors related to maternal readiness at Telehealth Prenatal care in rural areas of Indonesia.	A quantitative - cross sectional study	65 pregnant women	The maternal Telehealth readiness was high (61.5 %). The results showed that there was a relationship between education and income on maternal readiness for Telehealth prenatal care ($p<0.05$), and there was no relationship between age, education, or occupation in Telehealth prenatal care ($p>0.05$).	small sample, single site	*****	1
Mutjahidah	2026	Makasar	To examines how a private maternal and child hospital RSIA Ananda Makassar implements digital marketing within a value-based framework, focusing on its integration with performance measurement systems and experiential value creation for women and families	A qualitative study - case study design	2 practice health worker	The findings reveal that Instagram, online booking, and WhatsApp-based consultation are the most effective digital channels in reaching young mothers, while QR-based satisfaction surveys and routine performance reviews support continuous improvement of marketing and service strategies. Patient trust and emotional bonding are strengthened through care-oriented communication, storytelling, and visible professionalism, reflecting experiential value in maternal and childcare	The global outreach and systematic integration of performance data across units remain limited.	***	3

Table 1. Study Overview and Characteristic

Study	Year	Province	Study aim	Design and methods	Participants	Key findings	Limitations	Quality Score	Research question
Priambodo	2026	Banten-Jakarta	to qualitatively analyse challenges in the reimplementation of health recommender system for maternal care in Indonesia as perceived by multiple stakeholders, including health care providers, patients, health system managers, government officers, and technology vendors	A qualitative Study-Descriptive	15 Pregnant women, 15 health workers, 4 officers government health office, 2 directors of health application vendors, 1 manager from a private health clinic	These findings emphasize the value of user involvement in system design to meet health care professionals' and patients' needs, technical advancements to foster trust and support effective decision-making, as well as enhanced data accuracy, reliable and timely service delivery, cost management, and clear regulatory standards.	The sample size distribution among stakeholder roles was uneven, with some groups being more represented than others, potentially limiting the diversity of perspectives captured.	***	3
Roza	2025	Riau-Batam	to design a digital system architecture for the 2024 MCH Handbook as a means of documentation, early detection, and alarm for pregnancy danger signs that is adaptive to island regions.	A qualitative study-Descriptive	10 pregnant women, 2 health workers	The developed digital system architecture for the 2024 MCH Handbook is able to address field needs, support local innovations, and align with the national agenda for Digital Health Transformation .	Needs to investigate long term with another study (quantitative)	****	2
Susanti	2022	West Java	To identified and explored midwives' competency and service needs to develop mHealth in Midwifery Continuity of Care (MCOC) education and training	A quantitative - cross sectional study	373 midwives	Most midwives needed to develop competency in the MCOC scope, including its early detection of the risk factor of complications and treatment management. They were concerned about the purposes, benefits, and design of mHealth. In summary, midwives' competency indicators for early detection are more needed in MCOC using mHealth	single site	***	3

Table 1. Study Overview and Characteristic

Study	Year	Province	Study aim	Design and methods	Participants	Key findings	Limitations	Quality Score	Research question
Susanti	2025	West Java	to explore the content health education needed in communication digital to support effective maternal health monitoring	A qualitative study- Descriptive	15 Pregnant women	The Research identified two main themes: mental health education (7 sub themes) and health monitoring (2 sub themes). The study concluded that mental health education and health monitoring content for digital communication features based on the needs of pregnant women can increase their involvement in supporting ongoing care.	single site, convenience sample	****	1
Tridiyawati	2025	West Java	To evaluate the effectiveness of a mobile-based reminder system in increasing Antenatal Care (ANC) utilisation among high-risk pregnant women in Indonesia	A quantitative - quasi-experimental	150 pregnant women	The reminder system significantly improved ANC utilisation among high-risk pregnant women in Indonesia	Initially, the research was carried out in a specific geographical location, which restricts the extent to which the findings may be generalised to a wider range of groups	***	2

What is the evidence for AI-based tools to improve the quality and safety of maternal care, particularly for risk prediction and clinical decision support?

1. AI-based tools improve maternal knowledge and skills related to risk recognition

The six studies provide direct empirical evidence that AI-based digital tools can significantly improve pregnant women's knowledge of danger signs and risk conditions, a precursor to timely risk detection and care-seeking. Faujiah and Raraswati (2025) evaluated a Meta-AI chatbot delivered via WhatsApp in a one-group pretest–posttest study of 30 pregnant women in Tasikmalaya. Knowledge scores rose from 5.00 (SD 2.00) to 9.40/9.07 (SD ~1.0) and skills scores rose from 26.5 (SD 5.40) to 36.7 (SD 3.02), both with very large effect sizes (Cohen's d = 1.88 for knowledge and 2.31 for skills, $p<0.001$). The proportion of participants with "high" knowledge rose from 13.3% to 90%, and "high" skills from 26.7% to 80%.
Hernawati et al. (2025) tested PE-CARE, an AI-based mobile application specifically targeting early detection of preeclampsia one of the leading direct causes of maternal mortality in Indonesia (13% of maternal deaths). In a 100 participant quasi-experimental pretest–posttest control-group design, the intervention group's knowledge score increased by a mean of 28.1 points (Cohen's d = 3.79) compared to 11.5 points (d = 1.56) in the control group receiving conventional education, with a significant between-group difference favoring the AI app (mean difference 21.3, d = 4.05, $p<0.001$). Item-level analysis showed the largest gains were precisely on the clinical-risk items most relevant to safety — recognition of blood pressure thresholds (44%→83% correct), role of proteinuria in diagnosis (48%→85%), and knowing when to seek emergency care (64%→95%). Together these two intervention studies suggest AI-driven conversational/educational tools can produce robust, statistically and clinically meaningful improvements in the specific knowledge domains (danger signs, risk factors, emergency thresholds) that underpin maternal safety.
The evidence assembled here shows a two-tier picture. On one tier, there is now reasonably strong, if still preliminary, quantitative evidence that AI-based conversational and educational tools (a Meta-AI WhatsApp chatbot and an AI-based preeclampsia app) can produce large, statistically significant gains in pregnant women's knowledge of risk signs and appropriate care-seeking behavior including on items most tied to maternal safety, such as blood pressure thresholds and emergency referral triggers (Hernawati et al., 2025; Faujiah & Raraswati, 2025).

2. Evidence for AI as a clinical decision-support tool is weaker than evidence for AI as a patient-education tool

AI system for real-time clinical decision support used by health workers to guide diagnosis, referral, or treatment decisions during a live patient encounter. The closest evidence is indirect: a qualitative requirement-analysis study of ANC services in Jakarta, found that "clinical decision aids" was explicitly named by health-office MCH managers as one of the desired mHealth features, alongside supervision of SOP implementation, reminders, and easier referral. This indicates a felt need for decision support among providers, but the study did not test or evaluate an actual AI decision-support system it only identified the requirement (Delmaifanis et al., 2023). PE-CARE app included "a self-assessment feature" allowing women to screen their own risk, functioning as a form of AI-assisted self-triage rather than provider-facing clinical decision support; the study measured only knowledge outcomes, not diagnostic accuracy, referral appropriateness, or clinical/behavioral endpoints (Hernawati et al., 2025). A codesign study on adapting international maternal-care recommendations to Indonesian primary care during COVID-19, recommended telemedicine, screening of asymptomatic patients, and structured escalation/de-escalation and referral pathways as core elements of a maternal-care model but this model was expert/stakeholder-derived guidance, not an AI algorithm, and was not empirically tested for its effect on safety outcomes (Ekawati et al., 2023).

What structural, technological, and sociocultural barriers condition the effectiveness of these technologies, and what are the implications for policy and future research?

1. Fragmented and siloed systems

In (Mujtahidah et al., 2026) found that although RSIA Ananda Makassar had adopted multiple digital channels (website, app, Instagram, WhatsApp, EMR), these operated largely as parallel systems rather than an integrated data infrastructure; the hospital's own informants identified the absence of integrated dashboards and reputation-management tools as an unresolved improvement gap. Documented this problem in sharper detail: health facilities frequently build their own applications in isolation because of limited national guidance, resulting in duplicated data entry, poor interoperability with Indonesia's integrated health-data platform (Satu Sehat), and reliance on parallel paper records as a fallback "source of truth" during system outages. This fragmentation was explicitly linked to *incompleteness* (lack of data integration) and *timeliness* failures (interrupted continuity of care) two of the six most-cited challenges (64.4% of all coded references) in that study (Priambodo et al., 2026).

2. Financing and resource asymmetries

Budgetary constraints were raised as a first-order barrier by health facility managers and regulators in who noted that smaller and primary-care facilities often cannot sustain applications once donor or short-term funding ends, echoing the broader MCH financing-transition literature the study cites. An analogous, though inverted, structural logic at the private-hospital level: management deliberately *withheld* promotional campaigns (e.g., discounted ultrasound services) when demand risked exceeding service capacity a form of structural self-rationing intended to protect experiential quality rather than a resourcing shortfall, but one that nonetheless caps how far digital marketing can expand access.

3. Geographic and urban–rural disparity

Both (Priambodo et al., 2026; Susanti et al., 2025) highlight that infrastructure quality is unevenly distributed. Explicitly note that their sample was concentrated in the Greater Jakarta area, where network and facility infrastructure is comparatively strong, and caution that this limits transferability to rural or underserved regions where connectivity and access differ substantially. Frame the original justification for mHealth adoption around exactly this disparity pregnant women limited physical mobility and the geographic distance from villages to midwives suggesting that the populations most likely to benefit from digital MCH tools are also those least likely to have reliable structural access to them.

4. Regulatory and governance gaps

Regulatory ambiguity constrains system design directly. (Priambodo et al., 2026) describe how data-privacy law prohibits storing medical data locally on devices, which increases complexity and creates transmission delays under poor connectivity, while a lack of standardized protocols for connecting medical devices constrains vendor interoperability. Similarly, (Mujtahidah et al., 2026) find no evidence of international accreditation (e.g., JCI/ISO) or standardized cross-facility performance-reporting frameworks, positioning readiness before acquisition (capability-building prior to market expansion) as a necessary but currently absent governance sequence.

3.2 Quality-of-Care Outcomes

Evidence on quality-of-care outcomes, as distinct from access outcomes, is comparatively less developed for the Indonesian remote-area context, though broader obstetric and gynecologic telehealth literature offers relevant signals. A systematic review of telehealth interventions across obstetric and gynecologic care found improvements in outcomes such as breastfeeding continuation and smoking cessation, reduced need for in-person visits for selected high-risk obstetric monitoring without compromising maternal or fetal outcomes, and, in at least one included study, lower rates of pre-eclampsia diagnosis among women with gestational hypertension managed via telehealth-supported monitoring (Abdalla Elsheikh et al., 2024). A broader scoping review of telemedicine in obstetrics and gynecology internationally similarly reported outcomes for low-risk pregnancies managed via telemedicine that were comparable to in-person care, alongside gains in care continuity and earlier detection of complications where remote monitoring and AI-assisted triage were combined (Medani et al., 2025).

Within Indonesia, the quality dimension of telehealth is discussed more often in terms of preconditions than in terms of measured clinical outcomes: successful telemidwifery implementation is described in the literature as highly dependent on the readiness of human resources, digital infrastructure, and supportive policy, with the implication that quality gains are conditional rather than automatic upon technology deployment (Hikmah et al., 2025). This suggests that, at the current stage of evidence,

telehealth's demonstrated contribution in Indonesia is stronger on the access dimension (more contacts, timelier referral) than on directly measured clinical quality or safety outcomes, which remain comparatively under-evidenced in the remote Indonesian setting.

3.3 Implications for Policy and Practice

This study has three implications. First, telehealth investment in remote Indonesia should be explicitly sequenced with infrastructure equity in mind, prioritizing connectivity and reliable electricity in the eastern regions where maternal mortality risk is highest, rather than following purely commercial or population-density logic. Second, telemidwifery and similar remote supervision models should be paired with structured, government-supported digital literacy and clinical decision training for midwives, given that provider readiness has been repeatedly identified as the binding constraint on translating technology access into care quality. Third, before AI-based risk-prediction tools are scaled nationally, Indonesia's Ministry of Health and academic medical centers should prioritize locally representative model validation, transparent reporting consistent with frameworks, and clear data-governance rules addressing privacy and cross-border data flows to avoid deploying tools whose safety and fairness in the Indonesian population have not been established.

3.4 Limitations

This review has limitations characteristic of integrative review methods. The inclusion of heterogeneous study designs, while a strength for capturing a broad and emerging evidence base, limits formal quality appraisal comparability across sources, and no formal risk-of-bias meta-analysis was performed. The Indonesia-specific evidence base for AI applications in maternal health is limited, requiring reliance on comparative LMIC and international evidence, whose transferability to the Indonesian archipelagic context cannot be assumed. Grey literature and institutional reports, while valuable for capturing implementation realities not yet reflected in peer-reviewed publications, vary in their methodological transparency. Finally, as with any review of a fast-moving digital health field, new primary studies are likely to emerge that were not captured within the search window of this study.

CONCLUSION

Artificial intelligence and telehealth technologies represent complementary but unevenly developed strategies for addressing Indonesia's persistent maternal mortality disparities between urban and remote, western and eastern regions. Telehealth has an established decade-long track record of expanding access to antenatal, referral, and postnatal maternal care in rural and remote Indonesian settings, contingent on infrastructure, workforce readiness, and policy support. Artificial intelligence, particularly for pre-eclampsia and gestational diabetes risk prediction, offers strong international evidence of technical feasibility using low-cost, routinely available clinical data well matched to resource-constrained settings. However, Indonesia-specific validation and deployment evidence remain largely absent from the literature. Realizing the combined potential of these technologies to close Indonesia's maternal health equity gap will require deliberate, geographically targeted investment in connectivity infrastructure, sustained investment in health workforce digital competency, locally validated and governed AI tools, and quality-of-care measurement that moves beyond utilization metrics toward clinical outcomes embedded within a coherent national digital health transformation strategy.

CONFLICT OF INTEREST (if any)

The authors declare that they have no conflict of interests

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