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A Prospective Review on Application of Artificial Intelligence in Maternal Health Nursing

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Abstract: Background: Maternal morbidity and mortality remain a primary global public health concern. Artificial intelligence (AI) has emerged as a disruptive technological advancement in healthcare, offering substantial capabilities to parse vast health datasets, predict complications, and augment clinical decision-making. In maternal health nursing and midwifery, AI applications have expanded rapidly, yet a comprehensive synthesis mapping these modalities within nursing workflows remains absent. This scoping review systematically maps the extant literature surrounding the clinical application of artificial intelligence tools, machine learning models, and natural language processing architectures within the domain of maternal health nursing.

Methodology: Following the Joanna Briggs Institute (JBI) methodology for scoping reviews and the PRISMA-ScR guidelines, a systematic literature search was executed across major databases, including PubMed, CINAHL, Scopus, Cochrane Library, and IEEE Xplore, spanning clinical literature published up to May 2026. Studies were screened and included if they explored AI applications integrated within prenatal, intrapartum, or postpartum nursing workflows, monitoring systems, or clinical decision support frameworks.

Results: A total of 34 eligible studies were retrieved and analyzed. The evidence base revealed three dominant thematic areas of AI implementation: predictive analytics for hypertensive disorders of pregnancy, gestational diabetes mellitus, and peripartum hemorrhage; intrapartum digital health interventions, featuring automated cardiotocography interpretation and intelligent partograph tracking; and (3) natural language processing platforms or conversational agents targeted at maternal mental health triaging and postpartum lactation education.

Conclusion: AI represents a highly promising augmentative framework for maternal health nursing. Realizing its systemic value demands deliberate nursing leadership in algorithmic development, rigorous external cross-validation, and an educational paradigm shift establishing digital competencies within global nursing curricula.

Keywords: Artificial Intelligence; Maternal Health Nursing; Machine Learning; Perinatal Care; Scoping Review; Obstetric Nursing.

Introduction

Maternal health stands as a critical barometer for global public health development. Despite systemic expansions in obstetric care infrastructures, complications arising during pregnancy, childbirth, and the postpartum period claim hundreds of thousands of lives annually, with a disproportionate impact seen within marginalized populations and resource-constrained environments [1]. Preventive, timely, and precise clinical monitoring constitutes the cornerstone of mitigating preventable maternal mortality. Within this clinical matrix, maternal health nurses and midwives operate as the primary line of defense, orchestrating patient triaging, real-time continuous physiological assessments, and evidence-based clinical decision-making throughout the perinatal continuum [2]. Over the last decade, contemporary clinical landscapes have witnessed an exponential inflation of health data volumes, generated by electronic health records (EHRs), continuous monitoring apparatuses, mobile health (mHealth) utilities, and high-fidelity wearable physiological sensors [3]. The manual processing, synthesis, and actionable interpretation of these extensive clinical datasets pose an escalating cognitive burden upon nursing staff, occasionally yielding clinical oversight or late recognition of critical decompensation thresholds. Within this context, the integration of Artificial Intelligence (AI)—including machine learning (ML), deep learning (DL), and natural language processing (NLP)—presents an impactful paradigm shift [4]. AI methodologies possess the capacity to execute sophisticated pattern recognition across multidimensional, nonlinear variables, thereby generating predictive insights far ahead of traditional deterministic screening instruments. While computer scientists and medical professionals have thoroughly analyzed the role of AI in diagnostic radiology and fetal medicine, the specialized application of these methodologies specifically within the context of maternal health nursing practice has not been systematically mapped. Maternal health nursing is inherently distinct, demanding a seamless synthesis of objective biometric interpretation, real-time bedside risk-stratification, patient advocacy, and culturally sensitive interpersonal care [5]. To optimize the adoption of these modern digital ecosystems without disrupting the humanistic essence of nursing practice, a comprehensive mapping of existing technologies is mandatory. Therefore, this scoping review aims to systematically identify, categorize, and critically evaluate the current state of literature concerning the application of AI within maternal health nursing workflows, investigating clinical utility, operational settings, outcomes, and existing translation barriers.

Methodology

This scoping review was conducted in strict compliance with the methodological guidance developed by the Joanna Briggs Institute (JBI) for scoping reviews [6], alongside the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) framework [7]. A scoping review architecture was deliberately chosen over a traditional systematic review to facilitate a broader mapping of heterogeneous methodologies, technological archetypes, and clinical implementation contexts characteristic of this evolving field.

Eligibility Criteria

Studies were evaluated using a clearly defined Population, Concept, and Context (PCC) framework:

- **Population:** Perinatal women (prenatal, intrapartum, and postpartum states), newborns, and the maternal health nursing professionals or midwives managing their care.
- **Concept:** Advanced computational architectures, including machine learning models, neural networks, computer vision, natural language processing tools, intelligent decision support software, and robotic process automation.
- **Context:** All tiers of healthcare infrastructure, encompassing acute tertiary labor suites, specialized outpatient antenatal clinics, community health centers, home-based remote monitoring frameworks, and nursing educational institutions.

Inclusion Criteria: Peer-reviewed primary research articles, observational studies, randomized controlled trials, experimental pilot assessments, and conference proceedings published in the English language up to May 2026. Studies were required to explicitly document an application relevant to nursing workflows, triage systems, or patient-nurse interaction models.

Exclusion Criteria: Dissertations, commentaries, opinion editorials, abstracts lacking complete manuscripts, studies focusing exclusively on fetal surgical procedures without maternal nursing clinical components, and algorithms restricted entirely to bench-top computational development without clinical relevance or simulated nursing utility validation.

Search Strategy and Information Sources

A comprehensive, multi-stage electronic search matrix was executed across five primary databases: PubMed/MEDLINE, CINAHL (Cumulative Index to Nursing and Allied Health Literature), Scopus, the Cochrane Library, and IEEE Xplore. The search algorithms integrated a combination of Medical Subject Headings (MeSH) terms and uncontrolled free-text keywords. A representative search syntax applied within PubMed is summarized as follows: *("Artificial Intelligence"[Mesh] OR "Machine Learning" OR "Deep Learning" OR "Natural Language Processing" OR "Algorithms" OR "Chatbot") AND ("Maternal Health Nursing"[Mesh] OR "Obstetric Nursing" OR "Midwifery" OR "Perinatal Care" OR "Postpartum Care" OR "Intrapartum Care")*. Manual reference tracking of all captured reviews and primary articles was simultaneously executed to ensure comprehensive data collection.

Evidence Screening, Selection, and Data Extraction

Retrieved records were imported into reference management software, where duplicate citations were electronically purged. Two independent review authors (SRS and MAJ) executed a blind screening phase utilizing title and abstract contents against the established a priori eligibility thresholds. Discrepancies were documented and reconciled through structured deliberation or, if necessary, via adjudication by a third senior reviewer (LKP). Full-text versions of tentatively qualifying manuscripts were thoroughly parsed. Data extraction was conducted utilizing a specialized instrument designed to capture key study metadata, clinical target objectives, specific AI architectures, sample cohorts, outcomes relevant to nursing, and implementation constraints.

Results

The electronic search matrix yielded an aggregate total of 412 distinct citations. Following abstract screening and subsequent full-text assessment, 34 primary research publications met all specifications for synthesis. Methodological frameworks exhibited profound heterogeneity, comprising retrospective cohort validation studies (n = 16), prospective pilot interventions (n = 8), non-randomized implementation trials (n = 6), and qualitative assessments of system usability (n = 4).

Table 1. Synthetic mapping of AI applications across the perinatal nursing continuum.

Perinatal Domain	Core AI Modality & Architecture	Target Nursing Workflows	Primary Documented Impact
Prenatal Care	Supervised Machine Learning (Random Forests, Gradient Boosting, SVM)	Risk stratification for Preeclampsia, Gestational Diabetes, and Sepsis triage.	Early detection of risk factors before clinical manifestation.
Intrapartum Care	Deep Learning & Convolutional Neural Networks (CNNs)	Automated CTG and cardiotocography tracing; digital partograph mapping.	Reduces subjective tracing variance; flags fetal distress early.
Postpartum Care	Natural Language Processing (NLP) & Conversational Large Language Models	Remote postpartum depression screening, text triage, and lactation support.	Extended continuity of care; prompt recognition of postpartum mental health issues.
Administration	Robotic Process Automation & Large Language Models	Automated shift handoffs, EHR transcriptions, and nurse resource tracking.	Mitigates clinical burnout; increases direct bedside time.

Clinical Domains and Technological Mapping

1. Prenatal Risk Stratification and Predictive Screening

The application of AI within prenatal nursing settings focuses primarily on the early identification of life-threatening conditions. Sixteen studies explored the validation of machine learning models integrated within Electronic Health Records to forecast the development of early-onset preeclampsia and gestational diabetes mellitus (GDM). Utilizing demographic variables, physiological measurements, and early biomarkers, algorithms such as Gradient Boosting Machines and Support Vector Machines (SVM) demonstrated superior sensitivity compared to standard risk checklist tools [8]. These tools allow triage nurses to dynamically classify high-risk individuals during early gestation, executing targeted surveillance protocols and preventive therapeutics such as low-dose aspirin regimens.

2. Intrapartum Surveillance and Labor Monitoring Automation

Within acute labor and delivery environments, nursing responsibilities demand continuous monitoring of maternal vitals and fetal heart rate (FHR) tracings via cardiotocography (CTG). Ten synthesized studies focused on the execution of deep Convolutional Neural Networks (CNNs) trained to interpret real-time digital CTG patterns [9]. Historically, visual CTG analysis by bedside clinicians has been limited by high inter-observer and intra-observer variability. The integrated deep learning frameworks achieved an Area Under the Receiver Operating Characteristic (AUROC) curve ranging from 0.86 to 0.93 in identifying late decelerations, loss of variability, and impending fetal acidemia. This automated dual-verification serves as a valuable clinical safety net, alerting labor nurses to subtle indicators of fetal distress during high-volume clinical shifts.

3. Postpartum Remote Monitoring and Natural Language Processing (NLP) Support

The immediate weeks following hospital discharge represent a vulnerable period often characterized by a sharp drop-off in active clinical oversight. Eight studies evaluated the efficacy of NLP engines and conversational AI systems designed to bridge this postpartum gap. These systems autonomously parsed patient-reported text inputs via secure mobile applications to screen for postpartum depression (PPD) signs and wound healing anomalies after cesarean sections [10]. Furthermore, automated triage networks successfully managed standard educational inquiries regarding breastfeeding challenges, infant sleep schedules, and physiological changes, routing cases flagged with high-severity linguistic tokens directly to on-call nursing personnel.

Discussion

This scoping review demonstrates that artificial intelligence is transitioning from an experimental engineering framework into a clinically viable augmentative mechanism within maternal health nursing. The primary utility of these systems lies in their capacity to execute continuous, automated risk-stratification, converting dense physiological metrics into actionable insights. By acting as a predictive cognitive partner, AI tools enable maternal health nurses to move from a reactive management approach to a preventive, highly personalized care paradigm [11]. In intrapartum environments, where nursing staff frequently navigate high-acuity environments, deep learning algorithms for CTG interpretation reduce the subjective ambiguities that can lead to diagnostic errors or unnecessary surgical interventions. Similarly, during the prenatal and postpartum periods, AI tools extend nursing oversight beyond hospital walls. These tools establish a continuous care pathway that helps mitigate structural access barriers for patients in rural or socioeconomically disadvantaged regions [12]. However, translating these algorithmic capabilities into safe bedside practices presents several notable challenges. A primary concern identified in the literature is the 'black-box' nature of advanced deep learning architectures. If an algorithm issues a high-risk warning for peripartum hemorrhage without a transparent, explainable path of clinical reasoning, it can create a conflict with a nurse's professional autonomy and evidence-based judgment. This lack of transparency can lead to automation bias—where clinicians blindly accept a machine's output—or alarm fatigue, where persistent alerts are ignored, compromising patient safety [13]. Furthermore, the integration of AI highlights a fundamental philosophical question regarding the nature of nursing care. Maternal health nursing is deeply rooted in human presence, therapeutic communication, emotional reassurance, and intuitive clinical judgment—elements that cannot be replicated by algorithms. An over-reliance on digital interfaces risks reducing patient care to a purely metrics-driven exercise.[14] Therefore, AI should be viewed not as a replacement for human clinicians, but as an optimization tool designed to handle routine analytical tasks, thereby freeing up valuable time for nurses to deliver direct, empathetic, and patient-centered care. AI models demonstrate substantial technical efficacy in optimizing risk stratification and reducing cognitive documentation burden for nursing professionals. However, implementation is profoundly hindered by digital literacy deficits, validation disparities among ethically diverse populations, algorithmic opacity, and a recognized gap in integrating patient-centered nursing empathy into computerized decision paths.

Limitations

Several limitations must be acknowledged within this scoping review. First, the search strategy was confined to manuscripts published in the English language, potentially omitting relevant technological innovations and implementation insights from non-English speaking contexts. Second, given the rapid velocity of development within healthcare informatics, newer algorithms and pilot deployments may have emerged post-search. Finally, because scoping reviews map existing evidence rather than appraise its quality, this paper does not formally grade the methodological bias or statistical power of the included clinical validation trials, requiring cautious interpretation regarding generalized clinical efficacy [15].

Conclusion

Artificial intelligence represents a significant technological advancement in maternal health nursing, providing robust capabilities across risk prediction, intrapartum decision support, and remote postpartum care. When properly integrated, these systems can reduce documentation burdens, minimize clinical errors, and improve maternal outcomes. To fully realize these benefits, nursing professionals must take an active role in the design, testing, and ethical oversight of healthcare algorithms. This involvement ensures that technology serves to enhance, rather than replace, the essential human-centered core of maternal care. Future research should prioritize large-scale, prospective multi-center trials to validate these tools across diverse clinical populations and establish standardized digital health competencies within nursing education frameworks.

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