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Revolutionizing Midwifery Education : A Scoping Review of Artificial Intelligence Methods

Harridhil Silmi[1]*, Ari Indra Susanti[2]
[1]*Master of Midwifery, [2]Department of Public Health Sciences, Faculty of Medicine, Universitas Padjadjaran, Indonesia.
*Corresponding Author. Email: Harridhil24001@mail.unpad.ac.id

Abstract: This study aims to explore the application of artificial intelligence (AI) methods in midwifery education and to identify key barriers to their effective implementation. This study employed a systematic literature review method conducted using the Arksey and O'Malley framework and aligned with PRISMA-ScR guidelines. Articles were sourced from PubMed, ScienceDirect, and Google Scholar, limited to publications from 2020 to March 2025. Data were analyzed through qualitative thematic analysis, with contextual analysis applied where relevant to infer missing or ambiguous details in the source articles. Of 182 articles identified, 9 met the inclusion criteria. The review revealed four main AI applications: predictive analytics for risk identification, decision support systems (DSS) for evidence-based practice, AI-powered simulations for clinical training, and generative AI tools like ChatGPT for fostering critical thinking and digital literacy. Despite these advancements, challenges such as ethical concerns (algorithmic bias, privacy issues), poor data quality, limited AI expertise among educators, and resistance to change in traditional learning environments were noted. AI has the potential to transform midwifery education, but overcoming technical, ethical, and pedagogical barriers is essential for its successful integration. Enhancing faculty capacity, ensuring data integrity, and incorporating AI literacy into curricula are vital steps toward sustainable implementation.

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Introduction

Artificial Intelligence (AI) has rapidly advanced and been widely integrated into education and other sectors in recent years (Pedro et al., 2019). In healthcare, AI supports diagnosis, clinical decision-making, and professional training (Patel et al., 2013). AI technologies are now used to support real-time risk stratification, optimize treatment decisions, and enhance patient monitoring in clinical settings (Alowais et al., 2023; Giordano et al., 2021). AI's ability to process large datasets and predict subtle clinical deterioration patterns makes it an invaluable tool in advancing personalized, proactive care models (Yu et al., 2018). However, successful integration requires careful evaluation, ethical oversight, and alignment with human decision-making processes to avoid unintended consequences (Hah & Goldin, 2021; Magrabi et al., 2019).

Healthcare education, including midwifery, is increasingly exploring AI's potential to enhance learning effectiveness and efficiency. Various AI methods have been applied in midwifery education—such as machine learning, virtual simulations, intelligent tutoring systems, and decision support systems (DSS)—to support conceptual understanding, clinical skill development, and evidence-based decision-making (Georgieva-Tsaneva et al., 2024). Generative AI tools like ChatGPT have also been used to teach critical thinking, digital

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literacy, and case analysis, thereby enhancing students' analytical skills in midwifery education (Bahroun et al., 2023; Unlu Bidik, 2025). Recent reviews also note that AI-powered teaching and assessment can personalize learning, monitor student progress, and reduce faculty workload, making them increasingly relevant for midwifery and medical education (Chan & Zary, 2019; Sriram et al., 2025).

Beyond health education, AI integration in digital learning platforms has shown promising results. Lestariningrum et al., (2024)reported that AI, combined with accessible digital materials, significantly improved academic performance through increased technology engagement, enhancing autonomy and motivation. Likewise, Saragih et al., (2025) found that AI-based teaching tools improved learning outcomes in a before-and-after study, highlighting AI's role in assessment and content delivery via gadgets. These findings affirm that AI enhances not only content delivery but also student engagement and competence, reinforcing its relevance in educational settings, including midwifery.

Despite these opportunities, significant challenges and barriers hinder the full implementation of AI in midwifery education. One of the primary obstacles is the lack of informatics training among educators, which prevents effective integration of AI-based tools and content into the curriculum (Aabaah et al., 2025). Ethical concerns, including AI-driven decision-making, patient data privacy and algorithmic bias remain significant challenges (Shoghli et al., 2024). Resistance to change among educators and practitioners accustomed to traditional methods further hinders adoption (Elyakim, 2025). The application of predictive analytics to identify high-risk pregnancies and the use of DSS in clinical practice are essential for preparing midwifery students to navigate fast-evolving healthcare environments. However, data quality remains a critical concern, as the use of biased or incomplete datasets can compromise prediction accuracy and result in unsafe clinical decisions (M. O. A. M. Ali et al., 2025; Liang et al., 2022).

Although AI holds transformative potential for midwifery education, no comprehensive review has yet synthesized its applications, challenges, and outcomes. This gap hinders the creation of AI-enhanced curricula and the development of evidence-based interventions. This review fills a critical gap by offering the first comprehensive synthesis of AI's transformative impact on midwifery education, guiding future innovation in curriculum design and digital integration. This scoping review aims to systematically explore the application of AI methods in midwifery education and identify key barriers to their implementation. The findings are expected to provide educators, researchers, and policymakers with evidence-based insights to inform the development of adaptive learning strategies, enhance digital literacy among faculty, and support the ethical and effective integration of AI technologies into midwifery curricula.

Research Method

This study used a qualitative approach with a systematic literature review adopted PRISMA-ScR guidelines to ensure methodological consistency (Arksey & O'malley, 2005; Levac et al., 2010; Tricco et al., 2018) and followed the framework proposed by Arksey and O'Malley, further refined by Levac et al. (2010). This approach was chosen as it is appropriate for exploring emerging topics, with the aim of identifying the breadth of evidence, types of approaches, and existing research gaps.

In Stage 1 (Identifying the Research Questions), the researcher formulated the main research questions and sub-questions as follows:

RQ1: What AI methods have been applied in midwifery education?

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RQ2: What are the challenges and barriers to the implementation of AI in midwifery education?

In Stage 2 (Identifying Relevant Studies), articles were retrieved from PubMed, ScienceDirect, and Google Scholar, limited to publications from 2020 to March 2025. The search used the keywords: ("Artificial Intelligence" OR "Machine Learning") AND ("Midwifery Education" OR "Midwifery Training"). Titles and abstracts were screened, followed by full-text reviews based on inclusion criteria. To ensure quality, only peer-reviewed journal articles or book chapters available in full text were selected, with Google Scholar results screened carefully to exclude non-academic sources. Two researchers conducted the selection independently, resolving disagreements through discussion or with a third reviewer.

Table 1. Initial Electronic Search Strategy

Database	PubMed	ScienceDirect	Google Scholar
Date coverage	2020-2025		
Date of search	29-03-2025		
Limits	Language: English Document type: Original research and Review		
Search query (keywords)	("Artificial Intelligence" OR "Machine Learning") AND ("Midwifery Education" OR "Midwifery Training")		
Number of Hits	5	32	145

In Stage 3, the study selection process was carried out systematically to minimize the risk of selection bias and ensure consistency. A selection protocol was developed based on the PRISMA-ScR guidelines(Tricco et al., 2018). Inclusion criteria were: (1) English language, (2) peer-reviewed journal articles, (3) relevant research reports, and (4) published between 2020–2025. Studies were excluded if not in English, published before 2020, or unavailable in full text. Out of 182 initial records, duplicates were removed, and the remaining titles and abstracts were screened, followed by a full-text review. Nine studies met all criteria and were included in the final analysis (see Figure 1). Two researchers screened independently, resolving any disagreements through discussion or with a third reviewer.

In Stage 4, two reviewers (HS and AIS) independently charted data from each article based on predefined components, including methodology, AI methods, implementation strategies, challenges, and outcomes. Contextual analysis was used to infer missing details. The full texts were rechecked for accuracy and consistency, with discrepancies resolved by consensus. The finalized data were compiled into Table 2, summarizing key implementation aspects and emerging themes in AI use within midwifery education.

In Stage 5, the extracted data were collated, synthesized, and summarized to map AI methods in midwifery education by function, technology, and educational purpose. Implementation challenges were thematically analyzed to identify patterns and divergences. One researcher (HS) conducted the initial coding, with independent validation by another (AIS); discrepancies were resolved by consensus. Final themes were summarized in Table 3 to support cross-study comparisons and highlight factors affecting AI effectiveness, adoption, and scalability in education.

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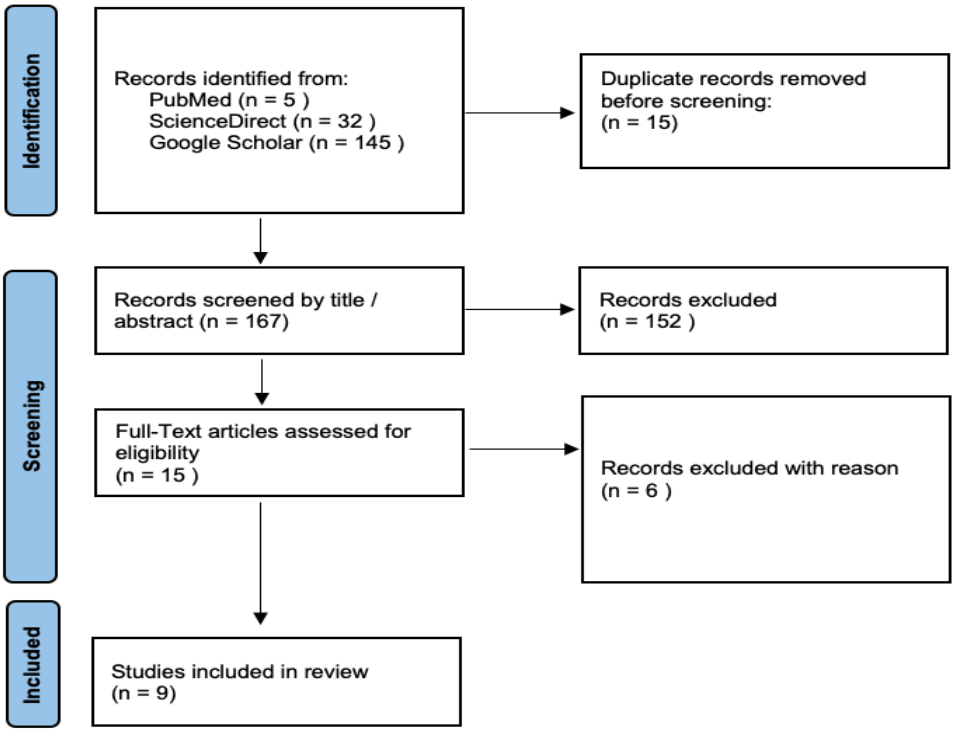

Figure 1. PRISMA Flow Diagram for Study Selection

Results and Discussion

Based on the search strategy shown in Figure 1 (PRISMA), this review includes nine studies examining the integration of Artificial Intelligence (AI) in midwifery education across countries such as the United States, United Kingdom, Australia, Germany, Belgium, Turkey, Indonesia, and Finland. These studies highlight global trends and challenges in applying AI to midwifery education and practice. The AI tools explored include predictive analytics, decision support systems, simulations, natural language processing (NLP), machine learning (ML), virtual assistants, and predictive algorithms. Most studies focused on improving clinical decision-making, enhancing digital literacy, and increasing student engagement. Common research designs were systematic reviews, scoping reviews, qualitative studies, and evaluative surveys.

Table 2. Data Charting Summary

No	Author, year Country	Methodological characteristics	AI Methods Applied	Implementation Components	Challenges and Barriers	Main Outcome
1	Kranz & Abele, (2024) Germany	Scoping Review	General AI applications in healthcare	Midwifery curricula, faculty training, integration of AI in education	Lack of trained faculty, insufficient AI integration in curricula, need for multidisciplinary research	AI integration in midwifery education is still in early stages; requires faculty support and curriculum adaptation.
2	O'Connor, (2022) United Kingdom	Editorial/Review	Machine Learning, Natural Language	Integration of AI in curricula	Lack of informatics expertise among faculty	There is a need for training and support for faculty to teach

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			Processing			AI in midwifery
3	O'Connor et al., (2023) United Kingdom	Systematic review	Machine Learning (ML), Natural Language Processing (NLP), and Deep Learning (DL)	Machine Learning techniques for predicting student attrition, academic failure, and using AI-assisted software	Lack of standardization in AI tools, ethical issues, inaccurate data	AI in nursing and midwifery education predicts student success, enhances learning through AI-assisted tools, and improves clinical skills training.
4	Kovalainen et al., (2025) Finland	Umbrella review of reviews; systematic narrative synthesis	Robotics, Machine Learning, Natural Language Processing, and Deep Learning	Personalized learning, predictive analytics in student success, virtual patient simulations	Ethical concerns, data privacy, integration complexity	AI supports personalized learning, enhances clinical skills training, and predicts student outcomes in health sciences education, including midwifery.
5	Edward et al., (2024) Australia	Evaluative retrospective study; data from student surveys and comparison with external data	Use of simulation, virtual reality, AI tools in practice labs	Block learning model (TBM), scaffolded learning, theory-practice integration	Challenges in full implementation across other contexts	Improved learner engagement, retention, pass rates, and employability outcomes using Block Model in nursing and midwifery education.
6	Gabriel et al., (2024) Australia	survey and content analysis	Generative AI (e.g., ChatGPT)	Critical evaluation of AI-generated case study responses and the development of digital literacy skills	Concerns over AI's lack of woman-centered care and contextualization	Generative AI effectively supports critical analysis and digital literacy in midwifery education
7	Ali et al., 2025) Pakistan	Systematic literature review, PRISMA guidelines	Predictive models, decision support systems, virtual assistants	AI for early detection of complications, personalized care, administrative automation	Data privacy concerns, algorithmic bias, over-reliance on AI, digital divide	AI improves clinical decision-making, reduces complications, enhances maternal care, but faces ethical and practical

						challenges.
8	Akinyemi et al., (2025) Nigeria	Randomized controlled trial, evaluating AI-driven assessment	Machine Learning, Computer Vision for performance analysis	AI-driven evaluation of midwives' skills using intrauterine balloon tamponade (IUBT); real-time feedback via simulations	Algorithmic bias, lack of datasets for training, ethical concerns	AI-enhanced assessment methods improve midwives' competence in IUBT, providing objective, scalable evaluations with real-time feedback.
9	Maulana et al., (2025) Indonesia	Bibliometric analysis, SWOT analysis, ChatGPT-assisted identification of strategies	ChatGPT-4.0 (Natural Language Processin)	SWOT analysis, keyword co-occurrence analysis, strategy formulation	Over-reliance on AI for strategy formulation, need for contextual adaptation	ChatGPT-4.0-assisted bibliometric analysis identified key strategies like midwifery training, telemedicine, and infrastructure improvement.

The review found several themes that align with the focus of the review. The table below presents the main themes identified in the review and their relevant sub-themes:

Table 3. Thematic Summary of AI Methods and Implementation Challenges in Midwifery Education

No	Theme	Sub-Theme
1	AI Methods Applied in Midwifery Education	a. Predictive Analytics (N. S. Ali et al., 2025; Kranz & Abele, 2024; O'Connor, 2022) b. Decision Support Systems (DSS) (Gabriel et al., 2024; Kovalainen et al., 2025) c. Simulations and Virtual Learning(Akinyemi et al., 2025; Edward et al., 2024; Kranz & Abele, 2024; Maulana et al., 2025) d. Generative AI (ChatGPT) (Gabriel et al., 2024; O'Connor, 2022)
2	Challenges in AI Implementation in Midwifery Education	a. Ethical Issues (Algorithmic Bias and Privacy) (Gabriel et al., 2024; Kranz & Abele, 2024) b. Poor Data Quality (Maulana et al., 2025; O'Connor, 2022) c. Lack of AI Expertise Among Educators (Kranz & Abele, 2024; O'Connor, 2022) d. Resistance to Change(Gabriel et al., 2024; O'Connor, 2022)

Main Outcome: AI Methods Applied in Midwifery Education

The scoping review identified four major AI approaches utilized in midwifery education, each contributing to different aspects of learning enhancement and clinical preparedness.

Predictive Analytics

The application of predictive analytics in midwifery education is a key advancement in midwifery education, enabling the early identification of high-risk pregnancies and

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complications like preeclampsia or postpartum hemorrhage. By integrating these tools into the curriculum, students gain hands-on experience with real-world data, learn to assess patient risk, and apply early intervention strategies. This approach enhances clinical skills and underscores the importance of timely care in improving maternal and neonatal outcomes. (Kranz & Abele, 2024; O'Connor, 2022). This study emphasizes that midwifery students must be trained to work with these predictive models, as predictive analytics is increasingly becoming an integral part of clinical practice in modern healthcare.

Decision Support Systems (DSS)

A key application of AI in midwifery education is supporting clinical decision-making through real-time, data-informed recommendations—commonly implemented through Decision Support Systems (DSS). These systems contribute to improved diagnostic accuracy and more effective care planning. DSS can help midwives evaluate treatment plans, anticipate complications, and make informed decisions, ultimately contributing to better patient care. By integrating DSS into midwifery training, students are better prepared to use AI-based technologies in clinical environments, facilitating a deeper understanding of evidence-based decision-making (Gabriel et al., 2024). As midwifery education evolves, DSS plays a crucial role in preparing students to handle complex clinical scenarios with AI support tools.

Simulations and Virtual Learning Tools

Midwifery education is undergoing transformation through enhanced student engagement in clinical decision-making and patient care, supported by the integration of AI-based simulations and virtual learning tools (Edward et al., 2024). These tools provide interactive and immersive learning experiences, enabling students to practice in a safe environment without real-world consequences. AI-powered simulations and clinical decision support systems (CDSS) present diverse patient scenarios, helping students refine clinical decision-making skills. In addition, they foster critical thinking and clinical reasoning, promoting greater confidence and competence in managing obstetric cases. By replicating real-world situations, AI-based simulations offer valuable experience in high-risk decision-making, ultimately improving student preparedness for clinical practice (Akinyemi et al., 2025; Kranz & Abele, 2024; Maulana et al., 2025).

Generative AI

Generative AI, such as ChatGPT, is increasingly being used to teach critical thinking, digital literacy, and analytical skills in midwifery education. This AI tool allows students to critically analyze AI-generated responses, helping them develop the necessary skills to interact with AI tools in clinical practice. Additionally, ChatGPT is used in case study analysis, encouraging students to assess different perspectives, evaluate evidence, and make informed decisions. This approach not only promotes critical thinking but also enhances students' ability to handle AI-generated data, a skill that will be crucial as AI becomes more integrated into healthcare practice. By integrating generative AI into the curriculum, midwifery programs are preparing students for the future of healthcare, where AI-based tools will play a significant role in clinical settings and education (O'Connor, 2022).

Secondary Outcome: Challenges and Barriers

Despite the benefits, several barriers hinder the full integration of AI into midwifery education. These challenges were grouped into four thematic categories.

Ethical Issues

Despite the clear benefits, ethical issues remain one of the main barriers in integrating AI into midwifery education. Algorithmic bias, privacy concerns, and the necessity for human oversight in AI-driven decision-making present significant challenges. Without

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diverse and representative training data, AI models risk perpetuating inequities in care delivery. Additionally, AI's reliance on large datasets raises concerns about patient information security and the reliability of AI tools. Midwifery educators must address these ethical issues by ensuring that students are not only trained to use AI tools but also understand their ethical implications. It is crucial for educators to emphasize AI's limitations and teach students that AI should complement, not replace, human expertise in clinical practice (Gabriel et al., 2024; Kranz & Abele, 2024).

Data Quality

Poor data quality is a critical barrier to effective AI integration. Since AI models depend on high-quality data for accurate predictions, biased or incomplete datasets can compromise model performance, leading to inaccurate outputs and suboptimal clinical decisions (O'Connor, 2022). This presents a significant concern in midwifery education, where students must develop the ability to assess data quality and understand its implications for clinical decision-making. Training AI models with accurate, representative, and diverse data is essential to mitigate these risks and to ensure the effectiveness and reliability of AI-driven tools (Maulana et al., 2025).

Lack of AI Expertise Among Educators

Another significant barrier to integrating AI into midwifery education is the lack of AI expertise among educators. Many midwifery educators do not have adequate training in informatics and AI, which hinders their ability to teach this technology effectively. To address this challenge, collaboration between midwifery educators and AI experts is essential. Developing specialized training programs for educators can help fill this gap and ensure that students receive a comprehensive and high-quality AI education. By providing midwifery educators with the necessary tools and knowledge to integrate AI into their teaching, AI technology can be more effectively applied in midwifery curricula (Kranz & Abele, 2024; O'Connor, 2022).

Resistance to Change

Although the benefits of AI in enhancing midwifery education and clinical practice are evident, resistance to change remains a significant barrier. Some midwifery practitioners and educators express skepticism about AI's role in clinical decision-making, preferring traditional methods of care. This resistance may slow down the adoption of AI-based tools in midwifery education and practice. To overcome this resistance, there needs to be a clear understanding of AI's advantages in improving patient care and supporting midwifery practice. Educators should be encouraged to view AI as a tool that enriches, not replaces, their expertise (Gabriel et al., 2024).

Discussion

This scoping review demonstrates that the integration of Artificial Intelligence (AI) into midwifery education is both promising and complex. The included studies show an increasing use of AI in various forms, including predictive analytics, decision support systems (DSS), simulations, and generative tools such as ChatGPT. Each of these methods introduces innovative learning opportunities that enhance clinical reasoning, critical thinking, and preparedness among midwifery students. Predictive analytics, for example, allow students to engage with real-world data to assess potential complications during pregnancy, such as preeclampsia and postpartum haemorrhage (Kranz & Abele, 2024; O'Connor, 2022). Such hands-on experiences enhance students' understanding of the importance of early detection and intervention in clinical practice. Likewise, DSS provides tools for evaluating

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treatment plans and supporting evidence-based decision-making, reinforcing the value of data-driven care (Gabriel et al., 2024; Kovalainen et al., 2025).

The use of simulations and virtual learning platforms offers immersive experiences that mirror real-life obstetric scenarios. These tools promote the development of clinical competence in a safe environment and build students' confidence in managing emergencies (Kranz & Abele, 2024; Maulana et al., 2025). Generative AI, especially ChatGPT, is also being used to teach students how to critically assess AI-generated content, enhancing digital literacy and fostering analytical thinking (Gabriel et al., 2024; O'Connor, 2022). These emerging applications signal a shift in midwifery education toward embracing technological advancements that align with the evolving demands of healthcare systems.

Despite ongoing advancements, several challenges continue to hinder the full integration of AI into midwifery education. Ethical issues—particularly algorithmic bias and data privacy are commonly reported. When AI tools are trained on non-representative datasets and implemented without critical oversight, they risk reinforcing existing healthcare disparities (Gabriel et al., 2024; Kranz & Abele, 2024). The reliance on large-scale patient data also raises significant concerns regarding confidentiality and data protection. Another key barrier is the lack of AI expertise among educators. Many midwifery faculty members lack the technical knowledge needed to teach AI-related concepts effectively, limiting the ability to fully incorporate AI into curricula (O'Connor, 2022). This gap emphasizes the need for interdisciplinary collaboration and targeted training for educators.

Furthermore, poor data quality can compromise the reliability of AI predictions, as flawed or incomplete training data may result in suboptimal clinical decisions. This highlights the importance of teaching students how to evaluate the validity of data and understand its impact on clinical outcomes (Maulana et al., 2025; O'Connor, 2022). Lastly, resistance to change was noted among educators and practitioners. While AI is often viewed as a tool to enhance care, some professionals remain skeptical of its accuracy and worry about its potential to replace human judgment (Gabriel et al., 2024). Overcoming this resistance necessitates cultivating a culture that embraces innovation while reinforcing the understanding that AI serves as a complement to, rather than a replacement for, human expertise.

The findings of this review confirm the transformative potential of AI in midwifery education, marking a shift from traditional models to learner-centered, data-driven, and technology-enhanced approaches. Conceptually, AI is not merely a tool but a catalyst for educational reform, enhancing clinical reasoning, cognitive engagement, and evidence-based practice. This underscores the need for a theoretical framework that aligns AI integration with pedagogical goals, ethical standards, and professional competencies. Practically, successful implementation requires developing AI literacy among educators, establishing ethical and regulatory guidelines, and aligning AI tools with curriculum standards. Addressing key barriers, such as algorithmic bias, data quality issues, and resistance to change, is critical to ensure equitable adoption. Institutional support, interdisciplinary collaboration, and investment in digital infrastructure are essential for long-term sustainability. Future research should assess the impact of AI-enhanced education on student outcomes and clinical competence across diverse contexts.

Conclusion

The integration of AI into midwifery education presents considerable potential to enhance clinical preparedness, decision-making, and digital literacy. This scoping review

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identified a range of AI tools, including predictive analytics, decision support systems, virtual simulations, and generative AI that are already contributing to advancements in educational practices within the field. However, challenges remain, including ethical issues, data quality limitations, lack of educator expertise, and resistance to change. Overcoming these barriers requires curriculum redesign, faculty training, interdisciplinary collaboration, and supportive policy development.

Recommendation

Further research is needed to evaluate the effectiveness of AI-integrated midwifery education, especially in low-resource settings, and to explore student perceptions and long-term impacts on clinical competence. To support ethical and effective adoption, programs should embed AI literacy, utilize simulation-based tools, and enhance faculty capacity in AI-supported teaching. For policymakers, a national roadmap is recommended to guide AI integration in midwifery education, including updating competency standards, accrediting AI-based curricula, and investing in infrastructure and faculty training. For program heads and lecturers, interdisciplinary training should be prioritized to bridge pedagogical and technological gaps. Faculty development must focus on AI competence, curriculum integration, and collaboration with health informatics experts. Institutions should also pilot AI-assisted modules to align with learner needs and professional expectations.

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