Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 5s, https://carcinogenesis.com/

A Systematic Review of Midwifery Practices and AI Integration in Maternal and Obstetric Healthcare: A Comparative Analysis

Basma W. Elrefay [1], Taghreed Hussien[2], Amal Mohammed Hamid[3], Sultan Abdulaziz Alfurayh[4], Majed Raja Owaid Al-Harbi[5], Lamiaa Rabie Kamel Goma [6], Amina Mohamed Rashad El-Nemer [7], Maurine Conde[8]

[1]Lecturer of Obstetrics and Gynecology Nursing, Faculty of Nursing, Delta University for Science and Technology, Gamasa, Egypt.

Email ID : bosywajih@gmail.com, basma.wageh@deltauniv.edu.eg. https://orcid.org/0009-0000-9878-2757

[2]Taghreed Hussien Alboelola, RN, PhD, Public Health Nursing Department, College of Nursing, Northern Border University, Arar, Saudi Arabia,

Email ID : tagreed.mohammed@nbu.edu.sa,ORCID Number- 0000-0002-7996-697X

[3]Assistant Professor of Obstetrics and Gynecological Nursing- Faculty of Medical Technical Sciences, Alzaiem Alazhari University, Sudan.

[3]Nursing Department, Prince Sultan Military College for Health Sciences, Dammam, Eastern, Saudi Arabia-

Email ID : amhamad@psmchs.edu.sa - https://orcid.org/0000-0002-9436-2189

[4]Nursing Specialist Emergency Department Nursing, Qusaybah General Hospital, Qassim Health Cluster, Saudi Arabia- Email ID : salfurayh@moh.gov.sa

[5]Nursing Specialist Director of Nursing at Al-Qawara General Hospital, Qassim Health Cluster

Kingdom of Saudi Arabia -

Email ID : Malharbi451@moh.gov.sa

[6]Lecturer of Maternal Health Nursing and Newborn department.Faculty of Nursing.Damietta University . Egypt,

Email ID : lamiaarabienu@gmail.com

[7]Professor of Obstetrics and Gynecology Nursing, Faculty of Nursing- Delta University for Science and Technology, Egypt

Email ID : Draminaelnemer@mans.edu.eg

[8]Lecturer of Child Health Nursing, University: Northern Border University, Arar Saudi Arabia ,College of Nursing ORCID ID: 0000-0001-7212-1424, maurineconde@yahoo.com, maurine.comoe@nbu.edu.sa

ABSTRACT

Background: Although its use in midwifery varies across the medical field, artificial intelligence (AI) is increasingly being incorporated into maternal and obstetric care. To examine midwifery practices and AI integration in Saudi Arabia and Egypt, this systematic review examined variations in midwives' perspectives, clinical applications, and educational attainment.

Methods: According to PRISMA criteria, a systematic review was carried out using articles acquired from PubMed, Scopus, Web of Science, CINAHL, and Google Scholar. The review included AI midwifery educational and practical articles published between 2022 and 2024 in Egypt and Saudi Arabia. AI-driven diagnostic investigations were evaluated using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2), whereas quasi-experimental investigations were evaluated using the Critical Appraisal Skills Programme (CASP) Checklist.

Results: Six research investigations from two countries were considered in the systematic review; three have been released in Saudi Arabia and three in Egypt between 2022 and 2024. The primary purpose of AI implementation in Egypt was education; standardized training programs significantly improved midwives' attitudes and knowledge of AI ($p < 0.000$). Saudi Arabia, on the other hand, has placed a strong emphasis on clinical AI applications, such as E-Partographs and predictive AI algorithms, which have improved the accuracy of stillbirth predictions and labor management. Insufficient awareness and training were obstacles to the widespread implementation of AI in Egypt, while issues with data privacy and workflow adaptation were identified in Saudi Arabia. Saudi Arabia's outstanding AI tools and supportive regulations, as well as Egypt's organised AI education programs, served as facilitators.

Conclusion: To improve maternal healthcare outcomes, the study suggests increasing AI education in Egypt and refining

AI clinical applications in Saudi Arabia. To optimise AI's influence on midwifery practice, future studies should focus on ethical issues, real-world AI assurance, and the integration of AI with electronic health records (EHRs).

Keywords: *Midwifery, Artificial Intelligence, Maternal Healthcare, AI in Obstetrics, Midwives' Perceptions, AI Education, AI Clinical Applications, Egypt, Saudi Arabia*

How to Cite: Basma W. Elrefay , Taghreed Hussien, Amal Mohammed Hamid , Sultan Abdulaziz Alfurayh , Majed Raja Owaid Al-Harbi , Lamiaa Rabie Kamel Goma , and Amina Mohamed Rashad El-Nemer , Maurine Conde, (2025) A Systematic Review of Midwifery Practices and AI Integration in Maternal and Obstetric Healthcare: A Comparative Analysis , *Journal of Carcinogenesis*, *Vol.24*, *No.5s*, 1207-1220.

1. INTRODUCTION

The World Health Organisation has released a report estimating that there are over 27 million nurses worldwide [1], including an additional 1.5 million specialists working as midwives, rendering them the most prominent occupational group in the healthcare industry overall [2]. In community and hospital settings, midwives and nurses have historically given patients direct care by determining their requirements, assisting with diagnosis, organising and carrying out a variety of medical interventions, and monitoring patient outcome measures. According to a Cochrane review, nurses are just as capable as primary care physicians in managing chronic illnesses, and they may even be able to improve patient satisfaction [3]. Along with providing care, midwives and nurses have the opportunity to pursue enhanced clinical practice and specialised knowledge. This might involve independent decision-making within a diverse team of medical and allied health professionals when evaluating, identifying, and managing (including prescription) patients with complicated requirements [4]. Research may additionally be incorporated into professional roles to support evidence-based practice, and many nations provide PhD programs that promote midwifery and nursing practice and research [5].

In order to prepare learners in midwifery and nursing and professionals for their future jobs, training is essential. As a result, some midwives and nurses pursue careers as medical coaches and supervisors to assist learners and fellow professionals in their line of work, or they become educators to teach Bachelor, Master, and PhD programs at educational institutions. In addition, midwives and nurses manage a variety of healthcare operations as Chief Nursing/Midwifery Officers in medical facilities and provide knowledge to create and carry out governmental medical policies [6]. While numerous nations continue to utilise paper-based record-keeping, midwives and nurses use Electronic Health Records (EHRs) along with additional electronic tools to gather and analyse an abundance of patient or educational details, as well as administrative and managerial data, in healthcare as well as community settings [7].

Rule-based computational methods, which are explicit and unambiguous commands defined in a programming language, make up the software that supports technologies for healthcare. But when it comes to solving complicated or abstract issues like translating languages or deciphering images, their usefulness is restricted [8]. In order to remedy such restrictions, computer scientists have worked to create artificial intelligence (AI) solutions, which has been identified as applications as well as hardware components created by humans that, provided an intricate objective, act in the digital or physical realm by observing their surroundings through data collection, analysing the structured or unstructured data gathered, applying knowledge, or analysing the information obtained from this data, and choosing the best course of action. AI systems may acquire a numerical model or employ symbolic rules. They can also modify their behaviour by examining the effects of their past actions on their surroundings [9]. AI aims to replicate human cognitive functions, including independent decision-making, logical thinking, knowledge representation, learning, natural language communication, and the ability to see and engage with the natural environment [10].

One area of AI, machine learning (ML), comprises numerous statistically based techniques that are frequently divided into the following categories: Three types of learning are supervised, unsupervised, and reinforced. In controlled learning, a software program masters the rules necessary to produce the final outputs from the training dataset and creates a computational framework from a dataset using predetermined inputs (also known as labelled input) and predefined outcomes. To forecast a result, these variables are subsequently applied to a fresh test dataset. For example, using an EHR dataset from an emergency room, nurses employed a decision tree to determine patients who were susceptible to readmission to the hospital. [11].

A supervised machine learning technique that processes data in layers is called an artificial neural network (ANN). With nodes being connected through connections known as edges, the software layout is similar to that of the human brain. It is only engaged when a specific threshold is met, and each edge is weighted using an algorithm that changes as the network understands how to respond. [12].

AI has many probable applications in midwifery and nursing; however, there are also risks and restrictions associated with these computational methods. Therefore, a study of the available data may help guide subsequent studies, practice,

education, and policy in the field of nursing and midwifery. There have been recent assessments of AI in nursing, but some of them only focus on practical nursing management. [13, 14]Mostly talked about fundamental or exploratory AI research that is more robotics-focused or hasn't been implemented in real-world health datasets or contexts [15].

Even though there is increasing interest in integrating AI into maternal healthcare, little is known about how AI is being implemented in Saudi Arabian and Egyptian midwifery practices. The duties, attitudes, and difficulties that midwives face when utilising AI-powered products are not given enough attention. Furthermore, there are few comparative studies of midwifery procedures in these two nations, which makes it challenging to evaluate how AI affects maternal health outcomes in various healthcare contexts. Additionally, little study has been done on the administrative, ethical, and training-related obstacles to the use of AI in midwifery, especially in middle-income nations like Egypt. To ensure both technical improvements and patient-focused maternal care, it is imperative to address these shortcomings to generate evidence-based recommendations for incorporating AI into midwifery education, practice, and policy.

Significance of the study

This study is important because it compares the use of midwives and the integration of AI in maternal and obstetric care in Saudi Arabia and Egypt, two nations with very different healthcare systems and technology developments. By evaluating the practice of midwifery in both contexts and the degree of AI integration, this study adds to the worldwide conversation on improving maternal healthcare by providing insightful information about the advantages and disadvantages of each system.

This study's emphasis on midwives' responsibilities in AI adoption—an area that has not received enough attention in the literature—is one of its significant accomplishments. Developing focused training programs and policies that guarantee successful integration without sacrificing the human-centered nature of midwifery care will be made easier with a comprehension of midwives' viewpoints, preparedness, and difficulties when using AI-driven tools. [16].

Furthermore, this study reveals the differences in AI adoption between a high-income nation (Saudi Arabia) and a middle-income nation (Egypt), illuminating governmental, financial, and infrastructure-related obstacles that can impede the digital transformation of maternity healthcare. The research can offer suggestions for closing the gap and improving AI availability in midwifery services across various socioeconomic contexts by recognizing these shortcomings.

From a policy standpoint, this research can help healthcare administrators develop AI-powered plans that support midwives while maintaining high standards of maternal healthcare. The results can be utilized by policymakers in Saudi Arabia and Egypt to enhance AI deployment structures, ensuring that AI complements human midwifery skills rather than replacing them.

Additionally, this study has implications for training and education of midwives. The study can help incorporate AI literacy into midwifery courses by evaluating the current applications of AI in maternal healthcare, providing aspiring midwives with the tools they need to successfully navigate digital healthcare contexts.

Lastly, by examining how AI-driven technologies can improve clinical decision-making, lower maternal problems, and optimise patient outcomes, this work advances the subject of maternal health more broadly. Healthcare professionals, academics, and tech programmers seeking to improve AI applications in maternity care will find value in the outcomes, which will guarantee that technological developments are consistent with the fundamentals of safe, moral, and patient-centred midwifery.

This study provides a thorough grasp of the possible advantages and difficulties of AI integration in midwifery across different medical environments, laying the groundwork for future research in this area.

Aims of the study:

In this study, midwifery practices and the use of AI in obstetric and maternal healthcare in Saudi Arabia and Egypt were systematically reviewed and compared. The specific objectives of the research are:

1. To compare and contrast clinical methods, education, and healthcare regulations between Saudi Arabia and Egypt's present midwifery procedures.

2. To find the kinds of AI-driven tools and technology being used in the midwifery profession can help determine the degree of AI incorporation in maternal healthcare in both nations.

3. To explore midwives' perceptions, readiness, and challenges regarding AI adoption, including factors influencing their willingness to integrate AI into their clinical practice.

4. To analyse the impact of AI on maternal health outcomes, such as improvements in diagnostic accuracy, patient monitoring, risk assessment, and overall quality of care.

5. To identify barriers and facilitators of AI adoption in midwifery within the healthcare systems of Egypt and Saudi Arabia, including ethical, financial, infrastructural, and policy-related challenges.

6. To provide evidence-based recommendations for enhancing midwifery education, training, and policy development, ensuring AI integration supports rather than replaces the human-centred approach in maternal healthcare.

Research questions

1. What are the current midwifery practices in Egypt and Saudi Arabia, and how do they compare in terms of clinical approaches, training, and healthcare policies?

2. To what extent is artificial intelligence (AI) being integrated into maternal healthcare in Egypt and Saudi Arabia, and what types of AI-driven tools are being utilized?

3. What are midwives' perceptions, readiness, and challenges regarding AI adoption in maternal healthcare, and what factors influence their willingness to integrate AI into their practice?

4. How does AI impact maternal health outcomes, including diagnostic accuracy, patient monitoring, risk assessment, and overall quality of care?

5. What are the key barriers and facilitators to AI adoption in midwifery within the healthcare systems of Egypt and Saudi Arabia, considering ethical, financial, infrastructural, and policy-related challenges?

6. What evidence-based recommendations can be made to enhance midwifery education, training, and policy development to ensure that AI integration supports, rather than replaces, the human-centered approach in maternal healthcare?

2. METHODS:

Search strategy

The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a comprehensive and transparent methodology. The search strategy for this systematic review was conducted following an extensive and structured approach to identify relevant studies on midwifery practices and AI integration in maternal healthcare in Egypt and Saudi Arabia. Databases including PubMed, Scopus, Web of Science, CINAHL, and Google Scholar were searched for peer-reviewed articles, government health reports, policy documents, and healthcare guidelines published between 2015 and 2024. The search terms were developed using a combination of Medical Subject Headings (MeSH) and free-text keywords, incorporating terms such as "midwifery," "artificial intelligence," "maternal healthcare," "AI in obstetrics," "Egypt," and "Saudi Arabia." Boolean operators (AND, OR) were used to refine the search, ensuring the inclusion of studies that addressed both midwifery practices and AI applications. Filters were applied to restrict results to studies published in English. Full-text publications that satisfied the inclusion criteria were obtained for additional evaluation after the abstracts and titles were vetted for relevancy. In order to find more pertinent studies, the reference lists of a few chosen papers were also manually examined. To guarantee openness and consistency, the entire search procedure was recorded.

Inclusion Criteria

To guarantee relevance and dependability, the papers that were part of this systematic review had to fulfil specific requirements. Studies that examined the application of AI in maternal healthcare in Saudi Arabia and Egypt, or that concentrated on midwifery procedures in these nations, were chosen. To guarantee that contemporary developments in AI applications were included, only English-language papers published between 2015 and 2024 were taken into account. To offer a range of viewpoints on the use of AI in midwifery, empirical investigations were incorporated, including cross-sectional analyses, retrospective assessment, and quasi-experimental research. Publications that offered quantitative or qualitative information on midwives' attitudes, education, or clinical results in relation to the use of AI were also included.

Exclusion Criteria

Publications that only addressed general obstetric care without making any particular mention of midwifery methods were disqualified. Additionally prohibited from consideration was investigation into AI applications irrelevant to maternal healthcare, including AI in general nursing or other medical specialities. Articles without full-text accessibility or those with insufficient methodological information to evaluate the calibre of the study were not taken into account. Additionally, to guarantee that only excellent, peer-reviewed material was included, conference abstracts, opinion pieces, editorials, and duplicate studies were removed. Studies conducted outside Egypt and Saudi Arabia were not included, as the review specifically aimed to compare AI adoption in midwifery between these two countries.

Screening Process

The screening process followed a systematic approach to identify relevant studies for inclusion in the review. A total of 2,094 records were initially retrieved from PubMed, Scopus, Web of Science, CINAHL, and Google Scholar. Before screening, 1,788 duplicate records were removed, along with 145 records marked as ineligible by automation tools and 55 records removed for other reasons. This resulted in 106 records that were screened based on their titles and abstracts. Of

these, 88 records were excluded for not meeting the inclusion criteria. The remaining 18 reports were sought for full-text retrieval; however, 6 reports were not retrieved due to access restrictions. A total of 12 reports were assessed for eligibility, and 6 were excluded due to reasons such as irrelevant study focus (n = 4), inaccessible full text (n = 1), and duplicate publications (n = 1). Ultimately, 6 studies were included in the final systematic review (Figure 1).

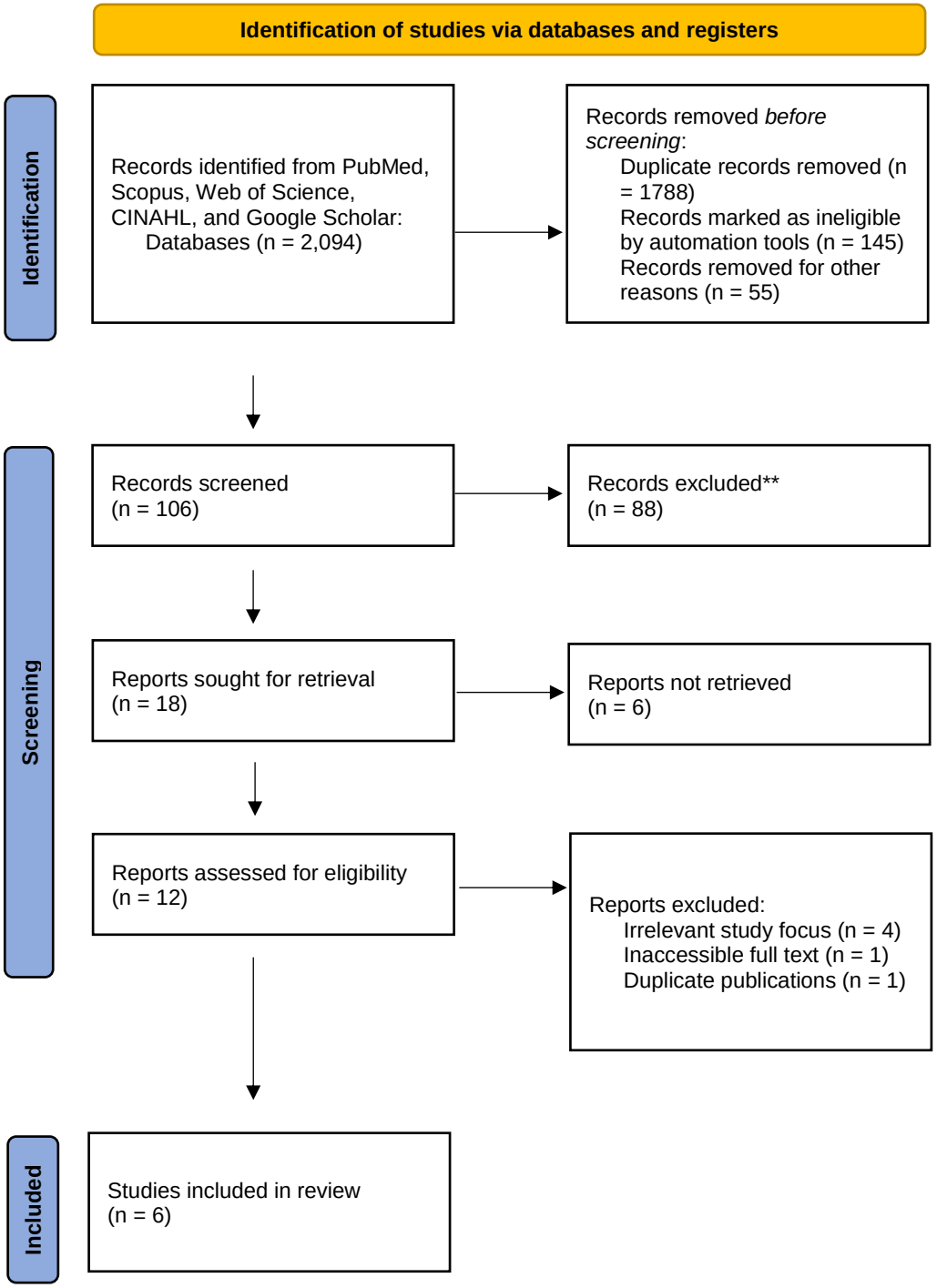

Figure (): PRISMA flowchart of the included studies

Quality assessment:

The quality assessment of the included studies was conducted using the Critical Appraisal Skills Program (CASP) Checklist for quasi-experimental and observational studies and the QUADAS-2 (Quality Assessment of Diagnostic Accuracy

Studies) tool for AI-driven diagnostic studies. Studies assessed with the CASP Checklist demonstrated high quality, as they had well-defined research aims, appropriate methodologies, and reliable measurement tools. However, some lacked control groups, increasing the risk of bias. The AI-based diagnostic studies were evaluated using QUADAS-2, which assessed domains such as patient selection, index test validity, reference standards, and applicability. These studies showed moderate quality, with strengths in model accuracy and internal validation but limitations due to the lack of external clinical validation, which affects generalizability (Tables 1 and 2).

Table (1): The quality assessment of the included studies using the CASP Checklist for quasi-experimental and observational studies

Study	1- Is it clear in the study what is the "cause" is and what the "effect"	2- Were participants included in any similar comparisons?	3- Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	4- Was there a control group?	5- Were there multiple measurements of the outcome, both pre- and post-intervention/exposure?	6- Was follow-up complete, and if not, were differences between groups in terms of their follow-up adequately described and analyzed?	7- Were the outcomes of participants included in any comparisons measured in the same way?	8- Were outcomes measured in a reliable way?	9- Was an appropriate statistical analysis used?	Final grade
Nawal [17]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	High
Rash [18]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	High
Amany [19]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	High
Walaa [20]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High

Table (2): The QUADAS-2 tool for AI-driven diagnostic studies

Study	Patient Selection	Index Test (AI Model: Light GBM)	Reference Standard	Flow and Timing	Confounding Factors & Bias	Final Quality Grade
Sarah A [21]	Low	Low	Low	High	Low	Moderate
Nisreen Innab [22]	Low	Low	Low	Moderate	Moderate	Moderate to High

Data extraction and analysis

The data extraction and analysis process were conducted systematically to ensure accurate synthesis of findings. Key details from each included study were extracted, including the author, year of publication, country, study type, study tools, aim, participants, and conclusions.

3. RESULTS

General characteristics of the included studies

Table 3 provides a structured overview of the six included studies. The studies were conducted in two countries, with three studies from Egypt and three from Saudi Arabia, allowing for a comparative analysis of midwifery practices and AI integration in maternal healthcare within different healthcare settings. The studies utilized two primary research designs: quasi-experimental studies (n = 4, 66.7%) and machine learning-based diagnostic studies (n = 2, 33.3%). The quasi-experimental studies primarily focused on assessing the impact of AI-driven educational interventions and clinical applications on midwifery knowledge, attitudes, and practice. These studies employed structured and interview questionnaires as their main study tools (n = 4, 66.7%). In contrast, the machine learning-based studies explored AI applications in maternal and fetal health assessment, utilizing advanced machine learning models such as TabPFN and

LightGBM. These studies relied on secondary data analysis, primarily using cardiotocography (CTG) datasets, to develop AI-driven predictive frameworks. The total number of participants across the included studies was 451, with human-based studies (n = 4, 66.7%) involving midwives (n = 201, 44.6%), laboring women (n = 100, 22.2%), and menopausal women (n = 100, 22.2%). The machine learning-based studies (n = 2, 33.3%) did not recruit human participants but instead utilized CTG datasets for algorithm training and validation. Among the human-based studies, the sample sizes varied, ranging from 50 to 100 participants per study.

Table (3): General characteristics of the included studies

ID	Author	Year	Country	Type of study	Study tool	Aim	Participants	Conclusion
1	Nawal Kamal [17]	2024	Egypt	A quasi-experimental research design with a pre/post-test	An interview questionnaire	To find out how educational regulations affect the knowledge and attitude of maternity healthcare professionals regarding AI applications through: 1- Assess maternity nurses' knowledge level regarding AI applications. 2- Assess maternity nurses' attitude level toward AI applications. 3- Designing and applying educational guidelines regarding AI for nurses according to their actual needs.	50 nurses working at Sohag University Hospital's obstetrics department.	The educational AI guideline application had a significant effect on the promotion of maternity nurses' knowledge and attitude.
2	Amany Shehata [19]	2024	Egypt	A quasi-experimental design was used, involving a single group pre- and post-intervention	An interview questionnaire	To evaluate how educational sessions affect nurses' attitudes and viewpoints about the application of AI-driven Cardiotocography (CTG) for fetal monitoring in maternity units.	A purposive sample of 51 nurses working in maternity units was selected based on specific criteria. This included 15 nurses from the obstetrics unit and 36 nurses from the labor units.	The training sessions significantly improved maternity nurses' perspectives and attitudes towards using AI-driven CTG for fetal monitoring.
3	Walaa Abd Elkader [20]	2024	Egypt	Quasi-experimental study	Structured interviewing questionnaire:	To compare the impact of AI-based and health promotion-based programs on menopausal women's standard of life through: - 1. Assessing knowledge of women regarding menopause pre/post two program implementation. 2. Assessing quality of life among menopausal woman pre/post two program implementation. 3. Designing and implementing group-based health promoting program and AI-based program for menopausal women	Purposive sampling of 100 peri menopause and menopausal women.	Implementation of health promoting based program associated with improve menopausal women knowledge compared to implementation of AI-based program. Implementation of health promoting based program associated with improve menopausal QoL compared to. Implementation of AI-based program.

						regarding their quality of life. 4. Compare the impact of AI-based programs with health promotion programs on menopausal women's knowledge and quality of life.		
4	Sarah A [21]	2024	Saudi Arabia	Machine learning-based diagnostic retrospective study.	The primary tool used was Tabular Prior Data Fitted Network (TabPFN), a machine learning model. The study also compared 13 other machine learning models for performance validation.	This work offers a unique TabPFN paradigm to detect still and live babies during pregnancy effectively.	The study used data from the CTG dataset from the UCI Machine Learning Repository, which includes fetal monitoring data from pregnant women. The dataset likely contains information on pregnancies categorized as live births or stillbirths	Anticipating stillbirth and live delivery holds great relevance in preventing deaths and taking appropriate precautions for women's health.
5	Rasha Mohamed [18]	2022	Saudi Arabia	A quasi-experimental design was adopted. An interview questionnaire	An interview questionnaire	To evaluate how AI methods affect nursing performance in obstetric units by achieving the following goal: 1- Assess nurses' knowledge and practice about new E-partographs sheets using AI techniques at obstetric units according to nurses' needs. 2- Design and implementation of a program for new E-partograph sheets using AI techniques at obstetric units. 3- Evaluate the effect of using E-partograph sheets in an obstetric unit on nursing performance, nurses, and obstetric women's satisfaction.	A convenience sample of 100 nurses and 100 labouring women.	Applying AI techniques through utilizing E-partographs in the labor unit positively affected nursing performance and satisfaction, as well as labouring women's satisfaction. This improvement was statistically significantly different in nurses' knowledge and practice (pre – post-program) P=0.00
edx	Nisreen Innab [22]	2024	Saudi Arabia	Development and evaluation of a machine learning model for fetal health classification.	• Data: Twenty-one attributes pertaining to foetal growth, development, and physiological factors are included in the cardiotocography (CTG)	To create a Light Gradient Boosting Machine (LightGBM) simulation for automated foetal health evaluation using CTG data, enhanced with SHAP (SHapley Additive exPlanations) for explainable AI.	The study utilized an existing CTG dataset	The proposed LightGBM model, combined with SMOTE for data balancing and SHAP for interpretability, achieved high performance metrics in classifying fetal health status. The study underscores the potential of integrating advanced machine learning

					dataset, categorized into three classes: 'normal,' 'suspect,' and 'pathological.' • Data Preprocessing: The dataset's class imbalance was addressed using the Synthetic Minority Oversampling Technique (SMOTE). • Machine Learning Model: Light Gradient Boosting Machine (LightGBM) was utilized for classification tasks. • Explainability Tool: SHAP (SHapley Additive			techniques with explainable AI tools to enhance fetal and maternal health management.
					exPlanations) was employed to interpret and explain the model's predictions.			

Study	1- Is it clear in the study what is the "cause" is and what the "effect"	2- Were participants included in any similar comparisons?	3- Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	4- Was there a control group?	5- Were there multiple measurements of the outcome, both pre- and post-intervention/exposure?	6- Was follow-up complete, and if not, were differences between groups in terms of their follow-up adequately described and analyzed?	7- Were the outcomes of participants included in any comparisons measured in the same way?	8- Were outcomes measured in a reliable way?	9- Was an appropriate statistical analysis used?	Final grade
Nawal [17]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	High
Rash [18]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	High
Amany [19]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	High
Walaa [20]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High

Midwifery Practices in Egypt and Saudi Arabia

The studies revealed key differences in midwifery practices between Egypt and Saudi Arabia, particularly in education, training, and clinical implementation. In Egypt, midwifery education emphasized structured AI training programs, with studies by Nawal Kamal (2024) [17] and Amany Shehata (2024) [19] Demonstrating that midwives had minimal prior exposure to AI (80%) and primarily relied on media (40%) as an information source. The knowledge and attitudes of

maternity midwives in Egypt significantly improved after a month of educational programs ($p < 0.000$). However, midwifery incorporation of AI in Saudi Arabia was more clinically oriented; Rasha Mohamed (2022) employed AI-assisted E-Partograph sheets in obstetric hospitals to improve labor surveillance and decision-making. [18]. The results indicate that Saudi Arabia has made more proactive measures to apply AI in clinical settings, whilst Egypt places a higher priority on midwifery AI education.

Extent of AI Integration in Maternal Healthcare in Egypt and Saudi Arabia

Saudi Arabia and Egypt used different ways to integrate AI in maternal healthcare. In Egypt, three studies (50%) evaluated the role of AI in midwifery education and practical skill acquisition, with the primary focus being on AI literacy and training. Amany Shehata (2024), for instance, used AI-driven CTG training and discovered that 76.5% of nurses had a favorable attitude towards AI in fetal surveillance, and 62.8% of nurses had a strong AI understanding after the intervention. [19]. Saudi Arabia, on the other hand, prioritized the use of AI in labor and delivery decision-support technologies. Rasha Mohamed (2022) reported that after AI-assisted E-Partograph training, nurses' knowledge of labor monitoring increased significantly ($p \leq 0.00$), with 85% demonstrating improved practical application. [18]. Similarly, Nisreen Innab (2024) used AI models to classify fetal health conditions, highlighting AI's predictive role in maternal healthcare. [22]. These findings suggest that while Egypt is working to enhance AI proficiency among midwives, Saudi Arabia has progressed further in real-world AI applications.

Midwives' Perceptions and Readiness for AI Adoption in Egypt and Saudi Arabia

Midwives' perceptions of AI adoption varied between the two countries, reflecting differences in training exposure and healthcare infrastructure. In Egypt, studies found that midwives had limited prior AI knowledge but demonstrated significant improvements post-training. Nawal Kamal (2024) reported that 80% of maternity nurses had never received AI training, yet post-intervention, their knowledge and attitudes significantly improved ($p < 0.01$) [17]. Similarly, Amany Shehata (2024) found that before training, 76.5% of nurses had low AI knowledge, which improved to 62.8% post-training [19]. Conversely, in Saudi Arabia, where AI applications are already embedded in clinical practice, midwives demonstrated a higher baseline familiarity with AI tools. Rasha Mohamed (2022) noted that 60% of nurses had poor knowledge of AI-assisted partographs pre-training, but post-intervention, 75% achieved a high knowledge level ($p \leq 0.00$) [18]. This contrast suggests that while Egyptian midwives require structured AI education, Saudi midwives are transitioning toward optimizing AI use in clinical practice.

Impact of AI on Maternal Health Outcomes in Egypt and Saudi Arabia

The impact of AI on maternal health outcomes was more pronounced in Saudi Arabia, where AI-driven clinical tools were actively tested in real-world scenarios. Sarah A (2024) [21] introduced a machine learning-based stillbirth prediction model, achieving an accuracy of 97.91%, with precision (97.87%) and recall (98.26%) outperforming traditional risk assessment methods. Similarly, Rasha Mohamed (2022) found that using AI-assisted partographs in labor wards reduced obstructed labor cases, improved decision-making, and enhanced laboring women's satisfaction ($p \leq 0.00$) [18]. In contrast, Egyptian studies focused on knowledge-based interventions rather than clinical AI applications. Whereas AI-based programs enhanced knowledge and quality of life, Walaa Abd Elkader's (2024) [20] investigation of AI-based interventions for menopausal women revealed that health promotion-based strategies were more successful ($p < 0.042$). These results demonstrate that while Egypt is still in the early stages of integrating AI, Saudi Arabia is already utilizing it for direct therapeutic applications.

Barriers and Facilitators of AI Adoption in Egypt and Saudi Arabia

Both Saudi Arabia and Egypt encountered obstacles to the deployment of AI, despite its potential advantages. The main obstacle in Egypt turned out to be a lack of knowledge and training. According to research by Nawal Kamal (2024) [17] and Amany Shehata (2024) [19], training programs were crucial for enhancing AI literacy because 80% of maternity nurses had never used AI before. Challenges in Saudi Arabia, on the other hand, were primarily associated with concerns about data protection and process adaptation. Sarah A (2024) emphasized the need for real-world clinical validation of AI models [21], while Rasha Mohamed (2022) highlighted concerns about data integration challenges with AI-driven decision-support tools. However, facilitators differed between the two countries [18]. In Egypt, structured AI training programs played a significant role in increasing the acceptance of AI among midwives. In Saudi Arabia, the availability of advanced AI technologies and supportive healthcare policies facilitated AI integration. These findings suggest that Egypt requires infrastructure development and policy support, while Saudi Arabia should prioritize optimizing AI implementation and addressing integration challenges.

4. DISCUSSION

Nowadays, one of the most important aspects of an individual's private and professional lives is technology [23]. It links to people over long distances and facilitates communication, navigation, understanding, inquiry, monitoring, and subjective knowledge evaluation in relation to more extensive and efficient uses in human existence [24].

Improved levels of productivity, proximity, and awareness among midwifery studies and educational practices are evolved by very successful recognition and adoption of modern curricula [25]. One of the biggest tactics used in all facets of life, particularly in the medical field and midwifery practices, is AI [26]. AI advancements have changed the health construct's position and hole, leading to more significant and noteworthy concerns with health-related challenges [27]. Each of these challenges determines the proportionate criteria and higher level of education that make nursing and midwifery care crucial [25]. With a focus on variations in education, clinical implementations, and midwives' perceptions, this systematic review compared midwifery practices and AI integration in Saudi Arabia and Egypt. It included six studies from two countries, three from Saudi Arabia and three from Egypt, published between 2015 and 2024.

In the current study, while Egypt prioritizes midwifery AI education, Saudi Arabia has taken more practical steps toward AI implementation in clinical settings. Innovation in AI in the modern day results in extremely efficient and comfortable medical procedures for both patients and healthcare professionals [28]. This is due to the fact that it improves practitioners' knowledge, expertise, and skill, particularly in the context of midwifery. The more competences and skill environments there are, the more comfort the patient and nurse can receive depending on the operationalisation of machine learning mechanisms in their hands [29]. With regard to predetermined criteria, a scientific evaluation of AI innovation in midwifery education offers insight into the future of increased precision, accuracy, and generalisability [30]. The functioning and closer proximity in care were improved by a thorough comprehension of the prospectus as well as a better degree of proficiency and expertise [29].

AI subsets include the operationalisation of algorithmic machine learning to accomplish the varied tasks necessary for human intelligence [31]. Concerns about diagnosis, communication, care, treatment, services, the largest, rehabilitation, network, and proper care are linked to the advancement of pregnancy and the postpartum period [32]. Furthermore, one of the branches of AI that carries out the machine's indirect operation to carry out a larger portion of that execution is machine learning [33]. By establishing links between intricate factors, brain network connections, and environmental effects, it facilitates the deep learning process [26]. The operationalisation and efficiency in healthcare settings are more significantly impacted by AI's recognition of midwifery education, enhancing engagement [34].

According to the current study, midwifery education in Egypt places a strong emphasis on structured AI training programs, requires prior exposure to AI, and mostly relies on the media for information. AI has a higher impact on the operationalisation and management of various abilities and skills among professionals in the Arabic-speaking region. As a result, the procedures are extremely detailed in comparison to the normative standards of international laws and regulations [35]. AI-related practices require reliability, productivity, understanding, empathy, compassion, peace, wealth, and worth to people's well-being [36]. Variable constructions related to AI are significantly altered in Arab nations due to many cultural, religious, and economic aspects that are linked to a larger desire to lead and a better awareness of women's lives during the gestational period, which can predict the time of birth [37]. The monetization of varying degrees of AI does not only concentrate on the greater proximity to the knowledge of the local healthcare sector. These regionally based sectors only serve to highlight the midwife's genuine and tranquil appreciation of expertise [38].

The research findings indicate that AI's potential to enhance medical care and clinical decision-making was regularly emphasised in Egypt. Midwives in Saudi Arabia, however, showed a greater level of first acquaintance with AI tools. Clinical decision support systems (CDSS) and other AI-powered tools have been shown in numerous studies throughout the world to help nurses make better judgements, which reduces clinical errors and improves patient outcomes [39]. Nurses were able to assess patient conditions more effectively and make appropriate treatments thanks to AI tools like predictive analytics and real-time monitoring technologies. These results are consistent with earlier studies, which highlight how integrating AI into nursing practice has enormous potential to enhance patient safety and care quality [40].

In Saudi Arabia, where AI-powered clinical tools were being actively evaluated in real-world settings, the impact of AI on maternal health outcomes was more pronounced. Numerous studies have demonstrated how AI can enhance diagnostic accuracy and automate complex tasks in midwifery contexts. By anticipating issues such as preterm labor and gestational diabetes, AI-powered solutions for prenatal diagnostics, labor administration, and maternal and fetal health monitoring have been demonstrated to enhance patient outcomes. Additionally, midwives were assisted by AI systems in making data-driven decisions throughout labor and delivery [41]. This is in line with earlier studies showing that AI has the potential to transform midwifery services by increasing the overall effectiveness of maternal healthcare delivery, eliminating repetitive jobs, and boosting diagnostic accuracy [42]. In midwifery environments, AI-driven automation can help improve productivity and maximize resource use, which is especially advantageous in situations with constrained healthcare resources [43]. Yet, data integrity, algorithm approval, and the incorporation of AI tools into current healthcare infrastructures are necessary for the successful application of AI in midwifery [44].

According to the present systematic review, the adoption of AI by midwives increased significantly as a result of standardized AI training programs in Egypt. AI integration was made easier in Saudi Arabia by the accessibility of cutting-edge AI technologies and encouraging healthcare regulations. Only a small number of studies documented real-world advantages of AI that was applied and utilised by practitioners, such as creating more precise lexicons or ontologies that recorded nursing knowledge to produce initial diagnoses, enhancing diagnostic procedures, or recognising patients who

were deteriorating. Others have pointed out the practical advantages of AI-based healthcare technologies. Similar concerns are raised by AI in medicine and other healthcare domains, highlighting the need for more thorough investigation into the effects of AI-based health technologies on patients and other outcomes through extensive clinical trials and longitudinal studies [39, 45]. Additionally, a statement advocating the open disclosure of a multivariable predictive model for a person's diagnosis or prognosis was created by Collins et al. (2015) [46]. There are currently established standards for clinical research procedures for AI-based interventions, which ought to be applied when organising, carrying out, and disclosing trials of AI-based digital health initiatives [47]. A thorough evaluation approach was recently released by Reddy et al. (2021) to direct the use of AI-based healthcare systems. These ought to be used to raise the calibre and openness of AI studies on midwifery and nursing [48].

However, certain investigations also highlighted the difficulties in adopting AI, such as the requirement for adequate training and the integration of AI systems with current clinical procedures. In Saudi Arabia, the main obstacles to AI integration were primarily related to workflow adjustment and data confidentiality issues, while in Egypt, the main obstacle was a lack of awareness and training [49]. Some worries were also expressed about the transparency and reliability of AI algorithms, specifically with regard to their interpretability in healthcare settings [50].

The current study had certain limitations in spite of its contributions. The primary obstacle is the dearth of research on AI integration in midwifery in both nations. Furthermore, the comparison was difficult due to the differences in sample size and methodological methods.

5. CONCLUSION

The study discovered that Saudi Arabia and Egypt had different approaches to integrating AI in midwifery, with Saudi Arabia advancing clinical AI applications and Egypt concentrating on AI training and education. After training, Egyptian midwives presented a notable increase in their knowledge, whereas Saudi Arabia used AI-powered maternal health tools such as E-Partographs and prediction models. Adoption was facilitated by structured teaching and supportive policies, but obstacles included Saudi Arabia's concerns about data privacy and Egypt's limited AI training.

6. RECOMMENDATIONS

The results indicate that the main goals of AI integration in Egypt should be to increase the number of AI training programs, create an AI curriculum tailored to midwives, and integrate AI literacy into nursing education.

On the contrary, Saudi Arabia ought to give top priority to boosting interoperability between AI systems and EHRs, optimizing AI clinical applications, and enhancing real-world AI validation.

To guarantee the smooth implementation of AI in maternity healthcare, both nations should solve ethical issues, data security, and AI usability concerns.

Data availability statement: The data that support the findings of this study are available in the article.

Funding statement: No external funding was received for this research.

Conflict of interest disclosure: The authors declare no conflicts of interest

Ethics approval statement: Not applicable

patient consent statement: Not applicable

Acknowledgment: Not applicable .

REFERENCES

[1] Organization, W.H., State of the world's nursing 2020: Investing in education, jobs and leadership. 2020.

[2] Nove, A., et al., The State of the World's Midwifery 2021 report: findings to drive global policy and practice. Human resources for health, 2021. 19: p. 1-7.

[3] Laurant, M., et al., Nurses as substitutes for doctors in primary care. Cochrane database of systematic reviews, 2018(7).

[4] O'Connor, S., et al., Artificial intelligence in nursing and midwifery: A systematic review. Journal of Clinical Nursing, 2023. 32(13-14): p. 2951-2968.

[5] Mapari, S.A., et al., Revolutionizing Maternal Health: The Role of Artificial Intelligence in Enhancing Care and Accessibility. Cureus, 2024. 16(9).

[6] Susanti, A.I., et al., Midwifery Continuity of Care in Indonesia: Initiation of Mobile Health Development Integrating Midwives' Competency and Service Needs. International journal of environmental research and public health, 2022. 19(21): p. 13893.

[7] Dlugatch, R., A. Georgieva, and A. Kerasidou, AI-driven decision support systems and epistemic reliance: a qualitative study on obstetricians' and midwives' perspectives on integrating AI-driven CTG into clinical decision making. BMC Medical Ethics, 2024. 25(1): p. 6.

[8] Fry, H., Hello World: How to be Human in the Age of the Machine. 2018: Random House.

[9] Samoili, S., et al., AI Watch. Defining Artificial Intelligence. Towards an operational definition and taxonomy of artificial intelligence. 2020.

[10] Khan, M., et al., On AI approaches for promoting maternal and neonatal health in low resource settings: A review. Frontiers in Public Health, 2022. 10: p. 880034.

[11] Georgieva-Tsaneva, G., I. Serbezova, and S. Beloeva, Application of Virtual Reality, Artificial Intelligence, and Other Innovative Technologies in Healthcare Education (Nursing and Midwifery Specialties): Challenges and Strategies. Education Sciences, 2024. 15(1): p. 11.

[12] Ramakrishnan, R., S. Rao, and J.-R. He, Perinatal health predictors using artificial intelligence: A review. Women's Health, 2021. 17: p. 17455065211046132.

[13] Ng, Z.Q.P., et al., The role of artificial intelligence in enhancing clinical nursing care: A scoping review. Journal of Nursing Management, 2022. 30(8): p. 3654-3674.

[14] von Gerich, H., et al., Artificial Intelligence-based technologies in nursing: A scoping literature review of the evidence. International journal of nursing studies, 2022. 127: p. 104153.

[15] Buchanan, C., et al., Predicted influences of artificial intelligence on the domains of nursing: scoping review. JMIR nursing, 2020. 3(1): p. e23939.

[16] Eikemo, R., Supporting maternal health and wellbeing in the perinatal period: the impact of midwifery care. 2025, Karolinska Institutet.

[17] Kamal Abd Elkhalek, N., et al., Effect of Educational Guidelines on Maternity Nurses' Knowledge and Attitude regarding Artificial Intelligence Application. Egyptian Journal of Health Care, 2024. 15(3): p. 663-680.

[18] Mohamed Hassan Eltelt, R., Enhancing Nursing Efficiency: The Impact of Artificial Intelligence Techniques on Obstetric Unit Care. Egyptian Journal of Health Care, 2022. 13(1): p. 2337-2362.

[19] Shehata Ahmed, A., S. Helmy Mohamed, and M. Ahmed Abd-Elhamed, Effect of Instructional Sessions on Nursing Perspectives and Attitudes Regarding Use of Artificial Intelligence for Fetal Monitoring in Maternity Units. Egyptian Journal of Health Care, 2024. 15(3): p. 1301-1314.

[20] Abd Elkader Mohamed, A., S. Gharib Ahmed, and M. Abo Bakr Abd Ellatif, Effectiveness of Health Promoting Based Program Versus Artificial Intelligence Based Program on Quality of Life among Menopausal Women. Egyptian Journal of Health Care, 2024. 15(2): p. 1411-1432.

[21] Alzakari, S.A., et al., Artificial intelligence-driven predictive framework for early detection of still birth. SLAS technology, 2024. 29(6): p. 100203.

[22] Innab, N., et al., Automated approach for fetal and maternal health management using light gradient boosting model with SHAP explainable AI. Frontiers in Public Health, 2024. 12: p. 1462693.

[23] O'Connor, S., et al., A Framework for Embedding Artificial Intelligence in Nursing: Education, Innovation, Collaboration, and Implementation–the ALIGN Model. 2023.

[24] Msweli, N.T., H. Twinomurinzi, and M. Ismail, The international case for micro-credentials for life-wide and life-long learning: A systematic literature review. 2022.

[25] Jaspher, M. and K. Kavichelvi, Innovation: Nurse practitioner in midwifery (NPM) the future of Indian nursing. Young Nurses Journal of Research, 2021. 1(2): p. 26-29.

[26] Anadol, Y. and M. Behery, Humanistic leadership in the UAE context. Cross Cultural & Strategic Management, 2020. 27(4): p. 645-664.

[27] Bani Issa, W., et al., Privacy, confidentiality, security and patient safety concerns about electronic health records. International nursing review, 2020. 67(2): p. 218-230.

[28] Alowais, S.A., et al., Revolutionizing healthcare: the role of artificial intelligence in clinical practice. BMC medical education, 2023. 23(1): p. 689.

[29] Golden, B., et al., Emerging approaches to redressing multi-level racism and reproductive health disparities. NPJ Digital Medicine, 2022. 5(1): p. 169.

[30] Oshida, Y., Artificial Intelligence for Medicine: People, Society, Pharmaceuticals, and Medical Materials. 2021: Walter de Gruyter GmbH & Co KG.

[31] El-Saharty, S. and A.C. Liu, COVID-19 in the Gulf Cooperation Council countries: health impact and response, in Handbook of Healthcare in the Arab World. 2021, Springer. p. 1325-1357.

[32] Obaideen, K., et al., Seven decades of Ramadan intermittent fasting research: Bibliometrics analysis, global trends, and future directions. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 2022. 16(8): p. 102566.

[33] Kumar MV, M., et al., ICT Enabled Disease Diagnosis, Treatment and Management—A Holistic Cost-Effective Approach Through Data Management and Analysis in UAE and India. Frontiers in Artificial Intelligence, 2022. 5: p. 909101.

[34] AlOmari, F., Does a doctor's skill influence patient satisfaction, loyalty and compliance in low-medium income countries? International Journal of Information and Decision Sciences, 2022. 14(2): p. 149-163.

[35] Khajeei, D., et al., Maternal health literacy and health numeracy conceptualizations in public health: A scoping review. Health & Social Care in the Community, 2022. 30(6): p. e3534-e3546.

[36] AbuAyed, Y. and K. Wainwright, Maternal Hybrid Healthcare, in Hybrid Healthcare. 2022, Springer. p. 87-103.

[37] Al-Marzooqi, S.M., et al., Human development index and innovation capabilities in the health sector of UAE. Journal of population therapeutics and clinical pharmacology= Journal de la therapeutique des populations et de la pharmacologie clinique, 2022. 29(3): p. e134-e156.

[38] Bajwa, J., et al., Artificial intelligence in healthcare: transforming the practice of medicine. Future healthcare journal, 2021. 8(2): p. e188-e194.

[39] Angus, D.C., Randomized clinical trials of artificial intelligence. Jama, 2020. 323(11): p. 1043-1045.

[40] Hummel, P. and M. Braun, Just data? Solidarity and justice in data-driven medicine. Life sciences, society and policy, 2020. 16(1): p. 8.

[41] Díaz, Ó., J.A. Dalton, and J. Giraldo, Artificial intelligence: a novel approach for drug discovery. Trends in pharmacological sciences, 2019. 40(8): p. 550-551.

[42] Chan, H.S., et al., Advancing drug discovery via artificial intelligence. Trends in pharmacological sciences, 2019. 40(8): p. 592-604.

[43] Vaishya, R., et al., Artificial Intelligence (AI) applications for COVID-19 pandemic. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 2020. 14(4): p. 337-339.

[44] Cruciger, O., et al., Impact of locomotion training with a neurologic controlled hybrid assistive limb (HAL) exoskeleton on neuropathic pain and health related quality of life (HRQoL) in chronic SCI: a case study. Disability and Rehabilitation: Assistive Technology, 2016. 11(6): p. 529-534.

[45] Nagendran, M., et al., Artificial intelligence versus clinicians: systematic review of design, reporting standards, and claims of deep learning studies. bmj, 2020. 368.

[46] Collins, G.S., et al., Transparent reporting of a multivariable prediction model for individual prognosis or diagnosis (TRIPOD) the TRIPOD statement. Circulation, 2015. 131(2): p. 211-219.

[47] Rivera, S.C., et al., Guidelines for clinical trial protocols for interventions involving artificial intelligence: the SPIRIT-AI extension. The Lancet Digital Health, 2020. 2(10): p. e549-e560.

[48] Reddy, S., et al., Evaluation framework to guide implementation of AI systems into healthcare settings. BMJ health & care informatics, 2021. 28(1): p. e100444.

[49] Harrer, S., et al., Artificial intelligence for clinical trial design. Trends in pharmacological sciences, 2019. 40(8): p. 577-591.

[50] Holzinger, A., et al., What do we need to build explainable AI systems for the medical domain? arXiv preprint arXiv:1712.09923, 2017