World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(REVIEW ARTICLE)

Check for updates

Transforming maternal healthcare: Harnessing the power of artificial intelligence for improved outcomes and access

Pradeep Kumar Panda * and Rahul Sharma

School of Public Health, Poornima University, Jaipur, Rajasthan, India.

World Journal of Advanced Research and Reviews, 2024, 23(01), 662–666

Publication history: Received on 25 May 2024; revised on 03 July 2024; accepted on 05 July 2024

Article DOI: https://doi.org/10.30574/wjarr.2024.23.1.2005

Abstract

Artificial intelligence (AI) signifies advanced computer systems adept at tasks traditionally within the purview of human intelligence. This paper explores the transformative landscape of AI applications in healthcare, with a specific focus on risk assessment, predictive modeling, and remote monitoring to proactively address high-risk pregnancies. Aligned with Sustainable Development Goal (SDG) 3.1, our investigation underscores AI's pivotal role in advancing maternal outcomes, encapsulating recent research across domains such as complication prediction, healthcare access enhancement, clinical decision support systems, and fertility treatments. AI-driven models demonstrate efficacy in predicting preterm birth, gestational diabetes, preeclampsia, and other adverse outcomes through meticulous analysis of maternal health data, enabling timely interventions. In underserved regions, AI acts as a catalyst, enhancing accessibility to vital services like prenatal ultrasounds and health education through telemedicine platforms. The integration of AI decision support systems empowers healthcare providers with real-time, patient-specific assessments and recommendations derived from population data analysis. Within fertility medicine, AI proves instrumental in refining genetic screening, embryo viability selection, and optimizing in vitro fertilization success rates. Despite these advancements, challenges persist in regulatory policy, privacy safeguards, accuracy, and seamless integration into clinical workflows, necessitating prudent consideration before widespread implementation. So, ethically applied AI emerges as a transformative force, offering substantial opportunities to advance maternal healthcare significantly. By averting complications, broadening access, informing sound decisions, and optimizing fertility outcomes, AI stands as a promising ally. This comprehensive review encapsulates pivotal applications of this burgeoning technology, outlining potential directions for future research, thereby contributing to the realization of SDG 3.1.

Keywords: Artificial Intelligence; Maternal Health; Pregnancy; Prenatal Care; Postpartum Care; Predictive Analytics

1. Introduction

Artificial intelligence (AI) refers to computer systems designed to perform tasks that typically require human intelligence, such as visual perception, speech recognition, and decision-making (Topol, 2019). In recent years, AI has shown immense promise in transforming healthcare through applications like medical imaging analysis, robotic surgery systems, virtual nursing assistants, and predictive analytics (Topol, 2019). The field of maternal health is starting to adopt these advanced technologies as well with the goal of improving pregnancy outcomes and access to care. This review synthesizes current research on the applications of AI in maternal health, focusing on areas like prediction of pregnancy complications, improving access to care, decision support systems, and fertility treatment.

1.1. Prediction of Pregnancy Complications

Several studies have explored using AI to analyze maternal health data to enable early prediction of complications. Caly et al. (2021) developed a machine learning model using pregnancy data that identified a subpopulation of newborns at

* Corresponding author: Pradeep Kumar Panda

high risk for autism spectrum disorder. Akazawa & Hashimoto (2022) systematically reviewed prediction models for preterm birth based on AI, finding promising results. Ivshin, Bagaudin & Gusev (2021) specifically focused their research on AI for predicting preeclampsia. Overall, these prediction models aim to allow earlier interventions that can improve outcomes.

AI shows promise in early prediction of pregnancy complications, benefiting vulnerable populations like tribal communities in remote areas. Geographical isolation poses challenges for timely healthcare access in tribal villages. AI, utilizing anthropometric data and clinical biomarkers, predicts risks before labor. Continuous at-home monitoring via connected devices provides real-time data to AI models tailored for tribal contexts, triggering alerts for clinical guidance and transportation plans.

Localized predictive models, drawing on historical population data, have the potential to significantly reduce tribal maternal mortality. AI's early detection and intervention address challenges of geography and limited infrastructure, contributing to a decline in maternal mortality rates among vulnerable tribal communities globally.

However, further validation is still needed before clinical implementation (Akazawa & Hashimoto, 2022).

1.2. Improving Access to Care

Lack of access to quality prenatal, obstetric, and postpartum care remains a major barrier to improving outcomes and reducing mortality rates, especially in low- and middle-income regions. AI tools are being leveraged in innovative ways to help overcome some of these access issues.

For example, Nti and Owusu-Boadu (2022) proposed an AI model trained on public health datasets that can predict maternal mortality rates on a regional basis to help inform resource allocation decisions and target interventions to highest need areas. Remote monitoring devices that use AI for real-time tracking of pregnancy vitals are also being tested to provide care for women in geographically isolated areas (Saif-Ur-Rahman et al., 2023).

Telemedicine platforms that employ conversational AI chatbots are another avenue being explored to increase accessibility of maternal health advice. Such chatbots can share reliable information on prenatal diet and supplements or recognize symptoms of concern to advise if a visit to a health facility is warranted (Chemisto et al., 2023). Especially when paired with remote patient monitoring devices, such telehealth services can help bring quality care to many underserved regions.

Beyond direct clinical applications, AI also shows promise for improving access and quality of maternal healthcare, especially in underserved regions. Self et al. (2022) proposed developing a computer-assisted ultrasound program to increase availability of prenatal imaging in low-resource settings. Nishtala et al. (2021) tested an AI system that analyzed missed calls to health hotlines in India to then send reminders and health information via automated voice calls. Overall, these types of AI interventions aim to bridge gaps in maternal healthcare availability and quality between high and low-resource regions.

1.3. Clinical Decision Support Systems

By rapidly analyzing large datasets from past medical records, AI systems can provide up-to-date clinical recommendations to assist providers in complex decision making at the point of care. For example, Davidson and Boland (2020) proposed an AI system that continually reviews emerging research on medication safety in pregnancy. This system would then provide patient-specific assessments of risks and benefits to aid prescribing decisions for pregnant women with various conditions and comorbidities.

AI is also showing early promise for integration into ultrasound software to help detect fetal anomalies or abnormalities for expedited referral to specialist care when concerning findings are present (Drukker, Noble & Papageorghiou, 2020). By acting as enhanced 'second set of eyes', such AI assisted interpretation of scans could improve detection rates and allow quicker interventions.

Finally, Lee and Ahn (2020) developed an AI algorithm specifically focused on early diagnosis of preterm labor by analyzing patterns in uterine contractions from tocography data. This type of narrow AI specializing in one clinical determination at which humans often struggle could greatly aid providers. It may also reduce delays in necessary treatments when preterm birth is imminent.

AI-based clinical decision support systems are also being developed specifically for maternal health contexts. For example, Gomes et al. (2022) created a mobile app using AI to assess gestational age and fetal presentation to guide referrals. AI is also being used to analyze and summarize emerging research to provide up-to-date evidence to better inform clinical decisions related to medications in pregnancy (Davidson & Boland, 2020).

Overall, these types of AI clinical decision support tools show immense potential to provide better informed, patient-specific, and timely recommendations to assist providers across a wide span of maternal health contexts. Realization of this potential will depend on integration into provider workflows and gaining trust through explainable AI models.

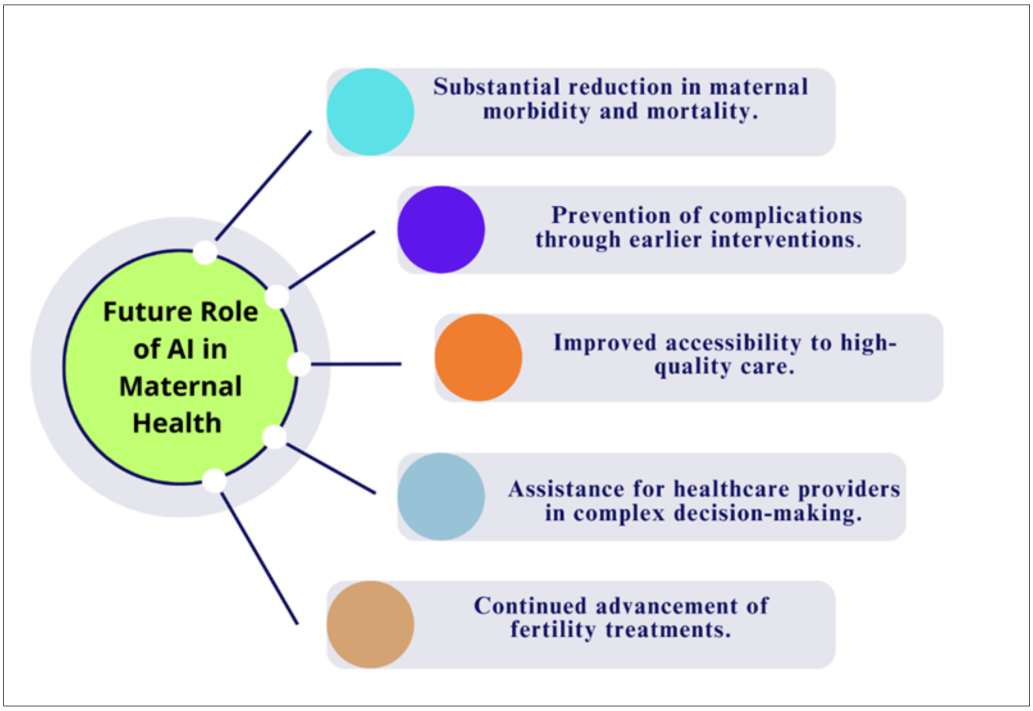

Figure 1 AI in maternal health: reduces morbidity, prevents complications, improves care, aids decisions, advances fertility

1.4. Fertility Treatment

Applications of AI are rapidly emerging in fertility treatment as well. For example, AI can analyze images of embryos to predict viability and success rates for procedures like in vitro fertilization (Trolice et al., 2021). Barkavi, Yamuna & Jayaram (2023) provided an extensive analysis of current and future applications of AI across virtually all aspects of fertility treatment and reproduction medicine. From follicle tracking to genetic testing to embryo selection, AI promises major improvements in outcomes.

1.5. Challenges and Future Directions

While great promise exists, there are still many barriers to translating AI research into clinical implementation and practice in maternal health. As Prakash et al. (2023) reviewed, key challenges include ethical concerns over data security and privacy, potential biases in dataset used to train algorithms, regulatory policy, and acceptance amongst patients and providers. Patel (2023) calls for increased focus on creating transparent AI models that can explain their reasoning and increase trust. Issues of accuracy, validity, and integration with clinical workflows must also still be addressed before widespread adoption.

However, if these challenges can be overcome, AI may help substantially reduce maternal morbidity and mortality, prevent complications through earlier interventions, make high-quality care more accessible, assist providers in complex decision making, and continue advancing fertility treatments (Maroju et al., 2023). Most researchers conclude AI should be seen not as replacing healthcare professionals, but rather as providing them enhanced capacities to improve care (Letterie, 2021). Significant work still remains, but the future for AI in maternal health looks bright.

2. Conclusion

So, artificial intelligence (AI) shows promise in transforming maternal healthcare by improving early complication detection, enhancing access to quality care, aiding complex decision-making, and advancing fertility treatments. However, deploying AI in tribal areas, which often face significant health disparities, requires careful consideration. AI tools like predictive algorithms for high-risk pregnancies, telemedicine with AI chatbots, and computer-assisted ultrasound interpretation could address healthcare gaps. Challenges in technological readiness, staff training, privacy, and cultural sensitivity must be navigated. Tailoring programs to local needs and engaging tribal communities as partners is crucial. Successful implementation in regions with limited infrastructure, including tribal areas, would underscore the generalizability of AI in maternal health, ensuring equitable access to quality care even in remote corners of the world.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Akazawa M, Hashimoto K. Prediction of preterm birth using artificial intelligence: a systematic review. J Obstet Gynaecol. 2022;42(6):1662-8.

[2] Barbounaki S, Vivilaki VG. Intelligent systems in obstetrics and midwifery: applications of machine learning. Eur J Midwifery. 2021;5.

[3] Barkavi R, Yamuna G, Jayaram C. Artificial Intelligence: Revolution in Assisted Reproductive Technology. In: International Conference on Communication and Computational Technologies. Singapore: Springer Nature Singapore; 2023. p. 947-61.

[4] Caly H, Rabiei H, Coste-Mazeau P, et al. Machine learning analysis of pregnancy data enables early identification of a subpopulation of newborns with ASD. Sci Rep. 2021;11:6877.

[5] Chemisto M, Gutu TJ, Kalinaki K, et al. Artificial Intelligence for Improved Maternal Healthcare: A Systematic Literature Review. 2023 IEEE AFRICON. 2023:1-6.

[6] Davidson L, Boland MR. Enabling pregnant women and their physicians to make informed medication decisions using artificial intelligence. J Pharmacokinet Pharmacodyn. 2020;47:305-18.

[7] Drukker L, Noble JA, Papageorghiou AT. Introduction to artificial intelligence in ultrasound imaging in obstetrics and gynecology. Ultrasound Obstet Gynecol. 2020;56(4):498-505.

[8] Gomes RG, Vwalika B, Lee C, et al. A mobile-optimized artificial intelligence system for gestational age and fetal malpresentation assessment. Commun Med. 2022;2(1):128.

[9] Ivshin AA, Bagaudin TZ, Gusev AV. Artificial intelligence technologies in predicting preeclampsia. Obstet Gynecol Reprod. 2021;15(5):576-85.

[10] Lee KS, Ahn KH. Application of artificial intelligence in early diagnosis of spontaneous preterm labor and birth. Diagnostics. 2020;10(9):733.

[11] Letterie G. Three ways of knowing: the integration of clinical expertise, evidence-based medicine, and artificial intelligence in assisted reproductive technologies. J Assist Reprod Genet. 2021;38(7):1617-25.

[12] Maroju G, Choudhari SRG, Shaikh MK, Borkar SK, Mendhe H. Application of artificial intelligence-based strategies for promotion of family planning in India: a scoping review. F1000Research. 2023;12:1447.

[13] Nti IK, Owusu-Boadu B. A hybrid boosting ensemble model for predicting maternal mortality and sustaining reproductive. Smart Health. 2022;26:100325.

[14] Patel SS. Explainable machine learning models to analyse maternal health. Data Knowl Eng. 2023;102198.

[15] Prakash C, Singh LP, Gupta A, Kumar R, Bhardwaj A. Future Consideration and Challenges in Women's Health Using AI. In: Combating Women's Health Issues with Machine Learning. CRC Press; 2023. p. 215-36.

[16] Saif-Ur-Rahman KM, Islam MS, Alaboson J, et al. Artificial intelligence and digital health in improving primary health care service delivery in LMICs: A systematic review. J Evid Based Med. 2023;16(3):303-20.

[17] Self A, Chen Q, Desiraju BK, et al. Developing clinical artificial intelligence for obstetric ultrasound to improve access in underserved regions: protocol for a Computer-Assisted Low-Cost Point-of-Care Ultrasound (CALOPUS) study. JMIR Res Protoc. 2022;11(9):e37374.

[18] Topol E. Deep medicine: how artificial intelligence can make healthcare human again. Hachette UK; 2019.

[19] Trolice MP, Curchoe C, Quaas AM. Artificial intelligence—the future is now. J Assist Reprod Genet. 2021;38:1607-12.17. Self, A., Chen, Q., Desiraju, B. K., Dhariwal, S., Gleed, A. D., Mishra, D., ... & CALOPUS Study Group. (2022). Developing clinical artificial intelligence for obstetric ultrasound to improve access in underserved regions: protocol for a Computer-Assisted Low-Cost Point-of-Care Ultrasound (CALOPUS) study. JMIR Research Protocols, 11(9), e37374.

[20] Topol, E. (2019). Deep medicine: how artificial intelligence can make healthcare human again. Hachette UK.

[21] Trolice, M.P., Curchoe, C. & Quaas, A.M. (2021). Artificial intelligence—the future is now. J Assist Reprod Genet 38: 1607–1612.