DOI: 10.21088/ijmfnm.2455.8621.12225.2

Indian Journal of Maternal-Fetal & Neonatal Medicine
Volume 12 Number 2 July - December 2025

REVIEW ARTICLE

The Role of Artificial Intellect and Machine Learning in Techniques for Assisted Fertility

Swati Jaiswal

HOW TO CITE THIS ARTICLE:

Swati Jaiswal. The Role of Artificial Intellect and Machine Learning in Techniques for Assisted Fertility. Indian Journal of Maternal-Fetal & Neonatal Medicine. 2025; 12(2): 45-50.

ABSTRACT

Large data sets and clever algorithms are the strengths of artificial intelligence (AI) and machine learning, the fields most frequently employed in medicine. These systems have the potential to transform treatment delivery, access to healthcare, and outcome improvement, especially in the field of reproductive medicine. More accurate follicular measurement or more reliable oocyte and embryo grading are just two examples of how AI can help doctors and most importantly, patients provide the best, most customised care possible. All of AI's potential benefits not with standing, algorithms are not impervious to prejudice and are susceptible to the numerous socio-economic and demographic prejudices that plague the healthcare systems of today. Inaccurate diagnoses and the continuation of healthcare discrimination are real potential outcomes if our understanding of AI's potential and constraints is lacking. Clinicians will be able to develop and apply machine learning-based innovations for the advancement of reproductive medicine and ultimately the creation of healthy families if they are equipped with the necessary knowledge about how AI can function most effectively in the field of medicine, particularly reproductive medicine.

KEYWORDS

• Convolutional neural networks • Artificial intelligence • Ethics • IVF • Machine learning • Support vector machines

Key Points:

- Understanding the components and important definitions of artificial intelligence.
- AI-based algorithms for the improvement of reproductive medicine.
- Ethical dilemmas and limitations potentially leading to worsening healthcare bias or misdiagnoses.

AUTHOR'S AFFILIATION:

Nursing Tutor, Naraina Nursing College, Kanpur, Uttar Pradesh, India.

CORRESPONDING AUTHOR:

Swati Jaiswal, Nursing Tutor, Naraina Nursing College, Kanpur, Uttar Pradesh, India.

E-mail: swatijais888@gmail.com

➢ **Received:** 02-06-2025 ➢ **Accepted:** 21-07-2025

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INTRODUCTION

In 1955, while participating in the Artificial Intelligence Summer Research Project at Dartmouth, John McCarthy was the first to use the term. AI stands for artificial intelligence. capacity of computers to learn and exhibit intelligence, which contrasts sharply with the innate intelligence exhibited by animals and humans. Since then, AI has advanced quickly and entered our social and personal lives. Thanks to advancements in computing storage of data, retention, strength, and data volume, computers have demonstrated remarkable proficiency in managing ever-more-complex learning tasks in recent years (Deo 2015). AI's everyday applications include self-driving cars, game AI, speech recognition, facial recognition, and intelligent voice assistants (Strayer *et al.* 2017).

In the healthcare domain, recent advances have resulted in a significant rise in the amount and intricacy of the biological data produced by patients, Atmospheric influences, hospitals, and biological research (Andreu-Perez *et al.* 2015). This has created both new opportunities and challenges for clinical activities. With the rapid growth of biomedical data, physicians can no longer use traditional statistical approaches to extract all relevant data and provide insights into complex disorders. In order to help physicians in understanding the data, a higher-level analysis approach is required, Deo 2015. With the help of sophisticated algorithms, AI discovers possible connections in vast amounts of biological data and applies these discoveries to support clinical procedures. Additionally, it might acquire fresh medical data from successful clinical trials and clinical recommendations to increase its precision. AI can produce real-time predictions about health risk and minimise the unavoidable mistakes in diagnosis and therapyin the therapeutic practice of humans (Patel *et al.* 2009).

The growing body of information in reproductive medicine is continuously driving advancements in AI applications. The best therapeutic method for treating infertility patients is to base judgments on the examination of medical data, notwithstanding certain possible drawbacks. The goal should be to combine ART with AI development in order to close the discrepancy between clinical practice and research. By using Models of AI and machine learning, reproductive specialists can identify the optimal course of treatment for each patient's unique infertility, which is a major breakthrough in the creation of ART. Individually, infertility patients can receive the best treatment, which will lower their financial burden and increase the likelihood of a healthy pregnancy. Using medical resources needlessly might have negative social effects prevented, resulting in lower medical expenses.

AI is currently mostly utilised in the following fields (see Figure 1): sperm cell selection and prediction to increase treatment success rate; evaluation of embryo and oocyte quality; and creation of a practical ART forecasting model and result prediction. Research is still being done to identify useful noninvasive markers that will boost ART treatment effectiveness and implantation rates. By automatically classifying sperm, embryos, and oocytes, an AI component combined Using image analysis would improve recognition efficiency, lower errors, and achieve a minimal manual classification effort. The primary constraints of existing research, however, stem from the volume and calibre of data, which have a substantial impact on the trained model's functionality, relevance, and generalisability. The majority of research the models' data are retrospective, single-source, and sparsely distributed. Large-scale randomised controlled experiments to evaluate the algorithms' external validity are still lacking make the most use of the few resources available for study. Additionally, the majority of studies only applies classification and prediction algorithms without integrating the data analysed. AI is currently only being used in a small number of largely semi-automatic uses in the field of reproductive medicine. Further investigation is required into automated AI-assisted reproduction, remote medical expert systems, and personalised diagnosis and treatment. With special attention to its uses In the field of reproductive medicine, our goal is to provide a succinct overview of the fundamentals of AI techniques. Regarding reproductive medicine, this assessment addressed the opportunities and future directions while identifying potential constraints and difficulties.

Why Is AI Necessary In Reproductive Medicine?

Since the first in vitro experiment forty years ago, fertilisation (IVF) baby was born, the rate of clinical pregnancy has significantly

increased due to the quick development of ART, including cryopreservation of eggs and fertilised eggs, with assistance fertilisation, preimplantation tools for embryo selection and genetic testing, even though many issues still exist (Niederberger et al. 2018). The most important element for IVF success is the calibre of the embryos, yet there are currently insufficient techniques for precisely assessing The level of the sperm, eggs, and embryos. There are currently no known embryo selection techniques that rely on One setting or algorithm. As a result, it is challenging to forecast each person's likelihood of having a healthy pregnancy.

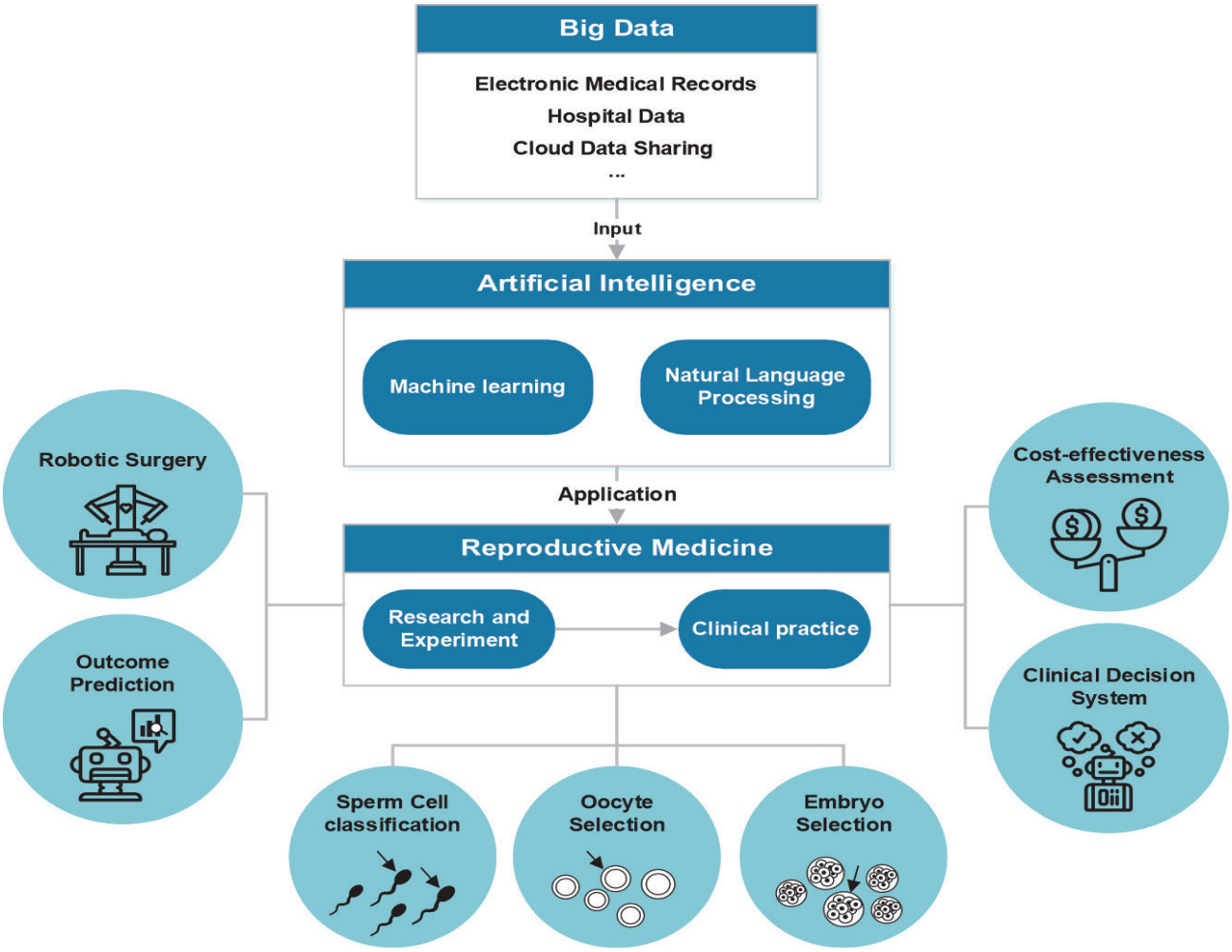


Figure 1: Artificial intelligence's function in reproductive medicine is depicted. Data such as electronic medical records (EMRs) are examples of big data. EMRs have the ability to collect data in a range of ways, and AI tools like Natural language processing (NLP) and machine learning are used to analyse the data. AI has been utilized to many facets of reproduction, ranging from clinical practice to research and experimentation. The seven primary uses AI's applications in reproductive medicine are reviewed in this diagram

AI based reproductive medicine techniques could provide answers to today's problems. The desire to use the vast amounts of information supplied by sophisticated Methods of diagnosis and treatment to enhance the care and outcome for individuals with infertility is the main motivator behind the creation of these applications. AI can improve clinical operations' efficacy and efficiency, which will maximise the ART treatment cycle.

A Review of Artificial Intelligence in Reproductive Medicine?

Currently, robotic surgery,processing of natural language (NLP), and machine learning (ML) are the three main types of AI techniques that are frequently applied in medical applications. By examining structured data, including genetic and medical imaging data, the machine learning approach seeks to cluster patient traits and forecast disease

outcomes (Darcy *et al.* 2016). To supplement the structured data, the NLP approach gathers and analyses valuable data from unstructured clinical sources, including electronic medical records (EMRs) (Mehta & Devarakonda 2018; Nadkarni *et al.* 2011). Raw data is transformed into structured data by NLP so that machines can read it and use machine learning techniques to analyse it. To enhance comprehension, the flowchart in Figure 2 illustrates the AI procedure in reproductive medicine.

Fundamental Understanding of Learning from Machines?

Learning from Machines is a branch of AI that allows computer programs to simulate the connection between a collection of variables (information output) with a collection of input data, or tangibles. Computers can automatically identify patterns in vast, intricate datasets thanks to the mathematical model, which then use these patterns to generate predictions. In contrast to conventional statistics, machine learning goes beyond simply estimating and rating disease conditions to help doctors make decisions by developing best solutions for infertility and forecasting pregnancy outcomes.

Machine learning algorithms usually need vast quantities of superior training data in order to produce a more precise mode to begin employing machine learning, samples must be gathered and stored in a format that is useful for computation (Bastanlar & Ozuysal-2014).

The results of the final output are not compelling if there is inadequate input data. According to Kaufman N *et al.* (1997) and Venkat *et al.* (2004), machine learning models had respective accuracy rates of 59 and 68%, in predicting the result of IVF. Despite the two studies' outstanding methodology, the results might have been hampered by subpar datasets that lacked reliable predictors, like data on embryo implantation. The intelligent use of data presents a challenge as well as an opportunity in the big data era; Clinical professionals will find machine learning to be an essential tool.

According to Jordan and Mitchell (2015), there are three categories of machine learning techniques: reinforcement learning, learning without supervision, and supervised learning. Nowadays, practically every use of AI in reproductive medicine make extensive use of supervised learning. This approach creates models that can forecast a known outcome using labelled training data. In clinical practice, a feature-rich dataset and labels is necessary.

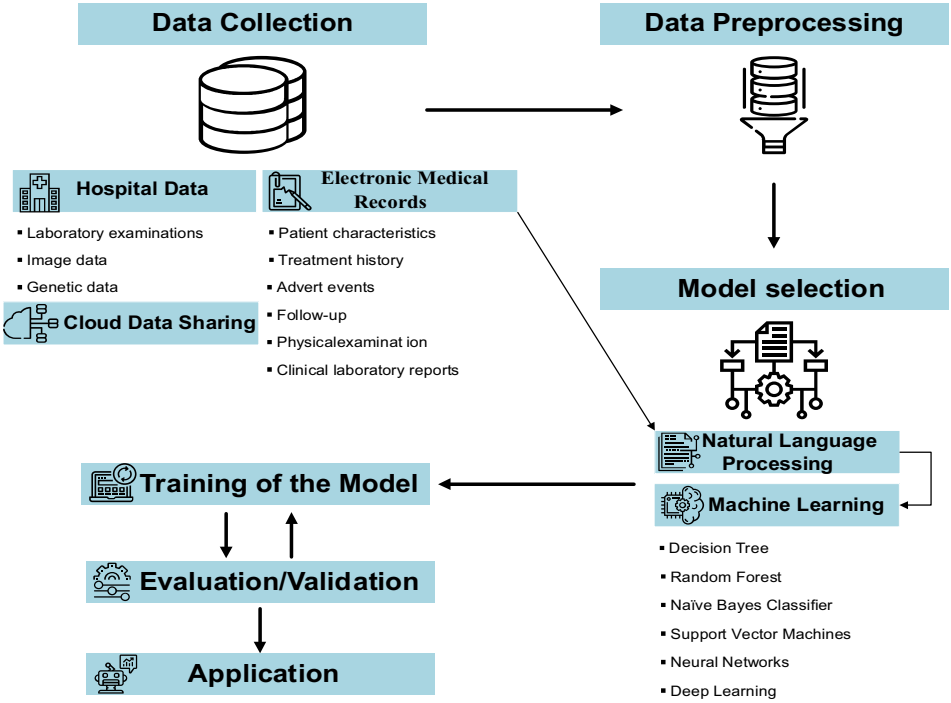
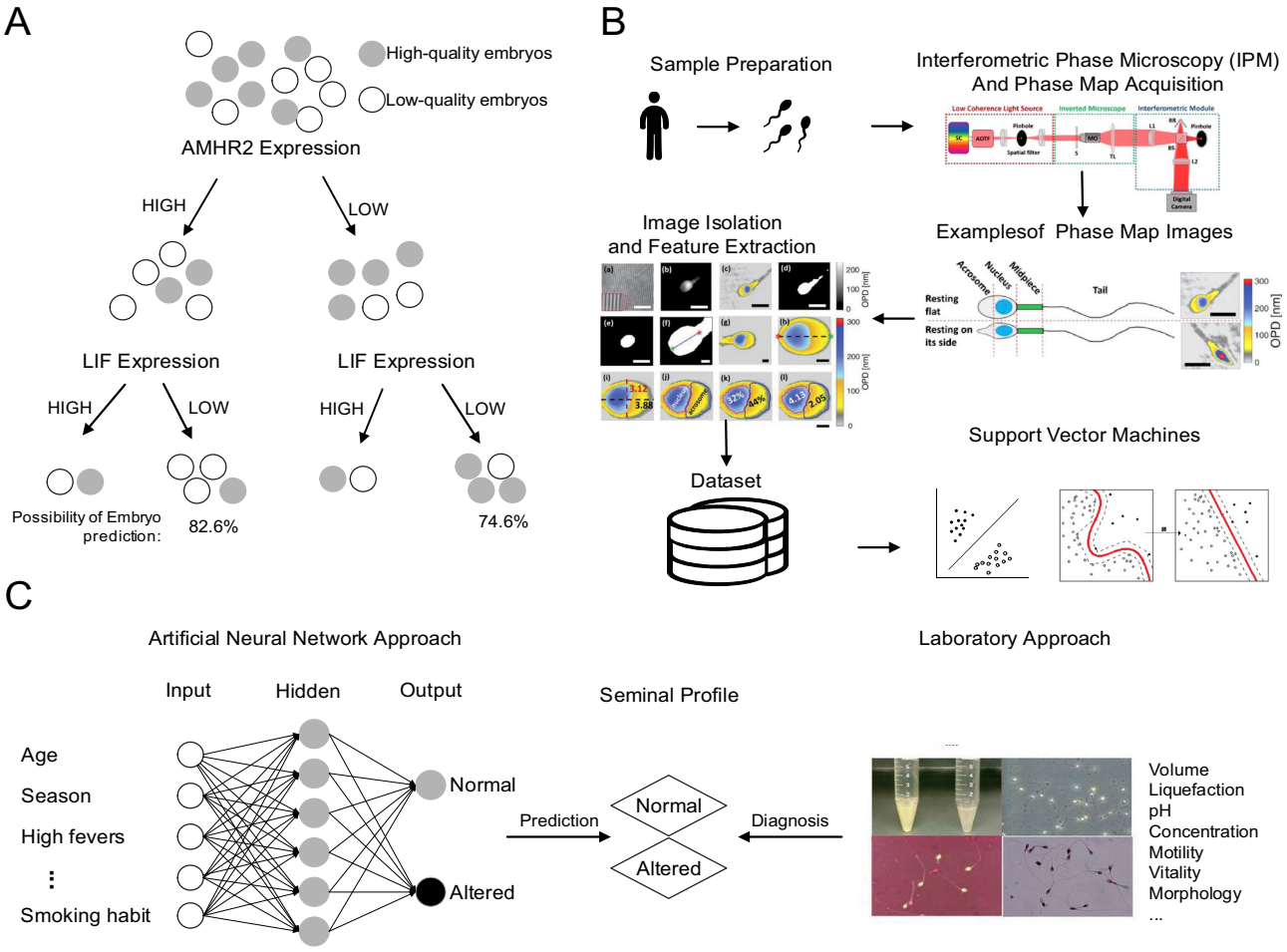


Figure 2: Artificial Intelligence Workflow in Reproductive Medicine. An An outline of the AI process is given by this flowchart. The gathering of data is the initial stage. Hospital data and electronic medical records (EMRs), and cloud data exchange are all included in the data. Data pre-processing is the second phase. Making the right model choice is the third stage. Artificial intelligence techniques like processing of natural language (NLP) and machine learning are used to analyse the data. After that, the model is trained using the training dataset. The model's validation and assessment are the last phases.



ARTIFICIAL INTELLIGENCE INNOVATIONS & APPLICATIONS

Artificial Intelligence incorporation into ART has been nothing short of transformative, creating a plethora of new clinical medical opportunities. AI-powered technologies have revolutionist many facets of ART, especially in the area of IVF, from patient consultation to embryo transfer. AI has the ability to completely transform IVF stimulation cycles in ways we could hardly have predicted before, and cutting-edge research is now revealing its full potential. This section explores the many fascinating uses of artificial intelligence.

Can Artificial Intelligence be Intelligent and Ethical?

As with any significant scientific discovery, biases and ethical issues must be carefully examined before broad use, especially if the technology directly affects healthcare and individual health outcomes (Table 2). AI, which is frequently hailed as an impartial instrument for making decisions, is not immune to moral dilemmas. Because creating an AI system involves a lot of data, issues with data ownership, privacy, and health insurance compliance arise.

The Future of Artificial Intelligence-Based Systems

Artificial intelligence (AI) can be a practical instrument for a range of indications in the fertility sector thanks to its constantly increasing applications and steadily improved performance accuracy. AI can help healthcare providers make more data-driven, objective, and efficient decisions that can enhance patient care, starting with predictive analytics and stimulation tools. AI could act as a safety net to assist non-fellowship trained doctors that interact with ART patients. Once retrieved, AI

SUMMARY

In conclusion, Artificial intelligenc (ML) and Artificial Intelligence (AI) have the power to transform the field of reproductive medicine, providing doctors with powerful tools to enhance patient care, improve outcomes, and increase the standard of care. As this

technology continues to evolve, it is essential that we remain vigilant in ensuring that it is well-validated and used ethically. The potential applications of AI and ML in reproductive medicine are incredibly intriguing, even if there is still much to learn about them.

CONCLUSION

Due in part to the widespread success of contemporary machine learning methods like deep learning, the accessibility of big datasets, and advancements in computing power, interest in artificial intelligence (AI) research has increased significantly in recent years. There is a growing number of tasks where algorithms have equalled or outperformed physicians, demonstrating AI's rising applicability in the healthcare industry. Even with the achievements, there are still a lot of issues and problems with algorithm opacity, trust, and patient data security. In spite of these obstacles, emergency medicine will probably use AI technology more and more in the years to come. An overview of recent AI research pertinent to emergency care is provided by this viewpoint.

Clinics Care Points

Leveraging AI for Reproductive Medicine: AI presents opportunities to enhance reproductive therapeutics through more precise follicular measurement and better oocyte and embryo grading.

Individualized Patient Care: AI can aid clinicians in providing individualized care, benefiting both clinicians and patients in achieving the best possible outcomes.

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