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Automation and Technical Advancement in IVF



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OMG!
Synthetic Embryo

Dr Durga G Rao,
Co-founder & Medical Director, Oasis Fertility



The image is a composite of three panels illustrating the IVF process:

- Panel 22:** A close-up of red blood cells, representing the initial health check and blood work.
- Panel 29:** A timeline titled "IVF Journey & Innovations" showing the progression from diagnosis to pregnancy. Key stages include:
 - Diagnosis:** Blood work, ultrasound, and hormone tests.
 - Injections:** Hormone therapy to stimulate egg production.
 - Ovum Pick Up:** Retrieval of eggs from the ovaries.
 - ICSI:** Intracytoplasmic sperm injection, where a single sperm is injected into an egg.
 - IVF Lab QA/QC:** Quality assurance and control in the laboratory.
 - Embryo Transfer:** Implanting the embryo into the uterus.
- Panel 32:** A microscopic view of an egg and sperm, representing the fertilization process.

Funding IVF treatment



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Automation and Technical Advancement in IVF





The IVF industry has been constantly innovating, discovering, and revolutionizing in order to improve patient outcomes, develop safer treatment procedures and reduce the time and cost of the treatment. IVF is a multi-step process that requires highly skilled professionals. The dearth of experienced embryologists and fertility specialists is the reason behind the inaccessibility and high cost of IVF. Automation and Artificial Intelligence (AI) can help in improving efficiency and also reduce the time taken in case of important decision-making.

AI and technical advancements cannot replace human interventions or expertise but can improve the overall process flow through quick prediction, data analysis, etc. But these are sure to change the way IVF is done today. There are a lot of challenges that need to be overcome before AI and automation get integrated into IVF.

Why AI in IVF?

AI is going to become an integral part of the IVF process due to several reasons:

- Accuracy: AI can analyse, and compare huge amounts of data which is humanely not possible. This can help in improving the accuracy of the prediction of the outcome of fertility treatments.
- Improved decision making: AI can help embryologists in making decisions faster and better.
- Improved success rates: AI can determine if the endometrium is receptive enough to receive an embryo or not thereby improving the chances of implantation rate.

How will automation and AI impact IVF?

The Big Data

Data is king in this digital era. Machine Learning can help in identifying the markers for infertility in a couple. i.e. predisposition of a couple to have infertility issues can be found out. The Automated Electronic Witnessing System can prevent sample mismatch and also reduce the time of the IVF, eliminate the chances of manual error, and enhance the efficiency of the whole process.

AI-integrated PGT A (Preimplantation Genetic Testing for Aneuploidy)

PGT A is used to select embryos that are devoid of chromosomal abnormalities in an IVF process and this process can be improved by using an AI algorithm. Embryo ploidy can be selected through image-based AI tools that can also predict the success rates of embryos thereby improving the sensitivity and accuracy of PGT A. AI models can open the doors for a non-invasive embryo selection process.

CAPA (Capacitation) IVM

Many women quit IVF due to several reasons like too many hormonal injections, long duration of treatment, side effects, and high cost. CAPA IVM is the latest addition to infertility treatment practices like IUI, IVF, etc. Very few injections are used in CAPA IVM and this is a much safer treatment option especially for women with PCOS, resistant ovary syndrome, oocyte maturation problems, patients with malignancy and thrombophilia. This advanced procedure is also cost-effective.

AI-based Personalised IVF treatment

AI algorithms can be trained to predict personalised medicine doses for patients based on their medical history, age, etc. and find out if they may develop OHSS

(Ovarian Hyperstimulation Syndrome) or other complications during the course of the treatment.

Personalised Embryo transfer through AI-powered ERA

Endometrial Receptivity Analysis (ERA) analyses the endometrial gene expressions to personalise embryo transfer. A particular time for embryo transfer is decided based on the receptivity of the endometrium. Integration of AI with ERA can be used to improve the success rates of transfer.

Microfluidics

The selection of high-quality sperm is highly crucial for the success of IVF treatment. Microfluidics technology (sperm sorting chip) mimics the female reproductive system and enables the selection of the best quality sperms.

AI-aided Oocyte Retrieval

Using AI algorithms to differentiate and identify follicles that are empty and that contain follicles can help in





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reducing the time taken for oocyte retrieval and improve accuracy as well. This technology has to be validated through clinical trials before being put into practice.

Robotic ICSI

The next major leap in ICSI is the use of a robotic arm for the injection of sperm into the egg. This novel approach can take a lot of time before it becomes a reality due to various limitations. But

the use of AI algorithms in ICSI may improve the outcomes.

Key considerations

- Regulatory laws should be in place to validate and monitor AI models before it is put to clinical use.
- Fertility experts and embryologists should have the final say and not the AI.
- AI models should adhere to ethical guidelines.



We have seen many innovations since the first IVF baby was born. Scientific and technological advancements have helped us transform the fertility sphere in many ways. Though AI has the potential to revolutionize the IVF industry it will never be a replacement for skilled embryologists and fertility specialists and IVF cannot be entirely AI driven as manual interventions in the form of crucial decisions are a must. AI and big data can help in predictive analysis and reduce the time and effort of experts in many areas.

Personalized treatment is the need of the hour for which AI tools and Machine Learning can play a vital role. AI can help us in deciding the right dose of hormones or medications for the patient and also know how the patient may respond to the treatment which can help us in preventing any complications and providing a much safer treatment experience.

Embryo grading is a crucial aspect of IVF and AI tools can help us to select good-quality embryos which is being done by highly skilled and experienced embryologists now.

We have been using EWS (Electronic Witnessing System) in our centres for many years. EWS uses RFID (Radio Frequency Identification) to identify, monitor and record each step in IVF to prevent any manual errors or sample mismatch.

I feel AI integration can reduce the cost of IVF treatment and make it accessible to all. IVF is a time taking process but with AI, many crucial decisions can be taken quickly thereby bringing down the time and effort. We have to wait and watch as AI and automation in the IVF process need to be studied well and validated before it becomes a reality as there are ethical concerns.

Dr Durga G Rao,

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