Clinics in Medicine

ISSN: 2688-6731

Research Article

Calculators of Predictive Results: Empowering Assisted Reproductive Technologies Programs

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Abstract

Global Assisted Reproductive Technology Market size was valued at USD 2101.5 million in 2021 and is poised to grow from USD 2507.09 million in 2022 to USD 12272.5 million by 2030, growing at a CAGR of 19.3% in the forecast period (2023-2030). (https://www.skyquestt.com/report/assisted-reproductive-technology-market#:~:text=Global%20Assisted%20Reproductive%20Technology%20Market%20Insights,period%20(2023%2D2030).

The present review was undertaken to analyze the predictors' result calculator validated and their values in the present demand to solve infertility problems. After analysis of more than 64 papers on this issue 22 predictor calculators were selected and presented.

The possibility to use calculators for results of personalized couples' cases are important in presence of high pressure of promotion of new big entrepreneurs and funds that recently acquired large number of medical centers for ART to reduce the management costs, improve the incomes and to sale the group after 5 to 10 years with more satisfying multipliers and bigger profit. The promotion is often contaminated from promise impossible to perform to a population with emotional fragility. These calculators are transparent methodology to estimate results of personal medical choices on treatments and centers where to treat infertility. The full transparency should be based on both the present couples profilation data and medical centers performances data to furnish to the couples' perspectives not constricted from other than the primary interest of the couples.

Disaggregate data from a single medical center are delivered rarely and the control authority is not fully allowed in everywhere to certify the concordance between declared and true results of treatments. Thus, not protecting the primary interest of couples.

Keywords: Calculators; Mathematical model; Algorithms predictive LBR with ART procedures; Assisted reproductive technologies; Reproductive science; *In vitro* fertilization and embryo transfer; Implantation rate; Implantation failure; Recurrent implantation failure

The registry consulted were the following

Austria: http://www.ivf-gesellschaft.at/index.php?id=100

Belgium: https://www.belrap.be/Public/Default.aspx?Lg=En

Czech Republic: https://www.uzis.cz/index.php?pg=registry-sber-dat--narodni-zdravotni-registry--narodni-registr-reprodukcniho-zdravi--modul-asistovane-reprodukce

Denmark: https://sundhedsdatastyrelsen.dk/da/registre-og-services/om-de-nationale-sundhedsregistre/graviditet-foedsler-og-boern/ivf-registeret

Portugal: https://www.cnpma.org.pt/

Sweden: https://www.medscinet.com/qivf/

UK. https://www.hfea.gov.uk/

France: https://www.agence-biomedecine.fr/Assistance-medicale-a-la-procreation-46?lang=fr https://www.procreation-medicale.fr/

Germany: https://www.deutsches-ivf-register.de/ivf-international.php

USA: https://www.sart.org/

Australia and New Zeland: https://www.fertilitysociety.com.au/anzard/

South America: https://redlara.com/

Citation: Bulletti FM, Berrettini M, De Luca R, Sciorio R, Palagiano A, Guido M, et al. Calculators of Predictive Results: Empowering Assisted Reproductive Technologies Programs. Clin Med. 2023; 5(2): 1057.

Publisher Name: Medtext Publications LLC

Manuscript compiled: Nov 02nd, 2023

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Introduction

Assisted Reproductive Technologies (ART) have revolutionized the field of reproductive medicine, offering hope and possibilities to individuals and couples struggling with infertility. As these technologies continue to advance, predictive calculators have emerged as valuable tools to estimate the success rates and outcomes of various ART procedures. By leveraging data from extensive research and patient databases, these calculators provide evidence-based predictions to aid healthcare professionals and patients in making informed decisions. One of the major advantages of calculators based on important databases is preventing the spread of misleading advertising, which leads some doctors/centers to promise results that are impossible to obtain to attract couples and earnings. Profiting on the emotional fragility of couples this article's aim

i. to explore the significance of the results obtained through the use of calculators in ART programs and

ii. analyze their predictive capability and

iii. highlights some notable examples, supported by references to credible sources

Materials and Methods

Review Questions for the literature search on Pub Med, Cochrane, ESHRE, ASRM, RCOG, ACOG, National registries, and websites were:

1. Algorithms are predicting the whole or the single step of the entire *In vitro* fertilization and embryo transfer program?

2. It is possible to build up an algorithm calculator of IVF estimation results for a couple after their own and medical center profiling (from registers where data are expressed disaggregate)

a. Inclusion criteria and exclusion criteria

i. Inclusion all the articles validated as promoting advantages in the valid prediction of results as divided for

1. Comparative results analysis

i. With lab parameters considered

ii. With lab and clinical parameters considered

iii. With Lab, Clinical, and medical center profiling considered

2. Noncomparative power predictive value

i. With lab parameters considered

ii. With lab and clinical parameters considered

iii. With Lab, Clinical, and medical center profiling considered

ii. Exclusion criteria All the articles are unvalidated to promoting advantages in the valid prediction of results the article

Results

After the first research, we found 64 papers, which became 41after the first search excluding the unvalidated power of prediction we divided the papers in

41 papers reporting comparative model of analysis

22 papers reporting calculated noncomparative prediction models

The most affordable calculators found were 22 as is evident from results published.

Tab Calculators are divided for the comparative exhibition of their predictive capability and noncomparative calculation of their predictive power. We classified the tools already published by the author reported for their predictive power (A, B, and C groups).

The importance of Predictive Calculators in Assisted Reproductive Technology (ART) Programs Predictive calculators in ART programs, serve to offer credible forecasts regarding the probability of success in fertility treatments. These calculators are grounded in extensive datasets drawn from a range of research avenues, such as clinical trials, observational studies, and registries. By synthesizing these data, these tools can provide individualized estimates based on distinct patient variables like age, BMI, ovarian reserve, reproductive history, and treatment plans. Consequently, these calculators enhance the decision-making process for both healthcare providers and patients, aiding in a collaborative approach to treatment [1,2].

Role of Predictive Models in Estimating IVF Success Rates *In Vitro* Fertilization (IVF) stands as one of the most frequently utilized procedures within Assisted Reproductive Technology (ART). To help patients and healthcare providers establish grounded expectations, predictive calculators are employed to gauge the likelihood of successful IVF cycles. Notably, the Society for Assisted Reproductive Technology (SART) provides a web-based predictor for IVF success, which takes into account variables such as age, underlying causes of infertility, and history of previous IVF cycles [3]. Another model, known as the Predicting Ongoing Pregnancy using an easily calculated (POP-UP) model, includes factors like maternal age, the number of embryos transferred, and prior live births to predict the probability of a live birth following IVF [4].

The Utility of Preimplantation Genetic Testing and Predictive Models in Enhancing IVF Success Rates Preimplantation Genetic Testing (PGT) serves as a crucial tool in selecting embryos devoid of specific genetic issues before they are implanted thereby are increasing the probability of a successful pregnancy. In this context, predictive calculators have been formulated to offer estimates on the chances of having a euploid (chromosomally normal) embryo ready for transfer. One such tool is the PGT-A Success Calculator, pioneered by the Reproductive Medicine Associates of New Jersey. This calculator integrates variables such as maternal age, the count of tested embryos, and a history of prior IVF failures to assess the probability of acquiring euploid embryos for implantation [5].

Predictive Tools for Assessing Ovarian Stimulation in ART Protocols Fine-tuning ovarian stimulation protocols is key to the successful outcome of Assisted Reproductive Technology (ART) procedures. Various predictive calculators have been designed to forecast an individual's response to ovarian stimulation. These tools assist healthcare providers in setting the right medication dosage for optimal results. For example, the Ovarian Reserve Calculator, created by the Center for Human Reproduction, factors in variables like age, antral follicle count, and Anti-Müllerian Hormone (AMH) levels to provide estimates on the number of oocytes that may be collected during an IVF cycle [6].

Ethical Dimensions and Constraints of Predictive Calculators in ART Outcomes Predictive calculators in Assisted Reproductive Technology (ART) serve as indispensable tools for estimating treatment success, yet it's crucial to recognize both their ethical

implications and limitations. Such models typically rely on data aggregated from large populations, which may not necessarily reflect the idiosyncrasies of an individual case. Therefore, these calculators should function as supplementary decision-making aids rather than as absolute prognosticators. The nuanced interpretation of these tools' outputs remains a task best undertaken through personalized consultations with qualified fertility experts [7].

Incorporation of Embryonic Factors in Predictive Calculators for ART Success Embryonic characteristics is integral to the efficacy of Assisted Reproductive Technology (ART) methods, especially in the contexts of *in vitro* Fertilization (IVF) and embryo transfer. Predictive calculators designed to encompass embryonic variables offer invaluable perspectives on an embryo's developmental potential, aiding in the selection of the most promising candidate for implantation. Such calculators consider a range of parameters, including embryo morphology, established grading systems, the blastocyst stage, and results from genetic evaluations like preimplantation genetic testing for aneuploidies or specific gene disorders. Through the integration of these factors, predictive calculators are capable of approximating the odds of successful embryo implantation and subsequent pregnancy [8].

The Role of Clinical Factors in Enhancing the Accuracy of Predictive Calculators for ART Clinical attributes pertaining to both partners in the couple undergoing Assisted Reproductive Technology (ART) procedures are paramount in shaping treatment outcomes. These parameters encompass a diverse array of factors affecting fertility and the effectiveness of ART. For women, these can include age, markers of ovarian reserve like anti-Müllerian hormone levels or antral follicle counts, reproductive history, and any medical conditions that could impact fertility. For men, clinical factors may include variables like sperm count, motility, and morphology, as well as genetic test results related to male infertility. The incorporation of these clinical parameters into predictive calculators allows for a holistic evaluation of a couple's fertility prospects, thereby aiding in the formulation of individualized treatment approaches [9].

Holistic Couple Assessment Tools in Assisted Reproductive Technology (ART) Holistic couple assessment calculators in the realm of ART strive to amalgamate both embryonic and clinical variables for generating individualized outcome predictions. These advanced calculators adopt a comprehensive strategy to evaluate the overall likelihood of achieving success through ART interventions. Key elements such as a woman's age, indicators of ovarian reserve, and characteristics of male semen, embryo viability, and outcomes from genetic screening are taken into account. By synthesizing this multifaceted data, the calculators furnish estimates that gauge the odds of not only a successful pregnancy but also the prospects for a live birth [10].

Pros and Cons of Using Predictive Calculators in Couple Profiling for ART Predictive calculators that integrate both embryonic and clinical factors offer multiple benefits in the context of couple profiling within Assisted Reproductive Technology (ART). For healthcare providers, these tools facilitate the tailoring of treatment protocols to suit the specific needs and conditions of individual couples, thereby enhancing the likelihood of successful outcomes. These calculators also serve to empower patients by equipping them with realistic projections, aiding them in making well-informed choices about their fertility treatment options. Nonetheless, the limitations of these predictive calculators should not be overlooked. These tools generally rely on statistical models developed from population-wide datasets, which may not fully account for the unique variations observed in individual cases [11].

Tailored Treatment Strategies in ART through Comprehensive Profiling of Couples and Medical Centers Merging couple profiling with medical center assessments allows healthcare practitioners to gain an all-encompassing view of both the patients and the healthcare setting involved. Such a comprehensive approach enables the customization of treatment plans to fit the unique requirements and conditions of the couple. This includes considering their medical background, genetic predispositions, lifestyle habits, and individual preferences. Studies have indicated that such personalized treatment regimens result in enhanced patient outcomes and elevated treatment efficacy [4].

Improved Risk Evaluation through Comprehensive Profiling of Couples and Healthcare Facilities Couple profiling offers a multifaceted approach to health risk assessment by taking into account both personal and joint factors affecting the couple. This includes scrutinizing genetic vulnerabilities, family medical histories, and lifestyle decisions. Such a comprehensive analysis aids healthcare professionals in pinpointing potential risks and formulating proactive prevention strategies. Concurrently, medical center profiling serves to gauge the quality and competency of the healthcare facility, considering aspects like infrastructure, staff credentials, and historical patient outcomes. The amalgamation of these two types of profiling augments the precision of risk assessments, thereby enabling timely interventions or suitable specialist referrals [12].

Holistic Health Surveillance through Integrated Couple and Medical Center Profiling The nclusion of couple profiling with medical center evaluations provides a robust framework for all-encompassing health monitoring. This dual-pronged approach allows for the continual tracking of individual health metrics within the specific context of the healthcare facility involved. Such a unified method is advantageous for the early identification of health irregularities and prompt medical interventions. For instance, if a health concern arises in one partner, the data from the couple profiling could trigger a heightened level of monitoring for the other partner for potentially correlated health conditions [13].

Enhanced Predictive Analytics through Integrated Profiling Approaches Utilizing data gathered from both couple and medical center profiling, predictive analytics can be honed to offer more accurate forecasts of health outcomes. These models are capable of incorporating a wide range of variables, from genetic susceptibilities and lifestyle decisions to medical histories, planned treatments, and the capabilities of the healthcare institution. With the application of machine learning algorithms, these advanced predictive analytics can yield insights into the course of disease progression, responsiveness to treatments, and possible complications. Such data-driven insights empower healthcare providers to make better-informed decisions, thereby elevating the standard of patient care [14].

Strategic Long-Term Healthcare Planning Through Integrated Profiling The amalgamation of couple profiling with medical center evaluations serves as a valuable asset for long-term healthcare planning and sustained support. This combined approach enables healthcare practitioners to foresee potential future health hazards, devise preventative actions, and tailor intervention plans. Furthermore, it fosters an environment of continuous dialogue and teamwork among

healthcare providers, the couples involved, and the medical facility. This cohesive approach ensures enduring support and proactive management of the couple's healthcare needs [15].

Discussion

Reproductive Technology: A Comprehensive Overview Predictive calculators have become indispensable instruments in Assisted Reproductive Technology (ART) programs, offering invaluable foresight to both healthcare professionals and patients. These calculators harness patient-specific traits and rely on an extensive pool of research data to furnish evidence-backed projections regarding the likelihood of success and other outcomes in various ART interventions [16]. Calculators that amalgamate both embryonic and clinical aspects in couple profiling stand out as particularly useful tools in the ART landscape [17-20]. These calculators integrate an array of elements, including embryo viability, clinical metrics, and results of genetic testing, to formulate tailored predictions that inform treatment plans. While these tools are not without limitations, their utility is significantly amplified when coupled with specialized medical consultation [21-24]. They endow couples with actionable insights, aiding them in making informed choices on their fertility treatment journey. As the realms of technology and research progress, the significance of these calculators in enhancing ART outcomes for couples globally is poised to escalate [25].

Conclusion

The integration of couple and medical center profiling provides a multifaceted advantage in the field of predictive healthcare [26-30]. This approach supports personalized treatment schemes, improved risk evaluations, holistic health tracking, refined predictive analytics, and strategic long-term care [31-35]. By capitalizing on these composite profiles, healthcare practitioners are better positioned to administer targeted and effective care, thereby promoting optimal health outcomes for couples [36].

The Importance of Valid Predictive Response in ART: Ethical and Professional Considerations The credibility of predictive responses regarding treatment outcomes is paramount, especially when counseling couples considering Assisted Reproductive Technology (ART). This is particularly important in light of the current landscape where some healthcare providers or websites engage in misleading advertising, capitalizing on the emotional vulnerability of couples [37,38]. The ART industry, with annual expenditures of around 22 billion euros, has seen an explosion in the number of treatment centers and the entry of large financial groups, turning infertility treatment into a competitive, profit-driven field. Predictive calculators, grounded in both couple and treatment center profiling, offer a much-needed layer of defense against deceptive practices [39]. These calculators can provide anonymized evaluations of treatment outcomes based on the specific demographics of the couples, which is invaluable for couples seeking trustworthy information and for healthcare providers committed to maintaining a high level of ethical and professional integrity [40-42]. It's worth noting that the focus should not solely be on treatment success rates in evaluating the quality of a center. As outlined by the Health and Fertility Ethics Association (HF&EA), a high-quality clinic is characterized not just by effective treatments but also by compassionate staff, transparent pricing, efficient administrative processes, and excellent emotional support.

Therefore, it's critical that predictive calculators, along with transparent and ethical practices, become standard tools for evaluating ART treatment centers, aiding couples in making well-informed decisions, and contributing to the overall integrity of the ART industry [43,44].

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Table

Calculators Predicting Individualized Results			
A comparison of 12 machine learning models developed to predict ploidy, using a morphokinetic meta-dataset of 8147 embryos. Bamford T et al.	STUDY QUESTION: Are machine learning methods superior to traditional statistics in predicting blastocyst ploidy status using morphokinetic and clinical biodata?	Summary answer: Mixed effects logistic regression performed better than all machine learning methods for ploidy prediction using our dataset of 8147 embryos.	https://pubmed.ncbi.nlm.nih.gov/36825452/
Predicting personalized cumulative live birth following in vitro fertilization. McLernon et al.	Develop *in vitro* fertilization (IVF) prediction models to estimate the individualized chance of cumulative live birth at two time points: pretreatment (i.e., before starting the first complete cycle of IVF) and posttreatment (i.e., before starting the second complete cycle of IVF in those couples whose first complete cycle was unsuccessful).	Pretreatment predictors included woman's age (35 years vs. 25 years, adjusted odds ratio 0.69, 95% confidence interval 0.66-0.73) and body mass index (35 kg/m^2 *vs.* 25 kg/m^2, adjusted odds ratio 0.75, 95% confidence interval 0.72-0.78). The posttreatment model additionally included the number of eggs from the first complete cycle (15 *vs.* 9 eggs, adjusted odds ratio 1.10, 95% confidence interval 1.03-1.18). The C-statistic for all models was between 0.71 and 0.73.	https://pubmed.ncbi.nlm.nih.gov/34674824/
Development and evaluation of a live birth prediction model for evaluating human blastocysts from a retrospective study. Liu H et al.	Most existing AI models for blastocyst evaluation only used images for live birth prediction, and the area under the Receiver Operating Characteristic (ROC) curve (AUC) achieved by these models has plateaued at ~0.65	The results suggest that the inclusion of patient couple's clinical features along with blastocyst images increases live birth prediction accuracy.	https://pubmed.ncbi.nlm.nih.gov/36810139/
Development and validation of a live birth prediction model for expected poor ovarian response patients during IVF/ICSI. Gong X et al.	The aim of this study was to develop a nomogram based on POSEIDON criteria to predict live birth in patients with expected POR.	We have developed a nomogram combining clinical and laboratory factors to predict the probability of live birth in patients with an expected POR during IVF/ICSI, which can helpful for clinician in decision-making. However, the data comes from the same center, needs a prospective multicenter study for further in-depth evaluation and validation of this prediction model.	https://pubmed.ncbi.nlm.nih.gov/36798666/
Artificial intelligence model to predict pregnancy and multiple pregnancy risk following *in vitro* fertilization-embryo transfer (IVF-ET).	o decrease multiple pregnancy risk and sustain optimal pregnancy chance by choosing suitable number of embryos during transfer, this study aims to construct artificial intelligence models to predict the pregnancy outcome and multiple pregnancy risk after IVF-ET	The AI models provide reliable outcome prediction and could be a promising method to decrease multiple pregnancy risk after IVF-ET. Wen JY et al. A.	https://pubmed.ncbi.nlm.nih.gov/36088053/
Nomogram for the cumulative live birth in women undergoing the first IVF cycle: Base on 26, 689 patients in China.	The aim of this study was to develop and validate a nomogram for the CLB in women undergoing the first IVF cycle.	We developed and validated a nomogram to predict CLB in women undergoing the first IVF cycle using a single center database in China. The validated nomogram to predict CLB could be a potential tool for IVF counselling.	https://pubmed.ncbi.nlm.nih.gov/36093101/
Development of a Model Predicting the Outcome of In Vitro Fertilization Cycles by a Robust Decision Tree Method. Fu K et al.	Development of a Model Predicting the Outcome of In Vitro Fertilization Cycles by a Robust Decision Tree Method. Fu K et al.	This study constructed a model predicting the outcome of IVF cycles through a robust decision tree method and achieved satisfactory prediction performance. Important factors related to IVF outcome and some interrelations among factors were found.	https://pubmed.ncbi.nlm.nih.gov/36093079/
Comparison of predictive models for cumulative live birth rate after treatment with ART. Bardet L et al.	Can a machine learning model better predict the cumulative live birth rate for a couple after intrauterine insemination or embryo transfer than Cox regression based on their personal characteristics?	Overall performances are still relatively modest, which is coherent with all reported ART predictive models. Explicability-based methods would allow access to new knowledge, to gain a greater comprehension of which characteristics and interactions really influence a couple's journey. These models can be used by practitioners and patients to make better informed decisions about performing ART.	https://pubmed.ncbi.nlm.nih.gov/35550345/
Predicting in vitro fertilization success in the Brazilian public health system: a machine learning approach. C N Barreto N et al.	The aim of this study was to apply ML models to determine variables related to pregnancy after IVF in a public health service, including pre-implantation variables.	The Random Forest algorithm achieved the best performance, with better accuracy, sensitivity and area under the ROC curve to predict the success of IVF evaluated by pregnancy frequency. We also trained a specific model only for women older than 35 years old. Variables in the Random Forest model related to pregnancy after *in vitro* fertilization.	https://pubmed.ncbi.nlm.nih.gov/35508786/

The Application of Artificial Intelligence in Predicting Embryo Transfer Outcome of Recurrent Implantation Failure. Shen L et al.	B.	Our research provided a new approach for targeted and personalized treatment of RIF patients to help them achieve efficient and reliable pregnancy. And an AI-assisted decision-making system will be designed to help clinicians and RIF patients develop personalized transfer strategies, which not only guarantees efficient and reliable pregnancy, but also avoids the risk of multiple pregnancy as much as possible.	https://pubmed.ncbi.nlm.nih.gov/35846016/ C.
Development and Validation of a Clinical Pregnancy Failure Prediction Model for Poor Ovarian Responders During IVF/ICSI. Li F et al.	This predictive model we developed aims to predict the individual probability of clinical pregnancy failure for Poor Ovarian Responders (PORs) under *in vitro* fertilization/Intracytoplasmic Sperm Injection (IVF/ICSI)	Our nomogram can predict the probability of clinical pregnancy failure in PORs before embryo transfer in IVF/ICSI procedure, to help practitioners make appropriate clinical decisions and to help infertile couples manage their expectations.	https://pubmed.ncbi.nlm.nih.gov/34497586/
Clinical implementation of algorithm-based embryo selection is associated with improved pregnancy outcomes in single vitrified warmed euploid embryo transfers. Friedenthal J et al.	To assess whether utilization of a mathematical ranking algorithm for assistance with embryo selection improves clinical outcomes compared with traditional embryo selection *via*. Morphologic grading in single vitrified warmed euploid embryo transfers (euploid SETs).	Clinical implementation of an automated mathematical algorithm for embryo ranking and selection is significantly associated with improved implantation and ongoing pregnancy/live birth as compared with traditional embryo selection in euploid SETs.	https://pubmed.ncbi.nlm.nih.gov/33932196/
Machine learning predicts live-birth occurrence before in-vitro fertilization treatment. Goyal A et al.	This work mainly focuses on making predictions of live-birth occurrence when an embryo forms from a couple and not a donor. Here, we compare various AI algorithms, including both classical Machine Learning, deep learning architecture, and an ensemble of algorithms on the publicly available dataset provided by Human Fertilisation and Embryology Authority (HFEA)	This study predicts a successful pregnancy through the clinically relevant parameters in *In-vitro* fertilization. Thus artificial intelligence plays a promising role in decision making process to support the diagnosis, prognosis, treatment etc.	https://pubmed.ncbi.nlm.nih.gov/33262383/
Artificial intelligence in in vitro fertilization: a computer decision support system for day-to-day management of ovarian stimulation during in vitro fertilization. Letterie G et al.	To describe a computer algorithm designed for in vitro fertilization (IVF) management and to assess the algorithm's accuracy in the day-to-day decision making during ovarian stimulation for IVF when compared to evidence-based decisions by the clinical team.	We describe a first iteration of a predictive analytic algorithm that is highly accurate and in agreement with evidence-based decisions by expert teams during ovarian stimulation during IVF. These tools offer a potential platform to optimize clinical decision-making during IVF.	https://pubmed.ncbi.nlm.nih.gov/33012555/
Machine learning algorithms to predict early pregnancy loss after in vitro fertilization-embryo transfer with fetal heart rate as a strong predictor. Liu L et al.	The objectives of this study were to construct a prediction model of embryonic development by using machine learning algorithms based on historical case data, in this way doctors can make more accurate suggestions on the number of patient follow-ups, and provide decision support for doctors who are relatively inexperienced in clinical practice.	In this study, we established and compared six classification models to accurately predict EPL after the appearance of embryonic cardiac activity undergoing IVF-ET. Finally, Random Forest model outperformed the others. The implementation of Random Forest model in clinical environment can assist doctors to make clinical decisions.	https://pubmed.ncbi.nlm.nih.gov/32623348/
Machine learning vs. classic statistics for the prediction of IVF outcomes. Barnett-Itzhaki Z et al.	To assess whether machine learning methods provide advantage over classic statistical modeling for the prediction of IVF outcomes.	Our findings suggest that machine learning algorithms based on age, BMI, and clinical data have an advantage over logistic regression for the prediction of IVF outcomes and therefore can assist fertility specialists' counselling and their patients in adjusting the appropriate treatment strategy.	https://pubmed.ncbi.nlm.nih.gov/32783138/
Computational prediction of implantation outcome after embryo transfer. Raef B et al.	The aim of this study is to develop a computational prediction model for implantation outcome after an embryo transfer cycle.	The proposed machine learning-based prediction model could predict embryo transfer outcome and implantation of embryos with high accuracy, before the start of an embryo transfer cycle.	https://pubmed.ncbi.nlm.nih.gov/31826687/

Personalized prediction of live birth prior to the first in vitro fertilization treatment: a machine learning method. Qiu J et al.	A prediction model to predict the live birth chance prior to the first IVF treatment is needed in clinical practice for patients counselling and shaping expectations.	A prediction model based on XGBoost was developed using age, AMH, BMI, duration of infertility, previous live birth, previous miscarriage, previous abortion and type of infertility as predictors. This study might be a promising step to provide personalized estimates of the cumulative live birth chance of the first complete IVF cycle before treatment.	https://pubmed.ncbi.nlm.nih.gov/31547822/
An artificial neural network for the prediction of assisted reproduction outcome. Vogiatzi P et al.	To construct and validate an efficient Artificial Neural Network (ANN) based on parameters with statistical correlation to live birth, to be used as a comprehensive tool for the prediction of the clinical outcome for patients undergoing ART.	The constructed ANN is based on statistically significant variables with the outcome of live birth and represents a stable and efficient system with increased performance indices. Validation of the system allowed an insight of its clinical value as a supportive tool in medical decisions, and overall provides a reliable approach in the routine practice of IVF units in a user-friendly environment.	https://pubmed.ncbi.nlm.nih.gov/31218565/
Predicting the cumulative chance of live birth over multiple complete cycles of in vitro fertilization: an external validation study. Leijdekkers JA et al.	Are the published pre-treatment and post-treatment McLernon models, predicting cumulative Live Birth Rates (LBR) over multiple complete IVF cycles, valid in a different context?	With minor recalibration of the pre-treatment model, both McLernon models accurately predict cumulative LBR in a different geographical context and a more recent time period	https://pubmed.ncbi.nlm.nih.gov/30085143/
Predictive Modeling of Implantation Outcome in an In Vitro Fertilization Setting: An Application of Machine Learning Methods. Uyar et al.	To predict implantation outcome of individual embryos in an IVF cycle with the aim of providing decision support on the number of embryos transferred. DESIGN: Retrospective cohort study.	A machine learning-based decision support system would be useful in improving the success rates of IVF treatment.	https://pubmed.ncbi.nlm.nih.gov/24842951/
Prediction of individual probabilities of livebirth and multiple birth events following In Vitro Fertilization (IVF): a new outcomes counselling tool for IVF providers and patients using HFEA metrics. Jones CA et al.	In this research, we describe a multivariate risk assessment model that incorporates metrics adapted from a national 7.5-year sampling of the Human Fertilisation & Embryology Authority (HFEA) dataset (1991-1998) to predict reproductive outcome (including estimation of multiple birth) after IVF.	http://www.formyodds.com is the first Software-as-a-Service (SaaS) application to predict IVF outcome.	https://pubmed.ncbi.nlm.nih.gov/21991292/
The application of neural networks in predicting the outcome of in-vitro fertilization. Kaufmann SJ et al.	In some instances, neural networks can identify a wider range of associations than other statistical techniques due in part to their ability to recognize highly non-linear associations. It was hoped that a neural network approach may be able to predict success for individual couples about to undergo In-Vitro Fertilization (IVF) treatment. A neural network was constructed using the variables of age, number of eggs recovered, number of embryos transferred and whether there was embryo freezing. Overall, the network managed to achieve an accuracy of 59%.		https://pubmed.ncbi.nlm.nih.gov/9262277/