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# RATIONALIZATION OF REPRODUCTION – PATH TOWARDS DEHUMANIZATION OF HUMANITY: POLITICAL, LEGAL, AND ETHICAL ASPECTS OF USING ARTIFICIAL INTELLIGENCE IN EMBRYO SELECTION

## Abstract

Artificial Intelligence is becoming an essential part of human life, and the creation of life is no exception. While using AI in biomedically assisted reproduction (BMAR) gives new hope to couples struggling with infertility, it also raises a difficult question: where are the ethical limits of letting a machine interfere with human conception? This paper argues that the growing "rationalization" of the reproductive process through AI selection is not just a technical upgrade, but a deeply political and complex issue. In this paper, we analyze the legal and ethical risks of this trend, specifically focusing on how the process of conception is becoming "dehumanized". A major concern is that we are relying too much on algorithms that nobody truly understands. This "black box" nature of AI can easily undermine the autonomy of parents and the validity of their informed consent in one of the most private moments of their lives. The philosophical danger of treating human embryos as mere objects for selection, which directly threatens their inherent dignity, is also examined. With the goal of pointing out gaps in our current laws, the paper looks closely at the regulations in the Republic of Serbia. We find that existing legal solutions are not fully prepared for these

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new challenges. Finally, we propose new regulatory steps that would put the dignity of the embryo first. Through a prism of ethics and a warning against the loss of human empathy, this paper concludes that an uncritical use of AI in reproduction carries a serious risk of turning the act of creating a human being into a cold, mechanical procedure.

**Keywords:** artificial intelligence (AI), embryo selection, dehumanization, dignity of embryos, legal and ethical challenges, Republic of Serbia

## INTRODUCTION

Artificial intelligence (AI) is becoming an unavoidable part of our everyday lives. It seems that no sphere of society is left untouched, including the most intimate one, the creation of life itself. This evolutionary step in human history brings AI into the field of biomedically assisted reproduction (BMAR), especially during the critical phase of embryo selection. This step has its pros and cons. On one hand, it promises higher success rates and gives hope to many couples struggling with infertility. On the other hand, it opens a series of complex legal, ethical, and deeply human questions that we cannot ignore.

There is an inherent conflict between AI's technical capacity to enhance clinical outcomes and the ethical complexities it introduces to human conception. With ART success rates stagnating at approximately 30% (a figure that declines sharply with maternal age), AI is often promoted as a definitive remedy. By promising objectivity in embryo selection, machine learning aims to eliminate the human variability and subjective bias that have always troubled the field (Salih *et al.* 2023, 2). Yet, algorithmic "optimization" raises troubling normative issues. Integrating AI into this process risks fostering an instrumental view of the embryo, reducing it to a data point for selection. Besides challenging the embryo's dignity, this shift fundamentally alters the nature of the reproductive process (Aufieri and Mastrocola 2024, 4). Moreover, the reliance on opaque "black box" models, algorithms that remain indecipherable even to their creators, undermines the very foundation of informed consent (Director 2025, 10). Ultimately, when an algorithm dictates the choice, it erodes parental autonomy in what is perhaps

the most intimate decision a human being can make. This challenge is particularly relevant within the domestic legal framework, where ensuring a patient's autonomous decision-making remains a complex ethical task. As Vukadinović Marković, Radomirović, and Stjepanović (2025) point out in their analysis of informed consent in Serbia, the ethical and sociological dimensions of patient agreement are often strained in emotionally charged and ethically complex medical settings. When the logic behind embryo selection remains hidden within a digital "black box", the consent process risks becoming a mere bureaucratic formality rather than a genuine exercise of parental autonomy. This surrender to technological authority not only compromises the dignity of the reproductive process but also alienates individuals from what is perhaps the most personal decision a human being can make.

The central argument of this paper is that the uncritical rationalization of reproduction through AI carries a profound risk of the dehumanization of the conception. The rise of AI in assisted reproduction is more than just a medical change. It reflects a broader social trend of trying to "fix" or optimize human life, turning deeply personal experiences into simple technical problems. While this pursuit promises efficiency, it threatens to collapse complex, value-laden moral dilemmas into cold, technical choices. In this frantic race for superior clinical outcomes, the embryo is subtly recast, no longer a unique entity with inherent dignity, but a "product" to be audited against algorithmic benchmarks. This form of "rationalization" extends far beyond clinical utility, representing a paradigm shift where human conception is no longer seen as a biological miracle, but as an engineering challenge to be optimized. Driven by a desire for the predictable, we are witnessing the transformation of a deeply intimate, natural act into a managed, industrial procedure. Consequently, this shift risks eroding our collective empathy for natural variation and human imperfection. This approach reduces the idea of "perfection" to whatever can be calculated by an algorithm. When algorithms routinely filter for the "optimal" embryo, they broadcast a silent, yet powerful, message that those falling short of these metrics are less worthy. Such a trajectory risks fostering a societal demand for "flawless" offspring, progressively narrowing our tolerance for human diversity. Selecting embryos based on algorithms is an ethical danger. The relentless pursuit of perfect control over birth could lead to a world that leaves no space for difference or the unpredictability of life.

In the Republic of Serbia, the legal framework for BMAR is still evolving, and the use of AI in medicine is only at the beginning. It is crucial to identify legal gaps and ethical challenges before these technologies become standard practice.[1] We must pay special attention to the transparency of algorithms and ensure that parents can give truly informed consent in this complex technological environment.

The aim of this paper is to critically assess whether the drive for "effective" reproduction leads to a loss of humanity. We will examine existing laws, the principles that protect human dignity from the very beginning, and the philosophical relationship between humans and technology. At the end, we will propose a regulatory and ethical framework that ensures the responsible and humane use of AI.

## THE TECHNICAL AND CLINICAL JUSTIFICATION FOR AI INTEGRATION IN ASSISTED REPRODUCTION

AI is fundamentally reshaping the specialized practice of embryo selection by introducing sophisticated machine learning architectures capable of synthesizing vast, multidimensional datasets. This technological integration goes beyond simple data processing, leveraging high-resolution imaging and time-lapse microscopy to capture the nuanced dynamics of embryonic development, cross-referencing these with complex patient clinical profiles. These systems are designed to identify the embryo with the highest statistical probability of a successful live birth. The driving force behind this rapid adoption is a perceived mandate for "objectivity". Before, embryo selection has been an interpretative art, tethered to the embryologist's expert gaze, a process inherently subject to human variability and cognitive bias. AI is now being positioned as a definitive corrective, promising to replace subjective clinical judgment with a standardized, data-driven methodology.

[1] As Vukadinović Marković and Kambovski (2026**)** emphasize, the application of AI in healthcare demands a rigorous re-evaluation of our existing legal frameworks to address the diagnostic potential and ethical challenges these systems introduce. Their analysis suggests that without a clear multidisciplinary approach, the benefits of AI could be overshadowed by the risks it poses to fundamental human rights.

The primary impasse in Assisted Reproductive Technology (ART) remains a success rate that has plateaued at approximately 30%. The main obstacle in clinical practice is that many embryos simply fail to implant, meaning a pregnancy is not established even after a successful transfer. Rising maternal age makes this issue even more urgent, as the probability of success drops significantly as women get older. In response to these limitations, the field is undergoing a transition toward AI-enhanced selection. Traditionally, embryologists have had to rely on their own visual judgment to pick the best embryo. But this method is limited by human fatigue and the inconsistencies that arise when different specialists look at the same sample.

Studies show that AI models are performing better than clinical teams in predicting both embryo quality and final outcomes. AI achieved a median accuracy of 75.5% in predicting embryo morphology, while embryologists reached 65.4%. The difference is even bigger in predicting actual pregnancy. When AI combines images with patient clinical data, its accuracy reaches 81.5%, compared to 51% for human experts. In some cases, the difference in accuracy between the machine and the human was 45%. This data creates a strong pressure to move away from human judgment toward algorithmic "certainty" (Salih *et al.* 2023, 5).

Specialists around the world are quickly adopting AI tools. In 2022, only about 24.8% of professionals used AI, but by 2025, that number is over 53%. While there was a huge initial wave of optimism about AI's potential for embryo selection (91.6% in 2022), the excitement has leveled off recently (38.6% in 2025) as the focus shifts to other benefits, like improving medical education and daily workflows (Shoham *et al.* 2025). Practical applications of AI, such as the ERICA algorithm and PGTai 2.0 platform, have shown significant potential in improving embryo selection, with some studies reporting pregnancy rates that notably exceed those of traditional morphological grading (Salih *et al.* 2023). Looking at these numbers, it is clear why there is such an urge to integrate AI into assisted reproduction. From a purely clinical and technical perspective, the goal is to optimize results for couples who are struggling. However, this clinical success is exactly what leads us to the deeper, more troubling questions about what we lose when we let an algorithm decide the future of a human life.

Despite the impressive numbers AI shows in laboratory settings, we must solve major scientific and ethical problems before we can responsibly use it in everyday clinical work. A major problem is the lack

of rigorous randomized controlled trials (RCTs). These trials are the only way to truly prove if AI should replace human involvement in selecting embryos. Currently, most of the knowledge comes from "retrospective studies" (looking at old data rather than from real, clinical evaluations) (Afnan *et al.* 2021). While AI might look very accurate on a computer screen, we still don't know how it works in the "real world" with a wide variety of patients. Adopting this technology too quickly, based only on laboratory success, is a dangerous path that could lead to poor clinical results and misinformed decisions. For AI to actually help people, there must be a fundamental shift in how developers and regulators define "success". Instead of just trying to predict if an embryo will implant, the focus must be on predicting a "live birth", a fact that only matters to future parents (Salih *et al.* 2023*,* 7). Unfortunately, many current AI models focus on indirect, less important metrics instead of actual live birth rates (Shoham 2025).

The "black box" nature of these algorithms also must be considered. If an AI is trained on data from only one clinic or one specific population, it might not work at all for a different group of people. Because these algorithms are so complex and opaque, it is almost impossible to see how they make their "decisions". Lack of transparency makes it very hard to find and fix biases. There is a real risk that AI could select or discard embryos based on irrelevant or even discriminatory factors (Afnan *et al.* 2021).

In 2025, the biggest obstacles to using AI were high costs (38.01%) and a lack of proper expertise (33.92%). However, the most worrying concern is "over-reliance" on technology, which was cited by 59.06% of professionals (Shoham *et al.* 2025). The IVF industry today is very aggressive in marketing unproven "add-ons". When aggressive marketing meets the deep hope of couples seeking a child, it creates a fragile environment where the line between medical help and exploitation becomes blurred. This has been seen with PGT-A testing. Even though it was not AI, it was marketed as "nearly 100% accurate", which led some patients to discard perfectly healthy embryos because of misleading results (Ducharme 2025). This is a clear warning of what happens when we adopt new, unproven technologies without strict legal and ethical oversight (Afnan *et al.* 2021).

## DEHUMANIZATION AND THE DIGNITY OF THE EMBRYO

The "rationalization of reproduction" is a term that describes a growing trend of using scientific and technological principles to optimize and control the human reproductive process.[2] This approach carries an immense risk of the "instrumentalization of embryos". If we leave this process uncontrolled, we risk the dehumanization of human conception. It could become a cold, technical procedure, stripped of its deep personal, relational, and existential meaning[3] (Aufieri and Mastrocola 2024, 10).

Many authors are deeply worried that using AI to rank embryos turns potential human beings into mere commodities. In this view, a new life is seen less as a "miracle" and more as a product that must pass a "quality check". This perspective fits perfectly into the "technocratic paradigm", where efficiency and optimization are more important than the sacredness and inestimable value of human life. The real danger here is the combination of advanced AI and the pursuit of profit. In such a delicate area, we risk reducing the deeply personal act of having a

[2] The process of the rationalization of reproduction is rooted in the Weberian tradition of social rationalization, seeking to eliminate biological uncertainty and replace it with calculated outcomes. However, as Habermas (2003) warns, this transformation of life into a manageable project risks stripping the reproductive act of its existential dignity, reducing it to a mere engineering task.
"Rationalization" is part of a broader trajectory toward a "digitally enhanced future" that is increasingly reshaping the legal and structural foundations of the family itself. Even the traditional framework of marriage contracts in Serbia is being transformed by digital integration, signaling a deeper shift toward embedding technology into the most intimate spheres of human life. When we view AI embryo selection alongside these digital legal reforms, a clear pattern emerges: the transition from a natural, spontaneous act of family-making to a managed, engineered, and digitally-mediated procedure (Stjepanović 2025, 191).

[3] This dehumanization extends to the identity of the child born through these technologies. As Stjepanović (2018) points in her comparative legal analysis, the right of a child conceived through assisted reproduction to know their biological origins is a fundamental legal and ethical issue. When AI-driven selection adds another layer of algorithmic complexity to this process, the transparency of a child's heritage becomes even more precarious. If the selection process remains an opaque, data-driven "black box", we risk not only commodifying the embryo but also complicating the child's future right to access the truth about their biological identity

child to nothing more than a cold, commercial transaction (Aufieri and Mastrocola 2024, 4).

For many people, an embryo is a human life with full moral value from the moment of conception. From this point of view, any form of selection is a direct violation of a child's dignity and their right to life. This ethical dilemma is best described by Habermas, who warns that trying to "design" children changes human nature itself. He believes that a child who has been "programmed" in advance loses their independence. Such a person may no longer feel like the true author of their own life, nor can they feel equal to the parents who acted as their "designers." Čović (2023) builds on these ideas, warning that modern examples like "GMO babies" show that we are starting to treat human life as just another technical task. When algorithms begin to rank embryos, we are no longer just choosing health. We are entering a dangerous territory where life is treated like a product that can be customized. Instead of accepting a child for who they are, we reduce them to a list of "optimized" traits meant to satisfy parental or societal demands. Ultimately, this creates a huge emotional burden for both parents and scientists. They are forced to act as "judges", deciding which life is good enough to start and which will be discarded or frozen forever (Aufieri and Mastrocola 2024, 10).

A crucial point of the philosophical debate regarding the embryo's moral status is the "potentiality argument" (Stier and Schoene-Seifert 2013, 2). From this perspective, since an embryo carries everything it needs to develop into a human being, we must recognize its fundamental moral status. Supporters of this view argue that an embryo is not just a random cluster of cells. It is life with the potential to become a fully grown adult, just as an infant has the potential to grow up (Pereira Daoud *et al.* 2024). Another important argument is that human life has inherent dignity and worth from the very beginning. This means that every human life, from conception, shares this dignity and should never be treated as a "means to an end." An embryo should never be treated as a means to an end, even for a "good cause" like finding a cure for a disease (Pereira Daoud *et al.* 2024). On the other hand, some philosophers suggest that personhood is not "all-or-nothing" but a matter of degree. They argue that embryos might have some moral status, but not the same as a fully formed human being. Others tie moral status to "sentience" – the ability to feel pain or have consciousness. Sandel offers a middle ground. He argues that even if an embryo isn't a "full person," it is undeniably "potential human life" and deserves a certain respect. Sandel believes

we should treat life as a gift – an approach that limits how much we can manipulate or use it for our own goals (Pereira Daoud *et al.* 2024).

One of the most serious concerns today is the risk of "algorithmic eugenics". This happens when AI is used to pick embryos based on traits that society considers "superior" – health, intelligence, or physical appearance. This practice is a major warning sign that human life is being turned into a commodity. It suggests that embryos are being judged not by their inherent value, but by a cold, market-driven logic. If we start "grading" embryos this way, we are sending a deeply negative message about the value of life itself, especially for anyone born with conditions that the algorithm deems "sub-optimal" (Aufieri and Mastrocola 2024, 11). This is clearly reflected in the ongoing criticism of screening for conditions like Down syndrome, which is often seen as expressing a negative view about the value of people living with that condition. This is known as the "expressivist objection." It suggests that methods aimed at preventing the birth of individuals with anomalies might, perhaps unintentionally, devalue the lives of people with disabilities who are already part of our society (Aufieri and Mastrocola 2024, 7). The pursuit of a calculated "perfection" through AI could seriously reduce our society's tolerance for diversity and human difference. The ability of AI to make sex selection easier raises grave ethical concerns. This is not just a medical issue; it has serious societal ramifications, such as biased population ratios. Statistics from a 2022 survey highlight public divide: nearly 72% of people agree with sex selection for medical necessity, but less than 43% support it for personal preference (Shoham *et al.* 2025). These numbers show how most people are still uncomfortable with using technology for non-medical choices. Using AI uncritically in reproduction threatens to take the "human" out of creating life. We aren't just updating a clinic's tools; we are changing the way we value human life and what it means to be human.

## THE FRAGILITY OF IVF OVERSIGHT

Even before AI became widespread in the laboratory, real-world incidents showed us how dangerous and complex the legal and ethical landscape of embryo selection can be. The human cost of technical errors is becoming visible in the United States. Class-action lawsuits have been filed against providers of Preimplantation Genetic Testing for Aneuploidy (PGT-A). The plaintiffs allege that patients were misled

about how accurate and useful these tests really are, which led to the decision to discard embryos that were actually viable. One specific case stands out. In this case, a patient decided to proceed with an embryo that the PGT-A test had flagged as having a serious chromosomal abnormality. The result was a perfectly healthy baby (Ducharme 2025). This case is a powerful warning about the dangers of over-reliance on selection tools. These lawsuits, even if they aren't strictly about AI, show that in an environment where AI is deployed, any technical error or hidden bias could lead to massive legal and ethical repercussions.

The Supreme Court of Alabama's ruling created a very important legal shift. The Court ruled that the definition of a "child" under the state's Wrongful Death of a Minor Act includes embryos, whether they are inside or outside a biological uterus. This decision, which started when frozen embryos were accidentally destroyed, raises fundamental questions about the moral and legal status of every embryo in a clinic. It forces us to rethink how IVF clinics operate and how they must handle "spare" embryos (Supreme Court of Alabama 2024). When we bring a "black box" problem into a system that is already struggling with oversight, the danger grows. Because we cannot always see why an algorithm makes a specific choice, it becomes nearly impossible to hold anyone accountable when something goes wrong.

A report from April 2025 described a milestone that feels like science fiction: the birth of the first baby conceived through an "almost entirely automated" IVF process. In this case, a robotic system controlled by AI was used to select, immobilize, and inject sperm into eggs. As we cross this technical line, we are forced to ask ourselves: Should technical efficiency ever be allowed to replace human judgment at the very moment a new life begins (Bioethics Center CADEBI 2025)? This event is a clear signal of growing technological power, but it also highlights the urgent need for an ethical framework to guide it.

The philosophical debate about the embryo's status is not just "academic." It directly shapes how countries write their laws. Jurisdictions that give the embryo a high moral status (such as the strict regulations seen in Italy) will inevitably impose much tougher rules on AI selection. They may even ban it entirely. This direct link between moral philosophy and healthcare policy shows that our "ethical crossroads" has very real, immediate consequences for society and the law.

## THE ALGORITHMIC VEIL

The integration of AI into assisted reproduction forces us to rethink two core principles of medical ethics: informed consent and transparency. Informed consent is a complex process of communication where the patient is an active participant whose autonomy is deeply rooted in the protection of human dignity (Vukadinović Marković, Radomirović, and Stjepanović 2025). In the context of AI, this means that parents must fully understand the machines' role in their care, including its real capabilities, its limitations, and what its "choices" actually mean for the future of their embryo. Without transparency, informed consent loses its meaning. Algorithms need to be "explainable", so that doctors and patients aren't just following a computer's lead, but actually understanding the reasoning behind each choice. Without it, parental autonomy in one of life's most intimate moments is effectively lost.

A major challenge to these ethical requirements is the "black box" problem. In almost every case, the AI used for embryo selection operates through computational processes that are opaque, "hidden" from human understanding (Habli, Lawton, and Porter 2020). This lack of real-time explainability creates a serious "responsibility gap" (Afnan *et al.* 2021). If an AI model is opaque, true understanding becomes impossible for both the doctor and the parents. This directly violates the spirit of informed consent, making any permission given by the parents ethically problematic, or even legally invalid. This lack of transparency destroys the essential dialogue between doctor and patient. Neither the clinician nor the parents can truly know why the AI chose one embryo over another. Is it a subtle structural detail, or is there a hidden reason for potential failure? These details remain locked inside the algorithm, making "shared decision-making" a mere illusion.

This opacity puts doctors in a very difficult position. We are seeing a shift where clinicians may begin handing over their decision-making authority to computer programs they do not actually understand. This leads to what is called "machine paternalism" (Aufieri and Mastrocola 2024, 6). In this scenario, doctors become too comfortable and simply accept the AI's "recommendation" without using their own critical judgment. This creates a serious legal trap. If a doctor decides to challenge the AI and something goes wrong, they might face legal liability for simply "going against the machine" without a reason that the law recognizes as "good enough" (Afnan *et al.* 2021).

Beyond the technical confusion, opaque AI models pose a more serious, more political threat. These systems might secretly be selecting for specific characteristics that the algorithm has "learned" are linked to success, even if those are traits the parents do not want, such as an unintended bias toward a certain sex. If a bias is buried deep within a hidden algorithm, it is impossible to detect or correct. This leads to a quiet, systematic favoring of certain outcomes over others. Parents cannot make a truly "informed" choice if they don't know the rules of the game. At the very least, parents must have the explicit right to decline AI involvement if they have moral or ethical objections to a machine guiding such a sensitive decision.

The issue of data privacy is also a massive concern. AI systems handle the most sensitive information imaginable: electronic health records, diagnostic scans, and deep genetic data (Aufieri and Mastrocola 2024, 5). This requires "iron-clad" protection measures like encryption and constant security audits. Beyond harming the patient, a data breach undermines the collective trust that is the foundation of the healthcare system (Director 2025, 20). The lack of transparency in these models leads to a dangerous erosion of accountability (Afnan *et al.* 2021). If a doctor cannot be held responsible because they relied on a "black box", and the developer has no institutionalized accountability, we are left with a "responsibility gap" where no one is liable for the harm caused.

To face these challenges, we must implement strict ethical and technical mandates. The development of Explainable AI (XAI) is an absolute necessity. The purpose of XAI is to make complex algorithms understandable to humans, which is the only way to build genuine trust (EDPS 2023, 9). Techniques like SHAP and LIME must be used to deconstruct how a model arrives at a prediction. Without XAI, "machine paternalism" will continue to erode human agency in the most critical life decisions (Afnan *et al.* 2021). Furthermore, "Human-in-the-Loop" oversight must be established. AI should augment and assist human expertise, not replace it. Clinical workflows must ensure that the doctor retains ultimate decision-making authority, allowing them to bypass AI recommendations whenever necessary. Informed consent must be updated to use clear, non-technical language that explains exactly what the AI does, what its limits are, and how the data is protected (EDPS 2023, 9).

Transparency is not optional. AI systems must report their confidence scores and explain which "features" they used to make a

calculation. Every step of the model's life (from where the data came from to how it was tested) must be documented. Finally, algorithmic bias must be actively fought by using diverse datasets and conducting regular "demographic audits" (Hickman *et al.* 2025).

## THE EVOLVING LEGAL AND REGULATORY LANDSCAPE

The global regulation of ART is deeply fragmented. There are massive differences across the world in which procedures are allowed, who can access them, and how much they cost. Adding AI to an already sensitive field creates a whole new level of complexity. The central problem is that our legal frameworks are consistently lagging behind the disruptive pace of technology (Shoham *et al.* 2025). This "regulatory gap" means that we are often applying old rules to a completely new biological and digital reality.

The European Union has taken a significant step with the EU AI Act. It classifies AI systems used in medical devices, including those for in vitro fertilization (IVF), as "high-risk". This is a political and legal decision. It means companies cannot simply put these systems on the market. They must undergo strict assessments. Under this Act, high-risk AI must meet tough requirements: they must have robust risk-management systems, use only high-quality data, provide clear information to users, and ensure strong human oversight. The Act entered into force on August 1, 2024, but there is a 36-month transition period before these rules are fully applied (European Parliament 2023). This delay reminds us once again of how slowly the law moves compared to the speed of the lab.

On a global level, the UNESCO Recommendation on the Ethics of Artificial Intelligence (2021) serves as an international ethical compass for 194 member states. This document treats human rights and dignity as its absolute cornerstone. It insists on principles that are often ignored by the industry: transparency, fairness, and the necessity of human control. Its ethical framework is built on proportionality, safety, and non-discrimination, aiming to protect the most vulnerable stages of human life from technological exploitation (UNESCO 2021).

In the United Kingdom, the Human Fertilisation and Embryology Authority (HFEA) acts as the central regulator to ensure that fertility treatments are both safe and ethical. The HFEA is known for its cautious

approach to "treatment add-ons". Interestingly, "time-lapse imaging", a technology often marketed together with AI, has received a "black rating". This means there is no clear evidence that it actually benefits most patients. Even specific AI algorithms, like CareMaps-AI, have not been rated yet because there simply isn't enough published evidence. The HFEA is currently struggling to adapt its framework to keep up with the rapid changes in both AI and genetics (Department of Health and Social Care [DHSC] 2023).

The situation in the United States is much more chaotic. There is no comprehensive federal law for AI, which has created a fragmented landscape of different state rules (Shoham *et al.* 2025). The FDA has not yet authorized any add-on preimplantation genetic tests (Ducharme 2025). Furthermore, after the Dobbs Supreme Court ruling, new proposals to restrict abortion have created a "political shadow" over the future of IVF. There is a real fear that laws aimed at abortion could lead to a ban on common IVF practices, such as the disposal of "spare" embryos (American Society for Reproductive Medicine [ASRM] 2024). This shows how quickly reproductive technology can become a battlefield for broader political conflicts.

China has focused on national security, mandating clear labeling for all AI-generated content starting in 2025. Singapore, on the other hand, updated its Model AI Governance Framework in May 2024. They are trying to find a balance between encouraging innovation and maintaining public accountability through voluntary ethical guidelines (Shoham *et al.* 2025). These different approaches show that there is no global consensus on how to handle the machine's role in creating human life.

## Legal regulation and AI gap in Serbia

The legal landscape of ART in Serbia is defined by the Law on Biomedically Assisted Fertilization from March 2017 (Zakon o biomedicinski potpomognutoj oplodnji 2017). Although it follows EU directives, this law is a product of its time and does not account for the ethical challenges that have since emerged with the use of artificial intelligence in reproduction. Under Article 13, the law focuses on the technical aspects of the field, specifically the testing, retrieval, processing, freezing, and distribution of reproductive cells and embryos. It covers standard procedures such as IVF and ICSI, and permits the

freezing of a couple's own genetic material. At the same time, Article 49 sets strict limits: it prohibits the combined use of donated eggs and sperm, bans surrogacy, and forbids sex selection unless it is to prevent serious hereditary diseases. The main problem is that the Serbian legal framework has a significant gap: it contains no rules regarding the use of AI for embryo selection. The law is written strictly for biological and medical procedures as they were understood years ago. It was never envisioned that a machine, and not a human professional, would be the one assessing and choosing which embryo has the right to life.

At the same time, Serbia is undergoing a significant legislative shift, driven by an ambition to modernize its legal landscape in response to rapid technological advancements. Although the Strategy for the Development of Artificial Intelligence (2025–2030) (Office for IT and eGovernment 2025) laid the groundwork for the drafting of the first comprehensive law, Serbia is still waiting for this legal act in early 2026. The drafting process is facing delays, which prolongs the state of legal uncertainty and leaves sensitive areas, such as reproductive medicine, in a complete regulatory vacuum. (Office for IT and eGovernment 2025). Such initiatives position Serbia as a regional leader and a key member of the Global Partnership on AI (GPAI). Additionally, in 2023, the government introduced the non-binding "Ethical Guidelines for the Development and Use of Responsible AI", which aim to safeguard individual freedom and human decision-making (Government of the Republic of Serbia 2023). However, a closer look reveals that neither the new Strategy nor these Ethical Guidelines provides any specific rules for the use of AI in embryo selection or assisted reproduction.

All this results in a significant "regulatory vacuum." We are caught between a Law on BMAF that remains focused on a strictly biological era and a new, general AI framework that lacks sector-specific safeguards for healthcare. This absence of rules causes a dangerous gray area that allows the unchecked expansion of AI in a domain where the stakes are nothing less than the future of human life. Despite Serbia's ambition to become a regional leader in AI, the lack of a specific legal framework for assisted reproduction creates deep uncertainty. Without clear rules on accountability, ethical oversight, or patient rights, we are opening the door to legal and moral crises. This regulatory gap risks permanently altering the nature of human reproduction in our society before a single protective rule is ever applied.

## The accountability deficit in AI-driven ART

The legislative gap in Serbia is not an isolated issue, but rather a reflection of a much deeper, systemic crisis in modern law. This regulatory void represents a dangerous space in which accountability vanishes. By its very nature, the opacity of AI systems threatens to erode the foundations of human trust and responsibility. The integration of these opaque AI systems into the selection process triggers a profound legal crisis, effectively dissolving the traditional lines of accountability that protect both patients and doctors. The core of the problem lies in the fact that when an AI's decision-making is opaque and hidden from human view, holding a doctor responsible for malpractice becomes structurally impossible. Because these self-learning systems are constantly evolving, we can no longer trace the "chain of events" that led to a specific choice. This creates a dangerous "responsibility gap". In this vacuum, both legal and ethical accountability for any harm caused by an AI's decision is left unclear, leaving patients without a clear path to justice (Afnan *et al.* 2021).

Beyond the question of medical malpractice, the search for accountability must extend to other legal frameworks, such as the EU's Product Liability Directive. This law allows victims to claim compensation from manufacturers if a "defective product" causes them harm. In the future, this framework could potentially be expanded to cover AI systems embedded in medical devices, including those used in IVF (European Commission 2025). If a system is proven to be defective and causes demonstrable harm to a patient, the focus might shift from the doctor's negligence to the developer's liability.

However, the absence of a unified global approach to regulating these technologies creates a major systemic risk that cannot be ignored. There is a stark difference between the EU, which classifies AI in IVF as "high-risk," and the US, which takes a much more relaxed approach. This fragmentation creates a powerful incentive for "regulatory arbitrage," where clinics and tech developers are encouraged to "shop around" for countries with minimal accountability standards. By doing so, they can market or use AI tools that might be banned or strictly limited in other parts of the world. Not only does this environment encourage "fertility tourism" but it also creates a new, more dangerous variant of "AI-fertility tourism". Patients are now going abroad for AI treatments specifically to avoid the strict rules and ethical checks in their own countries. The fact

that countries have such different rules is a direct threat to patient safety and the basic standards of medicine. It suggests that the protection of human life is no longer a universal standard, but something that depends on which jurisdiction can offer the most "relaxed" rules for profit.

## A POLICY FRAMEWORK FOR RESPONSIBLE AI IN ASSISTED REPRODUCTION

The fast-growing use of AI in reproductive medicine means that laws can no longer just focus on technical details. Instead, policies must ensure that human dignity is the most important part of every decision. To prevent the dehumanization of the act of creation, our regulatory response must move beyond the "black box" and toward a system of total transparency and accountability.

A truly responsible integration begins with the development of harmonized legal and ethical frameworks that transcend national borders. By building on global standards like those from UNESCO and adopting risk-based approaches similar to the EU AI Act, we can finally stop "regulatory arbitrage" and the rise of "AI-fertility tourism". Future regulations must demand transparency. AI systems should not be allowed if they cannot explain their reasoning to the people who rely on them. When AI can explain how it works, it preserves the foundation of informed consent. This transparency is the only way to bridge the gap between technology and human responsibility (Hickman *et al.* 2025).

However, transparency alone is not enough, requiring the support of rigorous validation and continuous human oversight. The true success of these systems must be measured by actual live birth rates rather than surrogate metrics (Salih *et al.* 2023*,* 7). In this process, the concept of "Human-in-the-Loop" becomes a strategic imperative. AI should be a tool that supports doctors, not a technology that replaces their years of experience and judgment. By giving doctors the authority to override AI, we ensure that human reasoning guides every decision. This stops us from treating embryos as simple objects in a technical process.

This focus on people must also include how we handle data. Protecting the private genetic records of patients with the best possible security is the only way to keep their trust. We must also prevent "algorithmic eugenics" by making sure AI is trained on data from all kinds of people. This stops the technology from repeating old prejudices or discriminating against certain genetic traits.

To protect the ethics of tomorrow, human values must lead the way for innovation. This means making sure that informed consent is real, giving patients the freedom to choose traditional care over AI whenever they wish (Director 2025, 13). This must be supported by independent, interdisciplinary ethical boards and a commitment to continuous training for all staff. By carefully navigating the complex philosophical status of the embryo and prioritizing the "gift" of life over market-driven efficiency, we can ensure that AI serves the advancement of medicine without sacrificing the very essence of our humanity.

## CONCLUSION

The integration of AI into assisted reproduction marks a definitive turning point in medical history. The clinical evidence is hard to ignore, as AI's 81.5% accuracy rate offers a level of precision in predicting pregnancy that often surpasses even the most experienced human eye. However, this statistical success remains incomplete. The current lack of robust Randomized Controlled Trials (RCTs) focused on the only metric that truly matters (the live birth) suggests that our rush toward technology may be outpacing our scientific and ethical foundations.

This rapid progress carries big risks that reach into the most personal parts of our lives. The cold logic of algorithmic optimization threatens to turn the "miracle of life" into a quantifiable commodity, leading to the instrumentalization of human embryos. We are standing at a crossroads where the pursuit of "perfection" through AI risks reviving the specter of "algorithmic eugenics," potentially eroding our society's tolerance for natural biological diversity and the inherent dignity of every human life.

At the heart of this crisis is the "black box" problem. The use of opaque algorithms is not just a technical problem but a direct assault on the principles of informed consent and parental autonomy. By creating a "responsibility gap" where accountability is lost in complex code, we risk turning one of life's most intimate decisions into a machine-led process. Therefore, the implementation of Explainable AI (XAI) and Human-in-the-Loop oversight is not merely a technical preference but an ethical necessity required to preserve the integrity of medical decision-making and the trust between a doctor and a patient.

On a global level, we are witnessing a dangerous legal fragmentation. While the European Union has taken a stand by

designating these systems as "high-risk", other regions, including Serbia, face a critical regulatory vacuum. Serbia's rapid advancement in general AI governance is commendable, but the lack of specific, binding laws for AI in assisted reproduction leaves a space wide open for "regulatory arbitrage". This inconsistency threatens to turn human conception into a global marketplace where ethical standards are sacrificed for clinical or commercial speed.

The ethical integration of AI into human conception demands a response that is as sophisticated as the technology itself. It must be insisted on mandatory transparency, rigorous validation focused on live births, and clear, enforceable accountability. Most importantly, the focus must shift toward a human-centered design, a philosophy dedicated to using technology as a way to augment, rather than replace, the essential role of human judgment. In this uniquely personal and morally weighted domain of medicine, the machine must remain a tool, while the profound act of creating a life must remain, fundamentally and forever, human**.**

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# РАЦИОНАЛИЗАЦИЈА РЕПРОДУКЦИЈЕ – ПУТ КА ДЕХУМАНИЗАЦИЈИ ЧОВЕЧАНСТВА: ПОЛИТИЧКИ, ПРАВНИ И ЕТИЧКИ АСПЕКТИ ПРИМЕНЕ ВЕШТАЧКЕ ИНТЕЛИГЕНЦИЈЕ У СЕЛЕКЦИЈИ ЕМБРИОНА

## Резиме

Вештачка интелигенција постаје неизоставан део људског живота, а стварање човека у томе није изузетак. Иако примена вештачке интелигенције (ВИ) у биомедицински потпомогнутој оплодњи (БМПО) буди нову наду код парова који се суочавају са неплодношћу, она истовремено намеће тешко питање: где су етичке границе допуштања алгоритму да задире у сам чин зачећа? У раду се заступа теза да све израженија „рационализација" репродукције путем селекције засноване на вештачкој интелигенцији не представља обично техничко унапређење, већ дубоко политичко и комплексно питање. Анализирају се правни и етички ризици оваквог поступања, са посебним освртом на дехуманизацију самог зачећа. Нарочиту забринутост изазива претерано ослањање на нетранспарентне алгоритме, чија природа „црне кутије" може угрозити аутономију родитеља и валидност њиховог информисаног пристанка у овом дубоко интимном акту. Напослетку, разматра се филозофска опасност третирања ембриона као објеката селекције, чиме се директно нарушава њихово урођено достојанство. Тежећи да укаже на празнине у важећем законодавству, овај рад детаљно анализира прописе Републике Србије и утврђује да постојећа правна решења нису спремна за предстојеће изазове. У раду се предлажу нови регулаторни кораци којима се достојанство ембриона поставља у први план. Кроз призму етике и уз апел за очување људске емпатије, закључак рада је да некритичка примена вештачке

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интелигенције у репродукцији носи ризик да чин стварања живота претвори у хладан и механизован поступак.

**Кључне речи**: вештачка интелигенција (ВИ), селекција ембриона, дехуманизација, достојанство ембриона, правни и етички изазови, Република Србија

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