

Epistemic Integrity in Reproductive Medicine: Algorithmic Amplification, Financialization, and the Future of Clinical Trust

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Note: CAPSULE reproductive medicine is uniquely vulnerable to algorithmic authority distortion because irreversible biological time intersects with emotionally vulnerable decision-making inside engagement-driven ecosystems.

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ABSTRACT

Reproductive medicine is increasingly shaped by digital platforms, artificial intelligence, and financially consolidated models of care. These forces do not merely alter how fertility services are delivered; they also reshape how clinical authority is produced, perceived, and trusted. In a field defined by probabilistic outcomes, emotional vulnerability, irreversible biological time, and profound informational asymmetry, the migration of professional reputation from evidence-based competence toward algorithmically amplified visibility raises distinctive ethical concerns. Engagement-driven communication may privilege repetition, emotional clarity, technological novelty, and promotional certainty over transparent reporting of uncertainty, age-stratified outcomes, cumulative live birth rates, complications, and limits of evidence. At the same time, financialized care structures may influence institutional priorities, while AI-mediated communication can accelerate both patient education and epistemic distortion. This article argues that reproductive medicine requires an ethics of epistemic integrity: a governance framework that protects patients not only from misleading claims, but also from distorted hierarchies of credibility. Such a framework should include transparent outcome reporting, disclosure of ownership and conflicts of interest, clear distinction between education and promotion, careful regulation of add-ons and experimental procedures, and merit-based professional evaluation insulated from visibility metrics.

Keywords: Reproductive Medicine; Bioethics; Clinical Trust; Artificial Intelligence; Algorithmic Authority; Financialization; Epistemic Integrity; Medical Professionalism

Structure

- 1. Introduction:** Reproductive medicine as a field built on evidence, probability, and irreversible biological time.
- 2. From Evidence Hierarchies to Attention Hierarchies:** How algorithmic visibility may compete with traditional evidence-based authority.
- 3. Financialization and the Market Mediation of Trust:** How investment, consolidation, branding, and scalability can reshape reproductive care without assuming that private capital is intrinsically unethical.
- 4. Reproductive Vulnerability and Communication Ethics:** Why infertility patients are uniquely exposed to distorted communication because hope, urgency, uncertainty, and informational asymmetry coexist.
- 5. Artificial Intelligence and Epistemic Acceleration:** How AI can improve access, prediction, and education, but may also simulate authority without embedded validation.
- 6. Governance Safeguards for Epistemic Integrity:** Transparent outcomes, conflict disclosure, add-on regulation, AI auditability, and merit-based evaluation.

7. **Discussion:** The future of clinical authority, physician identity, patient trust, burnout, and relational medicine.
8. **Conclusion:** Reproductive medicine must preserve alignment between evidence, competence, communication, and trust.

Figure Plan

1. **Figure 1:** From evidence hierarchy to attention hierarchy in reproductive medicine.

A conceptual model showing the transition from authority grounded in reproducible evidence, peer review, and audited outcomes toward authority increasingly mediated by digital visibility, repetition, and engagement metrics.

2. **Figure 2:** Biological time and financialized translational pathways.

A framework illustrating how irreversible reproductive aging intersects with market-driven translational priorities, investment incentives, and patient vulnerability.

3. **Figure 3:** Governance safeguards for epistemic integrity.

A model integrating transparent outcome reporting, ownership disclosure, AI auditability, add-on classification, and merit-based professional evaluation.

4. **Figure 4:** Standardized Public Profile for Professional Competence in Reproductive Medicine. Conceptual infographic illustrating a transparent, non-promotional framework for reporting the competence of a gynecologist with expertise in reproductive medicine and surgery.

5. **Table 1:** New Medical Phenotypes in Reproductive Science

Introduction

Modern medicine was historically constructed upon hierarchies of evidence intended to protect clinical judgment from persuasion unsupported by reproducible outcomes. Evidence-based medicine formalized these hierarchies through methodological rigor, systematic verification, peer scrutiny, and graded evaluation of uncertainty [1,2]. Clinical legitimacy therefore derived not primarily from visibility or rhetorical influence, but from demonstrable reliability of outcomes and transparent acknowledgment of limitations. In this epistemic architecture, scientific authority depended upon the capacity of claims to withstand scrutiny, replication, and longitudinal verification rather than their ability to attract attention. Reproductive medicine developed within this broader framework while simultaneously occupying a uniquely fragile clinical space. Infertility care combines probabilistic outcomes, emotional vulnerability, irreversible biological timing, and profound informational asymmetry [3-5]. Ovarian reserve progressively declines with age, embryo aneuploidy rates increase

predictably over time, and reproductive potential itself changes irreversibly [6,7]. Consequently, delays in diagnosis, treatment, or access to effective interventions may produce losses that cannot later be recovered. Few medical disciplines operate under comparable temporal constraints.

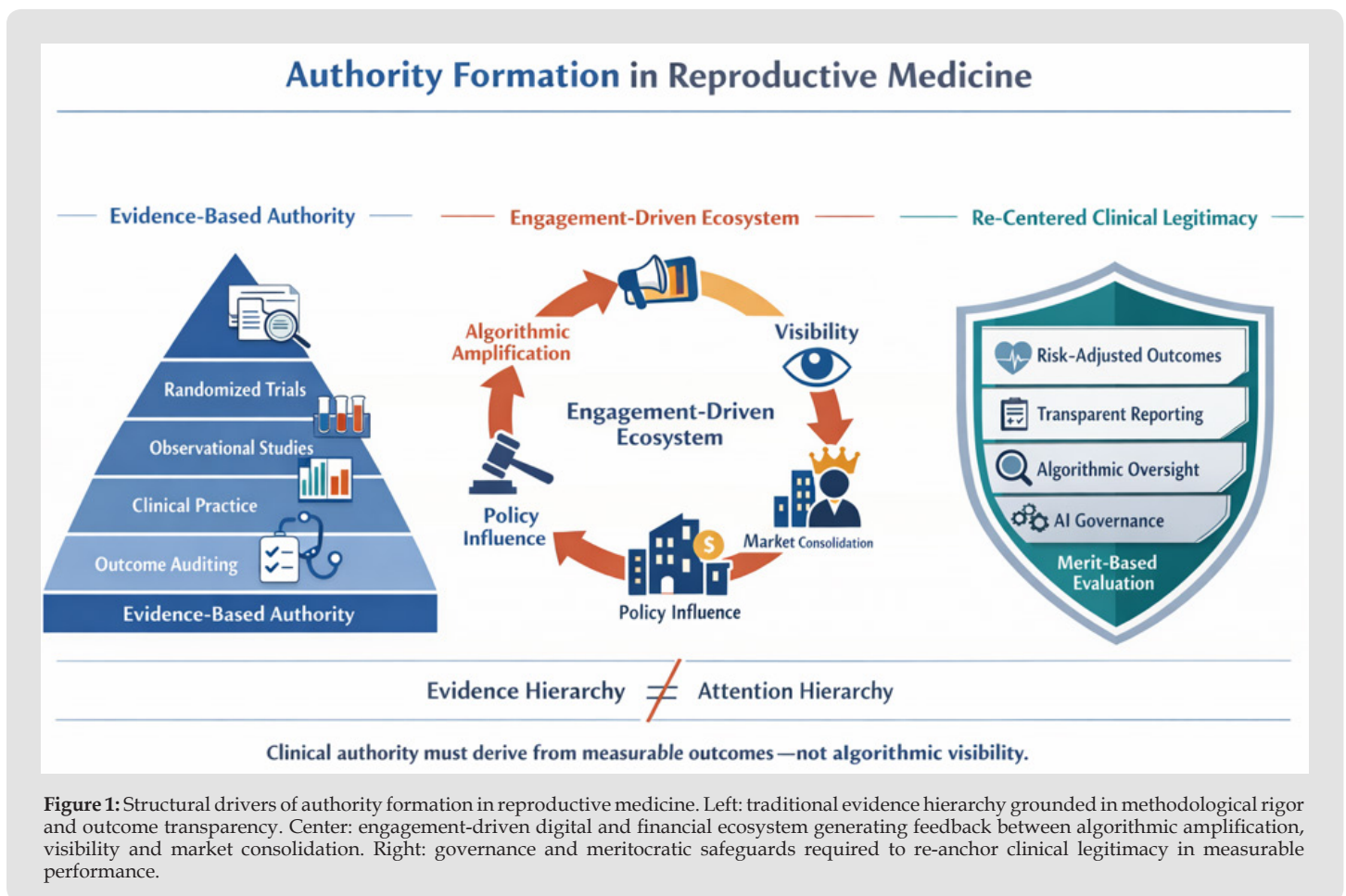
This biological irreversibility profoundly shapes the ethical structure of reproductive care. Patients frequently confront uncertainty regarding prognosis, treatment efficacy, financial sustainability, and future family formation while simultaneously experiencing pressure generated by declining fertility potential [4,5]. Communication therefore assumes unusual clinical significance. The framing of probabilities, innovation, urgency, and therapeutic possibility may directly influence decisional trajectories, allocation of family resources, and perceptions of reproductive hope [8,9]. In reproductive medicine, communication is not merely adjunctive to care; it becomes constitutive of care itself. Over the past decade, however, the informational environment surrounding reproductive medicine has undergone substantial transformation. Digital platform ecosystems increasingly mediate how patients encounter fertility information, evaluate expertise, identify specialists, and construct perceptions of professional credibility [10,11]. Algorithmic ranking systems prioritize engagement metrics such as visibility, emotional activation, repetition, and watch time rather than methodological rigor or evidentiary proportionality. Within such environments, attention itself may progressively acquire epistemic influence.

Psychological research demonstrates that repeated exposure increases perceived truthfulness independently of factual accuracy, a phenomenon commonly described as the “illusory truth effect.” [12] When amplified algorithmically, repetition may therefore generate self-reinforcing credibility loops in which visibility strengthens perceived authority independently of audited clinical performance. Importantly, this process does not necessarily depend upon overt misinformation. Accurate information may coexist with epistemic distortion when communicative prominence becomes progressively detached from comparative evidence quality or transparent outcome reporting. The ethical concern is therefore broader than false claims alone. Scientific medicine depends upon visible distinctions between levels of evidence. Randomized trials, systematic reviews, observational findings, mechanistic hypotheses, expert opinion, and anecdotal narratives do not possess equivalent epistemic weight [1,2]. Yet digitally accelerated communication environments often flatten these distinctions by assigning comparable visibility to claims supported by profoundly different levels of validation [13,14]. Reproductive medicine is especially vulnerable to this flattening because patients frequently lack the technical expertise required to independently evaluate embryo selection strategies, laboratory methodologies, cumulative live birth denominators, or the evidentiary maturity of emerging interventions. Hope further complicates this landscape. In infertility care, hope functions simultaneously as therapeutic ne-

cessity and potential source of vulnerability. Patients experiencing irreversible temporal pressure may understandably gravitate toward narratives emphasizing innovation, technological superiority, exceptional outcomes, or therapeutic optimism.

Digital ecosystems structurally reward such narratives because emotionally resonant communication generates greater engagement than probabilistic restraint or methodological nuance. The resulting asymmetry creates ethical tension between the communicative logic of engagement-driven systems and the epistemic norms of evidence-based medicine (Figure 1). These transformations do not im-

ply that digital communication is inherently incompatible with ethical reproductive care. Public-facing educational dissemination may improve access to information, reduce barriers to specialized consultation, and enhance patient literacy. The ethical challenge instead concerns preservation of epistemic integrity within communication environments increasingly optimized for amplification rather than verification. Reproductive medicine therefore faces a historically novel question: whether clinical authority can remain anchored to reproducible evidence and transparent accountability within ecosystems where visibility itself increasingly shapes perceptions of expertise.



From Evidence Hierarchies to Attention Hierarchies. Financialization and the Market Mediation of Trust

The transformation of reproductive medicine over recent decades cannot be understood solely through scientific and technological progress. It must also be interpreted within the broader restructuring of health-care delivery, investment models, and market organization that increasingly shape contemporary medicine [15-18]. Across mul-

tiiple countries, fertility care has undergone substantial consolidation through private investment, vertically integrated networks, and private equity participation [15,16]. These developments have expanded laboratory infrastructure, facilitated technological standardization, increased geographic accessibility, and accelerated translational implementation. At the same time, they have introduced new ethical tensions concerning professional autonomy, communication practices, translational priorities, and the institutional foundations of clini-

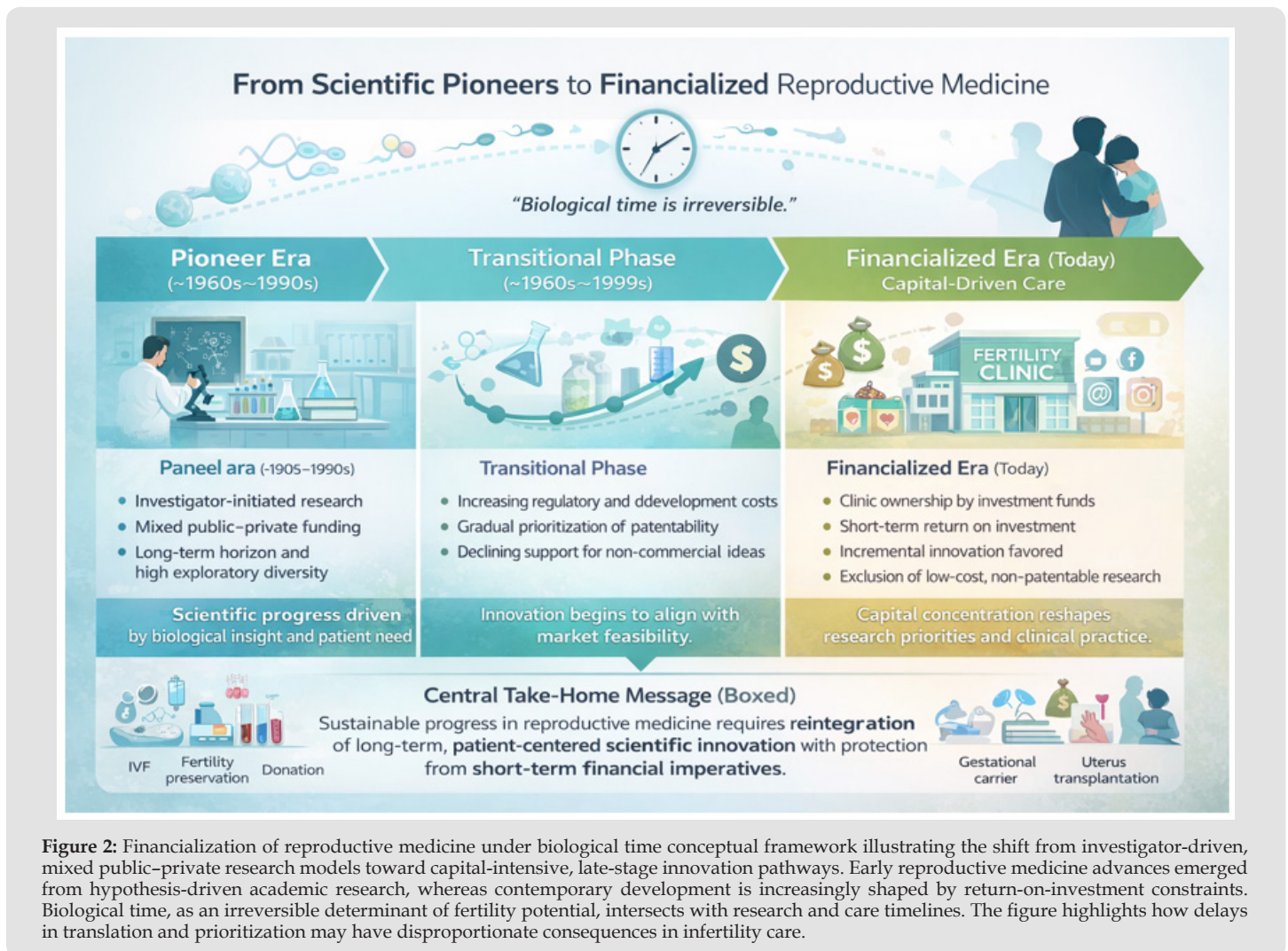
cal trust. Private investment in medicine is not inherently incompatible with ethical clinical care. Reproductive medicine is technologically intensive and depends upon sophisticated embryology laboratories, cryopreservation systems, genetic technologies, regulatory compliance, and increasingly complex digital infrastructures. Many important therapeutic advances emerged precisely through collaboration among academic medicine, biotechnology, and translational financing.

The ethical question is therefore not whether capital should participate in reproductive medicine, but how financialized environments may influence the structures through which therapeutic legitimacy and professional authority are constructed. Infertility care occupies a particularly sensitive position within health systems because it frequently develops within hybrid public-private models. Although infertility is recognized internationally as a disease, access to treatment remains unevenly incorporated into universal health coverage frameworks. Consequently, reproductive medicine often operates within partially market-mediated systems where institutional competition, technological differentiation, and patient acquisition become unusually important organizational priorities. Several characteristics make fertility care especially attractive to investment-driven expansion. Delayed childbearing has increased demand for assisted reproduction internationally; treatment pathways often involve repeat cycles; technological differentiation permits premium positioning; and emotional urgency may increase patient willingness to pursue innovative interventions despite uncertainty [15,16]. None of these dynamics are inherently unethical. However, they may create environments in which visibility, branding, scalability, and continuous technological novelty progressively acquire strategic importance alongside evidence-based clinical care.

This transformation may subtly alter institutional incentives. Historically, professional prestige in reproductive medicine depended primarily upon scientific contribution, peer-recognized competence, cumulative outcomes, teaching, and methodological innovation. In highly competitive and financially consolidated systems, institutional success may increasingly depend upon market visibility, operational expansion, digital engagement, and growth-oriented communication strategies. As a result, tensions may emerge between the probabilistic nature of reproductive medicine and communication ecosystems that structurally reward certainty, differentiation, and emotionally compelling narratives. The expansion of reproductive add-ons illustrates these tensions particularly clearly. Several adjunctive interventions currently marketed within fertility care remain characterized by heterogeneous, preliminary, or incompletely validated evidence bases [9,19]. These include some immunological interventions, ovarian “rejuvenation” approaches, platelet-rich plasma applications, and various laboratory adjuncts introduced before definitive cumulative live birth validation. Importantly, uncertainty does not imply ineffectiveness. Many therapies initially emerge from biologically plausible hypotheses and early exploratory findings.

The ethical concern instead arises when market visibility accelerates more rapidly than evidentiary consolidation. Digital ecosystems may intensify these pressures. Institutions competing within engagement-driven informational environments often experience incentives toward continuous presentation of innovation, exclusivity, or technological superiority. Under such conditions, distinctions between exploratory possibility, compassionate experimentation, investigational intervention, and validated standard care may become increasingly difficult for patients to recognize. Visibility may therefore function as a surrogate marker of credibility independently of comparative outcome performance. This dynamic is particularly consequential in infertility because biological time functions as a nonrenewable clinical resource. Ovarian reserve, gamete quality, and implantation potential decline progressively and irreversibly with age [6,7]. Consequently, patients may perceive even preliminary interventions as rational opportunities under conditions of temporal pressure. Such decisions are understandable and often deeply personal. Yet they occur within environments characterized by profound informational asymmetry, where patients typically lack the expertise required to independently evaluate evidentiary maturity, denominator effects, or statistical robustness. The resulting asymmetry may render infertility patients especially vulnerable to communication emphasizing urgency, scarcity, or therapeutic exclusivity.

Again, this vulnerability does not imply widespread bad faith among clinicians or institutions. Most reproductive specialists remain strongly committed to patient welfare and evidence-based practice. The issue is structural rather than individual. Competitive systems naturally reward forms of communication that maximize engagement, differentiation, and perceived hope. The ethical challenge lies in ensuring that such pressures do not progressively weaken proportionality between evidence and promotion (Figure 2). Financialization may also indirectly influence translational priorities themselves. Contemporary therapeutic development increasingly depends upon costly regulatory pathways, multicenter validation, biotechnological infrastructure, and scalable commercialization models. Consequently, interventions that are patentable, technologically differentiable, or commercially scalable may possess structural advantages over low-cost, nonproprietary, or prevention-oriented approaches. Such asymmetries emerge not necessarily from deliberate exclusion but from the economics of translational medicine itself. This concentration of translational authority raises broader ethical questions regarding distributive justice and epistemic pluralism within reproductive care. Therapies lacking strong commercial pathways may struggle to attract sufficient investment despite potential patient benefit. Similarly, younger investigators, exploratory concepts, or unconventional lines of inquiry may encounter structural barriers within systems favoring scalable and lower-risk trajectories. In reproductive medicine, where delays carry irreversible biological consequences, such translational asymmetries acquire particular ethical significance.



Financial consolidation may further affect professional identity within fertility care. Increasingly, physicians practice within systems shaped by branding departments, institutional visibility strategies, digital communication teams, productivity metrics, and market differentiation frameworks. Under such conditions, clinicians may experience subtle tension between fiduciary obligations toward patients and organizational pressures favoring growth, procedural expansion, or visibility optimization. Most often, this tension is not explicit. Rather, it emerges gradually through normalization of institutional communication styles and performance expectations. Trust in reproductive medicine depends not only upon technical competence but also upon confidence that recommendations remain proportionate, transparent, and fundamentally oriented toward patient welfare. Financialized systems risk complicating this perception when ownership structures, institutional affiliations, or commercial incentives remain insufficiently visible to patients. Preserving clinical trust therefore requires governance mechanisms capable of maintaining transparency without demonizing investment itself.

For this reason, the ethical response to financialization should not be framed as opposition to innovation, entrepreneurship, or private participation in fertility care. Reproductive medicine has benefited enormously from translational investment and technological development. The challenge instead lies in preserving epistemic integrity within systems increasingly shaped by market mediation. Transparent conflict disclosure, denominator-standardized reporting, careful differentiation between investigational and validated interventions, external auditing, and separation between educational communication and promotional amplification may therefore represent essential safeguards for maintaining trust in reproductive medicine under conditions of increasing financial consolidation.

Reproductive Vulnerability and Communication Ethics

Communication in reproductive medicine occupies a uniquely sensitive ethical position because infertility is experienced not solely as a biomedical diagnosis, but also as uncertainty, anticipatory loss, temporal pressure, and disruption of deeply personal expectations

regarding identity, family formation, and future life trajectories [3,5]. In this context, communication cannot be understood as a neutral transfer of information. The manner in which probability, innovation, urgency, and therapeutic possibility are framed may directly shape patient expectations, emotional states, and decisional pathways. All medicine involves informational asymmetry between clinicians and patients. Reproductive medicine, however, intensifies this asymmetry through the convergence of several factors: probabilistic outcomes, rapidly evolving technologies, complex embryological concepts, emotionally charged decision-making, and irreversible biological timing. Most patients cannot independently evaluate laboratory performance, embryo selection methodologies, cumulative live birth denominators, evidentiary maturity of emerging interventions, or statistical limitations of reported outcomes. Consequently, fertility care depends heavily upon trust-mediated indicators of professional credibility.

Historically, such trust emerged primarily through longitudinal physician relationships, institutional reputation, scientific contribution, and peer referral networks. Increasingly, however, patients encounter reproductive medicine through digitally mediated ecosystems in which educational content, institutional promotion, social media visibility, AI-generated communication, and patient testimonials coexist within the same informational space. Under these conditions, the distinction between patient education and patient acquisition may become progressively blurred. This distinction is ethically important because infertility patients frequently experience elevated psychological vulnerability. Studies consistently document increased rates of distress, anxiety, depressive symptoms, relational strain, and decisional fatigue among individuals undergoing fertility treatment [4,5,20]. Hope therefore assumes unusual clinical significance within reproductive care. Hope may sustain resilience and treatment persistence under conditions of uncertainty; yet it may also become vulnerable to distortion when communication selectively amplifies possibility while minimizing evidentiary limitation, uncertainty, or probabilistic variability. The ethical challenge is amplified by the temporal structure of infertility itself. Reproductive medicine differs from many other clinical disciplines because delay may irreversibly reduce future therapeutic possibilities. Ovarian reserve declines progressively, embryo aneuploidy rates increase predictably with age, and implantation potential changes over time [6,7]. Patients may therefore perceive fertility treatment not merely as optional medical care but as a narrowing window of existential opportunity. Under such conditions, communication emphasizing urgency, exclusivity, or “last opportunity” narratives may exert disproportionate psychological influence.

This influence does not necessarily depend upon overt misinformation. Even factually accurate communication may become ethically problematic when proportionality is lost. Selective presentation of favorable outcomes without cumulative denominators, age stratification, confidence intervals, or discussion of uncertainty may substantially alter patient interpretation despite technical accuracy.

[8] Fertility outcomes can be expressed through multiple denominators—biochemical pregnancy, clinical pregnancy, implantation rates, live birth per transfer, cumulative live birth per retrieval, or cumulative outcomes across multiple cycles. Different denominators may produce dramatically different perceptions of efficacy. Ethical communication therefore requires transparency not only of data but also of framing. Digital communication ecosystems further complicate these dynamics. Patients increasingly encounter reproductive medicine through short-form videos, highly curated testimonials, physician influencers, clinic-sponsored educational campaigns, AI-assisted informational systems, and social-media-based fertility communities. Some of these resources may improve access to information and reduce barriers to specialized consultation. Others may unintentionally privilege anecdote over probability, exceptional outcomes over representative outcomes, or emotional resonance over evidentiary proportionality.

Narrative communication itself is not ethically problematic. Personal stories often reduce isolation, foster psychological support, and help patients navigate emotionally complex experiences. Difficulties arise when emotionally compelling narratives begin to substitute for transparent discussion of uncertainty, selection bias, denominator effects, or evidentiary limitations. Reproductive medicine remains intrinsically probabilistic. No physician, laboratory, algorithm, or institution can fully eliminate biological variability. Ethical communication therefore requires preserving visibility of uncertainty even within highly competitive informational environments. Several contemporary communication patterns illustrate these tensions. Public dissemination of operative procedures, continuous emphasis on technological uniqueness, highly curated success narratives, and repeated amplification of innovation may gradually contribute to a performative culture in which professional legitimacy becomes partially mediated through audience engagement. Such environments risk rewarding persuasive certainty more strongly than methodological nuance because emotionally simplified narratives often perform better within algorithmically amplified systems. Artificial intelligence may intensify these vulnerabilities further. AI-generated fertility content can now provide fluent, personalized, and emotionally responsive explanations regarding ovarian aging, embryo quality, add-on interventions, or treatment pathways [21,22]. Although these systems may improve informational accessibility, they do not inherently distinguish between validated evidence, preliminary findings, speculative interpretation, or commercially amplified claims.

When such content circulates within engagement-optimized ecosystems, patients may encounter increasingly flattened distinctions between evidence levels and forms of expertise. These developments raise broader questions concerning the fiduciary structure of reproductive medicine itself. Historically, patients trusted physicians not only because of technical expertise, but because communication was presumed to remain fundamentally oriented toward patient welfare rather than persuasion or institutional expansion. Digital ecosystems

complicate this fiduciary clarity because clinicians and institutions increasingly function simultaneously as caregivers, educators, communicators, institutional representatives, and participants within competitive visibility economies. Importantly, the ethical concern here should not be interpreted as a moral accusation directed toward individual clinicians. Most reproductive specialists remain deeply committed to evidence-based care and patient well-being. The problem is structural rather than personal. Engagement-driven communication environments systematically reward repetition, emotional immediacy, certainty, and narrative simplicity more strongly than probabilistic restraint or explicit acknowledgment of uncertainty. As a result, even ethically motivated professionals may experience subtle pressure toward communication styles progressively shaped by visibility dynamics. Protecting reproductive patients therefore requires more than preventing explicitly false claims.

It requires governance structures capable of preserving epistemic proportionality within communication itself. Transparent outcome reporting, denominator standardization, explicit differentiation between investigational and validated interventions, disclosure of uncertainty, careful regulation of testimonials and promotional framing, and separation between educational communication and commercial amplification may all represent important safeguards for maintaining trust within fertility care (Figure 3). Ultimately, communication ethics in reproductive medicine cannot be reduced to conventional advertising regulation alone. The issue concerns preservation of trust under conditions where emotional vulnerability, irreversible biological time, technological complexity, and informational asymmetry converge. Under such circumstances, epistemic integrity becomes inseparable from clinical ethics itself (Table 1).

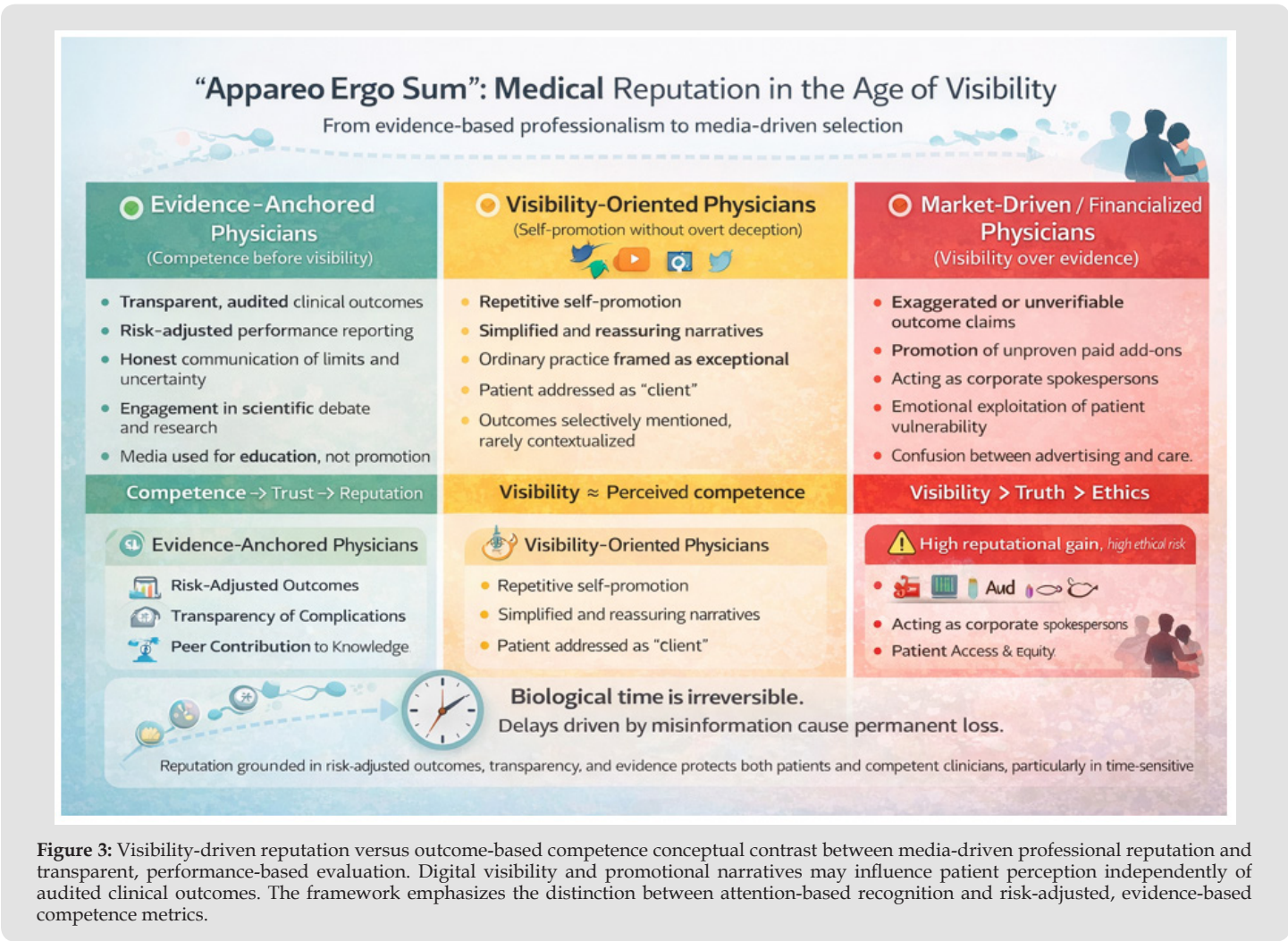


Figure 3: Visibility-driven reputation versus outcome-based competence conceptual contrast between media-driven professional reputation and transparent, performance-based evaluation. Digital visibility and promotional narratives may influence patient perception independently of audited clinical outcomes. The framework emphasizes the distinction between attention-based recognition and risk-adjusted, evidence-based competence metrics.

Table 1: Models of Professional Authority in Contemporary Reproductive Medicine.

Model of authority	Primary source of legitimacy	Risks	Potential strengths
Evidence-centered clinician	Peer-reviewed outcomes, longitudinal competence	Lower public visibility	Higher methodological reliability
Platform-mediated authority	Digital visibility and engagement	Attention-driven distortion	Broader informational reach
Technology-centered authority	Innovation and technological branding	Premature translational adoption	Accelerated implementation
Corporate-network authority	Institutional scale and operational infrastructure	Commercial pressure	Resource concentration
AI-mediated informational authority	Predictive and communicative scalability	Opacity and epistemic flattening	Accessibility and personalization

Artificial Intelligence and Epistemic Acceleration

Artificial intelligence is rapidly transforming the informational ecology of medicine. Large language models, predictive analytics, automated decision-support systems, and generative communication tools increasingly participate in clinical workflows, patient education, institutional communication, and scientific dissemination [21,22]. In reproductive medicine, AI applications now extend across embryo selection, ovarian stimulation modeling, laboratory automation, image analysis, predictive prognosis, and patient interaction systems. These technologies possess substantial potential to improve efficiency, accessibility, personalization, and analytical precision. At the same time, they introduce new ethical challenges concerning authority, validation, accountability, and epistemic integrity. Historically, medical knowledge acquisition depended upon relatively slow processes of peer review, methodological scrutiny, institutional mediation, and longitudinal verification. Scientific legitimacy emerged through cumulative evaluation rather than instantaneous dissemination. Artificial intelligence fundamentally accelerates this process. AI systems can now generate coherent medical explanations, summarize literature, simulate expertise, and produce persuasive informational content at unprecedented speed and scale. The consequence is not simply greater informational abundance, but transformation of how epistemic authority itself is perceived.

Large language models operate probabilistically rather than through embedded scientific verification [21]. They generate responses by identifying statistical relationships within training data rather than by independently validating the truthfulness, evidentiary quality, or contextual appropriateness of claims. Consequently, AI systems may simultaneously reproduce accurate consensus recommendations, outdated guidance, speculative interpretations, fabricated references, or subtly distorted conclusions depending upon prompt structure, training composition, and contextual ambiguity [21,22]. The ethical concern is therefore not merely factual error, but simulation of authoritative coherence independent of epistemic reliability. This distinction acquires particular significance in reproductive medicine because fertility patients often seek information under conditions of urgency, uncertainty, and emotional vulnerability. AI-generated communication may appear highly credible precisely because

it is fluent, immediate, personalized, and emotionally responsive. Yet persuasive clarity is not equivalent to evidentiary validity. In probabilistic medical domains characterized by heterogeneous evidence and rapidly evolving technologies, the appearance of certainty may itself become ethically destabilizing.

Digital platforms intensify these vulnerabilities. AI-generated content increasingly circulates within engagement-driven ecosystems optimized for amplification rather than verification. Algorithmic systems reward material that maximizes interaction, emotional salience, and retention time [10,11]. Consequently, AI-generated reproductive content emphasizing innovation, certainty, exceptional outcomes, or simplified explanations may receive disproportionate visibility independently of evidentiary robustness. When combined with the illusory truth effect, repeated exposure to AI-mediated claims may progressively shape perceived credibility even in the absence of rigorous validation [12]. Importantly, the ethical challenge extends beyond misinformation narrowly defined. AI may contribute to epistemic flattening: the erosion of visible distinctions between levels of evidence, expertise, and methodological reliability. Scientific medicine depends upon asymmetries of validation. Randomized controlled trials, systematic reviews, observational data, mechanistic hypotheses, expert opinion, and anecdotal narratives do not possess equivalent epistemic weight [1,2]. Evidence-based medicine was constructed precisely to preserve these distinctions. AI-mediated communication environments, however, may obscure them by presenting heterogeneous claims with similar rhetorical fluency and comparable informational accessibility.

In reproductive medicine, such flattening may influence both patient behavior and professional identity. Patients increasingly encounter AI-assisted educational tools before consulting physicians. Fertility clinics themselves may deploy automated communication systems, predictive counseling algorithms, chatbot-based triage, and AI-generated informational content. These systems may improve accessibility and reduce informational barriers. However, they may also unintentionally reinforce institutional branding, standardize emotionally persuasive messaging, or privilege operational efficiency over individualized probabilistic counseling. AI additionally introduces novel tensions regarding the meaning of expertise itself. Histori-

cally, reproductive specialists acquired authority through prolonged training, peer-reviewed contribution, procedural competence, and cumulative clinical experience. Generative AI now permits rapid production of medically sophisticated language without equivalent clinical grounding. The resulting environment risks confusing linguistic fluency with expertise. Authority may become increasingly mediated through communicative performance rather than demonstrable competence or audited outcomes.

This phenomenon is especially relevant within digital ecosystems where professional visibility already depends partly upon audience engagement. AI-assisted communication may amplify preexisting reputational asymmetries by enabling continuous content production, optimized messaging strategies, and scalable audience interaction. Under such conditions, algorithmic amplification and AI-generated fluency may reinforce one another, producing feedback loops in which prominence progressively detaches from independently verifiable clinical performance. At the institutional level, AI may also reshape governance structures within reproductive medicine. Predictive analytics and algorithmic decision-support systems increasingly influence embryo ranking, treatment personalization, ovarian stimulation protocols, and patient prioritization. Some applications demonstrate genuine promise for improving efficiency and reducing variability. Yet many AI systems remain characterized by limited transparency, proprietary modeling, incomplete external validation, and restricted reproducibility [23-25]. In such environments, clinicians and patients may struggle to evaluate whether algorithmic recommendations reflect robust evidence, biased training datasets, commercial optimization, or opaque statistical inference.

Opacity creates additional ethical concerns regarding accountability. When AI systems contribute to reproductive decision-making, responsibility for error, bias, overestimation, or inequitable outcomes may become diffused across clinicians, institutions, software developers, and platform infrastructures. This diffusion risks weakening traditional fiduciary clarity within medicine. Patients may increasingly encounter systems in which recommendations emerge from hybrid interactions among physicians, algorithms, institutional protocols, and digital communication architectures without clear transparency regarding how authority is distributed. The ethical implications extend further into the sociology of medicine. AI systems increasingly perform tasks historically associated with professional expertise: literature synthesis, differential diagnosis generation, outcome prediction, image interpretation, and even empathic conversational simulation [22,26]. As these capabilities expand, physicians may progressively transition from autonomous epistemic authorities toward supervisors of semi-autonomous informational systems. This transformation may alter not only workflows but also professional identity itself. Medicine risks evolving from a vocation grounded in interpretative judgment and fiduciary trust toward a model emphasizing oversight, throughput management, and algorithmic coordination.

Such developments do not imply that AI is inherently incompatible with ethical reproductive medicine. On the contrary, artificial intelligence may substantially improve access to care, reduce administrative burden, enhance predictive precision, facilitate personalized treatment, and democratize educational information. AI may also strengthen evidence-based practice when deployed transparently and subjected to rigorous external validation. The ethical challenge therefore concerns governance rather than prohibition. Preserving epistemic integrity within AI-mediated reproductive medicine requires safeguards capable of maintaining visible distinctions between validated evidence, probabilistic modeling, commercial amplification, and synthetic authority. Several principles may therefore become increasingly important: transparency regarding AI involvement in communication or decision support; independent external validation of predictive systems; explicit acknowledgment of uncertainty and model limitations; separation between educational content and promotional optimization; algorithmic auditability; and maintenance of human fiduciary accountability even within highly automated environments.

Recent regulatory initiatives, including emerging frameworks within the European Union concerning artificial intelligence and digital services governance, represent important initial efforts toward structured oversight [27,28]. Yet regulatory harmonization remains incomplete, and many reproductive applications occupy ethically ambiguous zones situated between medical device regulation, digital communication, and commercial platform governance. Ultimately, the ethical question raised by artificial intelligence in reproductive medicine is not whether machines can generate persuasive medical language or sophisticated predictive outputs. They already can. The deeper question concerns whether clinical authority will remain anchored to reproducible evidence, transparent accountability, and fiduciary responsibility in environments increasingly optimized for speed, visibility, scalability, and engagement. Preserving epistemic integrity under such conditions may become one of the defining ethical challenges of contemporary reproductive medicine.

Governance Safeguards for Epistemic Integrity

If reproductive medicine is increasingly shaped by algorithmic amplification, financial consolidation, and AI-mediated communication, then preservation of clinical trust requires more than individual professionalism alone. Structural transformations require structural safeguards. Ethical medicine cannot depend exclusively upon the presumed virtue of individual actors operating within ecosystems that systematically reward visibility, emotional engagement, institutional branding, and market expansion. The challenge is therefore not merely moral but institutional: how can reproductive medicine preserve epistemic integrity when the mechanisms through which authority is perceived are themselves undergoing transformation? Historically, medicine protected professional legitimacy through layered systems of verification. Peer review, specialty training, institutional accredi-

tation, morbidity and mortality review, longitudinal outcomes, and scientific reproducibility collectively functioned as mechanisms insulating clinical authority from purely reputational or rhetorical influence [1,2]. Although imperfect, these systems maintained an essential principle: professional credibility required demonstrable competence subject to external scrutiny.

Digital ecosystems complicate this model because visibility increasingly functions as an independent source of authority formation. Attention-based metrics now influence patient perception, institutional prominence, and even professional opportunities. Yet visibility itself is not inherently correlated with audited clinical outcomes, cumulative live birth performance, complication rates, or quality-adjusted reproductive care. The resulting asymmetry risks generating what may be described as epistemic drift: gradual divergence between perceived expertise and independently verifiable performance. Preserving trust under such conditions requires re-anchoring professional legitimacy in transparent and measurable indicators of competence. This does not imply reducing medicine to purely quantitative evaluation. Clinical judgment, empathy, contextual reasoning, and ethical discernment cannot be fully captured numerically. Nevertheless, absence of transparent evaluative frameworks may leave patients increasingly dependent upon algorithmically mediated impressions of authority rather than audited evidence.

One potential response involves development of structured merit-based evaluation systems integrating multiple dimensions of professional performance. Composite frameworks such as the proposed Merit-Based Professional Value Score (MPVS) and Integrity and Impact Score (IIS) illustrate how clinical legitimacy might be operationalized beyond visibility metrics alone. Rather than privileging popularity, institutional branding, or social media prominence, such frameworks would incorporate multidimensional indicators including clinical effectiveness, safety outcomes, cumulative live birth reporting, patient-reported outcomes, transparency practices, educational contribution, scientific rigor, and professional conduct. Importantly, any meritocratic framework must remain risk-adjusted and context-sensitive. Raw outcome reporting alone may produce misleading comparisons because reproductive medicine involves substantial variability in patient age, ovarian reserve, embryo quality, genetic factors, prior treatment history, and comorbid conditions. Clinics or physicians accepting more complex patients may appear to perform worse when evaluated through unadjusted metrics despite providing higher-quality care. Ethical evaluation therefore requires sophisticated adjustment for case mix, uncertainty intervals, and patient complexity rather than simplistic performance ranking. Transparency itself constitutes a central governance principle.

Fertility clinics increasingly operate within complex ownership structures involving private investment groups, vertically integrated networks, laboratory partnerships, and international financing arrangements. Such arrangements are not intrinsically unethical. However, patients possess legitimate interests in understanding

whether financial incentives, institutional affiliations, or commercial relationships may influence clinical recommendations or communication practices. Transparent disclosure of ownership structures and conflicts of interest therefore represents an important component of preserving fiduciary trust. A related issue concerns the distinction between educational communication and promotional communication. Digital environments often blur these categories. Physicians and institutions may simultaneously function as educators, scientific disseminators, marketers, and public-facing brands. Ethical governance does not require prohibition of public communication. On the contrary, patient education and public engagement remain valuable professional functions. Yet governance structures may need to establish clearer norms regarding denominator reporting, uncertainty disclosure, testimonial use, AI-generated communication, and presentation of investigational interventions.

Particular caution is warranted regarding reproductive add-ons and emerging therapies characterized by incomplete evidence bases. Professional societies have increasingly emphasized the importance of transparent disclosure concerning evidentiary strength and uncertainty for adjunctive fertility interventions [19,29]. However, digital amplification may create environments in which investigational possibilities acquire visibility comparable to validated standards of care. Governance frameworks should therefore require explicit differentiation between established interventions, promising but preliminary approaches, and experimental procedures lacking robust validation. Algorithmic transparency represents another emerging necessity. Increasingly, reproductive medicine operates within platform-mediated informational systems in which search ranking, recommendation algorithms, advertising optimization, and engagement metrics influence what patients encounter online. Yet these algorithmic architectures remain largely opaque. Patients may therefore interpret prominence as evidence of superiority without awareness that visibility itself may be shaped by commercial optimization strategies rather than clinical performance. Greater transparency regarding sponsored visibility, algorithmic amplification, and AI-generated communication may become essential for preserving informed patient choice.

Professional societies also possess an important governance role. Organizations such as European Society of Human Reproduction and Embryology and American Society for Reproductive Medicine historically functioned as custodians of methodological standards, guideline development, and evidence synthesis. Yet digital ecosystems increasingly challenge traditional gatekeeping structures. Scientific societies may therefore need to expand beyond conventional guideline production toward active engagement with digital communication ethics, AI governance, denominator standardization, and transparency frameworks for public-facing fertility communication. Academic institutions similarly face evolving responsibilities. Traditional academic medicine emphasized peer-reviewed productivity, mentorship, teaching, and scientific contribution as primary markers of legitimacy. Contemporary systems increasingly reward media visibility, digital engagement, and institutional branding alongside scholarly output.

Universities and training programs may therefore need to reconsider how professional prestige is constructed and communicated within digitally mediated ecosystems. Failure to do so risks normalizing environments in which algorithmic prominence progressively competes with evidence-based evaluation as a determinant of authority. Governance discussions must also address physician well-being and professional identity. Increasing administrative burden, productivity pressure, digital exposure, and commercialization contribute to widespread professional burnout across medicine [30,32]. Reproductive specialists often work within emotionally intense environments characterized by repeated exposure to patient grief, uncertainty, and high expectations. Simultaneously, clinicians increasingly navigate institutional metrics emphasizing throughput, visibility, patient acquisition, and online reputation management.

Under such conditions, professional identity may gradually shift from fiduciary vocation toward performance management within attention-driven systems [32-37]. These pressures affect patients as well. Fragmented, corporatized, or highly transactional systems may weaken continuity of care and destabilize longitudinal trust relationships. Some patients increasingly search for what might be described as relational medicine: sustained physician relationships grounded in transparency, continuity, and individualized interpretation rather than algorithmically optimized service delivery. Preserving such relationships may become progressively difficult within systems dominated by scalability and operational efficiency metrics. Importantly,

governance safeguards should not be interpreted as opposition to innovation, artificial intelligence, or institutional modernization. Reproductive medicine has historically advanced through scientific experimentation, technological adoption, and interdisciplinary collaboration. Digital communication may improve access to information; AI may enhance predictive precision; investment may expand technological infrastructure and accessibility. The ethical objective is therefore not resistance to modernization but preservation of proportionality between innovation and fiduciary responsibility.

Ultimately, epistemic integrity depends upon maintaining visible alignment between authority and accountability. Clinical trust becomes fragile when patients cannot distinguish validated expertise from amplified visibility, investigational promise from established efficacy, or educational communication from promotional persuasion. Reproductive medicine requires governance structures capable of protecting these distinctions precisely because infertility patients often make irreversible decisions under conditions of emotional vulnerability and biological urgency. The future legitimacy of reproductive medicine may therefore depend less upon technological sophistication itself than upon whether institutions preserve transparent relationships between evidence, communication, competence, and trust. In digitally accelerated and financially consolidated environments, epistemic integrity becomes not an abstract philosophical concern but a practical prerequisite for ethical reproductive care (Figure 4).



Figure 4: Standardized Public Profile for Professional Competence in Reproductive Medicine. Conceptual infographic illustrating a transparent, non-promotional framework for reporting the competence of a gynecologist with expertise in reproductive medicine and surgery. The figure integrates education and certified skills, case-mix stratified by low-, medium-, and high-complexity procedures, performance outcomes versus internationally expected benchmarks (including IVF/ART success rates and cumulative live birth), major and minor complications compared with standards, peer-reviewed scientific output (including bibliometric indicators), and final judicial outcomes related to malpractice. The model aims to realign professional reputation with audited clinical competence rather than media visibility, supporting informed patient choice and ethical accountability.

Evidence-Based Fertility Care Versus Add-On Interventions in Reproductive Medicine: Clinical Effectiveness, Transparency, and Ethical Responsibilities

Over the past four decades, reproductive medicine has evolved from a discipline largely focused on diagnosing infertility and restoring natural fertility to one increasingly reliant on assisted reproductive technologies (ART). Contemporary fertility practice encompasses a broad spectrum of interventions, ranging from evidence-based diagnostic investigations and treatments supported by randomized controlled trials and international guidelines to numerous adjunctive procedures commonly referred to as “add-ons.” These interventions are frequently proposed with the aim of improving reproductive outcomes despite limited, conflicting, or absent evidence of clinical benefit. The rapid expansion of fertility technologies has generated increasing concern among professional societies, regulators, patients, and ethicists regarding the distinction between interventions supported by robust clinical evidence and those that remain experimental. This distinction is particularly important because infertility patients are often emotionally vulnerable, highly motivated to achieve pregnancy, and willing to accept substantial financial burdens in pursuit of success. Consequently, transparency, informed consent, and evidence-based practice have become central ethical obligations in reproductive medicine.

Evidence-Based Diagnostic Investigations

Several investigations are universally recognized as standard-of-care diagnostic procedures because their clinical utility has been demonstrated and their findings influence management decisions. These include:

Female Evaluation

- Medical and reproductive history
- Physical and gynecological examination
- Ovulation assessment
- Ovarian reserve testing (AMH, AFC)
- Pelvic ultrasound
- Tubal patency assessment (HSG, HyFoSy, HyCoSy)
- Diagnostic hysteroscopy in selected patients
- Endocrine evaluation (TSH, prolactin, etc.)

ASRM, ESHRE, NICE, RCOG and ACOG consistently recommend these investigations as evidence-based components of infertility assessment [38-42].

Male Evaluation

- Semen analysis according to WHO criteria
- Hormonal assessment when indicated
- Genetic evaluation in severe male factor infertility
- Sperm DNA fragmentation testing in selected circumstances

Although sperm DNA fragmentation may provide prognostic information in specific clinical settings, routine use remains controversial and is not universally recommended [43].

Evidence-Based Fertility Treatments the Following Treatments are Supported by Moderate-to-High Quality Evidence and are Considered Standard Clinical Practice.

Ovulation Induction For anovulatory infertility: Letrozole, Clomiphene citrate Gonadotropins.

Particularly in women with PMOS, letrozole has become the preferred first-line therapy [44].

Surgical Restoration of Fertility Evidence supports:

- Hysteroscopic removal of submucosal fibroids
- Hysteroscopic septum correction in selected patients
- Endometrial polypectomy
- Salpingectomy for hydrosalpinx before IVF

These interventions improve reproductive outcomes by restoring normal anatomy and physiology [45-48].

IVF and ICSI IVF and ICSI Remain the Most Extensively Validated ART Procedures Worldwide. Multiple Randomized Trials and Registry Studies Demonstrate their Efficacy in Appropriately Selected Patients [49].

Recurrent Implantation Failure and Recurrent Pregnancy Loss for Recurrent Implantation Failure (RIF) and Recurrent Pregnancy Loss (RPL), Evidence Supports Investigation and Treatment of:

- Uterine anomalies
- Hydrosalpinx
- Antiphospholipid syndrome
- Uncontrolled thyroid disease
- Chronic endometritis (selected settings)

In contrast, many interventions routinely offered to these patients remain poorly supported by evidence [50-53].

PGT-A: Evidence and Controversies Preimplantation Genetic Testing for Aneuploidy (PGT-A) is Among the Most Debated Technologies in Reproductive Medicine.

Current evidence suggests:

Potential Benefits

- Reduced transfer of aneuploid embryos
- Lower miscarriage rates
- Improved implantation per transfer
- Shorter time-to-pregnancy in selected populations

Limitations

- No consistent increase in cumulative live birth rate in all age groups
- Increased treatment costs
- Potential embryo loss through biopsy and diagnostic uncertainty

ESHRE and ASRM currently recommend individualized use rather than universal application [54-57].

The Add-On Problem the Human Fertilisation and Embryology Authority (HFEA) Introduced the Concept of IVF add-ons to Identify Interventions Lacking Sufficient Evidence of Effectiveness.

According to HFEA, an add-on is: "An optional treatment offered in addition to standard fertility treatment, often at additional cost, for which evidence of benefit remains uncertain." Many interventions currently marketed worldwide fall into this category [58].

Common Add-Ons

1. Endometrial Scratch Initial enthusiasm was followed by multiple RCTs demonstrating little or no benefit in unselected populations [59].
2. Embryo Glue (Hyaluronic Acid Medium) Evidence suggests a possible modest improvement in implantation, but certainty remains low and recommendations remain cautious [60].
3. Immunological Therapies Including:
 - Corticosteroids
 - Intralipid infusions
 - IVIG
 - TNF-alpha inhibitors

Current evidence does not support routine use outside research protocols [61].

4. Anticoagulants
5. Heparin
6. Aspirin

Evidence supports use only in women with antiphospholipid syndrome. Routine administration for implantation failure or unexplained infertility remains unsupported [62].

7. Probiotics and Vaginal Lactobacilli Although microbiome research is promising, there is currently insufficient evidence that routine probiotic treatment improves live birth rates [63].
8. Antioxidants and Nutraceuticals Evidence remains heterogeneous and generally insufficient to justify routine recommen-

dation [64].

9. Ovarian Rejuvenation (PRP) One of the most controversial interventions currently available. Although preliminary studies report encouraging findings, major societies consider ovarian PRP experimental and investigational [65].

10. Stem Cell-Based Ovarian Therapies Currently experimental. No society recommends routine clinical use [66].

11. High-Intensity Focused Ultrasound (HIFU) for Fibroids HIFU may improve symptoms and reduce fibroid volume. However, evidence demonstrating improved fertility outcomes remains limited compared with myomectomy [67].

Ethical and Economic Implications of Add-Ons a Fundamental Ethical Dilemma Emerges when Clinics Derive Substantial Income from Procedures they Simultaneously Acknowledge Lack Proven Efficacy. This Creates a Potential Conflict between: Patient Benefit, Commercial Interests, Scientific Evidence

Professional societies consistently emphasize that uncertainty must be clearly communicated [58].

Transparency and Informed Consent when Proposing an add-on, Clinicians should Explicitly State:

Evidence Status

- a) Proven effective
- b) Limited evidence
- c) Experimental
- d) Research only

Expected Benefits Quantitative Estimates whenever Available.

Risks Including Financial Costs.

Alternatives Including Standard Treatment without the Add-On.

Scientific Position Statements Reference to HFEA, ESHRE, ASRM, NICE or RCOG Recommendations. Patients should Understand when a Procedure is not Considered Standard Care.

Should Add-Ons Be Charged? An Unresolved Ethical Question Concerns Charging Patients for Interventions Lacking Proven Benefit. Three Possible Models Exist:

Model 1 No Charge Experimental Intervention Provided within Research.

Model 2 Cost-Recovery Only Patients Pay Direct Costs but No Profit Margin.

Model 3 Commercial Pricing Full Market Pricing Despite Uncertain Efficacy.

From an ethical perspective, many bioethicists argue that inter-

ventions classified as experimental should ideally be offered within research frameworks or at cost-recovery levels rather than as major revenue-generating services [68,69]. Conclusions Evidence-based reproductive medicine requires a clear distinction between established treatments and add-on interventions. International organizations including NICE, RCOG, ACOG, ASRM, ESHRE and HFEA consistently support transparency regarding the quality of evidence underlying fertility treatments. Patients deserve accurate information regarding expected benefits, risks, uncertainty, and costs. While innovation remains essential for progress, commercialization of unproven interventions should not outpace scientific validation. The future of reproductive medicine should be guided not only by technological possibilities but also by rigorous evidence, informed consent, and ethical responsibility.

Conclusion

Reproductive medicine stands at a pivotal moment in the evolution of contemporary health care. Digital communication systems, algorithmic amplification, artificial intelligence, and financial consolidation are transforming not only how fertility care is delivered, but also how professional authority is constructed, perceived, and trusted. These transformations create substantial opportunities for innovation, accessibility, personalization, and translational progress. At the same time, they introduce structural tensions capable of destabilizing the epistemic foundations upon which evidence-based medicine depends. The distinctive vulnerability of reproductive medicine arises from the convergence of several ethically consequential conditions: irreversible biological time, probabilistic outcomes, profound informational asymmetry, emotional fragility, and highly competitive visibility-driven environments. Under such circumstances, even subtle distortions in how expertise is communicated or perceived may significantly influence patient decisions, resource allocation, treatment trajectories, and expectations concerning reproductive possibility. The central ethical challenge examined in this article is therefore not simply misinformation, commercial influence, or technological disruption considered separately.

Rather, it is the preservation of epistemic integrity itself. Medicine depends upon reliable alignment between evidence, competence, communication, and trust. When algorithmic visibility progressively competes with evidence-based legitimacy as a determinant of authority, this alignment risks weakening. Repetition, emotional salience, and engagement optimization may acquire structural advantage over probabilistic restraint, methodological transparency, and acknowledgment of uncertainty. Importantly, this analysis should not be interpreted as opposition to innovation, digital communication, artificial intelligence, or private investment. Reproductive medicine has historically advanced through scientific experimentation, technological progress, interdisciplinary collaboration, and translational infrastructure supported by both public and private actors. Artificial intelligence may enhance prediction and educational accessibility;

digital communication may reduce informational barriers; financial investment may expand technological capabilities and patient access. The ethical problem emerges only when these systems operate without sufficient governance safeguards preserving transparency, accountability, and proportionality.

Preserving trust in reproductive medicine will therefore require deliberate institutional responses. Transparent denominator-standardized outcome reporting, explicit distinction between investigational and validated interventions, disclosure of ownership structures and conflicts of interest, external auditing, algorithmic transparency, and governance frameworks insulated from visibility metrics alone may all become increasingly necessary. Professional societies, academic institutions, regulatory bodies, and clinicians themselves will likely play essential roles in defining these safeguards. Equally important is preservation of the fiduciary orientation of medicine. Infertility patients are not merely consumers selecting among competing technological services. They are individuals confronting uncertainty, suffering, temporal limitation, and existential vulnerability under conditions in which they cannot independently verify most technical claims. Ethical reproductive care therefore depends upon maintaining confidence that communication and clinical recommendation remain fundamentally oriented toward patient welfare rather than engagement optimization or institutional expansion.

The future legitimacy of reproductive medicine may consequently depend less upon technological sophistication itself than upon whether the discipline succeeds in preserving visible alignment between authority and accountability. Clinical trust cannot ultimately be sustained through amplification alone. It requires reproducible evidence, transparent uncertainty, measurable competence, and governance structures capable of protecting the distinction between validated expertise and algorithmically mediated prominence. Reproductive medicine now operates within a historical transition in which the architecture of credibility itself is being renegotiated. Whether the discipline can preserve epistemic integrity while adapting to AI-mediated, financially consolidated, and digitally accelerated ecosystems remains one of the defining ethical questions of contemporary medicine.

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Conflicts of Interest

Owner of the worldwide platform Helpme Doctor for 1st and 2nd medical opinions.

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