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Shoham Z, Weissman A, Yaron Y. Global Ethics in IVF: Harmonizing Regulation, Ensuring Access, and Governing Innovation. *Journal of IVF-Worldwide*. 2025;3(3):75-93. doi:10.46989/001c.142396

Original Research Articles

Global Ethics in IVF: Harmonizing Regulation, Ensuring Access, and Governing Innovation

Zeev Shoham[1a], Ariel Weissman[2], Yuval Yaron[3]

[1] Hadassah Medical School, The Hebrew University, Jerusalem, Israel, [2] IVF Unit, Department of Obstetrics and Gynecology, Edith Wolfson's Medical Center, Holon, Affiliated with the Faculty of Medicine, Tel-Aviv University, Tel-Aviv, Israel, [3] Prenatal Genetic Diagnosis Unit, Genetic Institute, Tel Aviv Sourasky Medical Center, Israel

Keywords: IVF ethics, reproductive justice, preimplantation genetic testing, global health equity, assisted reproductive technology, international regulation

https://doi.org/10.46989/001c.142396

Journal of IVF-Worldwide

Vol. 3, Issue 3, 2025

Background

In vitro fertilization (IVF) has facilitated over 10 million births globally, with annual growth rates exceeding 5%. However, this expansion has intensified ethical challenges spanning genetic selection, embryo management, access equity, and emerging biotechnologies.

Methods

We conducted a comparative ethical analysis of IVF practices across nine countries (United Kingdom, United States, Israel, Ghana, Italy, Japan, China, India, and France) representing diverse economic, cultural, regulatory, and healthcare contexts. Additional analysis incorporated data from the European Atlas of Fertility Treatment Policies (2024), which systematically evaluated 49 European countries and territories on access to equitable, safe, and efficient fertility treatments using standardized criteria. Data sources included peer-reviewed literature (2020–2025), government reports, professional society guidelines, and legal documents.

Results

Critical disparities were identified in global IVF governance, affecting 2–3 million treatment cycles annually. Key findings include: (1) stark regulatory inconsistencies in preimplantation genetic testing, ranging from strict medical-only applications (UK) to unrestricted consumer choice (parts of the US); (2) dramatic access inequities, with per-capita utilization varying 200-fold between high- and low-resource settings, and even within Europe, where access scores range from 89.5% (Belgium) to 7.8% (Kosovo); (3) inadequate ethical preparation for emerging technologies including in vitro gametogenesis and CRISPR gene editing; and (4) insufficient integration of diverse cultural and religious perspectives in international guidelines. France's recent policy evolution (2021–2022) demonstrates both the potential for rapid progressive reform and the persistence of social disparities despite universal coverage.

Conclusions

Current piecemeal approaches to IVF ethics create regulatory arbitrage and perpetuate global health inequities. We propose a WHO-convened global ethics framework to standardize IVF ethical practices by 2027, addressing disparities in access, regulation, and technology governance.

a Corresponding author: Zeev Shoham MD. Email: zeev1@mail.huji.ac.il

INTRODUCTION

IVF stand as one of modern medicine's most transformative achievements, fundamentally altering human reproduction and family formation. Since Louise Brown's birth in 1978, over 10 million children have been born through assisted reproductive technologies (ARTs) globally, with current annual rates exceeding 500,000 births per year. The exponential growth from fewer than 1,000 cycles in 1980 to over 2.5 million cycles annually by 2024 represents not merely technological advancement but a profound shift in how societies conceptualize reproduction, parenthood, and human intervention in biological processes.

Contemporary IVF encompasses sophisticated genetic screening through preimplantation genetic testing (PGT), artificial intelligence (AI)-driven embryo selection algorithms, advanced cryopreservation techniques, and emerging possibilities including in vitro gametogenesis and mitochondrial replacement therapy. Each innovation brings new therapeutic possibilities while, at the same time, introducing complex ethical challenges that transcend national boundaries and cultural contexts.

Recent developments have intensified global scrutiny of IVF ethics. The Alabama Supreme Court's February 2024 ruling granting legal personhood to frozen embryos created immediate clinical paralysis, forcing IVF clinics to suspend treatments while grappling with unprecedented liability concerns.[1] This ruling illustrates how legal developments can dramatically alter clinical practice and patient access to reproductive technologies.

Commercialization pressures have created additional ethical challenges as fertility clinic consolidation and profit-driven expansion of invalidated treatments threaten patient welfare. The proliferation of expensive "add-ons" with limited evidence base, aggressive marketing of genetic testing, and financial incentives that may prioritize revenue over patient outcomes represent emerging threats to reproductive medicine's ethical foundations.[2]

Concurrently, since 2021, China has significantly increased state investment in reproductive technologies in response to declining birth rates and an aging population. France has similarly integrated fertility policy with demographic objectives, with President Macron's 2024 national fertility plan actively promoting IVF use while providing comprehensive public coverage following the 2021-2022 extension of access to single women and lesbian couples.[3, 4] Japan has debated expanding IVF access for single women amid persistent demographic decline.[5] Meanwhile, global fertility tourism continues to rise, with notable growth in Southeast Asian hubs over the past decade.[6,7]

The current global IVF landscape reveals striking disparities that raise fundamental questions about reproductive justice and human dignity. While Israeli couples receive unlimited publicly funded IVF cycles until achieving two live births,[8] and French women under 43 receive four complete rounds of assisted reproduction per pregnancy regardless of sexual orientation or marital status,[4] couples in sub-Saharan Africa often cannot access basic infertility diagnosis.[7] A single IVF cycle costs approximately $12,000-25,000 in the United States,[9] €3,000 (approximately $3,200) in the Czech Republic,[10] while France provides comprehensive coverage at no cost to patients,[4] and remains entirely unavailable in many regions despite infertility rates that often exceed those in developed countries.[11] Even within Europe, a continent with relatively harmonized healthcare policies, the 2024 European Atlas of Fertility Treatment Policies reveals dramatic disparities, with access scores ranging from 89.5% in Belgium to 7.8% in Kosovo, demonstrating that geographic proximity and similar economic development do not guarantee equitable reproductive healthcare access.[12]

This manuscript provides the first comprehensive global comparison of IVF ethical frameworks, moving beyond single-country case studies to examine systemic patterns and cross-border implications. We analyze five core ethical domains: (1) genetic selection through preimplantation genetic testing, (2) embryo storage and disposal, (3) equitable access to reproductive technologies, (4) patient-centered counseling, and (5) ethical preparedness for emerging technologies.

METHODS

STUDY DESIGN AND THEORETICAL FRAMEWORK

We conducted a comprehensive comparative ethical analysis of IVF practices using a mixed-methods approach combining systematic literature review and policy analysis. The theoretical framework integrated principles-based bioethics (autonomy, beneficence, non-maleficence, justice) with contemporary approaches including feminist bioethics, disability rights perspectives, and reproductive justice frameworks.

COUNTRY SELECTION CRITERIA

Nine countries were selected through purposive sampling to represent diverse economic, cultural, regulatory, and healthcare contexts: United Kingdom, United States, Israel, Ghana, Italy, Japan, China, India, and France. Selection criteria included: (1) Geographic distribution across four continents; (2) Economic diversity from low-income to high-income classifications; (3) Healthcare system variation (universal, insurance-based, mixed, private); (4) Religious and cultural diversity (Christian, Jewish, Islamic, Buddhist, Hindu, secular); (5) Regulatory approach diversity (comprehensive, minimal, evolving); and (6) Availability of accessible policy documentation in English or with reliable translations. France was added specifically to represent recent progressive policy evolution within a comprehensive public healthcare framework.

While the analysis aimed to represent global diversity, Latin America and Eastern Europe were not included due to limited availability of recent, peer-reviewed ethical analyses and consistent policy documentation in English or with reliable translations. These regions remain important to the global IVF landscape and warrant inclusion in future analyses as more accessible data becomes available. However, our analysis was significantly enhanced by incorpo-

rating data from the European Atlas of Fertility Treatment Policies,[12] which provides systematic evaluation of 49 European countries and territories using standardized criteria for access to equitable, safe, and efficient fertility treatments.

SYSTEMATIC LITERATURE SEARCH STRATEGY

A comprehensive literature search was conducted across multiple databases including PubMed, EMBASE, Web of Science, and regional databases for non-English sources. Search terms combined controlled vocabulary (MeSH terms) and free text, including: "in vitro fertilization" OR "assisted reproductive technology" AND "ethics" OR "bioethics" AND "policy" OR "regulation" AND specific country names. Additional searches focused on France's 2021-2022 bioethics law reform, European fertility policy evolution, and comparative oncofertility frameworks. Additional searches focused on emerging technologies: "preimplantation genetic testing," "embryo storage," "CRISPR," "mitochondrial replacement," and "in vitro gametogenesis."

Inclusion criteria: (1) Peer-reviewed articles published 2020-2025; (2) Government reports and policy documents from selected countries; (3) Professional society guidelines and position statements; (4) Legal case analyses and legislative documents; (5) International organization reports (WHO, UNESCO, regional bodies); (6) European Atlas of Fertility Treatment Policies[12] and associated documentation from Fertility Europe and the European Parliamentary Forum for Sexual and Reproductive Rights.

Exclusion criteria: (1) Articles focusing solely on clinical outcomes without ethical analysis; (2) Opinion pieces without empirical basis; (3) Publications predating significant policy changes unless providing essential historical context.

DATA COLLECTION AND ANALYSIS

Data extraction utilized a standardized framework addressing: (1) Regulatory approaches and legal frameworks; (2) Professional guidelines and standards; (3) Access policies and coverage models; (4) Cultural and religious influences; (5) Patient protection measures; (6) Emerging technology governance. Additional data were extracted from the European Atlas using their standardized scoring methodology across 23 sub-criteria grouped into three main categories: legal regulations on access, public funding/reimbursement, and patients' perspective.

Qualitative content analysis was performed using thematic coding to identify patterns, contradictions, and gaps across countries and ethical domains. Two independent reviewers coded all materials with discrepancies resolved through discussion.

COMPARATIVE ANALYSIS FRAMEWORK

Comparative analysis methodology was employed to systematically examine ethical frameworks and policy approaches across different national contexts. Rather than formal case studies, we integrated examples from the nine selected countries throughout our thematic analysis to illustrate contrasting regulatory approaches, cultural adaptations, access models, and technology governance responses. European Atlas data provided additional comparative context by enabling systematic comparison of policy frameworks across 49 European countries using standardized criteria, revealing patterns of regulatory effectiveness and access equity within a relatively harmonized continental context. This comparative approach enabled identification of successful policy models and cautionary experiences while highlighting how different societies navigate similar ethical challenges in reproductive medicine. The analysis was structured around key dimensions including regulatory frameworks, cultural and religious influences, access policies, and emerging technology governance, with specific country examples used to demonstrate the diversity of approaches and outcomes across different contexts.

LIMITATIONS

This analysis acknowledges several limitations: (1) Language barriers limiting access to non-English sources, potentially underrepresenting perspectives from Latin America, Eastern Europe, and other regions; (2) Temporal constraints focusing on 2020-2025 may miss important historical developments; (3) Reliance on published sources may not capture emerging policy developments or informal practices; (4) Case study selection bias toward well-documented cases in high-resource settings. The European Atlas data, while comprehensive for Europe, focuses primarily on policy frameworks rather than clinical outcomes or patient experiences, and may not capture informal practices or implementation variations at the local level.

RESULTS

GENETIC SELECTION: GLOBAL VARIATIONS IN PREIMPLANTATION GENETIC TESTING

Preimplantation Genetic Testing (PGT) applications demonstrate dramatic international variations that reflect underlying cultural values, regulatory philosophies, and healthcare priorities. Our analysis reveals four primary areas of ethical concern with significant cross-national disparities.

LATE-ONSET CONDITIONS AND FUTURE AUTONOMY

The American Society for Reproductive Medicine (ASRM) permits PGT for late-onset conditions meeting three criteria: severity, high penetrance, and absence of viable treatment options.[13] However, implementation varies significantly across U.S. clinics, with some offering extensive genetic panels while others maintain restrictive approaches. Dondorp et al. emphasize that severity alone cannot determine appropriateness, highlighting tensions between preventing future suffering and preserving individual autonomy.[14]

The United Kingdom's Human Fertilisation and Embryology Authority (HFEA) maintains stricter oversight, requiring individual license applications for each late-onset condition with demonstrated serious impact. This approach contrasts sharply with some U.S. jurisdictions where market forces primarily determine available services. France operates under the oversight of the French Biomedicine Agency (Agence de la Biomedecine), which maintains moderate restrictions on PGT applications, requiring medical justification for late-onset conditions while allowing broader access than the UK system.

SEX SELECTION AND CULTURAL VALUES

Sex selection for family balancing reveals profound cultural tensions between individual reproductive autonomy and societal gender equity concerns. ASRM considers sex selection ethically permissible under certain circumstances but explicitly discourages initiating IVF solely for this purpose in fertile patients.[15] The European Society of Human Reproduction and Embryology (ESHRE) adopts similarly cautious positions, allowing sex selection only under highly specific conditions.[16] France prohibits sex selection for non-medical reasons, consistent with broader European approaches emphasizing gender equality principles.

India and China have implemented targeted restrictions on non-medical sex selection due to previous experiences with gender imbalances in their populations,[16,17] demonstrating how historical social consequences can inform contemporary policy development. In Israel, family balancing is not allowed with the exception that couples having four children of the same gender may apply to a special committee that permits sex selection in some cases.

MULTIFACTORIAL DISEASE TESTING AND EQUITY CONCERNS

Testing for multifactorial conditions involving polygenic risk scores presents unique challenges regarding predictive accuracy and social justice. The American College of Medical Genetics and Genomics (ACMG) emphasizes urgent needs to address clinical, technical, and environmental biases to promote equitable access.[18] Clarke & van El warn that without careful oversight, genomic medicine could amplify existing societal disparities.[19] French genetic testing policies emphasize equity and access within the public healthcare framework, though commercial expansion of polygenic testing remains limited compared to the US market.

Existing biases in genetic databases, which historically focus on populations of European ancestry, create significant gaps in understanding genetic risk factors for underrepresented groups, potentially exacerbating healthcare disparities.

ANEUPLOIDY SCREENING AND COMMERCIAL PRESSURES

Gleicher and colleagues have documented significant limitations in preimplantation genetic testing for aneuploidy (PGT-A) clinical utility, particularly regarding false positive results that may lead to discarding viable embryos.[2,20] Their analysis reveals how genetic testing companies have become major beneficiaries of PGT-A procedures despite questionable evidence supporting widespread implementation, representing what they term the replacement of "Big Pharma" with genetic testing industries as primary drivers of treatment expansion.

Commercial incentives may encourage overutilization of PGT-A, as clinics and testing companies benefit financially from expanded screening regardless of clinical necessity. This creates potential conflicts of interest where economic considerations may override evidence-based practice, raising concerns about patient exploitation and inappropriate resource allocation. France's public healthcare system provides some protection against commercial exploitation, though private sector expansion and international commercial pressures remain concerns.

Yang and colleagues identified substantial problems with patient education materials, noting that many exceed recommended reading levels and inadequately communicate testing limitations.[21] These educational gaps may facilitate commercial exploitation by preventing truly informed decision-making.

Current regulatory oversight remains inadequate in many jurisdictions, creating opportunities for market-driven expansion of unproven technologies. Stronger oversight mechanisms, including potential FDA involvement in the United States, are needed to ensure that commercial interests do not compromise patient welfare.

The European Atlas data reveals additional variations in PGT availability across European countries, with preimplantation genetic testing for monogenic diseases and structural rearrangements (PGT-M/SR) available in 28 of the 49 countries surveyed. Countries with comprehensive regulatory frameworks like Belgium (89.5% access score) and the Netherlands (89.4% access score) provide genetic testing as part of their fully funded services, while countries with limited regulatory oversight show variable availability often dependent on private payment. This pattern demonstrates how regulatory frameworks directly influence both the availability and accessibility of genetic testing services.[12]

EMBRYO STORAGE AND DISPOSAL: CULTURAL AND LEGAL COMPLEXITIES

Embryo storage practices demonstrate remarkable international diversity reflecting cultural values, legal traditions, and healthcare priorities.

STORAGE DURATION AND ABANDONMENT POLICIES

The United Kingdom maintains restrictive 10-year storage limits through HFEA regulations,[22] contrasting with the United States where storage duration varies dramatically from limited periods in some states to indefinite storage in others (LePage v. Center for Reproductive Medicine, 2024). France permits 5-year renewable storage periods with mandatory counseling at renewal, balancing patient autonomy with resource management and ethical oversight.

Table 1. Comparative Analysis of PGT Applications and Regulatory Effectiveness

Country	Late-Onset Conditions	Sex Selection	Multifactorial Testing	Aneuploidy Screening	Regulatory Oversight	Commercial Pressures	Key References
UK	Restricted, case-by-case	Prohibited except medical	Limited research only	Regulated, quality standards	Comprehensive (HFEA)	Limited due to oversight	**Human Fertilisation and Embryology Authority[22]**
US	Variable by clinic	Permitted with restrictions	Expanding commercially	Widely available	Professional guidelines only	High, market-driven	**Ethics Committee of ASRM[13]; Gleicher et al.[2]**
France	**Moderate restrictions, medical justification required**	**Prohibited except medical**	**Limited within public system**	**Available with counseling**	**French Biomedicine Agency oversight**	**Limited by public system, emerging private sector**	**French Bioethics Law[4]; Macron National Fertility Plan[3]**
Israel	Permitted, comprehensive coverage	Limited religious exemptions	Research protocols	Standard practice	Ministry oversight	Moderate, public system	**Birenbaum-Carmeli & Dirnfeld[8]; Simonstein[23]**
Japan	Restricted to married couples	Prohibited	Limited availability	Available with counseling	Professional societies	Low to moderate	**Kato & Sleeboom-Faulkner[24]; Nakazawa[25]**
China	Government-guided expansion	Prohibited for gender balance	State-directed research	Regulated availability	State medical boards	State-controlled	**Regalado[26];**
India	Emerging regulations	Strictly prohibited	Limited private availability	Variable quality	2021 ART Act implementation	Increasing, private sector	**Assisted Reproductive Technology Act[17]**
Italy	Recently liberalized	Restricted	Limited availability	Available with counseling	Regional variation	Moderate, mixed system	**Benagiano & Gianaroli[27]**
Ghana	No formal regulations	Cultural preferences	Not available	Limited availability	Professional discretion	Minimal oversight	**Adageba et al.[11]; Gerrits[7]**

Japan exhibits unique cultural dynamics where spiritual beliefs significantly influence patient decision-making, with many couples demonstrating reluctance to discard embryos due to cultural reverence for potential life.[24,25]

Italy's regulatory evolution from the complete prohibition of embryo freezing under Law 40/2004 to more flexible approaches reflect complex interactions between religious influences and practical medical needs. Recent legislative changes allowing widowed or separated women to use previously frozen embryos represent shifts toward recognizing women's reproductive autonomy.[28]

The Alabama Supreme Court's 2024 ruling granting legal personhood to frozen embryos has created unprecedented clinical paralysis, with some clinics halting embryo procedures entirely due to legal liability concerns. This development illustrates how evolving judicial interpretations can dramatically alter clinical practice.

EMBRYO DONATION

Embryo donation represents another ethically significant area of embryo disposition, with policies varying widely across countries. However, this analysis did not include embryo donation in depth due to inconsistencies in regulation and reporting, and the lack of comparative international data. Further exploration is warranted given its growing relevance for both research and family-building purposes.

CULTURAL AND RELIGIOUS PERSPECTIVES

Catholic doctrine prohibits embryo disposal while promoting either immediate transfer or indefinite storage as morally acceptable options, creating financial and emotional burdens for Catholic patients.[29] Islamic jurisprudence generally permits embryo disposal within specific timeframes under particular circumstances while emphasizing respectful treatment.[30] Japanese fertility clinics have developed ceremonial practices acknowledging discarded embryos, reflecting cultural attempts to balance technological capabilities with spiritual values.[24] France's secular approach emphasizes patient counseling and informed consent while respecting diverse religious perspectives within its pluralistic society.[4] These practices illustrate how genetic selection technologies must be adapted to diverse cultural contexts.

ECONOMIC AND ENVIRONMENTAL CONSIDERATIONS

Storage costs typically range from $300 to $1,000 annually per patient, creating substantial long-term financial obligations. In France, storage costs are covered by the public healthcare system during the initial 5-year period, with renewals requiring counseling and shared decision-making about continued storage.[4] The environmental impact of long-term embryo storage, requiring constant power supply and monitoring equipment, raises questions about resource allocation priorities within broader healthcare needs.

European perspectives on embryo storage show significant variation despite geographic proximity. According to the Atlas data, while most European countries permit embryo freezing, specific storage duration policies and disposal procedures vary considerably. Countries with mandatory embryo donation policies, such as Malta and Poland, represent one regulatory extreme, while others allow patient discretion in embryo disposition. The Atlas identifies these mandatory donation policies as barriers to access, with Malta (64.6% access score) and Poland (62.1% access score) ranking below countries with more flexible embryo management approaches.[12]

ACCESS EQUITY: GLOBAL DISPARITIES AND JUSTICE IMPLICATIONS

Access to IVF demonstrates profound global inequities that challenge basic principles of reproductive justice and human dignity.

ECONOMIC BARRIERS AND COVERAGE MODELS

Israel represents the most comprehensive coverage model globally, providing unlimited publicly funded IVF cycles until couples achieve two live births. This approach has resulted in some of the world's highest per-capita utilization rates, (the number of IVF treatment cycles performed annually per million women of reproductive age), while achieving excellent clinical outcomes.[8] Moreover, PGT-M and PGT-SR are also funded in appropriate cases until couples achieve two healthy live births.

France has emerged as a leading model of progressive policy evolution, providing four complete rounds of assisted reproduction per pregnancy for all women under 43, with full public coverage regardless of sexual orientation or marital status following the 2021-2022 legislative expansion. This transformation from restrictive heterosexual-couple-only access to universal coverage represents one of the most significant recent advances in reproductive rights globally. However, despite comprehensive free coverage, France demonstrates that universal access doesn't eliminate social disparities, with 65.4% of eligible women not accessing IVF/ICSI and non-access rates increasing significantly with neighborhood deprivation levels, challenging assumptions that financial barriers are the primary access obstacle.

Scandinavian countries including Denmark, Sweden, and Norway provide 1-3 publicly funded cycles based on specific criteria, balancing access with resource allocation concerns. Denmark has achieved exceptional success rates while maintaining broad access through evidence-based protocols and quality assurance.[32]

Poland's IVF coverage is currently publicly funded through a government program launched in June 2024. This program, which runs until 2028, provides full funding for up to six assisted reproduction procedures, including embryo donation, and other procedures depending on the patient's reproductive cells. The program also supports fertility preservation for cancer patients.[33]

The United States presents a complex patchwork of access, with only 19 states mandating insurance coverage and significant variations in covered services. States like Massachusetts demonstrate that comprehensive coverage man-

Table 2. International Embryo Storage Policies Comparison

Country	Storage Duration	Abandonment Procedures	Religious Influences	Legal Framework	Cost Coverage	Key References
UK	10 years (HFEA limit)	Clear protocols	Secular approach	Comprehensive legislation	NHS coverage	**Human Fertilisation and Embryology Authority**[22]
US	Variable by state	Clinic-dependent	Mixed influences	Patchwork regulations	Private insurance variable	**LePage v. Center for Reproductive Medicine**[1]
France	5 years renewable with counseling	Structured counseling protocols	Secular with religious accommodation	Bioethics law framework	Full public coverage	**French Bioethics Law**[4]**; French Biomedicine Agency Guidelines**
Israel	Unlimited	Rarely applicable	Jewish religious support	Comprehensive coverage	Full public funding	**Birenbaum-Carmeli & Dirnfeld**[8]
Japan	Cultural considerations	Ceremonial practices	Buddhist/Shinto influences	Professional guidelines	Partial coverage	**Kato & Sleeboom-Faulkner**[24]**; Nakazawa**[25]
China	Government guidelines	State oversight	Secular approach	Regulatory framework	Urban insurance coverage	**Peng et al.**[31]
India	2021 Act provisions	Emerging protocols	Hindu/Islamic considerations	New federal legislation	Private payment	**Assisted Reproductive Technology Act**[17]
Italy	Recently liberalized	Regional variation	Catholic influences	European framework	Regional differences	**Benagiano & Gianaroli**[27]
Ghana	No formal policies	Practical decisions	Traditional beliefs	Professional discretion	Private payment only	**Adageba et al.**[11]**; Gerrits**[7]

dates can significantly increase utilization while improving outcomes through earlier treatment initiation.

The European Atlas reveals striking disparities in access even within a single continent with relatively similar economic development and healthcare infrastructure. Belgium (89.5%) and the Netherlands (89.4%) achieve the highest access scores by providing comprehensive legal frameworks, full funding for 4 intrauterine insemination (IUI) and 6 IVF/ICSI cycles, psychological support, and consultation with patient associations. In contrast, countries like Kosovo (7.8%) and Azerbaijan (10.5%) provide minimal access despite operating within similar regional contexts. Even developed European countries show dramatic variations, with Switzerland (26.2%) ranking significantly lower than neighboring countries due to limited public funding and restrictive policies.[12]

Within Europe, only 23 countries offer up to 4 funded cycles of IUI, while merely 8 countries offer 6 or more fully funded cycles of IVF/ICSI, with an additional 7 offering partially funded cycles. This demonstrates that even among developed European nations, comprehensive funding remains the exception rather than the rule, with most countries providing limited coverage that may not meet the clinical needs of many patients.[12]

SUB-SAHARAN AFRICA: UNIQUE CHALLENGES

Sub-Saharan Africa presents particularly challenging access conditions where high infertility rates (often exceeding 16% of couples) coincide with severe treatment limitations.[7] Ghana, with a population of about 25 million, has approximately 12 IVF centers,[11] while Nigeria faces similar ratios with limited functional facilities serving over 200 million people, creating impossible access ratios that leave the vast majority of infertile couples without treatment options.

Cultural consequences of infertility extend beyond medical challenges to encompass profound social stigmatization, with women experiencing infertility often facing blame, social isolation, and marital dissolution that can lead to depression and domestic violence.[34] Traditional healing systems may compete with modern reproductive medicine, creating complex medical pluralism that requires culturally sensitive intervention approaches.[7]

Innovative approaches include the Walking Egg Foundation and similar organizations working to establish sustainable local capacity rather than relying on medical tourism or foreign treatment.[7] South Africa has developed the most comprehensive reproductive medicine infrastructure in the region, with established training programs, quality standards, and research capabilities, yet even there only 6.4% of ART need is met.

MEDICAL TOURISM AND REGULATORY ARBITRAGE

Patients frequently travel internationally to bypass legal restrictions, access more affordable treatment, or obtain services unavailable in their home countries. An estimated 25,000-30,000 couples annually cross international borders for reproductive care, creating what critics describe as "reproductive colonialism."

Thailand and Malaysia have emerged as major fertility tourism destinations within Southeast Asia, offering modern facilities and internationally trained physicians at costs significantly lower than Australia, Japan, or Western countries. However, medical tourism creates ethical challenges including limited follow-up care, language barriers, and potential exploitation. France's comprehensive coverage and progressive policies have reduced the need for French citizens to seek treatment abroad, while simultaneously attracting international patients seeking high-quality care within a well-regulated system.

European fertility tourism patterns reflect the access disparities revealed in the Atlas data. Patients from countries with limited coverage or restrictive policies frequently travel to countries with better access scores. The Czech Republic (50.6% access score) has become a major destination for fertility tourism, particularly from neighboring countries with more restrictive policies. This cross-border movement within Europe demonstrates how regulatory arbitrage operates even within relatively harmonized continental frameworks, with patients voting with their feet for better access and lower costs.[12]

PATIENT PERSPECTIVES AND COUNSELING: CULTURAL COMPETENCY CHALLENGES

Patient decision-making in reproductive medicine is profoundly influenced by cultural and religious frameworks that shape understanding of fertility, parenthood, and appropriate medical intervention.

RELIGIOUS AND CULTURAL VALUE SYSTEMS

In Islamic contexts, religious jurisprudence significantly influences reproductive choices, with most interpretations prohibiting third-party gamete use while permitting IVF using spouses' genetic material.[30] Islamic scholars have developed detailed guidance about permissible reproductive technologies, emphasizing the importance of maintaining clear genetic lineage and avoiding practices that might confuse family relationships. However, interpretations vary among different schools of Islamic thought, creating complexity for patients seeking religiously consistent care.[40,41]

Jewish perspectives often emphasize religious obligations to "be fruitful and multiply," leading many rabbinical authorities to encourage fertility treatments under appropriate religious guidance. Moreover, this obligation is interpreted as a requirement of having at least one male and one female offspring. Orthodox Jewish communities have developed sophisticated frameworks ensuring treatments comply with religious requirements while maximizing therapeutic effectiveness.[42]

Christian traditions demonstrate significant diversity, ranging from Catholic teachings restricting certain procedures to Protestant denominations generally supporting fertility treatments as expressions of healing ministry. France's secular healthcare approach accommodates diverse religious perspectives through comprehensive counseling and respect for individual value systems, while main-

Table 3. Global Access Patterns, Coverage Models, and Implementation Strategies

Country/ Region	Cost per Cycle (USD)	Public Coverage	Private Insurance	Utilization Rate	Access Barriers	Implementation Model	Success Factors	Key References
Israel	$0 (public)	Unlimited to 2 births	Comprehensive	Highest globally	Minimal	Universal coverage, gradual expansion	Political commitment, demographic priority	**Birenbaum-Carmeli & Dirnfeld[8]; Simonstein[23]**
France	$0 (public)	4 cycles per pregnancy, universal under 43	Comprehensive	High, rapid growth post-2021	Social disparities despite free access	Progressive expansion, demographic integration	Political will, public health integration, evidence-based policy	**French Bioethics Law[4]; Macron Fertility Plan[3]; Ben Messaoud et al.[35]**
Denmark	$0-2,000	3 cycles public	Comprehensive	Very high	Age/lifestyle criteria	Evidence-based protocols, quality assurance	Public health integration, outcome monitoring	**Nyboe Andersen & Erb[36]; Westergaard et al.[37]**
US	$12,000-30,000	19 states mandate	Variable	Moderate-high	Economic, geographic	State-by-state approach	Insurance mandate effectiveness varies	**Ethics Committee of ASRM[13]**
UK	$0-8,000	Limited NHS	Private options	Moderate	Waiting lists, criteria	Rationed public access, private supplement	NICE guidelines, clinical commissioning	**Human Fertilisation and Embryology Authority[22]**
Czech Republic	$8,000	Partial coverage	Available	High (tourism)	Language, travel	Medical tourism destination	Cost advantage, EU mobility	**Culley et al.[38]**
Japan	$15,000-20,000	Partial coverage	Limited	Moderate	Marital status restrictions	Professional society guidance	Cultural adaptation, quality focus	**Kato & Sleeboom-Faulkner[24]**
China	$5,000-15,000	Urban insurance	Expanding	Increasing rapidly	Rural access limited	Urban-first implementation	Economic development integration	**Peng et al.[31]**
India	$3,000-8,000	Minimal public	Private only	Low overall	Economic, cultural	Private sector development, emerging regulation	Market expansion, regulatory catch-up	**Assisted Reproductive Technology Act[17]**
Nigeria	$6,000-8,000	None	Private only	Very low	Economic, availability	Private clinics, international partnerships	Capacity building, training programs	**Okonofua et al.[39]**
Ghana	$8,000-12,000	None	Limited	Extremely low	Economic, infrastructure	International NGO support, local capacity building	External assistance, professional development	**Adageba et al.[11]; Gerrits[7]**

taining evidence-based medical standards and universal access principles.

PSYCHOSOCIAL SUPPORT NEEDS

Research demonstrates that infertility patients experience psychological distress comparable to those facing serious medical conditions such as cancer or heart disease.[43] Treatment-related stress includes not only medical procedures and outcome uncertainty but also financial pressures, time commitments, and social disruption affecting all life aspects. The cyclical nature of IVF treatment, with alternating hope and disappointment, creates particular psychological challenges requiring sustained support.[44] France's comprehensive public system includes mandatory counseling services and psychological support as standard components of IVF care, recognizing the importance of addressing both medical and psychosocial aspects of treatment.

Couples therapy and individual counseling interventions have demonstrated effectiveness in reducing psychological distress and improving treatment outcomes, suggesting psychological support should be integrated into comprehensive fertility care rather than treated as optional.[45] Group interventions have shown particular promise in reducing anxiety and improving pregnancy rates.[43]

The European Atlas reveals significant gaps in psychosocial support across European countries, with only 10 countries offering funded psychological support for medically assisted reproduction (MAR) treatment. Countries with comprehensive access scores like Belgium and the Netherlands provide psychological support as standard care, while many other European countries require patients to seek private psychological services, creating additional barriers and costs.[12]

COUNSELING AND INFORMED CONSENT CHALLENGES

Current informed consent processes often fail to adequately address the complexity of reproductive decisions, particularly regarding genetic testing, embryo disposition, and long-term implications.

Effective counseling must address not only technical aspects but also emotional, ethical, and psychological dimensions. Patients beginning IVF treatment often focus on achieving pregnancy rather than considering hypothetical future decisions about unused embryos. France has developed comprehensive counseling protocols that address these multifaceted aspects, with mandatory consultation periods and specialized training for counseling staff in fertility centers.

Patient consultation and engagement in policy-making represents another critical gap identified by the Atlas data. Only 19 of the 49 European countries surveyed report that patient associations are consulted on public policies related to fertility treatment. This lack of patient voice in policy development may contribute to the disconnect between policy frameworks and patient needs observed across many jurisdictions.[12]

EMERGING TECHNOLOGIES: GOVERNANCE GAPS AND ETHICAL CHALLENGES

Rapid technological advancement in reproductive medicine has outpaced ethical reflection and regulatory framework development, creating significant governance gaps.

IN VITRO GAMETOGENESIS: REVOLUTIONARY POSSIBILITIES

In vitro gametogenesis (IVG) enables generation of functional gametes from stem cells or somatic cells, potentially enabling reproduction for individuals previously considered permanently infertile. Japan has emerged as a leader in IVG research with significant government investment, while Western countries have adopted more cautious approaches emphasizing regulatory oversight and ethical consultation. France has established research protocols for IVG within its comprehensive bioethics framework, balancing scientific advancement with ethical oversight through the French Biomedicine Agency.

IVG raises fundamental questions about parenthood nature, genetic relationships, and appropriate reproductive intervention limits. The technology could enable previously impossible family configurations, including children with genetic contributions from more than two parents.

MITOCHONDRIAL REPLACEMENT THERAPY: GERMLINE MODIFICATION

Mitochondrial replacement therapy (MRT) is aimed at preventing serious mitochondrial diseases by replacing faulty mitochondrial DNA with healthy mitochondria from donor eggs. The United Kingdom became the first country approving MRT for clinical use following extensive scientific review and public consultation.

United States regulatory agencies have expressed support while Congressional appropriations language has prevented clinical trials from proceeding, leading some American patients to seek treatment in the UK or other jurisdictions. France permits MRT research under strict oversight, with potential for clinical application following comprehensive ethical review and public consultation processes.

CRISPR GENE EDITING: INTERNATIONAL RESPONSES

China has been at the forefront of human embryo gene editing research, but the birth of gene-edited babies in 2018 with disregard to ethical concerns and state regulations has led to international condemnation and significant regulatory reforms. The international response included widespread condemnation from scientific organizations and calls for enhanced international coordination.

Regulatory approaches vary significantly among countries, with some permitting basic research while others prohibit such research entirely, creating potential for regulatory arbitrage and complicating coordinated international approaches. France permits basic research on CRISPR gene editing in embryos under strict conditions and prohibits

clinical applications, maintaining alignment with European consensus on germline editing restrictions.

DISCUSSION

PATTERNS OF GLOBAL DIVERSITY AND COMMON CHALLENGES

Our analysis reveals both striking diversity in national approaches to IVF ethics and common challenges that transcend cultural and regulatory boundaries. The diversity reflects legitimate differences in cultural values, religious traditions, and healthcare system priorities, while common challenges suggest opportunities for international cooperation and shared learning.

Regulatory effectiveness correlates strongly with comprehensiveness and enforcement mechanisms. Countries with integrated oversight systems like the UK's HFEA and France's Biomedicine Agency demonstrate superior patient protection and practice consistency compared to fragmented approaches.[46] However, comprehensive regulation requires substantial institutional capacity and sustained political commitment that may be challenging for resource-limited settings. The European Atlas data confirms this pattern, with countries scoring highest on comprehensive regulatory frameworks (Belgium 89.5%, Netherlands 89.4%) demonstrating better outcomes across multiple dimensions of access and patient protection.[12]

Market-driven regulatory gaps create particular vulnerabilities where commercial pressures can potentially override ethical considerations. The proliferation of invalidated interventions in less-regulated jurisdictions illustrates how regulatory arbitrage can undermine both patient welfare and professional standards. Effective regulation requires balancing innovation promotion with patient protection through evidence-based approval processes. France's experience demonstrates how public healthcare systems can provide protection against commercial exploitation while still enabling innovation within regulated frameworks.

Access equity emerges as a universal challenge, though manifested differently across economic contexts. High-resource countries struggle with insurance coverage variations and geographic disparities, while low-resource countries face fundamental infrastructure and affordability barriers. Successful models like Israel's comprehensive coverage and Poland's and France's progressive expansion demonstrate that universal access is achievable with appropriate political commitment, though France's persistent social disparities highlight that coverage alone doesn't eliminate all barriers. Even within the relatively harmonized European context, the Atlas reveals dramatic access disparities, with scores ranging from 89.5% to 7.8%, demonstrating that geographic proximity and similar economic development levels do not guarantee equitable access.[12]

CULTURAL ADAPTATION AND UNIVERSAL PRINCIPLES

The tension between cultural adaptation and universal principles represents a central challenge in developing international approaches to IVF ethics. Our analysis suggests that effective international cooperation requires identifying core universal principles while respecting legitimate cultural and religious variations in implementation.

Universal principles emerging from our analysis include informed consent based on accurate information, patient safety and quality assurance, robust psychosocial support, protection of vulnerable populations, and respect for diverse value systems. Cultural adaptations may be appropriate in areas such as family involvement in decision-making, religious accommodation in treatment protocols, and integration with traditional healing systems.

The Japanese example of ceremonial practices for discarded embryos illustrates how technological capabilities can be integrated with spiritual values, while Islamic jurisprudence demonstrates how religious frameworks can provide guidance for contemporary reproductive technologies. France's secular approach with religious accommodation shows how pluralistic societies can balance diverse value systems within comprehensive public health frameworks.

TECHNOLOGY ASSESSMENT AND ETHICAL ANTICIPATION

Emerging technologies require proactive ethical analysis rather than reactive policy development. Our analysis reveals significant gaps between technological capabilities and ethical preparedness, particularly for in vitro gametogenesis, advanced gene editing, and AI applications.

Recent developments illustrate these challenges. The medical literature in 2024 does discuss the rapid commercialization of polygenic risk score (PRS) technologies for embryo selection, the lack of proven clinical utility, and concerns about inadequate regulatory oversight.

The American College of Medical Genetics and Genomics (ACMG) explicitly states that polygenic risk score assessment for embryo selection (PGT-P) is an emerging technology offered by a small number of commercial laboratories, with no published reports of long-term or short-term outcomes to assess clinical utility. The ACMG highlights that the implementation of PGT-P has been challenged by multiple professional societies due to ethical, scientific, and regulatory concerns, and that the practice is being marketed directly to consumers despite the absence of robust evidence or regulatory standards[18]

Other recent reviews and opinion pieces in the medical literature echo these concerns, noting the expansion of commercial offerings, the lack of regulatory oversight in some jurisdictions, and the ethical and societal risks associated with the commercialization of unproven technologies for embryo selection using polygenic scores.[48-50]

These sources collectively support the statement that the commercialization of PRS-based embryo selection has raised significant questions about unproven technologies and regulatory gaps, even if a specific "first reported birth" in 2024 is not documented as a landmark case in the literature. France's approach of maintaining these technologies within regulated public systems while limiting commercial

Table 4. Emerging Technology Governance Across Countries

Technology	UK	US	Japan	China	France	International Consensus	Key References
In Vitro Gametogenesis	Cautious research approval	Limited research funding	Leading research investment	Moderate research activity	Research protocols within bioethics framework	No formal framework	**Human Fertilisation and Embryology Authority[22]; French Biomedicine Agency[46]**
Mitochondrial Replacement	Clinical approval (2015)	Research blocked by Congress	Research permitted	Research permitted	Research permitted, clinical potential under review	Limited international cooperation	**Human Fertilisation and Embryology Authority[22]; French Bioethics Law[4]**
CRISPR Gene Editing	Basic research only	Research permitted	Research permitted	Post-2018 restrictions	Basic research permitted, clinical applications prohibited	Informal moratorium calls	**Regalado[26]; World Health Organization[47]; French Biomedicine Agency Guidelines**
AI Embryo Selection	Regulated development	Commercial expansion	Research integration	State-guided development	Regulated within public system, limited commercial expansion	Professional guidelines only	**Gleicher et al.[2]; Yang et al.[21]; French AI Ethics Guidelines**

expansion provides a model for managing emerging technology risks.

International coordination is essential for emerging technology governance, as individual countries cannot effectively regulate technologies that transcend national boundaries. The birth of gene-edited babies in China despite international concerns illustrates risks of inadequate international cooperation, while recent developments in mitochondrial replacement therapy show how coordinated international oversight can enable responsible innovation.

Commercial exploitation risks require particular attention as biotechnology companies increasingly target reproductive medicine markets with invalidated interventions. Regulatory frameworks must establish clear evidence requirements for new technologies while preventing the premature commercialization that has characterized some genetic testing applications. France's participation in European coordination mechanisms and bilateral scientific agreements demonstrates how countries can maintain sovereignty while participating in international governance frameworks.

Public engagement must inform technology development and policy creation rather than being limited to expert professional circles. Successful examples like the UK's extensive public consultation on mitochondrial replacement therapy and France's national bioethics consultations demonstrate how inclusive processes can build social consensus for controversial technologies.[4] However, the Atlas data reveals that fertility education programs are rare even in developed European countries, with only 4 countries (France, Germany, Latvia, and the UK) offering state-organized fertility education programs, highlighting a critical gap in public engagement and education.[12]

IMPLICATIONS FOR HEALTHCARE SYSTEMS AND POLICY DEVELOPMENT

Our findings have significant implications for healthcare system design and reproductive medicine policy development. Comprehensive coverage models like those in Israel, France and Scandinavian countries achieve better clinical outcomes while reducing disparities, suggesting that universal access approaches may be both more equitable and more efficient than market-based systems. France's experience particularly demonstrates how rapid policy evolution can be achieved within existing healthcare frameworks when supported by political will and public consensus.

Professional education and training must evolve to address ethical complexity in contemporary reproductive medicine. Current training programs often inadequately prepare providers for cultural competency, ethical decision-making, and emerging technology assessment. France's integrated approach to counseling and psychosocial support provides a model for comprehensive professional development in reproductive medicine.

International cooperation mechanisms are urgently needed to address cross-border reproductive care, technology development coordination, and shared standard development. Current piecemeal approaches create opportunities for exploitation and undermine patient protection. The European Atlas demonstrates both the potential and limitations of regional cooperation, showing how shared frameworks can enable comparison and benchmarking while revealing persistent disparities that require coordinated policy responses.[12]

STUDY LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

This analysis is limited by several factors that should inform future research directions. Geographic representation remains incomplete despite efforts to include diverse global perspectives, with particular gaps in Latin American, Eastern European, and smaller developing country experiences.

Temporal scope focusing on 2020-2025 may miss important historical developments while potentially overemphasizing recent policy changes that may not represent stable long-term trends. Data availability varies significantly across countries, with some jurisdictions providing extensive policy documentation while others offer limited accessible information.

Future research priorities should include longitudinal studies of policy implementation outcomes, patient experience research across diverse cultural contexts, economic analysis of different coverage models, and prospective ethical analysis of emerging technologies. France's recent policy evolution provides particular opportunities for prospective studies of rapid healthcare system transformation and outcomes measurement.

RECOMMENDATIONS

INTERNATIONAL FRAMEWORK DEVELOPMENT

We propose that the World Health Organization convene a global summit on IVF ethics by 2027 to develop international minimum standards while respecting cultural diversity. This framework should address core principles including informed consent, evidence-based approaches, patient safety, quality assurance, and equity considerations while allowing flexibility for cultural adaptation. Special attention and focus should be given to cross-border reproductive healthcare.

Implementation mechanisms must include phased rollout strategies, beginning with voluntary adoption by leading institutions, followed by professional society endorsement, and eventual integration into national healthcare policies. The Israeli model demonstrates successful comprehensive coverage implementation through gradual expansion from pilot programs to universal access, while Denmark's approach shows how evidence-based protocols can be scaled across healthcare systems.[32] France's recent rapid expansion demonstrates how existing healthcare systems can be leveraged for swift policy implementation when supported by political commitment and public engagement. The European Atlas provides a potential model for systematic measurement and comparison of policy frameworks that could be adapted for global implemen-

tation, enabling countries to benchmark their progress against evidence-based standards.[12]

Regional cooperation networks should complement global frameworks by addressing shared challenges within geographic areas while facilitating cooperation and technology transfer appropriate for different resource contexts. European coordination mechanisms, including France's participation in EU bioethics networks, provide models for regional cooperation that balance sovereignty with shared standards.

EDUCATION AND PROFESSIONAL DEVELOPMENT

Mandatory ethics training should be implemented for all reproductive medicine practitioners by 2026, incorporating perspectives from feminist bioethics, disability rights, reproductive justice, and cultural competency. Training should be ongoing rather than one-time requirements and should address emerging technologies and evolving ethical understanding. France's integrated counseling and psychosocial support training provides a model for comprehensive professional development.

Patient education programs should ensure culturally sensitive, linguistically appropriate information about treatment options, ethical implications, and long-term consequences. Education materials should be developed at appropriate literacy levels and regularly updated to reflect technological advances. France's standardized patient education protocols and mandatory counseling periods demonstrate how comprehensive information sharing can be systematized. Given that only 4 European countries currently offer state-organized fertility education programs, there is significant opportunity for expansion of public education initiatives that could improve both access and informed decision-making.[12]

ACCESS AND EQUITY IMPROVEMENTS

Progressive coverage expansion should target 50% public subsidy coverage for IVF by 2035, prioritizing low-resource settings and vulnerable populations while developing sustainable financing mechanisms. Coverage models should avoid creating stigmatizing tier systems while ensuring appropriate utilization. France's experience demonstrates that rapid expansion is politically feasible and can be implemented within existing healthcare financing structures.

Commercialization oversight is urgently needed to address the proliferation of invalidated "add-ons" that increase costs without proven benefits. Gleicher and colleagues have documented how genetic testing companies have become major beneficiaries of procedures like PGT-A despite limited evidence supporting their widespread use.[2] Regulatory frameworks should require evidence-based validation before new technologies can be offered commercially, preventing exploitation of patients' desperation for improved outcomes. France's public system approach provides protection against commercial exploitation while maintaining innovation incentives.

Technology-enabled service delivery should be developed to reduce costs and improve access through telemedicine consultations, remote monitoring, and simplified treatment protocols adapted for resource-limited settings while maintaining safety and efficacy standards.

Social determinant interventions must address the persistent disparities observed even in comprehensive coverage systems. France's experience showing continued social gradients in access despite free care highlights the need for targeted interventions addressing education, transportation, cultural competency, and social support systems.

Patient engagement mechanisms should be strengthened, with systematic consultation of patient associations in policy development processes. Currently, only 19 of 49 European countries regularly consult patient associations on policies, representing a significant missed opportunity for incorporating patient perspectives into regulatory frameworks.[12]

QUALITY ASSURANCE AND COMMERCIAL OVERSIGHT

Mandatory public reporting of success rates, complication rates, and ethical compliance should be implemented by 2026 to ensure accountability and provide patients with information necessary for informed decision-making. Reporting should include standardized outcome measures and be accessible to patients and the public. France's national registry system and outcome monitoring provide models for comprehensive data collection and public transparency. The European Atlas demonstrates the value of systematic data collection and comparison across jurisdictions, providing a template for global monitoring and benchmarking of fertility treatment policies.[12]

Commercial practice regulation must address the proliferation of invalidated "add-ons" and aggressive marketing practices that exploit patient vulnerabilities. Regulatory frameworks should require evidence-based validation before new interventions can be offered commercially, with clear penalties for misleading marketing or exploitation of patient desperation.

Independent oversight bodies should monitor compliance with reporting requirements and investigate complaints about substandard care or ethical violations, with adequate authority and resources to enforce standards while maintaining fair procedures. These bodies should include patient representatives and be independent of commercial interests that may influence reproductive medicine practice. France's Biomedicine Agency provides a model for comprehensive oversight that balances innovation with patient protection.

Conflict of interest management should address financial relationships between clinics, testing companies, and pharmaceutical manufacturers that may influence treatment recommendations. Transparent disclosure requirements and limits on financial incentives can help ensure that patient welfare remains the primary consideration in treatment decisions.

RESEARCH AND INNOVATION PRIORITIES

Long-term outcome studies should be mandated with dedicated funding representing at least 1% of healthcare budgets by 2030, examining not only medical outcomes but also psychological, social, and ethical consequences for all stakeholders. France's national registry and longitudinal follow-up systems provide infrastructure for comprehensive outcomes research.

International research coordination should improve efficiency and ensure studies address questions relevant to diverse populations and settings rather than focusing exclusively on high-resource contexts.

CONCLUSION

The global IVF landscape stands at a critical juncture where technological capabilities expand rapidly while ethical frameworks struggle to keep pace, and commercial pressures increasingly threaten to compromise patient welfare and professional integrity. With over 10 million births achieved through assisted reproductive technologies and emerging innovations promising even greater possibilities, decisions made today about governance, access, and ethical practice will shape human reproduction for generations.

This analysis reveals both the promise and peril of current approaches. Countries like Israel demonstrate that universal access is achievable with appropriate political commitment and systematic implementation, while restrictive environments like post-2024 Alabama ruling illustrate how poorly designed legal frameworks can create unintended barriers. The Danish model shows how evidence-based protocols and comprehensive public coverage can achieve excellent outcomes while maintaining cost-effectiveness, providing a roadmap for other nations. France's rapid transformation from restrictive access to comprehensive universal coverage demonstrates that progressive policy evolution is achievable within existing healthcare systems when supported by political will and public engagement, though persistent social disparities highlight that coverage alone doesn't eliminate all access barriers. The European Atlas provides compelling evidence that even within a relatively harmonized continental framework, dramatic disparities persist, with access scores ranging from 89.5% to 7.8%, demonstrating that proximity and similar development levels do not guarantee equity.[12]

However, the emergence of commercial pressures that prioritize profit over patient welfare represents a growing threat to reproductive medicine's ethical foundations. The proliferation of unvalidated treatments, aggressive marketing of genetic testing, and financial incentives that may compromise clinical judgment require urgent regulatory attention and professional accountability measures.

The diversity of cultural approaches, from Japan's spiritual ceremonies for discarded embryos to Ghana's resource constraints forcing difficult practical choices, and France's secular approach accommodating diverse religious perspectives within comprehensive public frameworks, illustrates that ethical frameworks must be both globally coordinated and locally sensitive. Successful international cooperation requires finding common ground on core ethical principles while respecting legitimate cultural differences.

The path forward requires unprecedented international cooperation extending beyond professional networks to include patients, communities, and civil society organizations in reproductive medicine governance. The rarity of patient consultation in policy development, occurring in only 19 of 49 European countries, represents a critical gap that must be addressed to ensure policies reflect patient needs and values.[12] As we stand on the threshold of technologies like in vitro gametogenesis and advanced gene editing, the ethical frameworks established today will determine whether these powerful capabilities serve human flourishing or exacerbate existing inequalities.

The ultimate measure of success will not be technological achievement alone, but whether every person seeking to build a family can do so with dignity, support, and hope, regardless of geography, economy, or circumstances. This vision of reproductive justice requires sustained commitment to equity, inclusion, and human rights that transcends narrow technical or commercial interests.

True reproductive freedom encompasses not only the right to prevent unwanted pregnancies but also the right to have children when desired and to parent those children in safe, supportive communities. Achieving this comprehensive vision will require transformation of healthcare systems, legal frameworks, and social attitudes that currently create barriers for too many individuals and families.

By working together across professional, cultural, and national boundaries, we can create ethical frameworks for reproductive medicine that honor human dignity, promote social justice, and enable all people to participate fully in the fundamental human experience of creating and nurturing life.

CONFLICT OF INTEREST

No conflict of interest was declared by the authors

FINANCIAL SUPPORT

No financial support was provided for this project

AUTHORS' CONTRIBUTIONS

ZS: Conceptualization, Investigation, Writing – Original Draft, Writing – Review & Editing; AW and YY: Investigation, Writing – Original Draft, Writing – Review & Editing.

Submitted: June 22, 2025 CDT. Accepted: July 21, 2025 CDT. Published: September 08, 2025 CDT.

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