

ASSISTED REPRODUCTION: LAW, ETHICS, RIGHTS BIBLIOMETRIC MAPPING

REPRODUÇÃO ASSISTIDA: LEI, ÉTICA, DIREITOS MAPEAMENTO BIBLIOGRÁFICO

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Nazlı Emel Özer Yurdal*

*Çanakkale Onsekiz Mart University, Çanakkale, Turkey

Orcid: <https://orcid.org/0000-0003-2559-969X>

emelozer@comu.edu.tr

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Abstract

Assisted reproductive technologies (ART) pose governance issues that go beyond their efficacy to encompass issues of legality, ethics, and rights. This study employs bibliometric techniques to map the international academic landscape of ART-related research with explicit ethical-legal content. A dataset of publications was retrieved from Web of Science and Scopus (1996-2026), merged, and deduplicated using bibliometrix/Biblioshiny tools, followed by a filter for “topic fit” to ensure that only those publications substantively dealing with ART in relation to ethics, medical ethics, law, legal medicine, and related social science fields were retained for analysis. A total of 2,158 publications were retained for analysis. Performance indicators and science mapping techniques were employed to analyze temporal trends, key sources, geographic distribution, citation influence, and conceptual structure of this dataset. This study reveals that ART-related publications have demonstrated steady growth since the mid-2000s, accelerating in the late 2010s and early 2020s. Key publication sources include prominent reproductive medicine journals, as well as prominent bioethics and legal-focused journals. Country-wise distribution indicates that key countries dominate this dataset, with strong international collaboration links. Citation analysis reveals high influence synthesis and high-visibility journal publications. The factorial conceptual map (MCA) distinguishes between a clinical/technical IVF pole and a pole focused on governance, law, and ethics, with the terms related to surrogacy forming a substream. This evidence map provides clarity in the structure of the dispersed interdisciplinary field and can inform the research agenda and the setting of the

Resumo

As tecnologias de reprodução assistida (TRA) levantam questões de governança que vão além de sua eficácia, abrangendo questões de legalidade, ética e direitos. Este estudo emprega técnicas bibliométricas para mapear o panorama acadêmico internacional da pesquisa relacionada às TRA com conteúdo ético-legal explícito. Um conjunto de dados de publicações foi recuperado do Web of Science e do Scopus (1996-2026), mesclado e deduplicado usando ferramentas bibliométricas/Biblioshiny, seguido por um filtro de “adequação do tópico” para garantir que apenas as publicações que tratavam substancialmente das ART em relação à ética, ética médica, direito, medicina legal e campos relacionados às ciências sociais fossem mantidas para análise. Um total de 2.158 publicações foi retido para análise. Indicadores de desempenho e técnicas de mapeamento científico foram empregados para analisar tendências temporais, fontes-chave, distribuição geográfica, influência de citações e estrutura conceitual desse conjunto de dados. Este estudo revela que as publicações relacionadas à ART têm demonstrado um crescimento constante desde meados dos anos 2000, acelerando no final dos anos 2010 e início dos anos 2020. As principais fontes de publicação incluem revistas proeminentes de medicina reprodutiva, bem como revistas proeminentes de bioética e com foco jurídico. A distribuição por país indica que os principais países dominam este conjunto de dados, com fortes laços de colaboração internacional. A análise de citações revela uma síntese de alta influência e publicações em revistas de alta visibilidade. O mapa conceitual fatorial (MCA) distingue entre um polo clínico/técnico de FIV e um polo focado em governança, direito e ética, com os termos relacionados à barriga de aluguel formando uma



agenda for ART governance and rights in the future.

Keywords: Assisted Reproduction. Bioethics. Governance. Law. Rights.

subcorrente. Este mapa de evidências fornece clareza na estrutura do campo interdisciplinar disperso e pode informar a agenda de pesquisa e a definição da agenda para a governança e os direitos da ART no futuro.

Palavras-chave: Reprodução Assistida. Bioética. Governança. Direito. Direitos.

1 INTRODUCTION

Assisted reproductive technologies (ART)—including in vitro fertilization (IVF), gamete donation and sperm banking, oocyte cryopreservation (egg freezing), and surrogacy—have moved from niche medical interventions to globally visible pathways for family building. Their expansion reflects intersecting pressures: persistent infertility, later childbearing, changing family forms, and rapid technological advances that continually widen what is clinically possible. Yet as ART becomes more routine in clinical settings, it also becomes more legally and ethically complex in public life. Questions that initially appear “technical” (laboratory procedures, success rates, clinical indications) quickly become questions of governance: who may access which services, under what conditions, and with what protections for the people whose bodies, labor, genetic material, and future identities are implicated.

This governance dimension is particularly pronounced because ART reorganizes core legal categories. It separates genetic, gestational, and social parenthood; it creates new contractual and regulatory relationships among intended parents, donors, surrogates, clinicians, and intermediaries; and it forces legal systems to decide how to treat embryos, gametes, and reproductive tissues. At the same time, ART intensifies longstanding ethical concerns in reproductive medicine: informed consent under uncertainty; commodification and payment; exploitation risks and unequal bargaining power; privacy and data control; and the moral status of embryos and genetic information. As services globalize, cross-border care adds further challenges—regulatory arbitrage, uneven protections, and the practical difficulty of ensuring accountability when reproductive arrangements, medical procedures, and intended family life span multiple jurisdictions.

Across ART modalities, recurring dilemmas are visible. Donor anonymity intersects with donor-conceived persons' interests in identity and information. Egg freezing raises questions about medicalization, marketing, workplace pressures, and the boundary between elective and medically indicated interventions. Sperm banking and gamete donation bring governance questions about screening, traceability, limits on offspring numbers, and the management of accidental consanguinity risks. Surrogacy concentrates concerns about bodily autonomy and labor, compensation and coercion, intermediary markets, and the recognition of parentage and citizenship—especially where domestic legal regimes prohibit or restrict the practice. Even within IVF itself, the legal-ethical landscape expands with adjunct technologies such as preimplantation genetic testing, embryo cryopreservation, and the storage and disposition of embryos after relationship changes, death, or clinic closure.

For health professionals—including nurses who contribute to counseling, continuity of care, patient education, and psychosocial support—these governance questions are not abstract. Ethical-legal uncertainty shapes communication and informed consent, affects how risks and options are presented, and influences patients' experiences of stigma, agency, and trust. In many settings, nurses are also the most accessible point of contact for patients navigating emotionally difficult decisions about donor use, embryo storage, or cross-border options. A clear view of how the global literature frames these issues is therefore relevant not only for legal scholarship but also for clinical ethics, policy design, and patient-centered care.

Despite this importance, the research landscape on ART ethics and law is fragmented. Legal studies, bioethics, sociology, demography, health policy, and parts of reproductive medicine often operate with different vocabularies, different concepts of evidence, and different assumptions about what counts as a “problem.” Similar concerns may be discussed under distinct labels (e.g., “rights,” “justice,” “harm,” “exploitation,” “autonomy,” “governance,” “regulation,” “policy”), while different ART modalities may be examined in isolation even when they raise structurally similar questions. This dispersion makes it difficult to identify what has been most studied, where the field is concentrated geographically and institutionally, which themes have grown or declined, and which topics remain underdeveloped relative to their policy salience.

This article responds to that problem by providing a bibliometric mapping of peer-reviewed research on ART that explicitly engages ethical and legal questions. Using records indexed in Scopus and Web of Science and applying a transparent screening approach designed to retain publications aligned with ethics, medical ethics, law, legal medicine, and closely related social science domains, we construct a consolidated dataset suitable for performance analysis and science mapping. The goal is not to adjudicate the normative disputes in ART, but to clarify the structure of the scholarly conversation: how research output has evolved over time; how it is distributed across journals, countries, and author communities; how the literature clusters thematically across ART modalities; and which works and venues exert the strongest citation influence within this ethical-legal corpus.

By making the field's contours visible, the study aims to support more coherent agenda-setting for legal and policy scholarship on reproductive governance, while also offering a navigational map for clinicians and health professions researchers who engage ART as an ethical practice. In a domain where regulatory choices directly shape access, safety, equity, and the lived experience of patients, donors, and surrogates, systematic mapping is a pragmatic step toward identifying both points of convergence and persistent blind spots.

This study aims to make visible the global scholarly landscape of ethical and legal research on assisted reproductive technologies (ART). By employing records gathered through Web of Science and Scopus databases and filtered through a topic fit screening process in line with ethics, medical ethics, law, legal medicine, and other closely related social science domains of interest, we use bibliometric approaches to reveal: (i) the development of the field over time; (ii) the most prolific and influential journals, countries, and author communities; (iii) citation patterns and intellectual influence structures; and (iv) the major thematic clusters of debate in IVF, gamete donation/sperm banking, oocyte cryopreservation, and surrogacy. The evidence map synthesizes a diffuse body of literature, identifies areas of under-research in comparison to policy salience, and provides a structured basis for future interdisciplinary research in reproductive governance, rights, and ethical practice.

2 LITERATURE REVIEW

2.1 Assisted reproduction as a governance, ethics, and rights problem

Assisted reproductive technologies (ART) have generated legal and ethical debates not only because they enable new pathways to parenthood, but also because they reshape governance questions about access, responsibility, and the allocation of risks and benefits across multiple stakeholders (patients, donors, offspring, surrogates, clinicians, and intermediaries). In legal scholarship, a recurrent framing treats access to procreative assistance as a rights-relevant issue connected to reproductive autonomy and the right to health, with distributive concerns about affordability and structural barriers becoming increasingly central (DADIYA, 2025). At the same time, the ethics literature emphasizes informed consent under uncertainty, commodification and market dynamics, and justice-based concerns regarding who can realistically benefit from these technologies (ALON et al., 2023a).

A key feature of ART governance is regulatory diversity. Rules differ widely across jurisdictions on eligibility (marital status, sexual orientation, age), permissible third-party involvement, payment/compensation, embryo status and disposition, and legal parenthood recognition. This diversity, while reflecting local values and institutional arrangements, also creates practical and normative tensions in a globalized reproductive economy (ALON et al., 2023b). As a result, ART scholarship has become characteristically interdisciplinary, spanning legal medicine, bioethics, sociology, demography, psychology, health policy, and feminist theory—each offering different problem definitions and evaluation standards.

2.2 Cross-border reproductive care and regulatory spillovers

Regulatory diversity and uneven affordability have contributed to cross-border reproductive care, a phenomenon where individuals travel to access services that are restricted, unavailable, or unaffordable at home. A landmark narrative review documents how cross-border care is driven by legal barriers and cost differentials, while

also creating risks related to continuity of care, accountability, and the protection of donors and surrogates in destination settings (HUDSON et al., 2011). Professional guidance has increasingly addressed cross-border care as an ethics issue with practical duties for clinicians in counselling, risk communication, and follow-up, reflecting the integration of governance concerns into clinical responsibilities (ETHICS COMMITTEE OF THE AMERICAN SOCIETY FOR REPRODUCTIVE MEDICINE, 2022).

Cross-border dynamics are especially visible in surrogacy and third-party reproduction, where the legal recognition of parentage and citizenship can become uncertain across borders. Legal-ethical analyses emphasize that weak or inconsistent regulation may undermine the dignity and rights of vulnerable parties and intensify the need for governance mechanisms that reduce harm while protecting autonomy (FRATI et al., 2021). In this context, governance is not merely national; it is shaped by transnational flows of people, money, and reproductive materials.

2.3 Gamete donation, anonymity, and the ‘right to know’

Gamete donation and sperm banking raise a durable medico-legal controversy: donor anonymity versus the informational interests of donor-conceived persons. Early ethical-legal analysis documented an international trend toward greater information disclosure and examined the tensions between donor privacy, parental interests, and claims that offspring have a legitimate interest in knowing their biological origins (FRITH, 2001). Subsequent work strengthened a rights-based account by arguing that cross-border medically assisted reproduction can worsen informational deprivation, particularly when individuals conceived through donation face legal or practical barriers to accessing identity-relevant and health-related data (RAVITSKY, 2017).

This debate has also been analyzed through European human-rights frameworks. Legal scholarship argues that anonymous donation can conflict with protections of private life under Article 8 of the European Convention on Human Rights, depending on how competing interests are balanced and what disclosure mechanisms exist (MULLIGAN, 2022). Comparative legal analysis further shows that disclosure regimes vary considerably and that “access” is not a binary question but depends on what

information is stored, for how long, and under what conditions it can be retrieved and shared (BLYTH; FRITH, 2009). Together, these strands position donor anonymity as a governance problem involving privacy, identity, recordkeeping infrastructures, and cross-border enforceability.

2.4 Oocyte cryopreservation and fertility preservation: autonomy, commercialization, and information quality

The normalization of oocyte cryopreservation has intensified ethical and legal debates about autonomy, marketing practices, and the boundary between medical indication and elective use. A clinical-ethical review highlights that elective egg freezing should not be construed as “insurance” and underscores age-related effectiveness and counselling as central to ethically responsible practice (ALTERI et al., 2019). At the same time, empirical ethics scholarship identifies information deficits and commercialization risks: analyses of fertility clinic websites show frequent lack of clarity about total costs, imbalanced presentation of benefits versus limitations, and insufficient adherence to regulatory guidance for consumer information—concerns that overlap with legal standards for truthful advertising and informed choice (GÜRTIN; TIEMANN, 2020).

Legal and bioethical analysis has explicitly connected elective egg freezing marketing to consumer protection and professional duties, arguing that misleading narratives of empowerment can undermine autonomy and obscure the structural conditions that constrain reproductive choices (BAYEFSKY, 2020). Professional society ethics guidance recognizes planned oocyte cryopreservation as ethically permissible but emphasizes the obligation to communicate uncertainties about efficacy and long-term outcomes—reinforcing the point that governance operates not only through statutes, but also through professional standards and counselling practices (ETHICS COMMITTEE OF THE AMERICAN SOCIETY FOR REPRODUCTIVE MEDICINE, 2024). Because counselling and continuity of care often involve health professions teams beyond physicians, these debates have direct implications for patient education, decision support, and psychosocial care pathways.

2.5 Surrogacy: exploitation, commodification, and regulatory design

Surrogacy concentrates some of the most difficult normative conflicts in ART: bodily autonomy and reproductive labor, contract enforceability, payment and coercion, and the rights and welfare of children and surrogates. The literature repeatedly highlights the tension between claims of reproductive freedom for intended parents and concerns about exploitation and commodification in markets where surrogates may be economically vulnerable (WILKINSON, 2016; STUVØY, 2018). Ethnographic research on transnational commercial surrogacy illustrates how “gift” and altruism narratives can coexist with deep structural inequalities, complicating simplistic legal distinctions between altruistic and commercial models (PANDE, 2011).

Legal-ethical work has explored contrasting regulatory responses. Some analyses argue that carefully designed remuneration and international legal standards could mitigate exploitation by clarifying rights, responsibilities, and enforceable protections (RAMSKOLD; POSNER, 2013). Others suggest that expanding certain “options” may itself be harmful, and that neither blanket legalization nor punitive restriction necessarily addresses the structural conditions that produce vulnerability (HODSON; TOWNLEY; EARP, 2019). These debates underscore that surrogacy governance is not only about permission or prohibition, but also about labor protections, transparency, intermediaries, dispute resolution, and cross-border recognition mechanisms (FRATI et al., 2021).

2.6 Embryos, cryostorage, and liability: governance beyond access

ART governance also includes the infrastructures that store and safeguard reproductive tissues. Cryostorage failures and specimen mishandling have generated medico-legal analysis emphasizing the high stakes of loss, the complexity of liability, and the need for robust risk management and safety protocols (MOUTOS; LAHHAM; PHELPS, 2019). Related legal guidance addresses storage, transport, and disposition decisions—including the management of abandoned embryos—where documentation, consent, and institutional policies become central governance tools (RINEHART, 2021). These issues broaden the ethics–law lens beyond “who gets access” to “how

systems protect persons and materials over time,” which is increasingly salient as cryopreservation becomes routine in IVF, fertility preservation, and donor programs.

2.7 What bibliometric and mapping studies show—and what remains underdeveloped

Bibliometric and mapping studies confirm the rapid expansion and diversification of ART scholarship, but many field-level analyses combine clinical and non-clinical literatures unless sharply filtered (MENG et al., 2022; GARCÍA et al., 2020). More targeted mapping of the ethical, legal, and social implications (ELSI) has grown recently, offering structured overviews of where humanities and social science research concentrates geographically and thematically (ALON et al., 2023a; ALON et al., 2023b). Importantly, newer ELSI mappings have extended into specific domains such as fertility preservation and gamete donation, indicating continued growth, thematic specialization, and persistent geographical skew toward Western contexts (ALON et al., 2024a; ALON et al., 2024b). A surrogacy-focused bibliometric study likewise identifies trends and gaps, including under-attention to international law and policy-relevant harms relative to the scale of the global market (CORREA DA SILVA, 2021).

Taken together, this literature suggests two needs for ethics–law–centered ART scholarship. First, there is value in an updated, carefully delimited corpus that isolates ethical–legal debate from purely clinical outputs while remaining sensitive to how governance questions spill across modalities (donation, fertility preservation, surrogacy, embryo storage). Second, because influence and agenda-setting in interdisciplinary fields is often structured through citation dynamics, a mapping approach that can incorporate citation structures alongside thematic clustering may help clarify which works and venues function as intellectual anchors—and where high-salience governance questions remain relatively under-cited or under-theorized.

3 METHODOLOGY

3.1 Bibliometric design and analytical procedures

This study uses bibliometric methods to map a fragmented, interdisciplinary corpus at the intersection of assisted reproductive technologies (ART) and ethical–legal scholarship. Following established guidance, we combine performance analysis (e.g., annual production, leading journals, countries, and influential documents) with science mapping approaches (e.g., conceptual and intellectual structure via co-word and citation-based networks) to describe how the field is organized and how influence is distributed across sources and themes (ZUPIC; CATER, 2015; DONTU et al., 2021). The workflow was implemented in R using the bibliometrix package and its web interface Biblioshiny, which support reproducible bibliometric data conversion, merging, and analysis (ARIA; CUCCURULLO, 2017). The factorial map was generated using bibliometrix/Biblioshiny’s conceptual structure procedure with MCA to identify proximity-based clustering among recurrent terms.

3.2. Data sources and database-level filters

Records were retrieved from Web of Science (WoS) and Scopus to ensure broad multidisciplinary coverage and to enable comparable exportable metadata for bibliometric mapping. Searches were designed as a two-concept strategy that required the co-occurrence of: (i) ART-related terms (e.g., IVF, assisted reproductive technologies, egg freezing/oocyte cryopreservation, sperm banking/donation, surrogacy) and (ii) ethics–law–policy/regulation terms (e.g., ethic*, legal*, law*, regulat*, polic*). In both databases, proximity operators were used to increase topic specificity by requiring that ART and ethics/legal terms appear close to one another within the searchable fields. The full query strings are provided in the Supplementary Material.

3.3 Refinement criteria and journal-aligned scope

To improve comparability across databases and to reduce heterogeneity, results were restricted to the 1996–2026 time window and to article and review document types. In WoS, records were further refined using categories aligned with the study’s ethical–legal and social science scope (e.g., Ethics, Medical Ethics, Law, Medicine–Legal, Social Issues, and relevant social science categories). In Scopus, records were refined by subject areas selected to retain ethics–law and governance-oriented discussions while preserving interdisciplinary breadth (Medicine; Social Sciences; Arts and Humanities; Multidisciplinary; Health Professions).

3.4 Data harmonization and metadata preparation

Exports from WoS and Scopus were imported into Biblioshiny and converted to a unified bibliographic schema using bibliometrix routines (ARIA; CUCCURULLO, 2017). Prior to analysis, records were checked for completeness of core metadata needed for performance indicators and network construction (e.g., authors, sources, year, title, keywords, and citation fields). Records with irrecoverable missing critical fields were removed from the analytical dataset. Where needed for conceptual mapping, keyword fields were prepared by standard bibliometric cleaning steps (e.g., harmonizing obvious synonyms and acronyms such as “IVF”/“in vitro fertilization”; “ART”/“assisted reproductive technology”; and normalizing spelling variants) to reduce artificial fragmentation in co-word networks (DONTHU et al., 2021).

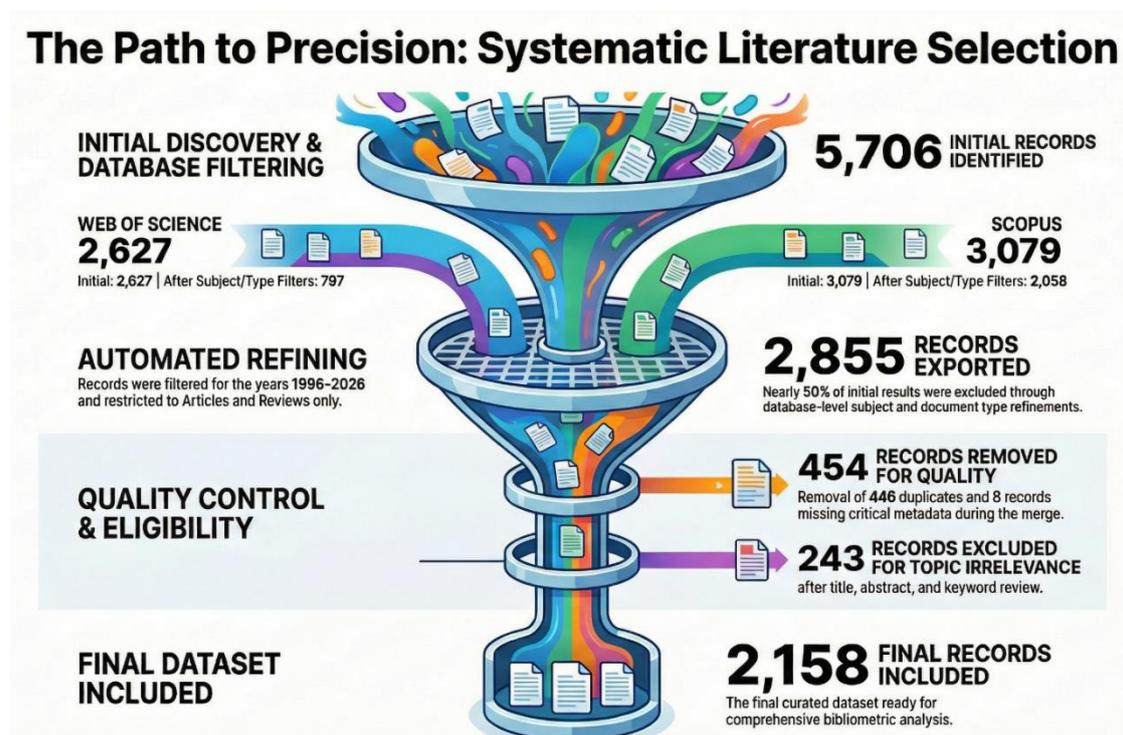
3.5 Identification, deduplication, and eligibility screening

Figure 1 (PRISMA-like flow) summarizes identification, filtering, and screening decisions, adapted from transparent reporting practices widely used for structured evidence selection (PAGE et al., 2021). The database searches returned 2,627 records in WoS and 3,079 in Scopus. After applying the 1996–2026 filter, WoS yielded 2,149 and Scopus yielded 2,730 records. Restricting to articles and reviews and applying the database-specific subject refinements resulted in 797 WoS records and 2,058 Scopus

records. The refined exports were merged in Biblioshiny (total 2,855 records), and 446 duplicates were removed, leaving 2,409 unique records. After excluding 8 records with missing critical data, 2,401 records remained for eligibility screening. Eligibility screening of titles/abstracts/keywords was performed to exclude publications that did not substantively treat the desired intersection of ART and ethics/law, even if they were included by database filters (such as false positives resulting from ambiguous abbreviation usage, purely technical/clinical publications lacking ethical-legal content, or irrelevant usage of key terms). This process eliminated 243 topic-irrelevant publications, leaving 2,158 for analysis.

Figure 1

PRISMA-like flow diagram of record identification, deduplication, and eligibility screening.



4 FINDINGS / RESULTS

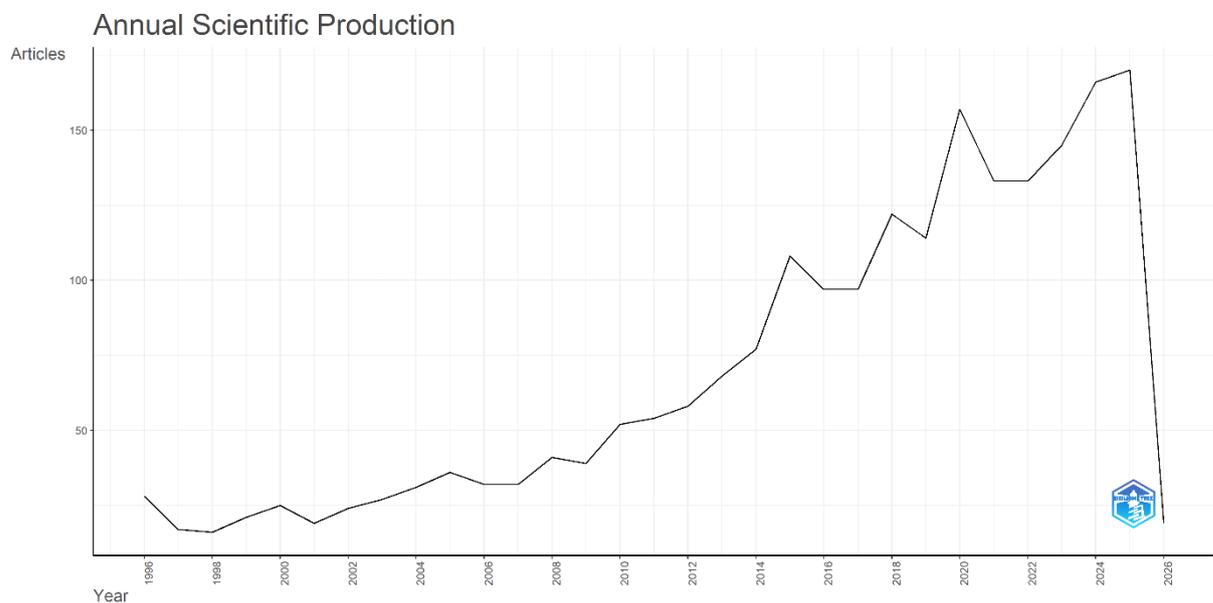
The last corpus used for analysis included 2,158 publications following database filtering, merging, deduplication, and screening for fit with the topics of interest.

4.1 Field growth

Figure 2 illustrates the clear trend of expansion in the long-run trend in ethics-law-oriented ART research. There is a low level of output through the end of the 1990s and the beginning of the 2000s, a steady increase in the 2010s, and a strong increase in the late 2010s and early 2020s. The drop at the end of the series is because 2026 is a partial year.

Figure 2

Annual scientific production.



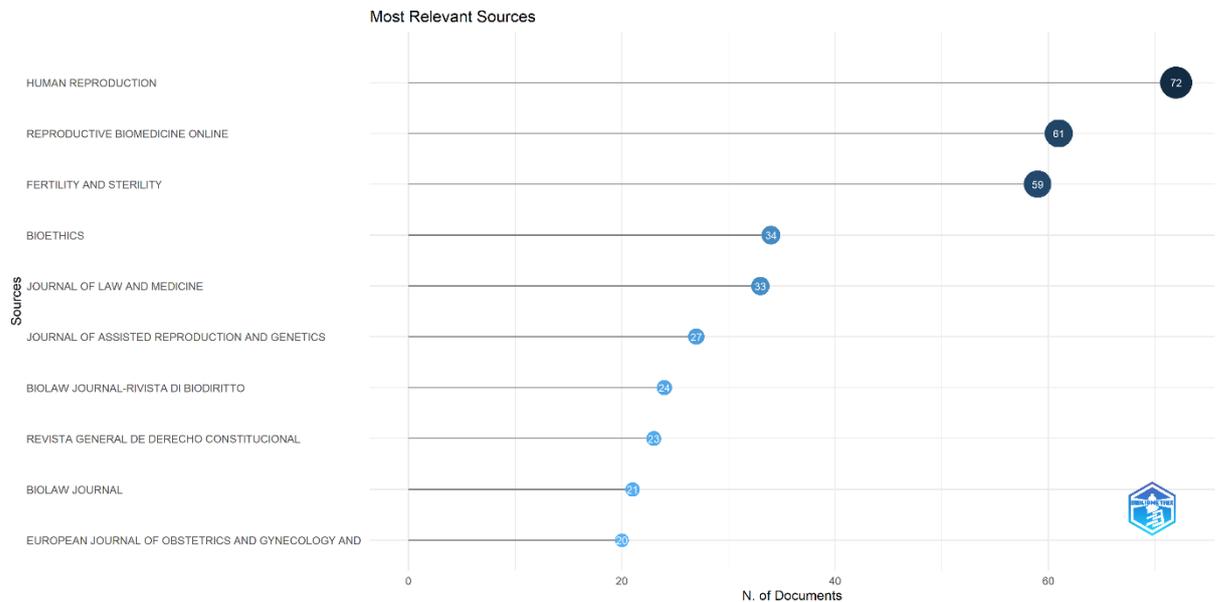
4.2 Core-Sources (journals)

The most pertinent publications (Figure 3) suggest that it is located around high-volume reproductive medicine publications but is also heavily drawing from bioethics and law-focused publications. It is also evident that the top publications by volume are Human Reproduction (n=72), Reproductive BioMed Online (n=61), and Fertility and Sterility (n=59), alongside more explicitly normative publications like Bioethics (n=34) and Journal of Law and Medicine (n=33). Further support from biolaw and constitutional law publications (e.g., Biolaw Journal, Rivista di Biodiritto, Revista

General de Derecho Constitucional) supports that there is discussion around ART governance from biomedical and legal/public policy publication streams.

Figure 3

Most relevant sources



4.3 Authors & institutions

Author productivity follows a highly skewed pattern (Figure 4), with a steep drop from single-paper authors to a small tail of more prolific contributors—consistent with the concentration dynamics often observed in bibliometric author-productivity distributions. Institutional contributions (Figure 5) show a strong presence of universities in Australia and other high-income settings. The top affiliations include University of Technology Sydney (n=22), Queensland University of Technology (n=21), Monash University (n=20), and University of Ottawa (n=20), followed by University of Melbourne (n=18) and Sapienza University of Rome (n=16). The appearance of “Not reported” (n=15) among the most relevant affiliation metadata are missing for a non-trivial subset of records, which is a known limitation when relying on exported bibliographic fields.

Figure 4

Author Productivity

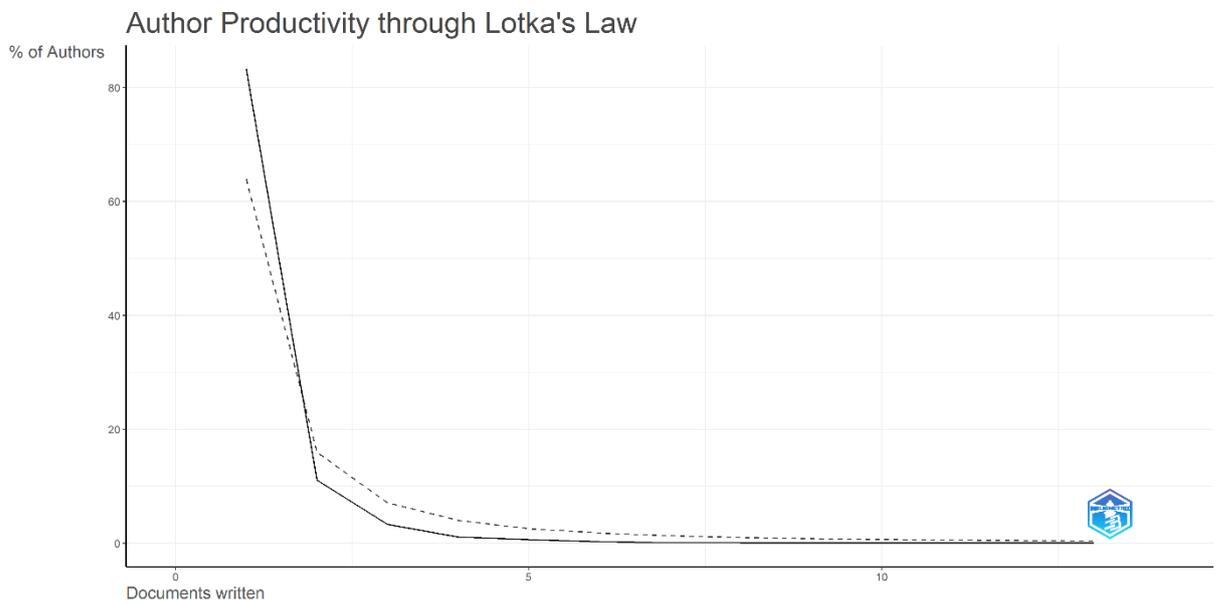
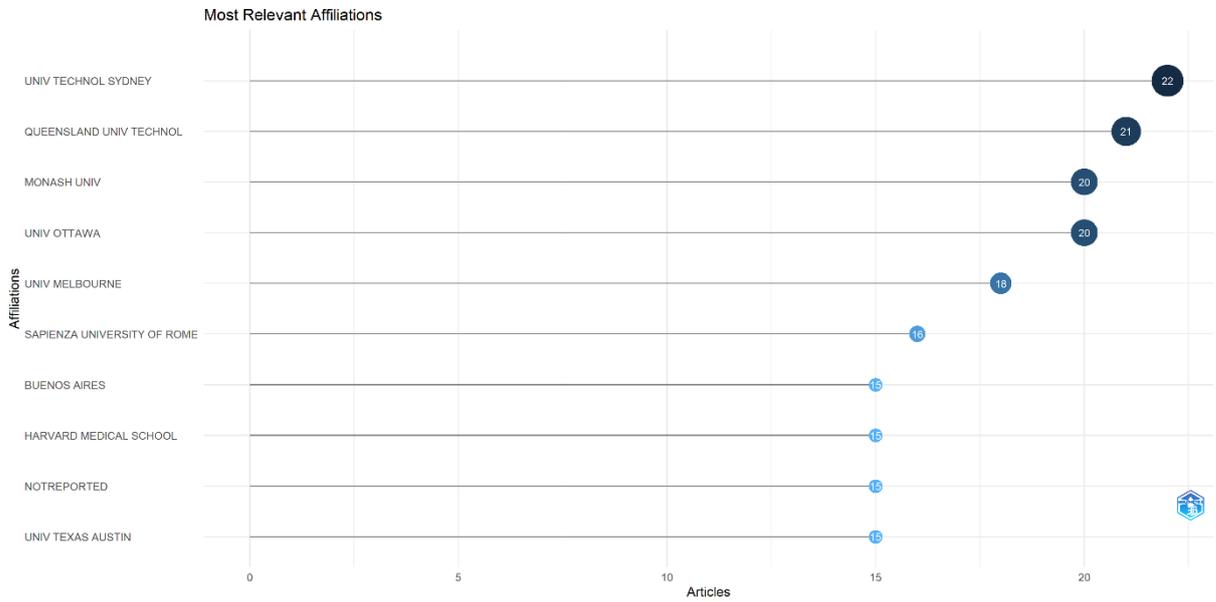


Figure 5

Most relevant affiliations



4.4 Geography & collaboration

The country collaboration map (Figure 6) suggests a globally distributed literature with visible cross-regional co-authorship links. The “country production over time” plot (Figure 7) highlights sustained growth among the leading producers, with a clear dominance of the United States and strong upward trajectories for other major contributors (notably the United Kingdom and Australia), alongside continued growth among additional European producers shown in the top-five set.

Figure 6

Country collaboration map.

Country Collaboration Map

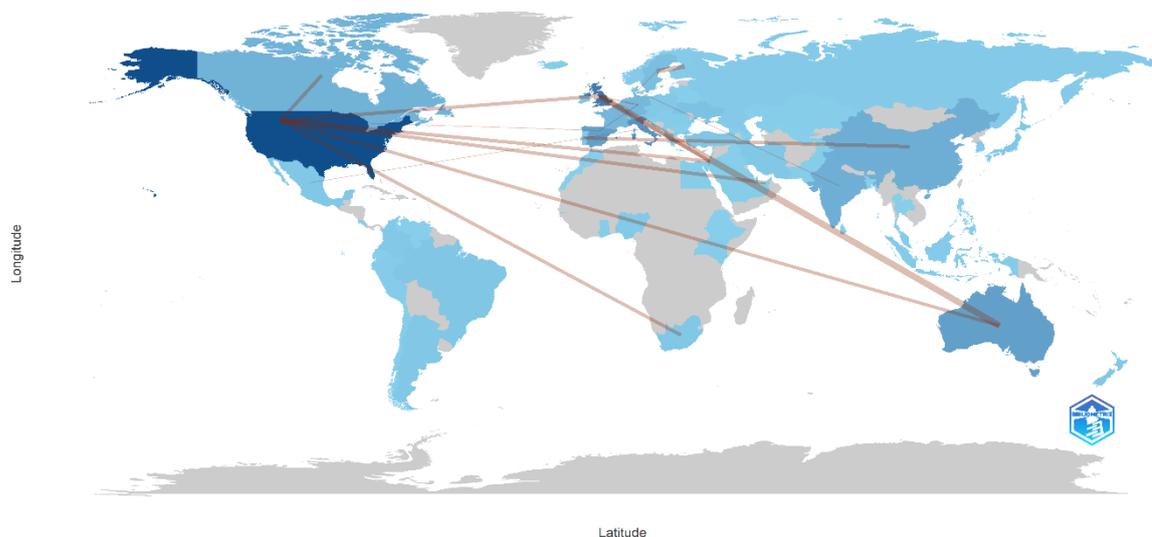
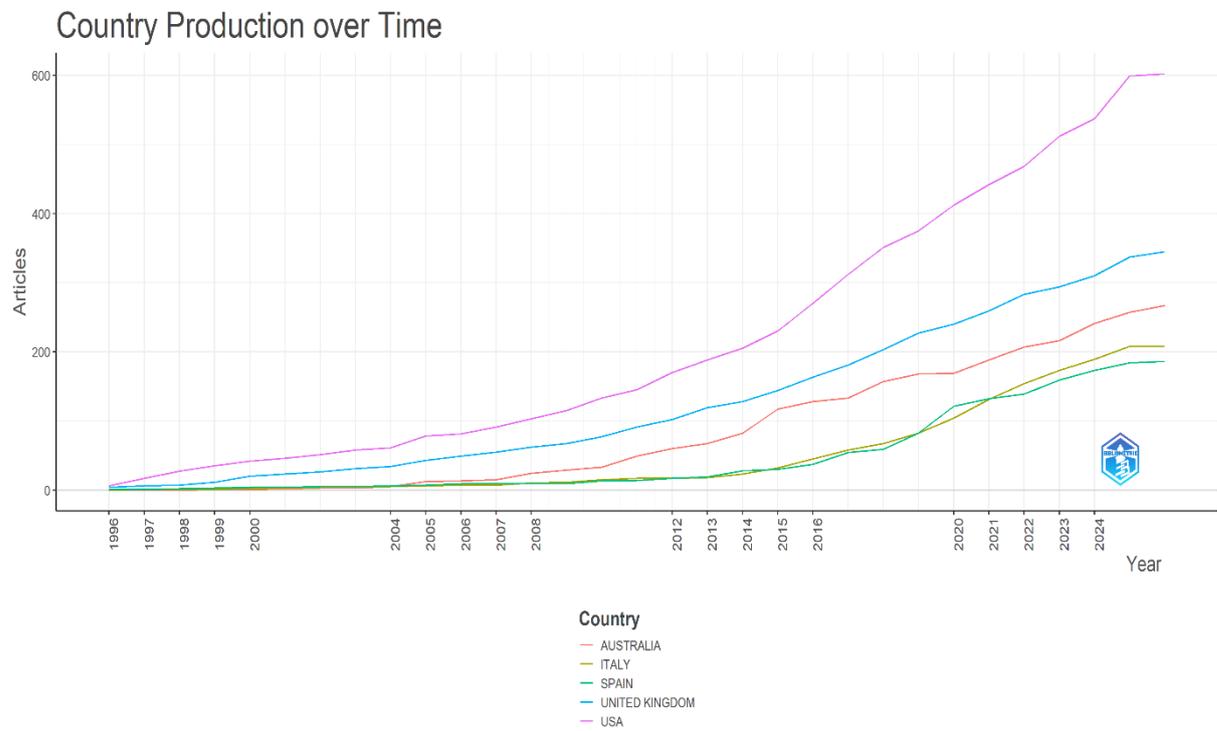


Figure 7*Country collaboration map (Top 5).*

4.5 Citation performance

Table 1 presents the most globally cited documents in the dataset. The highest-cited record is Maheshwari (2018, Human Reproduction Update) with 447 total citations (49.67 citations/year), followed by Hazout (2004, Fertility and Sterility) with 291 citations, Ginström (2019, American Journal of Obstetrics & Gynecology) with 276, and Nelson (2011, PLOS Medicine) with 265. The remaining top-cited set includes influential clinical and evidence-synthesis outputs spanning fertility treatment decision-making, guideline-type contributions, and widely cited empirical work, underscoring that—even within an ethics–law filtered corpus—citation influence is strongly shaped by high-visibility medical journals and synthesis-oriented publications.

Table 1*Most global cited documents*

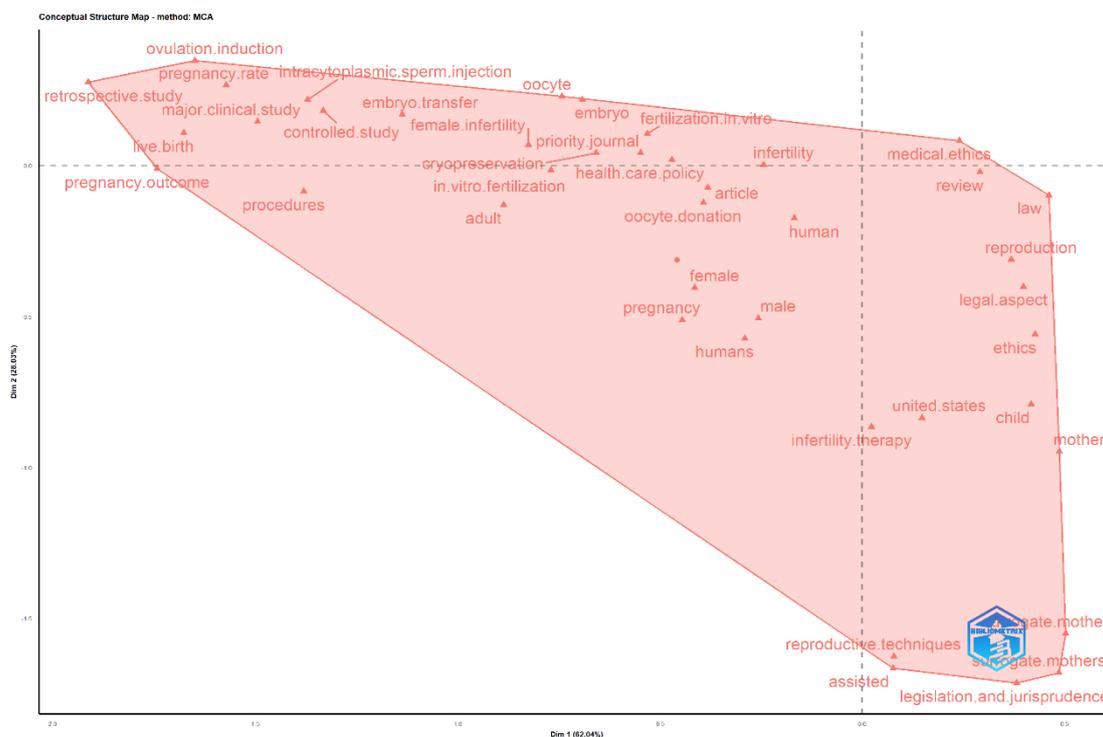
Paper	DOI	Total Citations	TC per Year	Normalized TC
MAHESHWARI A, 2018, HUM REPROD UPDATE	10.1093/HUMUPD/DMX031	447	49,67	26,67
HAZOUT A, 2004, FERTIL STERIL	10.1016/j.fertnstert.2004.03.061	291	12,65	8,16
GINSTRÖM E E, 2019, AM J OBSTET GYNECOL	10.1016/j.ajog.2019.03.010	276	34,50	29,11
NELSON S, 2011, PLOS MED	10.1371/journal.pmed.1000386	265	16,56	12,14
PARMEGIANI L, 2010, FERTIL STERIL	10.1016/j.fertnstert.2009.03.033	216	12,71	7,22
YOUSSEF M, 2010, COCHRANE DATABASE SYST REV	NA	204	12,00	6,82
POPOVIC-TODOROVIC B, 2003, HUM REPROD	10.1093/humrep/dmg181	183	7,63	6,68
CALHAZ-JORGE C, 2020, HUM REPROD OPEN	10.1093/hropen/hoz044	178	25,43	20,44
CHRONOPOULOU E, 2015, HUM REPROD UPDATE	10.1093/humupd/dmu040	172	14,33	11,73
CIL A, 2013, FERTIL STERIL	10.1016/j.fertnstert.2013.04.023	163	11,64	8,81

4.6 Mapping the conceptual landscape of ART governance (MCA)

The MCA conceptual structure map (Figure 8) indicates a strong distinction between a clinical/technical IVF pole (e.g., ovulation induction, embryo transfer, ICSI, procedures, pregnancy outcome) and a governance-oriented pole in which the terms law, ethics, legal aspect, and medical ethics tend to cluster. A separate, more peripheral cluster of terms related to surrogacy (e.g., surrogate/gestate mother(s), legislation, jurisprudence) indicates a modality-specific governance substream in the overall ART ethics-law discussion.

Figure 8

Conceptual structure map (MCA) of terms in the corpus.



5 DISCUSSION AND CONCLUSION

5.1 Discussion

As depicted in the current bibliometric map, it appears that after a period of low volume in the late 1990s/early 2000s, ethical-legal research in assisted reproductive technologies (ART) has been experiencing a period of growth in the 2010s, followed by a period of even stronger growth in the late 2010s/early 2020s.

Considering this development from a different perspective, Hernández-Torrano & Ibrayeva (2020) argue that exponential growth in publication and citation activity is a key characteristic of a new area of research. In this context, it appears that the growth pattern in ethical-legal research in ART, without any indications of a leveling off, suggests that this area of ethics-law scholarship should be viewed as a developing area of research, as opposed to a mature area of research (HERNÁNDEZ-TORRANO; IBRAYEVA, 2020).

The source structure supports this interpretation. Central publication outlets comprise reproductive medicine journals, along with bioethics and law-focused publications, suggesting that governance issues are located at the boundary of clinical practice and normative regulation. This is consistent with ELSI's previous mapping of ART literature, which found that ethical-legal scholarship is strongly linked to how ART is talked about, practiced, and regulated, and that it develops alongside clinical norms and public policy issues (ALON et al., 2023). Yet, database use may accentuate the visibility and citation impact of biomedical journals relative to some law-focused publications that are not fully covered by WoS/Scopus (MONGEON; PAUL-HUS, 2016).

The geographic patterns we observe are consistent with what has been found for ELSI-focused ART mapping: high concentrations in high-income countries and again a strong emphasis on Anglophone/Western research ecosystems. In a very similar vein, Alon et al. (2023) found that North America and Western Europe dominated ELSI research output (1999-2019) and that there is a need for more engagement with regions that are less studied and more locally focused research agendas and governance concerns. The collaboration network we present does demonstrate connections between regions, but it is overall consistent with a model where agenda-setting capacity is highly localized in a limited number of countries and institutions. This is particularly important for legal research, where there are significant differences between countries.

The factorial conceptual map (MCA) gives us a further, complementary, and theoretically relevant understanding of the field's conceptual structure. One pole is characterized by the dominance of clinical/technical IVF terms (procedures, embryo transfer, ICSI, pregnancy outcomes), while the other pole is characterized by the dominance of governance terms (law, ethics, legal aspects, medical ethics). Such a dichotomous structure may imply a conceptual split in the underlying understanding of the field: on one hand, clinical evidence and practice-oriented discourse are still central, even in an ethics-law-filtered dataset, while on the other hand, governance terms appear to represent a partially separate conceptual space. Such a dichotomy may have important implications for the understanding of the relationship between policy and law on the one hand and the clinical infrastructures that may fuel policy and law on the other (markets of fertility services, professional standards, traceability and storage infrastructures),

without such a relationship being able to be reduced to a simple metrics of clinical success.

In the governance pole, surrogacy-related words appear as a somewhat peripheral sub-area in the concept space. This corresponds to the broader literature that points to surrogacy as a particularly contested area of reproductive governance, often raising issues of exploitation, consent, cross-border arrangements, and recognition of legal parenthood (WILKINSON, 2016; HODSON; TOWNLEY; EARP, 2019). It is also consistent with the topic mapping of ART ELSI research that points to surrogacy and fertility preservation as particularly prominent and highly salient categories in the ELSI discussion (ALON et al., 2023; ALON et al., 2024). More generally, the prominence of governance-related clusters suggests a reading of ART ethics-law scholarship as a space in which the effects of rapid technological change and a globalizing service economy ensure a constant supply of new cases and issues, thereby fueling field growth and diversification.

Lastly, with respect to our dataset, patterns of citation emphasize that influence can be heavily driven by very prominent medical journals and synthesis materials, even with a dataset that is filtered towards ethics and law. While such a finding is not problematic per se, as clinical syntheses can help ground debates in governance by providing clarity on risks, effectiveness, and practice variation, it does highlight one of the perennial challenges for interdisciplinary fields: what is made central through citation does not necessarily align with what might be most pressing for law and policy (e.g., issues related to access inequities, cross-border accountability, or protections for donors/surrogates and offspring). Future research on ART governance might benefit from further efforts to bridge clinical evidence, normative analysis, and comparative regulatory scholarship.

5.2 Limitations and directions for future research

The limitations of this study are several and should inform future research. While WoS and Scopus are excellent tools for reaching a broad audience across many disciplines, they are not exhaustive with respect to legal literature, particularly with respect to jurisdiction-based law reviews written outside of English. The differences

between these databases and their structural biases can affect which journals, countries, and disciplines are found to be most central (MONGEON; PAUL-HUS, 2016). Future research could attempt to triangulate with legal specialist databases and incorporate regional indices.

Our proximity-based queries and subject/category refinements were intended to minimize clinical “noise” while preserving explicitly ethical-legal content. Nevertheless, relevant content for governance may employ different terminology, e.g., “policy,” “justice,” “equity,” “parentage,” “citizenship,” “donor identity,” that may not be captured as relevant. Similarly, clinically-focused content may be retained in the corpus if ethics/legal words are included in metadata but are not key to the content’s contribution. Future work may explore the use of full-text or abstract screening in addition to metadata screening.

Conceptual mapping approaches (e.g., MCA) are known to be sensitive to keyword and indexing practices. The use of generic indexing words (e.g., “human,” “female,” “article”) can skew the conceptual map if not filtered out. Also, incomplete affiliation fields can impact institution-level ranking. Future research could include and apply a standardized stop word/synonym dictionary and sensitivity analysis of author keyword sets versus index keyword sets.

The citation figures tend to privilege older works and vary across disciplines. While the measure of “citations per year” is helpful, it is not a perfect solution to the cohort problem. One direction for further research is to supplement citation analysis with other measures, such as normalized citation figures, co-citation clusters centered on governance papers, and/or policy citation linkages where available.

Expanding upon existing ELSI mappings that identify western-centric bias and encourage more inclusive practices (ALON et al., 2023; ALON et al., 2024), three areas seem promising for future development:

1. Governance comparisons across regions, connecting thematic clusters to regulatory systems (e.g., anonymity, payment systems, eligibility criteria, enforcement).
2. In-depth analyses of modality-specific areas (surrogacy, gamete donation, fertility preservation, embryo storage/disposition) using full-text topic modeling

to refine the identification of normative arguments, legal approaches, and evidence gaps.

3. Practice-governance interfaces, including how professional codes and counseling influence rights and ethical responsibilities, especially in internationalized care situations (HUDSON et al., 2011; ETHICS COMMITTEE OF THE AMERICAN SOCIETY FOR REPRODUCTIVE MEDICINE, 2022).

5.3 Conclusion

The bibliometric study conducted to analyze the global literature on ART with explicit ethical and legal content identified three main patterns, with the consolidated dataset comprising 2,158 publications. Firstly, the study found that the field is experiencing growth, with the rate of publication accelerating over time, suggesting that the field is an expanding and consolidating research area when viewed through the lens of developmental theory, where publication and citation paths are emphasized (HERNÁNDEZ-TORRANO; IBRAYEVA, 2020). Secondly, the study found that the knowledge production in the field is characterized by a heterogeneous core of reproductive medicine, bioethics, and legal studies, suggesting that the debates in ART governance involve both clinical infrastructure and normative/legal reasoning. Thirdly, the study found that the conceptual structure distinguishes between clinical/technical IVF discourse and governance-oriented themes, with surrogacy identified as a distinct modality-specific governance substream, providing an evidence map that can support more coherent agenda-setting in ART regulation and bioethics, identifying gaps in the geographic and thematic coverage, and providing an opportunity for further research in the field that brings together rights, clinical practice, and reproductive governance.

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Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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