Chapter

5

Narratives of (Ab)normality
IVF and Mosaic Embryos

Writing in *New York Magazine*'s women's interests site *The Cut*, Stephen Hall recounts the journey of Monica Halem, a single mother who dubbed her in vitro fertilisation (IVF) odyssey 'the fertility train' – a gruelling cycle of hopes raised and dashed by repeated miscarriages and failed embryo tests (Hall 2017). By the age of 44, after banking 18 embryos – all labelled genetically abnormal through genetic screening – Halem was on the verge of abandoning her biological quest. But her reproductive endocrinologist, Dr Jeffrey Braverman, challenged the prevailing trust in these genetic tests. Braverman noted that some visually promising embryos – 'good looking' under the microscope – might still have potential despite being labelled genetically abnormal. With Halem's consent, he transferred four embryos that had been deemed genetically abnormal. The result defied expectations: Halem became pregnant, prenatal diagnostics confirmed a healthy fetus, and in January 2016 she gave birth to a normal, healthy baby girl.

Initially assumed to be an outlier, Halem's story soon became emblematic of a broader shift. It revealed how patients' experiences were beginning to unsettle the binary logic of embryo selection, opening a grey zone in which so-called *mosaic embryos* – those containing a mixture of chromosomally normal and abnormal cells – challenge the assumption that 'genetically abnormal' is synonymous with 'non-viable'. Her case highlights how the finer resolution afforded by modern precision genomics can open new avenues of hope while also generating unsettling uncertainties and disrupting established clinical narratives. A test that was supposed to deliver certainty had instead introduced ambiguity: embryos once considered 'unsalvageable' were now believed to hold the potential of yielding healthy children under the right circumstances. The very concept of abnormality was no longer absolute; instead, IVF practitioners and patients alike were forced to reckon with uncertainty – an intermediate state between viable and non-viable that had no clear precedent in the IVF playbook.

For decades, IVF relied on relatively crude methods for assessing embryos: either visual inspection of embryo morphology or genetic probes, such as fluorescence in situ hybridisation (FISH), discussed further in the next section. These methods targeted only some chromosomes and necessarily reduced embryonic viability into a binary outcome: 'normal' or 'abnormal'. An embryo was either presumed sufficiently healthy to implant or deemed unusable and discarded. The introduction of next-generation sequencing (NGS) technologies in the mid 2010s disrupted this neat interpretive framework. Rooted in the principles of precision medicine, an approach that seeks to tailor healthcare decisions to each patient's unique genetic, molecular,

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and environmental profile, NGS offered a far more granular view of the embryo's genome. By interrogating DNA at a finer scale, NGS-based preimplantation genetic testing for aneuploidy (PGT-A), which provides a detailed examination of an embryo's chromosomal make-up, was able to detect chromosomal variations that earlier methods had missed. It soon became evident that many embryos classified as wholly 'normal' or 'abnormal' by earlier tests were in fact *mosaics* of normal and abnormal cells. Prior to NGS, such embryos were statistically categorised as viable or non-viable; now they occupied a liminal space, neither fully healthy nor definitively abnormal. This shift was no mere technical curiosity. The newfound visibility of mosaicism destabilised established decision-making frameworks and raised urgent practical and ethical questions. Should an embryo in this grey zone be transferred, cryopreserved, or discarded? How can both healthcare providers and prospective parents navigate the considerable amount of information produced by PGT-As to arrive at an informed decision (Kaye 2023)? And how should patients be counselled about an embryo that is part normal and part abnormal?

The first reports of healthy live births from mosaic embryos began to answer some of these questions. In late 2015, Italian clinician Ermanno Greco and his colleagues published a brief report on babies born following the transfer of embryos diagnosed as mosaic aneuploid blastocysts (Greco et al. 2015). All six women in their series who received such mosaic embryos went on to deliver healthy babies. These cases dispelled long-held assumptions that abnormal genetic findings necessarily preclude viability. By documenting healthy outcomes from embryos that conventional testing would have excluded, their study directly challenged the categorical separation between transferable and untransferable embryos. A new type of embryo with a more complex profile now features prominently as a key protagonist in an unfolding variant of the standard IVF narrative. This new protagonist could no longer be written off as 'non-viable' based solely on a single genetic test. Mosaicism had evolved from a theoretical possibility to a clinical reality. A new narrative was unfolding, with additional layers of complexity and detail emerging over subsequent years.

Once mosaicism entered the clinical lexicon, professional bodies moved rapidly to transform these emerging data into actionable recommendations. The American Society for Reproductive Medicine (ASRM) began to address the issue through its Practice Committee opinions: peer-reviewed, board-approved documents that synthesise evidence and recommend clinical, ethical, and laboratory approaches in reproductive medicine. In the US, the influence of the ASRM is amplified by its close relationship with the Society for Assisted Reproductive Technology (SART), which represents IVF programmes nationally. SART is a powerful narrator: it manages the national IVF outcomes registry, monitors clinic compliance with the ASRM guidelines, and helps enforce laboratory accreditation and the US Centers for Disease Control and Prevention (CDC) reporting requirements. Internationally, the Preimplantation Genetic Diagnosis International Society (PGDIS), a global network of scientists and clinicians specialising in embryo genetics, is similarly a prominent voice in this narrative. It issues technical bulletins and position statements, which often serve as the first site of narration regarding emerging laboratory challenges, including new detection thresholds and reporting standards for mosaicism. Together these societies form an interconnected ecosystem

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of knowledge translation and professional self-governance. First, specialist scientific societies, such as the PGDIS, develop early technical frameworks. Next, multidisciplinary consensus bodies and committees such as those of the ASRM refine and integrate these frameworks into broader practice recommendations. Then, regulatory or quasi-regulatory authorities adapt these recommendations into enforceable or advisory standards within their jurisdictions. Over the past decade, these actors have produced successive guidelines on embryo testing that do more than relay technical updates; they actively translate rapidly evolving laboratory capabilities into accountable, clinical practices.

Like many clinical guidelines, these documents often follow a structured methodology. They begin with **evidence synthesis**, reviewing the latest trials, observational studies, and laboratory innovations. They **acknowledge uncertainty**, indicating where data remain incomplete or contested, and they engage in **practice framing**, embedding findings into counselling protocols, institutional safeguards, and policy language. Yet the influence of precision medicine is unmistakable. Both the PGDIS and ASRM guidelines now stratify mosaic embryos according to the percentage of abnormal cells detected, the specific chromosomes involved, and the complexity of identified anomalies, albeit with different degrees of caution. This granular taxonomy reflects precision medicine's logical and narrative approach to healthcare: not all patients are alike, and not all genetic findings carry the same prognostic weight. Clinical care should be tailored accordingly.

Codifying such finely grained categories, however, exposes an interpretive gap between evidence and application. The guidelines do not dictate a single course of action; instead, they create a structured space within which clinicians, genetic counsellors, and patients must negotiate trade-offs and individual decisions. For example, in some contexts, a 'low-level' mosaic embryo (one with a small fraction of abnormal cells) may be reframed as a viable option when no fully euploid (chromosomally normal) embryos are available, whereas in other contexts, even low-level mosaics are categorically excluded from use. Therefore, the guidelines serve less as a definitive end-point and more as a mediating artefact, shaped by both evolving evidence and the epistemic commitments of precision medicine. They provide a framework, but there is considerable room for interpretation and judgement within that framework.

In this chapter, we use the evolving PGDIS and ASRM guidelines on mosaic embryos as central reference points and sites of narration, with a view to exploring how the same body of evidence can be interpreted/narrated in divergent and at times conflicting ways, both in formal recommendations and in terms of public uptake. Our concern is not only what these guidelines state, but how the evolving narratives at various other sites of narration shape the interpretations that emerge around them. Such divergences raise broader questions in reproductive medicine: Where, and on what grounds, should the boundary between a 'viable' and a 'non-viable' embryo be drawn? How are those boundaries negotiated across clinical, ethical, and societal domains? What types of knowledge are recognised as evidence? And what role do technological advances play in compelling us to reconsider concepts as fundamental as normality and abnormality?

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5.1 Chromosomal Mosaicism in IVF: From FISH to NGS and a New Paradigm of Embryo Selection

In the 1990s and early 2000s, FISH was the cutting-edge tool for preimplantation genetic screening (PGS; Brezina et al. 2016). With FISH, clinicians would biopsy a single cell from a day-3 embryo to detect a few common aneuploidies (chromosomal abnormalities). The goal was straightforward: identify a 'normal' embryo (euploid) to transfer and discard the 'abnormal' ones. This method, however, offered only an illusion of certainty. Because FISH only examines one cell and a limited set of chromosomes, it could easily miss abnormalities, especially mosaicism. If that one biopsied cell showed any chromosomal abnormality, the entire embryo was labelled abnormal and deemed untransferrable. Thus, many embryos were categorically classified as aneuploid when in fact they might have contained a mixture of normal and abnormal cells. The technology of the time effectively forced a binary classification onto a reality that was potentially more complex.

Around 2010, a new genetic assay called *array comparative genomic hybridisation* (aCGH) ushered in the next era of embryo testing. For the first time, laboratories could examine all 23 chromosome pairs, rather than just a select few, in an embryo biopsy (Campos et al. 2023). This comprehensive screening was a leap beyond FISH, yet it still yielded a mostly binary result: reporting embryos as either 'normal' (euploid) or 'abnormal' (aneuploid). Any sign of aneuploidy in the sampled cells meant an embryo was categorised as unsuitable for transfer. Mosaicism, if considered at all, was usually subsumed under the abnormal category – effectively treated as a technical footnote rather than a feature of the embryo. The all-or-nothing narrative persisted. Even as anecdotal evidence began to surface that some aneuploid embryos might not be entirely unusable, with Halem's story being one striking example, clinicians had little choice but to abide by the categorical interpretation that aCGH encouraged. In practice, the normal/abnormal narrative continued, now supported by a more powerful technology that nonetheless left subtle nuances undetected.

The introduction of NGS to PGT-A in the mid-2010s marked a major turning point, significantly enhancing the sensitivity and resolution of chromosome analysis in embryos. Instead of comparing fluorescence intensities or ratios (as in aCGH), laboratories could now sequence thousands of DNA fragments from an embryo's biopsy and quantify chromosome copy numbers with unprecedented precision (Chen et al. 2022). One unexpected result of this high-resolution approach was the sudden visibility of mosaicism. For the first time, genetic reports on embryos began to return with intermediate signals – neither fully euploid nor fully aneuploid. Embryos that earlier tests would have simply characterised as abnormal were now recognised as mosaic (some cells abnormal, some normal). This new knowledge created an immediate dilemma for clinicians and patients alike: what do we do with a mosaic embryo? As of the early NGS era (circa 2015–2016), professional guidelines had not yet caught up with this question; the idea of routinely detecting and reporting mosaicism was so new that organisations such as the ASRM had not officially endorsed the practice. Nevertheless, the biological reality was now plain to see: many human embryos are a genetic

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patchwork. NGS was forcing IVF medicine to grapple with shades of grey where it once saw only black and white.

A pivotal moment in reframing mosaicism came with the 2015 report by Greco and colleagues (2015), mentioned earlier. These Italian researchers documented a series of healthy babies born after the transfer of embryos diagnosed as mosaic (i.e., containing both euploid and aneuploid cells). By the prevailing standards of the time, such embryos likely would have been discarded as abnormal. Instead, mainly because no entirely normal embryos were available for the patients concerned, the clinicians took a chance on the mosaics, and the outcomes were successful live births. Greco and colleagues' 2015 letter in the *New England Journal of Medicine* was a watershed. It provided the first peer-reviewed proof that embryos labelled as abnormal or mosaic by PGT-A could still develop into healthy babies. The implications were profound: embryo selection in IVF was no longer a binary choice between a normal embryo and an unusable one; it had become a nuanced judgement call in a new narrative characterised by greater tolerance for uncertainty.

With mosaicism now recognised as a credible category on a continuum of results, decision-making in IVF practice shifted from a binary to a probability-based model. The choice was no longer simply between normal and abnormal embryos; instead, clinicians and patients faced a spectrum of results and had to weigh statistical probabilities and personal values. A mosaic embryo essentially represents a bet: it may be less likely to implant or more likely to miscarry than a euploid embryo, but it still offers a meaningful chance of producing a healthy birth. This reframing of the clinical mindset from certainty to calibrated risk is both empowering and unsettling for clinicians and patients alike. While patients with no normal embryos now have an additional option to consider, it comes with new uncertainties that have to be explained and understood to inform the patient's decision. The reasonably high level of uncertainty and the potential risks involved often result in emotional turmoil for patients, who have to make such a profoundly personal decision based on explanations provided by clinicians of what is ultimately highly technical pieces of information (Sekhon 2025). The support required is not always available, and clinicians and researchers continue to call for 'individual and couple decision support tools that incorporate patients' values and concerns in the decision-making process in order to promote more informed decisions, during counseling' (Kaye 2023:1; see also Besser et al. 2021 and Fransiak 2022).

At the same time, the very technologies that made mosaicism visible and ultimately led to its formal recognition have drawn criticism for the manner in which they shape interpretation. Some have argued that these advanced tests inadvertently reinforce a dichotomy between normal and abnormal by introducing new gradations that still place embryos into ranked categories of viability (Viotti 2020). Others have highlighted the variation in results across different platforms, stressing that the results of analysing the small sample of an entire embryo that has to be processed to identify it as mosaic 'cannot necessarily be extrapolated to all methods of PGT-A' (Franasiak 2022:179). As laboratories gained experience with mosaic findings, many introduced graded reporting systems, such as distinguishing low-level and high-level mosaicism, and developed scoring algorithms to prioritise mosaics with the highest expected potential for success. While intended to guide selection, these refinements

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highlight the fact that subjective interpretation remains unavoidable; there is no universally correct choice regarding a mosaic embryo; only a navigation of risk through careful counselling and shared decision-making with the patient.

In practice, two divergent philosophies have emerged among IVF practitioners regarding the use of mosaic embryos. One philosophy could be called 'maximize success' (Hall 2017). If multiple embryos are available to a patient, many clinicians will prefer to use only the chromosomally normal ones and avoid embryos with any abnormalities. In this case, a mosaic embryo might be held in reserve as a last resort or not used at all, since a euploid embryo offers the highest likelihood of a healthy baby. The other approach could be called 'no embryo left behind'. For patients with few or no euploid embryos, or for those who are willing to accept the risk, the willingness to transfer mosaics increases. Here the philosophy is that any embryo with developmental potential is worth considering, despite the added risks. In both cases, decisions are highly individualised and are negotiated through conversations about risk, uncertainty, and personal values. This is the landscape within which professional guidelines, which offer structure and evidence-based parameters, have been developed but are unable to eliminate the interpretive space in which such choices are ultimately made.

5.2 PGDIS: Championing a Precision Toolkit for Embryo Selection

Professional guidelines for PGT-A and mosaic embryos began to emerge in the late 2010s, as the field grappled with how to handle this new category of results. A major turning point occurred in 2016 when the PGDIS, a global specialist society focused on embryo genetic testing, issued its first formal guidance on PGT-A (PGDIS 2016). At that time, the PGDIS was a relatively small society with fewer than 200 members, most of whom were laboratory scientists and clinicians deeply involved in PGT-A (Gleicher et al. 2023). In formal terms, the document did not align with the conventions of a clinical guideline, such as a systematic review of evidence, mainly because the technique itself was new and the body of formal evidence was still limited. This absence did not mean, however, that the recommendations lacked an evidentiary basis; instead, they drew upon emerging empirical findings and the accumulated clinical experience of the experts who contributed to their formulation. Notably, the 2016 PGDIS guideline established a *third* possible diagnostic category for an embryo: 'mosaic'. Prior to that, embryos had been classified only as euploid (normal) or aneuploid (abnormal). The 2016 PGDIS guideline formally defined mosaicism in the PGT-A context as 'the presence of two or more cell lines with different chromosome sets' (PGDIS 2016) – in other words, a trophectoderm biopsy showing a mixture of chromosomally normal and abnormal cells. Along with this definition, the 2016 PGDIS guideline introduced an operational threshold system for interpreting NGS results: if approximately 20–80% of the DNA from the biopsy was aneuploid, the embryo should be reported as mosaic, with lower percentages reported as euploid and higher percentages as aneuploid. While somewhat arbitrary, this simple guideline gave laboratories worldwide a clear directive to start categorising embryos as mosaic when intermediate copy-number signals were observed.

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By introducing a formal category for mosaic results, the 2016 PGDIS position statement marked an important moment in the narration of PGT-A practice, responding to intermediate copy-number findings made visible by newer comprehensive chromosome screening technologies. Rather than forcing such results into the established binary of euploid and aneuploid, the guidance recognised that some trophectoderm biopsy samples show evidence consistent with the presence of more than one chromosomal cell line. At the same time, the document adopted a notably cautious stance towards the clinical implications of these findings. Acting primarily as a technical narrator, PGDIS focused on issues of laboratory detection, validation, and reporting, repeatedly stressing that PGT-A is a screening test based on a small number of biopsied cells and therefore characterised by significant technical and biological uncertainty. Mosaic results, it argued, should be reported explicitly as such, rather than being subsumed into a binary interpretive framework. Beyond this, however, the 2016 guidance offered only tightly circumscribed clinical advice, framing the transfer of mosaic embryos as a last-resort option when no euploid embryos are available and only after appropriate genetic counselling. The position statement thus brought mosaicism into the clinical story and provided a shared vocabulary for its identification, while leaving the ethical and practical emplotment of mosaic embryos – the question of whether, when, and how they should be used – largely open for later narrators to develop in divergent ways.

5.3 PGDIS 2019 and 2021: Guidance on Mosaic Embryo Transfer

Over the next few years, data on mosaic embryos began to accumulate. Case reports from 2015 to 2017 (including Greco et al. 2015) showed that transferring certain mosaic embryos could result in healthy live births. However, early outcome data suggested that success rates were generally lower with mosaic embryos than with euploid embryos; for example, they were associated with lower implantation rates and higher miscarriage rates. Given this emerging evidence, the PGDIS convened experts to update its recommendations, this time presenting them in a more standardised format and drawing on a broader range of knowledge sources. In 2019, the PGDIS published a position statement specifically on mosaic embryo transfer intended to 'review the current information and update recommendations' for handling mosaic embryos (Cram et al. 2019:e1). These guidelines acknowledged that a significant minority of tested blastocysts – roughly 5–10% in most clinics – were being reported as mosaic. Importantly, in the 2019 position statement, the PGDIS took the position that mosaic embryos have meaningful reproductive potential and should not be automatically discarded. The position statement summarised the growing evidence: by 2019, around 500 transfers of mosaic embryos had been reported in the literature. While implantation and ongoing pregnancy rates were indeed lower for mosaic embryos than for euploid embryos, 'the transfer of mosaic embryos appear[ed] to be a relatively safe option for couples' (Cram et al. 2019:e3); most babies born from mosaic embryos were healthy, with no confirmed chromosome-related syndromes in live births reported to date.

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The 2019 position statement from the PGDIS provided concrete guidance for clinics on how to prioritise and utilise mosaic embryos when no euploid embryos were available. It recommended a triage approach: if faced with multiple mosaics, clinicians should prioritise embryos based on the level of mosaicism and other characteristics. Specifically, it advised that embryos with low levels of mosaicism (interpreted as low-risk) are preferable to those with higher levels of mosaicism, as a higher fraction of abnormal cells in the biopsy is likely to correlate with lower viability. The exact cut-off between low and high levels of mosaicism was not rigidly defined in the text, but laboratories commonly began to treat mosaic embryos in the ~20–50% aneuploid range as low-level and those closer to 80% as high-level. Notably, the authors of the 2019 position statement from the PGDIS suggested that the percentage of aneuploid cells might be a better predictor of outcomes than which specific chromosome is abnormal – a point of contrast with earlier thinking that, for instance, an embryo mosaic for trisomy 21 (Down's syndrome) might inherently carry greater risk than one mosaic for a lethal chromosome, which would likely miscarry if the abnormal cells prevailed. Nonetheless, the 2019 position statement from the PGDIS still counsels that the nature of the chromosome abnormality should be considered. Certain mosaic aneuploidies, if they persisted in the fetus, could lead to known syndromes or uniparental disomy issues, such as issues arising from the presence of two copies of the same chromosome. The guidelines advised clinicians to assess mosaic embryos on a case-by-case basis, with the help of genetic counsellors. For example, a mosaic involving a chromosome linked to a severe fetal syndrome or growth restriction might be given lower priority for transfer (all else being equal), whereas a mosaic affecting a chromosome that is usually lethal – and thus unlikely to result in a live-born anomaly – might be viewed as less concerning.

The 2019 position statement from the PGDIS emphasised the importance of extensive counselling and informed consent. It stated that higher-risk mosaic embryos 'should be transferred with caution and only after appropriate genetic counselling' (Cram et al. 2019:e3). Patients needed to fully understand the specific areas of uncertainty involved in the transfer of a mosaic embryo, including the possibility of lower success rates and the small but non-zero risk of a chromosomal disorder in the child. In summary, by the time the 2019 position statement from the PGDIS was published, guidance had evolved from simply *detecting* mosaicism to actively *managing* it. Mosaic embryos were now officially a third category of IVF outcome that could be used, albeit as a last resort. The guidelines explicitly stated that the transfer of mosaic embryos should be considered only when no euploid embryos are available, reflecting a consensus that euploid embryos remain the first choice whenever possible.

By 2021, further data had reinforced these points. Compiled information with clinical follow-up from more than 2,500 cases involving mosaic embryos was available, providing a substantially larger basis for assessing outcomes (Leigh et al. 2022). The PGDIS convened another expert consultation and released an updated position statement in 2021 to replace the 2019 guidance, which was later published in *Reproductive Biomedicine Online* in July 2022 (Leigh et al. 2022). The 2021 update from the PGDIS reiterated that many mosaic embryos can lead to healthy births: it noted that 'a high proportion of mosaic embryos have significant developmental

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competence and should not be disregarded in terms of suitability for transfer' (Leigh et al. 2022:21). It cited studies showing that nearly all fetuses resulting from mosaic embryos have turned out to be chromosomally normal on prenatal testing and that 'all live births reported to date [from mosaic embryos] show[ed] no evidence of chromosome-based syndromes' (Leigh et al. 2022:21). In other words, while transfers of mosaic embryos may carry some additional risk of failure, the babies who *are* born from them have, so far, not shown chromosomal abnormalities attributable to the mosaicism.

The 2021 update from the PGDIS carried forward the practical triage principles from 2019 (e.g., by prioritising low-level over high-level mosaic embryos and by considering which chromosome is involved), but it also addressed technical and communication aspects in more detail. It advised laboratories not to misclassify mosaic embryos as 'fully aneuploid/abnormal' (Leigh et al. 2022:22), as doing so would risk discarding embryos with actual reproductive potential. Laboratories were instructed to report the percentage of mosaicism and their detection cut-offs clearly to clinicians, and to 'refrain from classifying a mosaic embryo as not suitable for transfer' (Leigh et al. 2022:22) – in other words, provide the data and category, but leave the ultimate utilisation decision to the clinicians and patients. The 2021 update from the PGDIS also recommended that IVF patient consent forms be updated to mention the possibility of mosaic results and to explain the uncertainties associated with them. Additionally, the 2021 update from the PGDIS emphasised quality control: clinics that see unusually high rates of mosaics in their testing should review their laboratory practices, as analytical thresholds or algorithms or technical errors can inflate mosaic diagnoses.

Throughout this evolution, the PGDIS stance has been generally supportive of PGT-A as a tool to improve IVF outcomes, while acknowledging the complexity of interpreting its results. By 2021, the PGDIS narrative was framing the transfer of mosaic embryos as a permissible option in carefully circumscribed circumstances: when no euploid embryos are available, and when patients have received appropriate genetic counselling and follow-up, in light of the low incidence of adverse outcomes reported in live births to date. In summary, the PGDIS promotes a precision medicine toolkit for embryo selection, encouraging the use of genetic information to refine choices and avoid known aneuploidies, while also integrating new data to safely expand the definition of what constitutes a transferable embryo.

5.4 ASRM's Evolving Opinions (2018–2023) on PGT-A and Mosaic Embryos

Through its Practice Committee, and in collaboration with SART and its Genetic Counselling Professional Group, the ASRM issued its own series of opinions on PGT-A and mosaic embryos. Its perspective has shifted over roughly the same period from early scepticism about PGT-A to a cautious acceptance of transferring mosaic embryos, albeit with a more guarded tone regarding the overall benefits of PGT-A and a stronger emphasis on patient autonomy in decision-making. Overall, the ASRM guidance has often paralleled the PGDIS technical assessment, but it diverges in framing and emphasis.

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Around the time the PGDIS was introducing its new PGT-A nomenclature and urging adoption of mosaic reporting, the ASRM was still stressing that routine PGT-A was not a panacea for all patients undergoing IVF. Together with SART, it later issued a comprehensive committee opinion on the use of PGT-A, authored by Penzias and colleagues and published in *Fertility and Sterility* in 2018. While the 2016 bulletin from the PGDIS had been mainly based on expert consensus and laboratory experience, the 2018 committee opinion from the ASRM followed a more formal evidence-based guideline structure, placing particular emphasis on systematic reviews of randomised controlled trials (RCTs). The ASRM committee noted that some non-randomised studies had found higher birth rates per embryo transfer with PGT-A, particularly in contexts such as facilitating single-embryo transfer to avoid multiple pregnancies. However, critically for this narrator, *no definitive proof* existed that PGT-A improved cumulative live birth outcomes per IVF cycle for *all* patients. In effect, the ASRM portrayed PGT-A as an unproven add-on: potentially useful in specific scenarios, such as for women of advanced age at higher risk of aneuploidy, or to reduce twin pregnancies by enabling confident single-embryo transfers. However, it did not endorse the use of PGT-A in every IVF case. This position contrasted with the PGDIS's more optimistic framing, which portrayed PGT-A as the new standard of care in embryo selection. The 2018 committee opinion from the ASRM stated plainly that 'the value of PGT-A as a universal screening test for all IVF patients has yet to be determined' (Penzias et al. 2018:434). The wording 'has yet to be determined' signalled a cautious stance, essentially urging that PGT-A be considered on a case-by-case basis and researched further, rather than adopted universally. In practice, however, by 2018 many clinics in the US were already rapidly adopting PGT-A as part of their standard IVF protocols; the use of the test was, in fact, outpacing the evidence. The ASRM guidance at that time served as a gentle reminder, encouraging individualised decision-making rather than routine use for every patient. Notably, although the issue of mosaicism was well-known by 2018, the ASRM Practice Committee largely deferred detailed discussion of how to manage mosaic results. It was perhaps too early; the data were still emerging and consensus was lacking. The dedicated mosaicism-focused guidance would come two years later, in 2020.

As data on mosaic embryos continued to accumulate, and especially following the 2019 position statement from the PGDIS, the ASRM decided to convene a group to address mosaicism. The ASRM Practice Committee, along with its Genetic Counseling Professional Group (GCPG), issued a committee opinion in 2020 on the 'Clinical Management of Mosaic Results from Preimplantation Genetic Testing for Aneuploidy (PGT-A) of Blastocysts', published in *Fertility and Sterility*. First published in 2020 and later updated in 2023, this document provided what it called 'evidence-based considerations' for dealing with mosaic embryos in IVF (Practice Committee and GCPG of the ASRM 2023:973). A key feature in the initial 2020 version was an almost defensive clarification: the ASRM did not want the act of providing guidance on mosaic embryos to be misinterpreted as a blanket endorsement of PGT-A itself. The document explicitly stated that it 'does not endorse, nor does it suggest that PGT-A is appropriate for all cases of in vitro fertilization' (Practice Committee and GCPG of the ASRM 2020:246). In other words, the

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ASRM was careful to include a caveat that advising on how to handle mosaic results should *not* be construed as a recommendation that every patient undergoing IVF should be undergoing PGT-A in the first place. This position reflected the ASRM ongoing scepticism about universal PGT-A. At the same time, the committee recognised the reality that many clinics were already offering PGT-A, and that many patients were receiving mosaic results. Thus it was important to offer some guidance on what to do in those cases. The ASRM perhaps chose to engage with a narrative that was already gaining much ground in order to temper it, rather than reject it altogether and risk failing to exercise any control over its spread.

The 2020 guidelines on mosaicism from the ASRM echoed some of the recommendations in the 2019 position statement from the PGDIS, but with a more guarded tone and several notable differences. For instance, the ASRM committee opinion acknowledged that embryos diagnosed as mosaic can lead to the birth of healthy babies, and that transfers of mosaic embryos generally have somewhat lower implantation and higher miscarriage rates than transfers of euploid embryos. However, the ASRM was more sceptical about the predictive power of the precise percentage of mosaicism reported. The committee wrote that 'it may be premature to apply' specific mosaic percentage thresholds (e.g., 30% versus 50%) 'for purposes of embryo-transfer decisions or for providing clinical recommendations to patients' (Practice Committee and GCPG of the ASRM 2020:249). In essence, it questioned the reliability of distinguishing 'low mosaic' from 'high mosaic' with great precision, given the technical variability and limited outcome data. The guideline states that 'there is currently *no evidence-based classification system* for prioritizing embryos according to the type of mosaic result' (2020:253; emphasis added). This position contrasts with that of the PGDIS, which by 2019 was advising clinicians to use percentage cut-offs to prioritise embryos. Consistent with the cautionary principles of evidence-based medicine (EBM), the ASRM emphasised the uncertainty inherent in a single-biopsy diagnosis, reminding clinicians that a mosaic result from one small tissue sample might not reflect the true status of the entire embryo. Therefore, the guidance suggested that while clinicians can stratify embryos to some extent, and indeed most laboratories would report an estimated mosaic percentage, they should be very cautious about over-interpreting those numbers when counselling patients.

In practical terms, the 2020 committee opinion from the ASRM advised that transferring a mosaic embryo would only be a legitimate option if no euploid embryos remained available to a patient, provided they are given appropriate counselling. The clinician should explain to the patient that the embryo has an uncertain potential, that the chance of live birth might be lower than with a euploid embryo, and that there may be a small risk of a chromosomal condition in the child. Here the ASRM stressed the need for caution even if no chromosomal condition had been observed. It offered the community a cautionary, prudent tale rather than an optimistic, reassuring one.

The revised 2023 committee opinion, which superseded the 2020 version, incorporated 'a growing number of published studies' (GCPG of the ASRM 2023:973) and provided updated evidence-based considerations for managing embryos with mosaic results. The overall position remained similar: the transfer of mosaic embryos is acceptable in carefully selected situations. However, the tone and details were refined

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by the stronger evidence base that had become available by 2023. For instance, by 2023, it was even clearer that most reported children born from mosaic embryos are chromosomally normal. The 2023 update from the ASRM reinforces the advice that patients should be informed that transfers of mosaic embryos may have lower success rates, but also that a mosaic embryo *could* still yield a healthy baby. Indeed, the accumulated evidence now made the ASRM somewhat more confident that transferring mosaic embryos does not significantly increase the risk of a chromosomal syndrome in the newborn, although it continued to note that long-term developmental data are still limited. Throughout the document, the ASRM continued to emphasise patient-centred decision-making: fertility clinics are encouraged to develop clear internal policies for handling mosaic results, and patients' personal values and tolerance for risk should drive the deliberation about whether to proceed with a transfer of a mosaic embryo. As before, patient autonomy is at the forefront; the role of the clinician is to inform and advise, not to unilaterally decide on the patient's behalf. This position is very consistent with the broader narrative of patient autonomy in which modern medicine is situated, and which is informed by Kantian philosophy (Campbell 2017).

The 2024 ASRM committee opinion on the use of PGT-A further reinforces this prudential stance. Despite ongoing technological refinements and a marked increase in clinical uptake, the ASRM reiterates that the value of PGT-A as a universal screening test has not been demonstrated. In this narrative, mosaicism is emplotted less as a new clinical opportunity than as a reminder of the epistemic and practical limits of embryo classification, including the risk of discarding embryos with reproductive potential. In this sense, the 2024 guideline retroactively frames ASRM's earlier mosaic-specific guidance as a pragmatic response to an already widespread clinical practice, rather than as an endorsement of the continued expansion or routinisation of PGT-A.

Thus, by 2023, an interesting convergence had occurred. Despite their different tones, the ASRM and PGDIS now shared several core recommendations on the transfer of mosaic embryos: both agreed that mosaic embryos can sometimes be used to achieve healthy pregnancies, both advised using them only when euploid options are exhausted, and both endorsed thorough counselling and consent processes. However, as we will see in the next section, the differences in their *emphases* reveal more profound narrative divergences. Their narratives ultimately tell different stories about the role of PGT-A and mosaicism in IVF, reflecting distinct philosophies and approaches to healthcare. One is the story of maximising technological potential and precision (*precision*), and the other is the story of cautious, evidence-checked integration into practice (*prudence*). These narratives set the stage for how professionals and patients interpret the guidelines, and they carry over into the public controversies surrounding PGT-A.

5.5 Two Narratives of Guidance: Precision versus Prudence

Although the ASRM and PGDIS now largely agreed on practical points – for example, that the transfer of mosaic embryos can be considered when no euploid

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embryos are available, and that patients must be counselled about the risks – the differences in how they frame their guidance imply more profound narrative divergences. Each society develops its narrative from a distinct vantage point and aligns it with a unique philosophy of healthcare. The PGDIS approaches guidance with a question akin to 'How can we use the tools we have to their fullest potential?' This orientation reflects a desire to optimise the value of technology and its role as a key protagonist in clinical practice, which is consistent with the broader narrative of precision medicine. The ultimate aim is to maximise IVF success rates and embryo utilisation, within specific safety limits. In contrast, the ASRM begins from a different question that locates it firmly within the broader narrative of EBM: 'How certain are we that this technology actually benefits patients?' The emphasis is on validation and proven benefit before widespread adoption is endorsed, meaning that the ASRM positions its recommendations firmly within the logic of patient-informed choice, rigorous evidence appraisal, and ethical responsibility. In other words, within the broader, long-established narrative of EBM, rather than the relatively new and competing paradigm of precision medicine.

Even as late as 2020, the ASRM felt compelled to stress that its guidance on mosaic embryos *did not* constitute an endorsement of universal PGT-A, and in its 2023 update, it continued to stop short of recommending PGT-A for all patients undergoing IVF. In this regard, the ASRM narrative foregrounds the patient as *the* key protagonist and places patients' deliberative space at the centre of this evolving story: patients must be free to choose or decline the technology based on their own values and with appropriate counselling that explains the risks involved, however small. In contrast, the PGDIS narrative places the clinician's and/or laboratory's decision-making framework at the centre, providing prescriptive technical instructions to optimise outcomes based on the available technological tools. The PGDIS guidelines read like a playbook of how to get the most informational mileage out of PGT-A. Their advice to laboratories and clinicians is provided through direct, confident statements: 'laboratories should refrain from classifying a mosaic embryo as not suitable for transfer', 'it is recommended that only five to ten trophectoderm cells be biopsied', and 'transfer of blastocysts with a normal euploid result should be prioritized over those with mosaic results' (Leigh et al. 2022:22–23). In contrast, the ASRM guidelines read as a cautious overlay: they incorporate many of the same facts and even similar recommendations, such as 'knowledge that transferrable embryos are euploid may outweigh the risk of having fewer transferrable embryos' (ASRM 2024:421), but they situate them in cautionary reminders about the limits of knowledge and the importance of patient preference. This is not to suggest that the ASRM approach is inherently more 'patient-friendly'; indeed, the safety-focused protocols that the PGDIS promotes are also intended to protect patients from transferring truly high-risk embryos, for instance. Instead, the distinction lies in the *point of view* or *narrative location* from which each story of mosaic embryo use is articulated.

A second difference in narrative orientation concerns how each society configures the primary actors in the clinical encounter. In the PGDIS narrative, the key protagonists – genetic assays, biopsy procedures, and data interpretation protocols – are arranged into a system primarily designed to ensure technical safety and to maximise the efficiency of embryo selection. The emphasis is on standardising

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laboratory and reporting practices to manage risk and improve success rates, as in the following directive to laboratories: 'Irrespective of cut-off values used for determining the euploid and aneuploid calls, . . . lower and upper mosaic limit points should be reported by the testing laboratory to the referring clinician to facilitate any transfer discussions with their patient' (Leigh et al. 2022:22).

The guidelines read as though the laboratory scientist or clinician is the protagonist who must skillfully deploy PGT-A to help the patient. In the ASRM narrative, the same elements are present but are positioned somewhat differently: the guidelines emphasise preserving patient autonomy as the foremost principle. Clinics are encouraged to establish clear policies on mosaic embryo handling, but the guidelines emphasise that it is the patient's personal values and risk tolerances that should drive the whole process and the final decision:

> More research is needed, particularly as costs for PGT-A decrease, and clinicians should tailor their recommendations to the preference and situation of the individual patient. (ASRM 2024:428)

> Clinics should strive to implement a written policy on disposition of abnormal embryos, including those with mosaic results and segmental aneuploidy. This policy should be disclosed to the patient before testing. (ASRM 2024:429)

The clinician's role in this narrative is not to unilaterally select or discard an embryo based on the test, but to equip the patient with a balanced understanding of the risks, uncertainties, and potential outcomes, thereby enabling a genuinely informed consent. In effect, the ASRM narrative portrays the patient (or the patient and their partner) as the protagonist in the decision-making drama at all stages of the process, with the clinician serving as an informed, expert guide. The PGDIS narrative casts the clinician–laboratory system as the protagonist, with the patient as the beneficiary of its optimised, technology-supported decisions.

Thirdly, and perhaps most fundamentally, the two societies differ in how they *emplot* scientific evidence. The PGDIS leans towards the ethos of precision medicine, assuming that nuanced stratification of mosaic results (by percentage of aneuploid cells, type of chromosomal abnormality, and complexity of the genetic lesion) can be used to generate actionable hierarchies for clinical decision-making. The underlying ethos here is that even preliminary or indirect data, if biologically plausible, should be operationalised to refine decisions at the embryo level. The PGDIS 2019 guidelines, for example, went beyond suggesting that mosaic embryos can sometimes work to proposing specific protocols and ranking systems (e.g., low versus high mosaicism) that clinics could implement immediately. In contrast, the ASRM remained more firmly rooted in traditional EBM, which privileges robust, preferably randomised evidence before endorsing widespread changes in practice. The ASRM narrative cautions against over-interpreting markers, such as a 'low-level' versus 'high-level' mosaic designation, when the outcome correlations for these categories are based on limited and potentially biased studies. Thus the PGDIS approach outlines specific technical steps that can be adopted immediately by laboratories and clinicians, while the ASRM approach layers each step with cautionary caveats, reminding clinicians and patients that these schemas are provisional and should not be over-relied on.

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In summary, both societies are committed to improving reproductive outcomes; however, they diverge in how they narrate the pathway to that goal, and in their choice of protagonists to foreground and empower. The PGDIS narrative pushes the envelope of embryo selection science, framing the laboratory bench as a site where incremental refinements in measurement can translate into better patient outcomes. It foregrounds technical tools and processes as the main protagonists in an optimistic, confident narrative that offers hope and promises successful outcomes in most cases. The ASRM narrative foregrounds the interpretive gap between measurement and lived outcomes, framing the patient as the main protagonist and the consultation room as a space where uncertainty must be made explicit and patient agency safeguarded.

Crucially, these narrative differences are not confined to ivory tower discussions; they eventually become raw material for public storytelling and debate. How the PGDIS and ASRM frame their guidance feeds into how the media discuss PGT-A, how clinics market it, and how patients perceive it. In the next sections, we will see how the *precision* narrative and the *prudence* narrative are adopted by different actors, leading to two contrasting public narratives surrounding PGT-A: one by proponents who hail it as a high-tech tool that brings IVF closer to guaranteed success, and another by critics who portray it as a premature, perhaps harmful intervention that needs reining in. Thus the formal guidelines' narratives of *precision versus prudence* set the stage for the broader public controversy that continues to surround PGT-A.

5.6 Proponents' Narrative: Precision, Progress, and the Promise of Control

Following – and in many respects amplifying – the PGDIS precision-medicine logic, proponents of PGT-A often frame the technology as a decisive leap forward in reproductive medicine, aligning it with a broader cultural script of biomedical innovation and mastery over biology. In their narrative, PGT-A is not just another laboratory test; it is a game-changer in assisted reproduction, a tool that makes IVF more efficient and personalised. Marketing materials from fertility clinics frequently echo this narrative. They describe this test as enabling a 'more personalized approach to fertility treatment' (IVF Clinics Abroad 2025), the very embodiment of precision medicine's central promise of tailoring healthcare decisions to the unique genetic profile of each embryo and each patient. This language draws upon a deep source of societal narratives about technological progress – the idea that with the right data and tools, we can conquer uncertainty and take control of outcomes that were previously left to chance. Within this frame, PGT-A is portrayed as 'a way to remove some of the guesswork' from IVF (Ducharme 2025). It promises clarity in a domain long defined by uncertainty and heartbreak. The emotional appeal is powerful: for patients enduring the rollercoaster of fertility treatment, who often feel at the mercy of luck or fate, PGT-A offers the prospect of a smoother journey and a greater chance of success. It is a narrative of optimisation and control, in which precision testing becomes the means of creating order from the natural unpredictability of human reproduction. If a regular IVF cycle is a gamble, PGT-A is pitched as stacking the odds in the patient's favour.

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Proponents support this narrative with a curated array of claimed clinical benefits. Especially in communications from fertility clinics (e.g., websites, brochures, informational seminars, and blog posts for patients), we are told that PGT-A 'helps select the healthiest embryos for transfer', thereby 'reducing the risk of miscarriage and implantation failure' (IVF Clinics Abroad 2025). The technology is presented as particularly beneficial for women aged over 35 years and those with recurrent pregnancy loss – populations in whom chromosomal abnormalities are more common. The implication is that it 'significantly increase[s] the chances of having a baby' in these populations (IVF Clinics Abroad 2025). From a narrative perspective, what is striking is how this evidentiary repertoire is selectively appropriated to emphasise certain strata of the patient population. The pattern aligns closely with the stratified reasoning of precision medicine itself: evidence is parsed to show utility in well-defined subgroups, rather than to argue for universal application in all patients undergoing IVF. Thus per-transfer metrics and subgroup analyses become central plot devices in the story of PGT-A as a valuable technology.

At the same time, other strands of evidence, such as the absence of an overall benefit in unselected patient populations, or the cautionary statements from bodies like ASRM, are given far less narrative weight. For example, the ASRM 2024 statement that 'the value of PGT-A as a routine screening test for all patients undergoing IVF has not been demonstrated' (ASRM 2024:430), or the findings of multicentre RCTs indicating that overall pregnancy outcomes were similar between PGT-A and conventional IVF without genetic testing, are seldom foregrounded in proponents' messaging. The juxtaposition of these two evidentiary streams reveals patterns of selective appropriation inherent in all narrative processes. In this case, it illustrates how the translation of medical data – that is, of conceptual narratives – into public narratives involves not only what is included and foregrounded, but also what is left out or backgrounded. In this sense, the proponents' framing can be seen less as outright distortion and more as strategic curation of evidence in the service of a precision medicine storyline. The data points that support the narrative of progress and benefit are foregrounded, while those that suggest limitations or failures are relegated to the background.

5.6.1 Selective Use of Evidence

A concrete example of this selective evidentiary framing is evident in how success rates are reported. Proponents of PGT-A often cite studies or internal clinic data showing that it increases the implantation rate per embryo transferred and reduces the risk of miscarriage. These figures can indeed be compelling, especially for patients who have suffered miscarriages or failed cycles. Yet they often come with important caveats that receive less attention. For instance, improved *per transfer* outcomes do not necessarily translate into improved *per patient* or *cumulative* live birth outcomes, because using PGT-A means some embryos never get transferred at all (having been deemed abnormal).[1] If a patient has many embryos and PGT-A helps choose

[1] However, some researchers have argued that PGT-A was never meant to improve the cumulative live birth rate and that 'time to a healthy baby is the key term' when answering the question about 'what specifically providers and patients are looking for in PGT-A' (Cooper and Viotti 2024:74).

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the best one first, it may reduce time to pregnancy or avoid a miscarriage – that is, a per-transfer benefit. But if a patient has only one or two embryos, PGT-A could end up excluding an embryo that might have been their only chance, thus lowering that patient's overall chance of having a baby. Proponents tend to focus on the former scenario. They stress, for example, that PGT-A allows single-embryo transfer with lower twin rates and that in older women it can reduce the chance of miscarriage by filtering out embryos with obvious aneuploidies. These are real potential advantages, but presented alone, they give an overly favourable impression. What is often overlooked in many optimistic narratives is the body of evidence showing, among other things, that in RCTs involving women in their late 30s, the overall birth rate was not higher among those who used PGT-A compared to those who did not – they simply had fewer miscarriages and fewer transfers (Ducharme 2025). These nuances rarely find their way into proponents' narratives that reach patients through various sources.

5.6.2 Empowerment, Choice, and the Complexity Paradox

Another feature of the proponents' narrative is its emphasis on empowering patients through information and choice. Here the proponents' narrative interestingly overlaps with the ASRM emphasis on patient autonomy, but with a significant difference: the complexity of decision-making is rhetorically downplayed. In marketing language, for example, PGT-A 'significantly enhances the chances of a successful conception and the birth of a healthy baby' (V Fertility Center),[2] 'guides clinicians toward embryos that are most likely to result in full-term, healthy pregnancies' (Ducharme 2025), and gives patients 'confidence in the path they choose in assisted reproduction' (IVF Clinics Abroad 2025). The implication is that more information leads to clearer, easier decisions. This portrayal presents decision-making as a straightforward, data-driven process rather than a fraught negotiation with probabilities and uncertainties. A brochure, media report, or website might suggest that with PGT-A, the patient can simply 'choose the best embryo' and be done, making them feel empowered by knowledge and technological advances.

The notion of empowerment here can be double-edged. While PGT-A may indeed offer actionable information that some patients value, it also introduces significant financial costs – often thousands of dollars that the patient must pay, as insurance typically does not cover it – and can subtly shift responsibility for outcomes onto patients themselves. If a patient has the power to choose the 'best' embryo and something still goes wrong, they might internalise that as personal failure for having bad luck or for choosing wrongly. Thus, like genetic testing in general, PGT-A 'serves as a form of privatization that makes the individual the site of governance through the self-regulation of genetic risk' (Roberts 2012:220–221). Moreover, the promise of clarity can be as much an emotional salve as an evidence-based guarantee. For some, the narrative of reducing guesswork masks the persistence of uncertainty, because even a euploid embryo is not a guaranteed success, nor is a mosaic embryo an inevitable failure. For others, it transforms uncertainty into

[2] www.v-ivf.com/2024/01/the-benefits-of-preimplantation-genetic-testing/.

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a high-stakes gamble: you pay for the test, trust its results, and decline to transfer certain embryos, effectively betting on the test's accuracy. In summary, the empowerment narrative sometimes obscures the very complexities that clinical guidance (like that from the ASRM) aims to keep visible. It sells a version of control that may not fully exist, at least not to the extent people hope or are led to believe.

Overall, the public-facing narrative of proponents of PGT-A combines the stratified promise of precision medicine with a narrative of technological progress, selectively foregrounding evidence that affirms the value of PGT-A for certain patients while downplaying contradictory findings. It translates the professional discourse of optimisation into a consumer-oriented language of hope, control, and empowerment. In doing so, however, it can downplay nuances and uncertainties – the grey zones that the science of mosaicism has highlighted.

5.7 Critics' Narrative: Caution in Evidence-Based Medicine, Risk Frames, and Ethical Concerns

If the proponents' narrative relies on precision medicine's promise of stratified benefits and technological mastery, the critics' narrative offers almost an inverted perspective. It is grounded in the epistemic caution of traditional EBM, where interventions must demonstrate robust and generalisable benefits before being widely adopted. Critics of PGT-A – a group that includes several prominent reproductive endocrinologists, embryologists, and even patient advocates – portray the technology as a case study in medical overreach: a costly add-on that was introduced into the clinic before sufficient evidence was available, now sustained by momentum, marketing, and hope more than by solid science.

5.7.1 Scientific Scepticism and the Evidence Gap

From this vantage point, as some outspoken critics have argued, PGT-A is not backed by solid science; it was 'never clinically validated for any of its claims of clinical utility' (Gleicher et al. 2021:2e). Over the course of more than two decades and three iterations of technology, the same critics note, investigators have repeatedly failed to confirm the PGT-A hypothesis 'either experimentally and/or in clinical practice'. This hypothesis – that identifying and excluding aneuploid embryos would improve IVF success rates – sounds compelling; however, the hard truth, they maintain, is that large-scale RCTs have repeatedly shown no significant improvement in overall live birth rates with PGT-A, and some, including Gleicher and colleagues (2021), have even suggested worse outcomes in certain patient populations. As they bluntly put it, 'if something does not work in over 20 years, why are we continuing to use it?' (Gleicher et al. 2021:2e). Critics frequently cite cautious statements made by the ASRM, such as 'the value of PGT-A as a routine screening test . . . has not been demonstrated' (ASRM 2024:421), as vindication of their view that the test's widespread use is built more on assumptions than proof. In the critics' narrative, a troubling disjuncture exists between evidence and practice: while the evidence for broad benefit is lacking, by 2019 PGT-A had already been adopted in roughly 40% of IVF cycles in the US (Ducharme 2025). For them, this signals a gap between

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commercial enthusiasm and scientific validation. PGT-A, they contend, was essentially introduced to the marketplace without prior validation through proper trials, raising ethical questions about offering an expensive, unproven service to often vulnerable patients. Proponents might respond that ongoing studies are refining the indications (i.e., precision medicine), but critics might counter that the absence of demonstrated benefit across the general IVF population fatally undermines the rationale for such widespread use.

5.7.2 Risk Narratives: Harm to Embryos and the Black Box of Long-Term Effects

A second pillar of the critics' narrative is a focus on risks – both known and potential – associated with PGT-A. One risk frame places the embryo biopsy procedure itself at the centre of the narrative. Critics describe PGT-A as 'a highly invasive technique' (Chin 2025) involving the removal of trophectoderm cells that could, in some cases, impair the embryo's development or implantation potential. While some studies, often cited by proponents, suggest that in experienced hands, biopsying a robust blastocyst has no measurable adverse effect on implantation, critics argue that these studies usually involve top-quality embryos in ideal conditions. The question remains open whether more fragile embryos – for example, embryos from older women or those with slower development – might be harmed by the biopsy insult. There is also the largely unknown realm of long-term effects: does removing a few cells that were destined to become the placenta subtly alter the placenta's development in ways that could affect the pregnancy or the baby? This concern has led some researchers to refer to PGT-A's long-term consequences as a black box – we simply do not know what we do not know.

This uncertainty is heightened when it comes to the transfer of mosaic embryos, which represents a convergence of multiple unknowns. Critics in the 'International Do No Harm Group in IVF', which includes Gleicher and colleagues (2021), among others, highlight a significant evidentiary gap in this respect. Although clinics and laboratories promote mosaic transfers as a viable option when no normals remain, almost none have committed to systematically tracking the health outcomes of children born from mosaic embryos. In this narrative framing, the risk is not confined to the issue of immediate IVF success or failure; it becomes a question of long-term, perhaps intergenerational responsibility. The immediate appeal of having 'one more chance' by transferring a mosaic embryo is moderated by what these critics see as a scientifically and ethically unresolved territory. Without decades-long follow-up, the true risk profile of children born from mosaic embryos remains unknowable. Are there rare developmental issues that might not be evident at birth but could emerge later? Could there be subtle health impacts? We simply do not yet have sufficient data. Thus critics portray decisions about transferring mosaic embryos as not only medically uncertain but also ethically unsafe. The precautionary principle, they argue, should prevail: when in doubt, err on the side of not using a potentially compromised embryo until more is known.

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5.7.3 The False Positive Problem and Epistemic Fragility

One critique, perhaps the most emotionally potent, focuses on what might be called the *false positive problem* – the possibility that PGT-A will misclassify a viable embryo as abnormal, leading to it being discarded. As Dr Demián Glujovsky observed, PGT-A has a significant false-positive rate – embryos categorised as abnormal or mosaic may in reality be viable, meaning that 'discarding normal embryos' is a very real risk (Glujovsky 2023). Likewise, fertility law experts have noted that 'false positives mean healthy embryos are being discarded' as non-viable.[3] Such warnings gained tangible weight after high-profile patient stories began to circulate through the media. In one case, Shannon Petersen, a 42-year-old patient who underwent IVF, was led by a PGT-A report to believe that all five of her embryos were chromosomally abnormal and 'garbage, essentially' (Ducharme 2025). She nearly gave up hope until one of those very embryos was later transferred – against earlier advice – and resulted in the birth of her healthy son. 'I would not have a baby if I had believed the PGT-A test', Petersen reflects (Ducharme 2025), highlighting the potential human cost of erroneous results. Such stories crystallise the fear that valuable embryos are being thrown away due to over-reliance on an imperfect test. Critics point to variability among laboratories as a key factor here: differences in testing platforms, algorithms, and reporting thresholds can mean that the same embryo might be classified as aneuploid by one laboratory, mosaic by a second, and euploid by a third. Thus the line between normal and abnormal is not only biologically indistinct but also operationally indistinct due to technological inconsistency. This variability, critics argue, exposes the epistemic fragility of the whole enterprise. If one laboratory's 'garbage' embryo is another laboratory's 'good' embryo, how confident can we be in any result?

The phenomenon of self-correction in mosaic embryos further undermines the authority of a single biopsy result. It is well-documented in developmental biology that some embryos can start out with abnormal cells but, through cellular selection or other mechanisms, end up with a normal fetus; the abnormal cells either fail to proliferate or become relegated to extra-embryonic tissues. Thus a mosaic result at the blastocyst stage may not necessarily mean the resulting baby will be mosaic. Critics argue that decisions about whether to transfer or discard embryos are being made based on data that are contingent, context-dependent, and potentially reversible. One journalist, writing in *Time* magazine, encapsulated this concern by raising 'a horrible prospect: are people needlessly throwing away embryos that could become their children?' (Ducharme 2025). The question highlights what is at stake in particularly stark terms: the narrative ceases to be merely about a technical flaw in a test; instead, with a potential future child at its centre, it now poses a profound challenge to how reproductive medicine defines viability and value in embryos. If the test states that an embryo is abnormal, but that embryo could have grown into a patient's child, what does that mean for the ethics of our current practice and the potential emotional toll for the patient? It is a question with immense scientific and moral implications.

[3] Justice Law Collaborative, www.justicelawcollaborative.com/pgta-lawsuit-fertility-industry.

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5.7.4 Ethical Concerns: Potential Life, Disability, Racial Justice, and Bottom-Up Eugenics

Overlaying the scientific and technical critiques are ethical arguments that bring different values and visions of reproduction to the foreground. One recurring strand highlights how PGT-A, especially when combined with mosaicism, alters the moral status of embryos by stratifying them into categories of worthiness. Rather than a binary of 'normal' and 'abnormal', mosaic embryos occupy an intermediate, problematic position that must be evaluated and ranked. However, some ethicists argue that this very act of classification risks creating a form of selective valuation of human life (Surrogate.com 2025). While proponents stress that the goal of PGT-A is to prevent the birth of a baby with severe genetic conditions, a goal often framed as unquestionably good, critics fear a chain of events toward 'designer babies'[4] and what some have termed 'bottom-up eugenics' (*Swiss Medical Weekly* 2020). By this, they mean a eugenic trend driven not by top-down state mandates but by cumulative individual decisions in the clinic – decisions shaped by societal norms and medical advice about what kinds of lives are 'worth living'. As the *Swiss Medical Weekly* bluntly noted in its recommendations on prenatal genetic testing, genetic selection has 'impacts both on people with disabilities and on how they are perceived, valued and integrated into society', insofar as embryos predicted to have genetic anomalies are routinely deprioritised or discarded, even when their actual developmental potential is uncertain (*Swiss Medical Weekly* 2020). In this version of the narrative, PGT-A is not just a diagnostic tool; it is a cultural practice that subtly redefines which future children are acceptable or preferable. Critics ask: are we inching towards a world where only the *genetically elite* embryos get a chance at life? And what message does this send about those living with genetic differences or disabilities?

The commercialisation of PGT-A heightens these bioethical concerns. Critics see PGT-A as emblematic of a broader 'proliferation of add-on services' in IVF (McArthur 2025) – optional interventions with high price tags and limited evidence, marketed aggressively in a competitive fertility marketplace. For example, a Los Angeles chain of fertility clinics (Fertility Institutes) offers customers the ability to select both the sex and eye colour of their next baby, reinforcing the narrative with various visuals of babies dressed in either blue or pink.[5] In response to critics who accused him of 'crossing a crucial line between testing for medical and non-medical traits as well as promising non-realisable results', the founder of the company, IVF pioneer Dr Jeffrey Steinberg, declared, 'Gender selection is a commodity for purchase.

[4] On designer babies, Dorothy Roberts discusses several cases of millionaires such as Robert Graham and a California sperm bank that select sperm donors based on high levels of intelligence (including sperm from Nobel Prize winners) or their resemblance to celebrities such as Ben Affleck and David Beckham. They offer this 'designer sperm' to wealthy, predominantly white women. A surrogate can then be 'implanted with carefully pieced together embryos' to give parents the dream child they long for, recalling dystopic novels such as Margaret Attwood's *The Handmaid's Tale* and Gena Corea's *The Mother Machine* (Roberts 2012:213).

[5] www.fertility-docs.com/programs-and-services/gender-selection/select-the-gender-of-your-baby-using-pgd/.

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. . . If you don't like it, don't buy it' (Roberts 2012:217). This stance reinforces the narrative of commercialisation denounced by critics of PGT-A. Moreover, at the time of writing, the Fertility Institutes website quoted a fee of approximately US$26,650 if customers are based in Los Angeles and approximately US$27,680 if they are based in New York, figures which lend credence to critiques by scholars such as Roberts (2012:213), who argues that these new technologies and their increased commercialisation deepen racial and social injustices in society: 'The multi-billion-dollar apparatus devoted to technologically facilitating affluent couples' procreative decisions stands in glaring contrast to the appalling numbers of infant and maternal deaths among blacks that have remained twice and quadruple the rates for whites for decades.'

In the narrative of PGT-A as a commercial enterprise, the aggressive promotion of this technology is not only medically questionable but also economically predatory. Fertility clinics operate in a for-profit environment; offering the latest high-tech add-ons can attract patients and increase revenue. Some critics argue that fertility clinics and genetic testing laboratories often operate within an environment of financial symbiosis – laboratories charge for the testing, and clinics charge for the biopsy, sometimes also receiving referral benefits – creating incentives that could bias counselling (Gleicher 2025). The fear is that what should be an impartial medical recommendation becomes influenced by the allure of an extra testing package that costs thousands of dollars. Thus the narrative shifts to one of *patient protection*: the emphasis is on ensuring that hopeful, vulnerable patients are not being sold something they do not truly need. The image of the IVF industry as the 'Wild West' of medicine – as Allison Freeman, the attorney leading class-action lawsuits, described it (quoted in Ducharme 2025) – resonates strongly. Herself a patient undergoing IVF who felt pressured to use PGT-A and then saw friends end up with no transferable embryos, Freeman became 'obsessed' with the issue and now spearheads legal action against testing companies. Her experience of being made to feel 'crazy' for questioning PGT-A, only to later discover that many others had similar doubts or adverse outcomes, highlights the apparent power imbalance between patients and the fertility industry. By saying 'It's the Wild West of medicine', Freeman highlights the perceived lack of oversight and the entrepreneurial culture that dominates the use of these technologies.

These critiques have now moved beyond medical journals and the media and are increasingly being employed in courtrooms. In 2023 and 2024, several patients filed a series of class-action lawsuits against major genetic testing companies that provide PGT-A, alleging fraud, false advertising, and consumer protection violations (Retassie 2024; Gleicher 2025; Ducharme 2025).[6] The plaintiffs' narratives in these lawsuits echo the broader critical frame: they claim they were promised near-certainty – that PGT-A was a 'foolproof' procedure – and were misled into discarding embryos that might have become their children. One plaintiff's story recounts how a couple was told all five of their embryos were abnormal and 'garbage', took out loans to try again, and later learned that some abnormal embryos could indeed become healthy babies (Ducharme 2025). The lawsuits cast a wide net of

[6] www.progress.org.uk/class-action-lawsuits-against-genetic-testing-companies-over-pgt-a/.

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responsibility, implicating not only the testing laboratories but, by extension, the clinics that promoted the tests. As of the time of writing, the outcomes of these legal challenges remain pending, but they have already sent shockwaves through the field. Companies like Natera (a major PGT-A provider) have publicly defended the accuracy and benefits of their tests, even as they face scrutiny over whether their marketing claims exaggerated the reliability of the evidence. Thus the legal arena has become a new stage on which the clash of narratives over this technology is played out. Patients and lawyers tell a story of deception and harm, while companies tell a story of valuable innovation being misunderstood.

In summary, the critics' narrative frames PGT-A not as a cutting-edge precision tool of modern reproductive medicine but as a potentially harmful, commercially driven intervention that was introduced ahead of robust validation. It contests the proponents' narrative of technological progress, promoting instead a cautionary tale about epistemic limits, unintended harms, and the moral boundaries of embryo selection.

5.8 Conclusions

We have seen how two leading professional societies, the PGDIS and the ASRM, translated the same scientific evidence into guidelines that convey different messages – one emphasising the promise of precision and progress, and the other urging prudence and patient-focused caution. In turn, these narratives of guidance set the stage for how the technology is understood and contested in the public realm. Proponents of PGT-A adopted the language of precision medicine to tell a story of control, empowerment, and hope, while critics of PGT-A drew on the ethos of EBM and ethics to tell a story of overreach, uncertainty, and the need for restraint.

Ultimately, the controversy surrounding PGT-A is not only about data or success rates; it is about the stories we construct to make sense of new biomedical capabilities. In the case of embryo testing, the precision narrative celebrates the newfound ability to detect and act on subtle genomic information, envisioning a future of IVF optimised to the highest degree. In contrast, the prudence narrative reminds us of the fallibility of tests and the values that can be compromised in our pursuit of perfection – and, beyond the purely scientific realm, of commercial gain. While both narratives contain some truths, they are also both biased, albeit in different ways and for different reasons. Therefore, in contending with the dilemma of where to draw the line between viable and non-viable embryos, we are ultimately choosing between competing narratives of IVF, the technologies that enable it, and the wisdom of investing in it as both a medical practice and a social enterprise.

This chapter has shown how two clinical guidelines on mosaic embryos offer different narratives based on the same evidence – one focused on optimisation and control, the other on caution and patient autonomy. Chapter 6 shifts the scale to the global arena, where the World Health Organisation's (WHO's) *Abortion Care Guideline* seeks to manage and stabilise a long-standing controversy by consolidating both epistemic and moral authority.

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