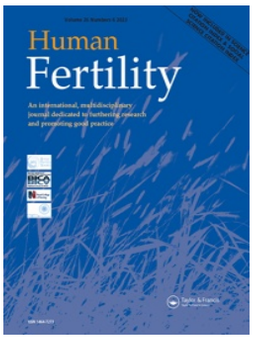

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RESEARCH ARTICLE

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A matter of choice? – patient decision-making and support in non-euploid embryo transfers

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ABSTRACT

Deciding whether to transfer a non-euploid embryo presents a challenge for both individuals and clinicians involved in assisted reproductive technologies (ART) with preimplantation genetic testing (PGT). The uncertainty surrounding clinical outcomes and long-term effects complicates this decision, and there is limited research on the factors that influence individuals' experiences during this decision-making process. An online survey was utilized to gather data on elements influencing the decision-making process. The survey included both closed and open questions and targeted individuals worldwide who had undergone PGT during their fertility journey. A total of 135 responses were received, with complete data from 111 respondents analyzed. Three primary factors emerged as significant influences on respondents' decision-making: the opportunity to discuss the implications of the transfer, the topics covered during consultations, and the country where the treatment was received. The study also identified three major themes related to the challenges faced by respondents: mismatched expectations, inadequate information provision, and an unsupportive decision-making process. These results highlight the critical need for appropriate support when deciding to transfer a non-euploid embryo. Respondents emphasized the importance of comprehensive discussions about the implications of PGT results. The study underscores the necessity for proactive clinic communication, patient-centred information, and increased support for patients considering non-euploid embryos.

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Non-euploid embryo; mosaic embryo; assisted reproductive technologies; preimplantation genetic testing; patient decision-making; clinical outcomes and patient support

Introduction

Pre-implantation genetic testing (PGT) is an assisted reproductive technique used to detect genetic and chromosomal abnormalities in embryos (ESHRE PGT Consortium Steering Committee, Carvalho, et al., 2020). PGT-A (aneuploidy) is commonly used alongside assisted reproductive technology (ART) to select embryos with a normal number of chromosomes (euploid) (Yang et al., 2022). Mosaicism in pre-implantation embryos is considered a natural phenomenon (Taylor et al., 2014). A mosaic result indicates that some cells in the embryo have an abnormal number of chromosomes (aneuploid), while others are euploid. The reported incidence of mosaicism at the blastocyst stage using next-generation sequencing (NGS) methods varies widely, from 2-40%, but is likely to be between 5% and 10% (Fragouli et al., 2019; Gleicher et al., 2020; Munné et al., 2016; Ruttanajit et al., 2016). Although embryonic mosaicism has been reported for nearly three decades, the evolution of PGT-A has increased the detection of mosaic embryos (Munné et al., 1994). Consequently, the reporting of mosaic embryos has complicated the decision-making process for patients (Besser et al., 2019). Furthermore, different genetic laboratories may consider different thresholds of mosaicism (high/low) with no consensus.

Guidelines and position statements have been published to provide recommendations for clinics and laboratories on supporting MET (mosaic embryo transfer) and counselling patients with mosaic embryos (ESHRE Working Group on Chromosomal Mosaicism, De Rycke, et al., 2022; Gleicher et al., 2020; Leigh et al., 2022). Counselling patients with mosaic embryos, especially those without euploid embryos to transfer, can be challenging for clinicians (Besser et al., 2019). A double-blinded prospective non-selection trial has demonstrated equivalent live-birth rates and miscarriage

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rates across different types of embryos euploid, low-grade mosaic and medium-grade mosaic embryos (Capalbo et al., 2021). Adverse outcomes are possible when mosaic embryos are transferred. Case studies on MET have demonstrated that some putative mosaic embryos correspond to true foetal mosaicism detected in pregnancy, resulting in chromosomal abnormalities in the foetus and severe disabilities (Kahraman et al., 2020). Current literature reports a prevalence of 1.2% persistent mosaicism in pregnancy after transfer of a mosaic embryo (Viotti, 2023).

Due to the uncertain outcomes of MET, the decision-making process for patients can be difficult. This research aimed to determine the specific factors influencing respondents' experience when deciding to transfer a mosaic embryo.

Methods

This research was approved by the UCL Research Ethics Committee ID Number: 22279/001. The sample population for this study was English-speaking patients who underwent ART treatment with PGT-A.

Survey design

The data for this study was collected using an anonymous online survey, including options for free text responses (Supplementary Material). The survey was created with Qualtrics XM software (Qualtrics, Provo, UT) and was designed by ART and academic professionals and pilot tested with volunteer individuals at a UK IVF clinic, who had themselves undergone IVF with PGT-A (one had mosaic embryos). The final survey included 48 questions. It was made available to the public on 16 February 2023 on a private Facebook group (My Perfect Mosaic Embryo) from 16 February 2023 to 5 July 2023. This group consists of a mix of members with both positive and negative clinical outcomes. To participate in the study, respondents had to meet the following criteria: they had to be at least 18 years old, have undergone IVF treatment with PGT-A at some point during their fertility journey, and have had either a non-euploid embryo transferred or cryopreserved. There was no upper age limit for participants.

The survey was divided into three sections: the first collected sociodemographic and medical history information, including details on egg collection, education, ethnicity, and treatment location. The second section explored experiences with genetic counselling and fertility specialists. The third section assessed clinical and neonatal outcomes following non-euploid embryo transfer. Each section included 8–17 questions, combining multiple-choice and open-text formats.

Data analysis

Statistical analyses were conducted using Qualtrics XM and SPSS Version 29, with significance set at 5%. Descriptive statistics analyzed patient demographics, and Fisher's Exact test assessed relationships between responses. For the question on feeling empowered to make reproductive decisions after clinic screening (Part 2; Question 7), responses were recoded to 'yes' (if from the clinic) or 'no' (if from elsewhere or not). Association tests and a binomial logistic regression with an ROC curve identified factors influencing respondents' feelings of support from their clinics.

Free text data were analyzed by qualitative thematic analysis (QTA) as outlined by Braun and Clarke (Braun & Clarke, 2006). This six-phase method guides data analysis to generate themes from qualitative data. Initially, all open text data were read, and initial codes were systematically generated by collating similar responses. Two additional researchers reviewed the initial codes, reassessed groupings, and generated further codes. The coding process was iterative, involving back-and-forth coding, separating, merging, and refining codes. Once assigned, codes were re-read and merged based on shared meanings, then collated into themes. These themes were reviewed and revised until a final set was produced. Selected quotes are referred to by standalone # numbers to indicate the range of participants represented.

Results

Survey

Sociodemographic characteristics

A total of 135 responses were recorded with a completion rate of 82.2% (111/135). The age of individuals at egg collection ranged from 27–47 years old and the age of partners at sperm collection ranged from 31–59 years old. The full details of the respondent's demographics are listed in Table 1. The majority of individuals who responded to the survey identified as White (84.7%, 94/111) and were largely from the USA (74.8%, 83/111). The majority of respondents also had university education (92.8%, 103/111) and were not religious (47.7%, 53/111). The origin of eggs used in treatment were largely own eggs (97.3%, 108/111), and the origin of sperm used in treatment was primarily partner sperm (79.3%, 88/111). Of those who had

Table 1. Sociodemographic characteristics of study participants.

Sociodemographic characteristics	N	%
Country of Treatment		
USA	83	74.8
Canada	8	7.2
United Kingdom	6	5.4
Australia	3	2.7
Malaysia	3	2.7
Philippines	2	1.8
South Africa	2	1.8
Ireland	1	0.9
Poland	1	0.9
Spain	1	0.9
Turkey	1	0.9
Ethnicity		
White	94	84.7
South Asian	5	4.5
Mixed/Multiple ethnic groups	4	3.6
East Asian	3	2.7
Arab	2	1.8
Black/African/Caribbean	1	0.9
Other	1	0.9
Prefer not to say	1	0.9
Education		
Degree/Higher Degree	103	92.8
Higher education qualification below degree	7	6.3
School leaving certificate	1	0.9
Religion		
No religion	53	47.7
Christian	42	37.8
Hindu	4	3.6
Jewish	3	2.7
Muslim	1	0.9
Buddhist	1	0.9
Any other religion	4	3.6
Prefer not to say	3	2.7
Origin of eggs		
Own	108	97.3
Donor	3	2.7
Origin of sperm		
Partner	88	79.3
Donor	23	20.7
Year of Treatment		
2016	3	2.7
2017	2	1.8
2018	5	4.5
2019	5	4.5
2020	10	9.0
2021	18	16.2
2022	49	44.1
2023	19	17.1
Indication for PGT-A (multiple response)		
Advanced maternal age (>35 years)	65	35.5
Implantation failure	14	7.7
Recurring miscarriage	14	7.7
Previous aneuploid pregnancy	0	0
Reported together with PGT-M/SR	10	5.5
Doctor recommendation	48	26.2
Own choice	32	17.5

proceeded with transferring a mosaic embryo and reported outcome (43/111), clinical pregnancy rate per mosaic embryo transferred was 93% (40/43) with an ongoing pregnancy rate of 86% (37/43). The transfer of high-level mosaic embryos resulted in lower clinical pregnancy (87.5% versus 96%) and ongoing pregnancy rate compared to those with low level mosaicism (75% versus 91%); however, this result was not significant ($p > 0.05$) (Supplemental Table 1). Twenty-two respondents (22/111) had MET, but the outcome was pending at the time of survey completion. Other respondents (38%, 43/111) were yet to transfer a cryopreserved mosaic embryo. Out of those, 58% (25/43) were planning on using the mosaic embryo, 21% (9/43) hoping to create more embryos to identify a euploid embryo first, 14% (6/43) were still deciding if proceeding this MET was right for them and 7% (3/43) hadn't done so for other reasons. Three respondents (3/111) proceeded with embryo transfer with an aneuploid embryo, one resulting in an ongoing pregnancy. The abnormality which impacted the aneuploid embryo which resulted in a pregnancy was polyploidy. The year of treatment (egg collection) ranged from 2016–2023.

Information provision and counselling

Only 29.1% of respondents reported that mosaicism was discussed by the clinic prior to testing, with even fewer recalling discussions on the clinical use of these embryos (Figure 1). Respondents who discussed mosaicism, the level of mosaicism, the representativeness of the results, the risk of harm to the embryo, and the clinical use of non-euploid embryos were significantly more likely to feel supported by their clinics (Table 2). The opportunity to discuss test result implications was significantly associated with respondents feeling empowered to make reproductive decisions.

Factors determining respondents' knowledge and experience influencing reproductive decision choices

A binomial logistic regression identified key factors influencing respondents' feelings of support in making reproductive decisions. The most influential factor was the opportunity to discuss test result implications, making respondents 3.98 times more likely to feel empowered. Receiving treatment in the USA reduced the likelihood of feeling informed (0.218). Although discussing mosaicism and embryo risks increased the likelihood of feeling informed, these factors were not statistically significant ($p > 0.05$). The model's AUC was 0.755 ($p < 0.001$).

Qualitative themes

One hundred eighteen pieces of code were identified, revealing three overarching themes: mismatched expectations of PGT-A testing, inadequate information provision from clinics, and an unsupported decision-making process.

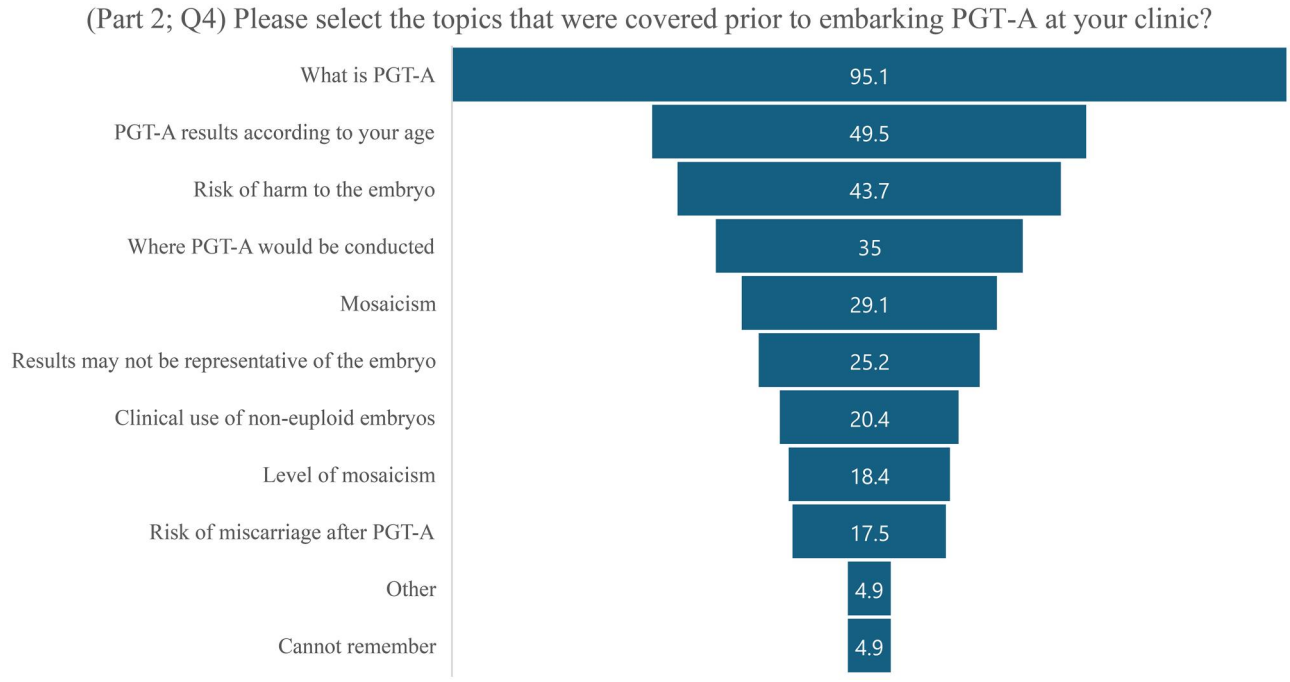

Figure 1. Proportion of topics discussed with respondents.

Table 2. Summary of results on factors which influence how supported respondents feel when making their reproductive decisions regarding non-euploid embryo transfer.

Respondents feeling supported	Yes (%)	No (%)	*p*-value
Topic discussed (Yes vs No)			
Mosaicism	73.7	26.3	
Level of mosaicism	73.7	26.3	<0.01
Results may not be representative of the embryo	65.4	34.6	<0.01
Risk of Harm to Embryo	53.3	46.7	<0.01
Clinical use of non-euploid embryos	61.9	38.1	<0.01
Country of treatment			
USA (vs rest of the world)	32.5	67.5	<0.01
Genetic Counselling Offered			
Yes (vs No)	43.7	56.3	>0.05
Opportunity to Discuss Implications			
Yes (vs No)	71.1	28.9	<0.01

Mismatched expectations of PGT-A

Respondents noted a gap between how medical professionals explain PGT-A to patients and the certainty with which it is offered. They felt that the presentation of the procedure did not align with the current knowledge about its accuracy.

> *I wish PGT-A was explained as not an exact science. #8*

> *Knowing what I do now, I would not recommend PGT. It is presented as though it is completely valid however there is still so much we do not know. #1*

Other respondents indicated that their medical professionals failed to clarify that PGT-A is not a diagnostic test for distinguishing between euploid and aneuploid embryos. They felt that the limitations of PGT-A were not adequately communicated. Some respondents stated the range of possible test outcomes was not sufficiently explained.

> *The test was not validated and is not diagnostic, no one was clear about this. #55*

> *I feel that we ruled out the aneuploid embryos but knowing the test isn't 100% accurate, I worry those embryos would have been fine. #69*

> *Just thought it was to sort good from bad. #46*

A minority of respondents had the expectation that the decision to transfer a non-euploid embryo would be theirs to make and voiced their frustrations about this. These respondents emphasized they were less likely to add PGT-A to subsequent IVF treatments, as they did not want to miss the opportunity to transfer a non-euploid embryo.

Inadequate information provision from clinics

Respondents expressed that their clinics provided limited (or no) information about PGT-A. While a superficial explanation was sometimes given, specific details were lacking. Unaddressed topics included outcomes after mosaic embryo transfer, different mosaic categories, incidence rates of mosaicism, and success rates following mosaic embryo transfer.

> *There was no discussion other than it was included in the IVF package. #107*

> *I was not provided information from the clinic prior to PGT-A. #39*

An overview of PGT-A was provided, but no information on the incidence of mosaicism and the potential outcomes of transferring a mosaic. #24

Respondents who were unhappy with the amount and scope of information provided, all stated they undertook their own self-directed research to ensure they had sufficient information. Respondents used language like 'had to' and 'required' in reference to them undertaking their own research about mosaic embryos. Sources of information included medical literature, peers, private genetic counsellors, and social media groups. Social media forums and groups were mentioned by several respondents as a helpful source of information. Some respondents reported that their clinic provided them with no or cursory information on mosaicism meaning that they were forced to rely on their own independent research.

The info was bad. They just did not have good info on mosaics at the time. I had to educate myself. #9

Very little was known about mosaics though they were being reported. #6

Some respondents considered that doctors at their clinics did not have a sufficient level of information about mosaic embryos to support them in their decision-making.

I wish clinics understood more about mosaics and that doctors were more educated by geneticists. #10

Doctor didn't seem to have adequate knowledge re my mosaic embryo. #50

The doctors don't really know what to do with mosaics. #48

Unsupported decision-making process

Some respondents who had undertaken their own independent research about mosaic embryos felt unsupported by their clinic in making an autonomous decision to transfer a mosaic embryo. This meant they had to self-advocate to secure a MET. Respondents reported that being forced to advocate for MET and convincing their clinics to effect MET exacted an emotional toll.

In the end I stopped all IVF because of the trauma of having to fight to use my mosaics. #54

[persuading a clinic to transfer a mosaic embryo] This caused a lot of frustration and heartache. #64

I had to advocate to transfer the mosaic. I researched mosaic and insisted we transfer her. #4

Some respondents perceived their difficulty in securing the transfer of a mosaic embryo as being due to their clinic classifying them as 'abnormal' and so not appropriate for transfer. A minority of respondents felt their clinic's unwillingness to transfer a mosaic embryo reflected their adherence to outdated evidence. As a result of this, one respondent moved their embryos to a different clinic. Many respondents reported feeling such pressure from medical professionals to undertake PGT-A testing that they had no choice but to agree to include PGT-A in their treatment. Some respondents felt their clinic 'played on' their fears to convince them to undertake PGT-A testing. One respondent expressed their frustration over pressure to include PGT-A in their treatment plan, however, their clinic would not transfer their mosaic embryos.

I feel pressured to test our embryos, but clinics won't even try transferring non-euploids. So I don't want to test because I just want to try. #54

I was made to feel like PGT-A was my only option. #63

Other, respondents described not only the absence of comprehensive information but also the limited nature of any discussion of PGT-A; it was not a topic 'discussed in any detail'. Some respondents perceived themselves to have sufficient info in relation to PGT-A in general but not in relation to mosaicism.

Discussion

Main findings

The aim of this project was to investigate respondents' experiences regarding factors affecting their reproductive decision-making related to the transfer of a non-euploid embryo. This study acknowledged three themes regarding support and challenges: mismatched expectations, inadequate information provision, and an unsupportive decision-making process.

The majority of respondents (59.5%) felt unsupported by their clinics in making reproductive decisions, citing an unmet need for accessible, clear information on mosaic embryos and the limits of PGT-A. Additionally, treatment location appeared to influence perceived support, with U.S.-based patients reporting less support.

Strengths and limitations

The study shows the nuanced perspectives of a specific patient group navigating decisions about mosaic embryo transfers. By using qualitative data, we captured detailed personal insights that quantitative studies may overlook.

There are some limitations to this study, primarily relating to the sample size and response rate, with only a proportion of the Facebook group's members who had visibility to the survey (0.8%, 135/17000). This limits the generalizability of our findings and could be a reason of selection bias. The majority of respondents were white and educated in the United States, meaning our findings may not fully represent the broader population of individuals undergoing PGT-A in other regions or demographic groups. The wide timeframe of responses in a field where PGT technology and clinical approaches are rapidly evolving; could affect how respondents perceive their support and outcomes over time. It would be valuable to assess the extent to which respondents who did not engage in self-directed research were adequately informed – either because they were already sufficiently informed or failed to recognize their own informational gaps.

Comparison with other studies

Previous research has demonstrated patients with mosaic embryos have unmet needs with regards to healthcare services (Cheng, Meiser, Kennedy, et al., 2022) which is similar to our findings with 59.5% of respondents reported feeling they did not feel supported by their clinics to make their own reproductive decisions. A recent study concluded that respondents with mosaic embryos expressed a need for more studies on short- and long-term clinical outcomes of babies born from MET, alongside more information about clinical outcomes such as IR and LBR (Cheng, Meiser, Kennedy, et al., 2022), similar to our findings.

A recent study has raised concerns about patients' knowledge and decision making, with one third of patients regretting their decision to use or not to use PGT-A in their treatment (Kaing et al., 2020). A systematic review of patients' decisional needs for PGT-A showed health professionals provide general information about PGT-A and will only discuss further details when requested by a patient (Cheng, Meiser, Kirk, et al., 2022).

Respondents in this study revealed the need for more information about mosaic embryos and PGT-A. Respondents stated limited information was provided about PGT-A and mosaic embryos, alongside several topics specific to both PGT-A and mosaic embryos. These results expand on findings by Cheng et al. which reported that patients felt they were provided with general information, however there was an insufficient amount of information provided about mosaic embryos (Cheng, Meiser, Kennedy, et al., 2022). Moreover, a systematic review demonstrated a need for greater information provision for patients relating to PGT-A (Cheng, Meiser, Kirk, et al., 2022). A recent study of health professionals' views and attitudes towards PGT-A reported medical professionals were more inclined to transfer certain types of mosaics (Cheng et al., 2023). Furthermore, the study highlighted how a substantial number of health professional were unsure if mosaic embryos should be used in clinical practice.

Explanation of the findings

The country of treatment was found to influence how supported respondents felt in making their reproductive decisions, with those treated in the USA feeling less supported compared to those in other countries. While guidelines for clinics state that patients should be advised and informed, clinics are not mandated to follow specific guidelines (Carvalho et al., 2020). Additionally, a study demonstrated that patient education materials in the USA did not meet the standards set by the Centres for Disease Control and Prevention and the Joint Commission, which require materials to be written at an 11-year-old reading level or below (Baur & Prue, 2014; Early et al., 2020). Therefore, individuals' experiences in fertility clinics can vary widely in the USA (Yang et al., 2022).

Our findings from the open-text data indicate that patients may have different expectations of PGT-A compared to their clinics. A common response among respondents was that they were unaware PGT-A was not a diagnostic test or that mosaic embryos were a possible test outcome. Similarly, respondents felt the uncertainties and limits of PGT-A were not sufficiently communicated to them. Previous research indicates patients do not accurately understand PGT-A, its limits, and diagnostic capabilities, highlighting the need for improved patient education before undergoing PGT-A (Lamb et al., 2018). Although clinicians may be providing accurate information, optimistic outlooks may create barriers to patients' comprehension of the information (Garrett & Sharot, 2017). Furthermore, respondents seemed to have different expectations of their clinics' policies regarding MET, with some expecting to make the decision to transfer.

Implications for future research

Our study highlights several potential areas for future research. Expanding the survey to include more

diverse and international patient groups and individuals experiencing recurrent pregnancy loss, would provide valuable insights into how different populations navigate mosaic embryo transfers. Further studies with larger, more representative samples could better characterize the varying informational needs and support preferences across patient demographics. Additionally, exploring clinical outcomes of those who chose not to proceed with MET, especially in relation to their subsequent success with euploid embryo transfers, would provide a more comprehensive view of patient experiences and needs.

Implications for clinical practice

Prior studies highlight the crucial role of genetic counselling in decision-making for PGT-A (Boivin & Gameiro, 2015; Kaing et al., 2020). The ASRM also emphasizes the importance of genetic counselling and patient education before and after PGT-A (Practice Committee and Genetic Counseling Professional Group (GCPG) of the American Society for Reproductive Medicine, 2020)

It is important to provide clear regulations to clinics offering PGT-A to ensure a sufficient level of support for patients (Early et al., 2020; Yang et al., 2022). To ensure at least minimum standards are met, it may be necessary to include specific information in the consent form that clearly outlines clinic policies and decision-making processes related to MET.

Continued education for clinicians and scientists is crucial to enhance their awareness and support for patients with mosaic embryos. Moreover, a more standardized approach to patient counselling, with pre-test and post-test counselling by genetic counsellors or well-informed embryologists, could improve the patient experience.

Respondents expressed the emotional toll of not feeling supported by their clinics and having to 'fight' their clinics for a MET. Prior research has demonstrated the emotional stress of fertility treatment is a major factor as to why patients end treatment prematurely and can impact patients years later (Järvholm et al., 2017; Kim et al., 2012). Due to variations in clinic methods, ESHRE published recommendations for IVF centres to support them in developing their own policies to manage these cases (ESHRE Working Group on Chromosomal Mosaicism et al., 2022). The adoption of these recommendations by clinics may aid in patients feeling more supported in their decisions to transfer mosaic embryos or provide clear policies so patients do not feel 'pressured'. Furthermore, ensuring patients are offered psychological support while undertaking treatment could help to alleviate the emotional toll of IVF treatment.

Conclusions

The study highlights the gap between patient expectations and clinical practices, a crucial insight that could inform patient-centered care improvements in fertility clinics offering PGT-A.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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References

Baur, C., & Prue, C. (2014). The CDC Clear Communication Index is a new evidence-based tool to prepare and review health information. *Health Promotion Practice*, *15*(5), 629–637. https://doi.org/10.1177/1524839914538969

Besser, A. G., McCulloh, D. H., & Grifo, J. A. (2019). What are patients doing with their mosaic embryos? Decision making after genetic counseling. *Fertility and Sterility*, *111*(1), 132–137.e1. https://doi.org/10.1016/j.fertnstert.2018.10.001

Boivin, J., & Gameiro, S. (2015). Evolution of psychology and counseling in infertility. *Fertility and Sterility*, *104*(2), 251–259. https://doi.org/10.1016/j.fertnstert.2015.05.035

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Capalbo, A., Poli, M., Rienzi, L., Girardi, L., Patassini, C., Fabiani, M., Cimadomo, D., Benini, F., Farcomeni, A., Cuzzi, J., Rubio, C., Albani, E., Sacchi, L., Vaiarelli, A., Figliuzzi, M., Findikli, N., Coban, O., Boynukalin, F. K., Vogel, I., … Simón, C. (2021). Mosaic human preimplantation embryos and their developmental potential in a prospective, non-selection clinical trial. *American Journal of Human Genetics*, *108*(12), 2238–2247. https://doi.org/10.1016/j.ajhg.2021.11.002

Cheng, L., Meiser, B., Kaur, R., Briggs, N., Kirk, E., Barlow-Stewart, K., & Kennedy, D. (2023). Health professionals' role in the transfer of mosaic embryos after preimplantation genetic testing for aneuploidies. *Reproductive*

Biomedicine Online, *46*(6), 926–938. https://doi.org/10.1016/j.rbmo.2023.02.009

Cheng, L., Meiser, B., Kennedy, D., Kirk, E., Barlow-Stewart, K., & Kaur, R. (2022). Exploration of decision-making regarding the transfer of mosaic embryos following preimplantation genetic testing: A qualitative study. *Human Reproduction Open*, *2022*(4), hoac035. https://doi.org/10.1093/hropen/hoac035

Cheng, L., Meiser, B., Kirk, E., Kennedy, D., Barlow-Stewart, K., & Kaur, R. (2022). Decisional needs of patients considering preimplantation genetic testing: A systematic review. *Reproductive Biomedicine Online*, *44*(5), 839–852. https://doi.org/10.1016/j.rbmo.2021.12.011

Early, M. L., Kumar, P., Marcell, A. V., Lawson, C., Christianson, M., & Pecker, L. H. (2020). Literacy assessment of preimplantation genetic patient education materials exceed national reading levels. *Journal of Assisted Reproduction and Genetics*, *37*(8), 1913–1922. https://doi.org/10.1007/s10815-020-01837-z

ESHRE PGT Consortium Steering Committee, Carvalho, F., Coonen, E., Goossens, V., Kokkali, G., Rubio, C., Meijer-Hoogeveen, M., Moutou, C., Vermeulen, N., & De Rycke, M. (2020). ESHRE PGT Consortium good practice recommendations for the organisation of PGT. *Human Reproduction Open*, *2020*(3), hoaa021. https://doi.org/10.1093/hropen/hoaa021

ESHRE Working Group on Chromosomal Mosaicism, De Rycke, M., Capalbo, A., Coonen, E., Coticchio, G., Fiorentino, F., Goossens, V., Mcheik, S., Rubio, C., Sermon, K., Sfontouris, I., Spits, C., Vermeesch, J. R., Vermeulen, N., Wells, D., Zambelli, F., & Kakourou, G. (2022). ESHRE survey results and good practice recommendations on managing chromosomal mosaicism. *Human Reproduction Open*, *2022*(4), hoac044. https://doi.org/10.1093/hropen/hoac044

Fragouli, E., Munne, S., & Wells, D. (2019). The cytogenetic constitution of human blastocysts: Insights from comprehensive chromosome screening strategies. *Human Reproduction Update*, *25*(1), 15–33. https://doi.org/10.1093/humupd/dmy036

Garrett, N., & Sharot, T. (2017). Optimistic update bias holds firm: Three tests of robustness following Shah et al. *Consciousness and Cognition*, *50*, 12–22. https://doi.org/10.1016/j.concog.2016.10.013

Gleicher, N., Albertini, D. F., Barad, D. H., Homer, H., Modi, D., Murtinger, M., Patrizio, P., Orvieto, R., Takahashi, S., Weghofer, A., Ziebe, S., Noyes, N., & International Do No Harm Group in IVF (IDNHG-IVF.) (2020). The 2019 PGDIS position statement on transfer of mosaic embryos within a context of new information on PGT-A. *Reproductive Biology and Endocrinology: RB&E*, *18*(1), 57. https://doi.org/10.1186/s12958-020-00616-w

Järvholm, S., Thurin-Kjellberg, A., & Broberg, M. (2017). Experiences of pre-implantation genetic diagnosis (PGD) in Sweden: A three-year follow-up of men and women. *Journal of Genetic Counseling*, *26*(5), 1008–1016. https://doi.org/10.1007/s10897-017-0078-7

Kahraman, S., Cetinkaya, M., Yuksel, B., Yesil, M., & Pirkevi Cetinkaya, C. (2020). The birth of a baby with mosaicism resulting from a known mosaic embryo transfer: A case report. *Human Reproduction (Oxford, England)*, *35*(3), 727–733. https://doi.org/10.1093/humrep/dez309

Kaing, A., Rosen, M. P., & Quinn, M. M. (2020). Perceptions, motivations and decision regret surrounding preimplantation genetic testing for aneuploidy. *Human Reproduction (Oxford, England)*, *35*(9), 2047–2057. https://doi.org/10.1093/humrep/deaa154

Kim, J., Oktay, K., Gracia, C., Lee, S., Morse, C., & Mersereau, J. E. (2012). Which patients pursue fertility preservation treatments? A multicenter analysis of the predictors of fertility preservation in women with breast cancer. *Fertility and Sterility*, *97*(3), 671–676. https://doi.org/10.1016/j.fertnstert.2011.12.008

Lamb, B., Johnson, E., Francis, L., Fagan, M., Riches, N., Canada, I., Wilson, A., Mathiesen, A., Sabatello, M., Gurtcheff, S., Johnstone, E., & Rothwell, E. (2018). Preimplantation genetic testing: Decisional factors to accept or decline among in vitro fertilization patients. *Journal of Assisted Reproduction and Genetics*, *35*(9), 1605–1612. https://doi.org/10.1007/s10815-018-1278-2

Leigh, D., Cram, D. S., Rechitsky, S., Handyside, A., Wells, D., Munne, S., Kahraman, S., Grifo, J., Katz-Jaffe, M., Rubio, C., Viotti, M., Forman, E., Xu, K., Gordon, T., Madjunkova, S., Qiao, J., Chen, Z.-J., Harton, G., Gianaroli, L., … Kuliev, A. (2022). PGDIS position statement on the transfer of mosaic embryos 2021. *Reproductive Biomedicine Online*, *45*(1), 19–25. https://doi.org/10.1016/j.rbmo.2022.03.013

Munné, S., Grifo, J., & Wells, D. (2016). Mosaicism: 'survival of the fittest' versus 'no embryo left behind'. *Fertility and Sterility*, *105*(5), 1146–1149. https://doi.org/10.1016/j.fertnstert.2016.01.016

Munné, S., Weier, H. U., Grifo, J., & Cohen, J. (1994). Chromosome mosaicism in human embryos. *Biology of Reproduction*, *51*(3), 373–379. https://doi.org/10.1095/biolreprod51.3.373

Practice Committee and Genetic Counseling Professional Group (GCPG) of the American Society for Reproductive Medicine. (2020). Clinical management of mosaic results from preimplantation genetic testing for aneuploidy (PGT-A) of blastocysts: A committee opinion. *Fertility and Sterility*, *114*(2), 246–254. https://doi.org/10.1016/j.fertnstert.2020.05.014

Ruttanajit, T., Chanchamroen, S., Cram, D. S., Sawakwongpra, K., Suksalak, W., Leng, X., Fan, J., Wang, L., Yao, Y., & Quangkananurug, W. (2016). Detection and quantitation of chromosomal mosaicism in human blastocysts using copy number variation sequencing. *Prenatal Diagnosis*, *36*(2), 154–162. https://doi.org/10.1002/pd.4759

Taylor, T. H., Gitlin, S. A., Patrick, J. L., Crain, J. L., Wilson, J. M., & Griffin, D. K. (2014). The origin, mechanisms, incidence and clinical consequences of chromosomal mosaicism in humans. *Human Reproduction Update*, *20*(4), 571–581. https://doi.org/10.1093/humupd/dmu016

Viotti, M. (2023). Assessing the risk-benefit of mosaic embryo transfers using 3,500+ clinical outcome datapoints. *Fertility and Sterility*, *120*(4), e20–e21. https://doi.org/10.1016/j.fertnstert.2023.08.724

Yang, H., DeWan, A. T., Desai, M. M., & Vermund, S. H. (2022). Preimplantation genetic testing for aneuploidy: Challenges in clinical practice. *Human Genomics*, *16*(1), 69. https://doi.org/10.1186/s40246-022-00442-8