Borut Kovačič

Senior Embryologist and Head of the IVF laboratory at the University Medical Center Maribor, Slovenia; Chair-Elect, European Society of Human Reproduction and Embryology (ESHRE)

Citation:	EMJ Repro Health. 2026;12[1]:70-72. https://doi.org/10.33590/emjreprohealth/1N1T76AG
Author:	Alena Sofieva, EMJ, London, UK

Q1 The IVF laboratory has transformed dramatically over the past three decades. Which developments have had the greatest impact on success rates?

I'm a senior embryologist, so I have experience with the evolution of laboratory techniques. We started from scratch, but there have always been new technologies coming into the lab. Looking back in history, for me, the first milestone was the culture media that were produced by commercial companies. This definitely meant the first step to the standardisation of laboratory conditions.

The second was intracytoplasmic sperm injection (ICSI), the micro-manipulation technique that solved the issue of relatively unsuccessful male infertility treatment before this milestone. In fact, 50% of infertile patients benefit from this technology. The next one was prolonged embryo culture. We know that embryos begin with gene expression and, consequently, develop their own metabolism after the third day of embryo development *in vitro*, and that is a critical point. With prolonged culture to the blastocyst stage, it is possible to identify embryos with greater implantation and developmental potential and, consequently, this dramatically improved the outcome of treatment with assisted reproductive technology. At that time, however, cryopreservation protocols were not adjusted to blastocyst stage embryos, so there was a lot of scepticism about whether prolonged culture was the right way to go, because of concerns around epigenetics and what to do with blastocysts that were not transferred to the uterus.

With the development of vitrification, this issue was solved not only for blastocysts but also for oocyte cryopreservation. Blastocyst, as a larger preimplantation embryonic stage filled with fluid and oocyte as the biggest cell, was not an optimal stage for standard slow-freezing procedure, and vitrification enabled oocytes and blastocysts to much better survive vitrification and thawing steps. Consequently, clinicians decided to perform single embryo transfers more often. The rate of multiple pregnancies significantly dropped, and, with new protocols using agonist triggering, it became possible to freeze all embryos or oocytes and reduce the risk of ovarian hyperstimulation syndrome to a minimum.

There are also some other technologies that proved themselves as safe and effective treatment options for certain sub-populations, such as artificial oocyte activation for patients facing problems with fertilisation failure after ICSI, and preimplantation genetic testing for those with heavy indications for genetic diseases.

Q2 You mentioned fertility preservation. How do you see this area developing?

Fertility preservation remains an important area of development. Ovarian tissue cryopreservation is becoming increasingly relevant, not only for oncology patients

> **Cryopreservation is becoming increasingly relevant, not only for oncology patients but also for women who may lose fertility because of other medical conditions**

but also for women who may lose fertility because of other medical conditions. However, relatively few patients currently return to use their preserved tissue, meaning there is still much to learn about its long-term clinical value.

The same applies to testicular tissue preservation. While preserving tissue is technically possible, particularly challenging questions remain for prepubertal boys. Preservation alone is not enough; we also need safe and effective methods to mature this tissue in vitro, and our current knowledge is still limited.

As these technologies develop, appropriate regulation becomes increasingly important. The new European Substances of Human Origin (SoHO) Regulation should help ensure that innovations are introduced responsibly. Because reproductive medicine involves handling human genetic material, any new technique should undergo ethical review, appropriate risk assessment, and transparent patient counselling.

Patients need to understand when a treatment remains experimental, and be fully informed about both the potential benefits and the unknown risks before making decisions together with their doctors. Better regulation should support this process

Q3 AI is increasingly being applied to embryo assessment. How close are we to meaningful clinical implementation, and where should the field remain cautious?

Embryo assessment by using time-lapse imaging combined with AI is an amazing technology to see the behaviour of embryo development during the first 5, 6, or 7 days. There are many morpho-kinetic parameters that can be followed by AI. It is much simpler to collect all this information and create a scoring system that can improve embryo selection or ranking.

However, most of the available evidence remains retrospective. Only a small number of prospective RCTs have been conducted, and so far they have not demonstrated improved clinical outcomes or cost-effectiveness.

That does not necessarily mean AI will not become useful. Future systems may be trained using much larger datasets and combined with additional non-invasive diagnostics. For example, analysing spent culture media to determine which metabolites an embryo consumes and produces could provide valuable information about embryo viability. These techniques remain technically challenging for routine clinical practice, but combining metabolic data with AI may represent an important direction for the future.

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Q4 As ESHRE President-elect, what do you see as the biggest challenges currently facing reproductive medicine in Europe?

One of the biggest challenges is implementing the new European SoHO Regulation.

When the original EU Tissue and Cells Directives (EUTCD) were introduced, many people viewed them simply as additional bureaucracy. Looking back now, they have clearly improved harmonisation and safety across the laboratory sector of reproductive medicine. I believe the SoHO Regulation will have a similarly positive long-term impact.

The regulation is expected to be implemented next year, followed by the authorisation of SoHO preparations. I strongly believe that ESHRE will play an important role in this process, directly or indirectly. ESHRE guidelines are already widely respected, and regulators frequently rely on them during inspections and quality assessments. They have become something of a reference document for reproductive medicine.

Laboratory practice has already undergone strict quality control through the implementation of the Tissue and Cells Directives and embryologists themselves have recognised ESHRE certification as a minimum educational standard for working in a clinical embryology laboratory. Clinical practice also requires robust guidance, along with subspecialist training and certification of individual professionals and accreditation of fertility centres. Accreditation allows independent assessors to evaluate whether centres genuinely follow ESHRE guidance and maintain high clinical and safety standards.

The ultimate goal is to spread quality consistently across Europe, and I would like to see many more centres participating in ESHRE's accreditation programmes.

Q5 Do you think accreditation could ever become mandatory?

I remain somewhat sceptical. Looking at the European MAR Registry (EuMAR), we believed it would become something regulated through the new SoHO Regulation.

ESHRE was very proud to receive funding from the European Commission to establish a pan-European cycle-by-cycle registry. Once the project was finished, however, we did not get a regulation that would require mandatory participation. The centres and national registries that will provide data will have the opportunity to use dashboards and compare their success rates with European averages, and we see a lot of benefits from EuMAR for all stakeholders.

There are other areas where further harmonisation is needed, particularly donor registries. As the demand for donated reproductive material continues to increase, Europe needs greater transparency and traceability for donations, the usage of donated gametes or embryos, and the health of offspring conceived from donated sperm or oocytes. At the same time, excessive regulation could unintentionally reduce access to donor material. The challenge is finding the right balance and communicating this effectively to policymakers.

Professional societies increasingly have an important role in supporting evidence-based policy development.

Q6 Looking ahead to the next decade, which emerging technology has the greatest potential to change the way IVF laboratories operate?

I believe the future lies in truly non-invasive embryo assessment. This may involve metabolomics, novel genomic technologies, and non-invasive genetic testing, although these approaches still require considerable validation. Some geneticists remain unconvinced about the current reliability of non-invasive genetic testing.

However, combining multiple non-invasive technologies may ultimately provide a much more complete picture of embryo viability. If metabolic profiling, genomic information, and other biological markers can be integrated and analysed using AI, this combination has the potential to substantially improve embryo selection in IVF laboratories over the coming decade.