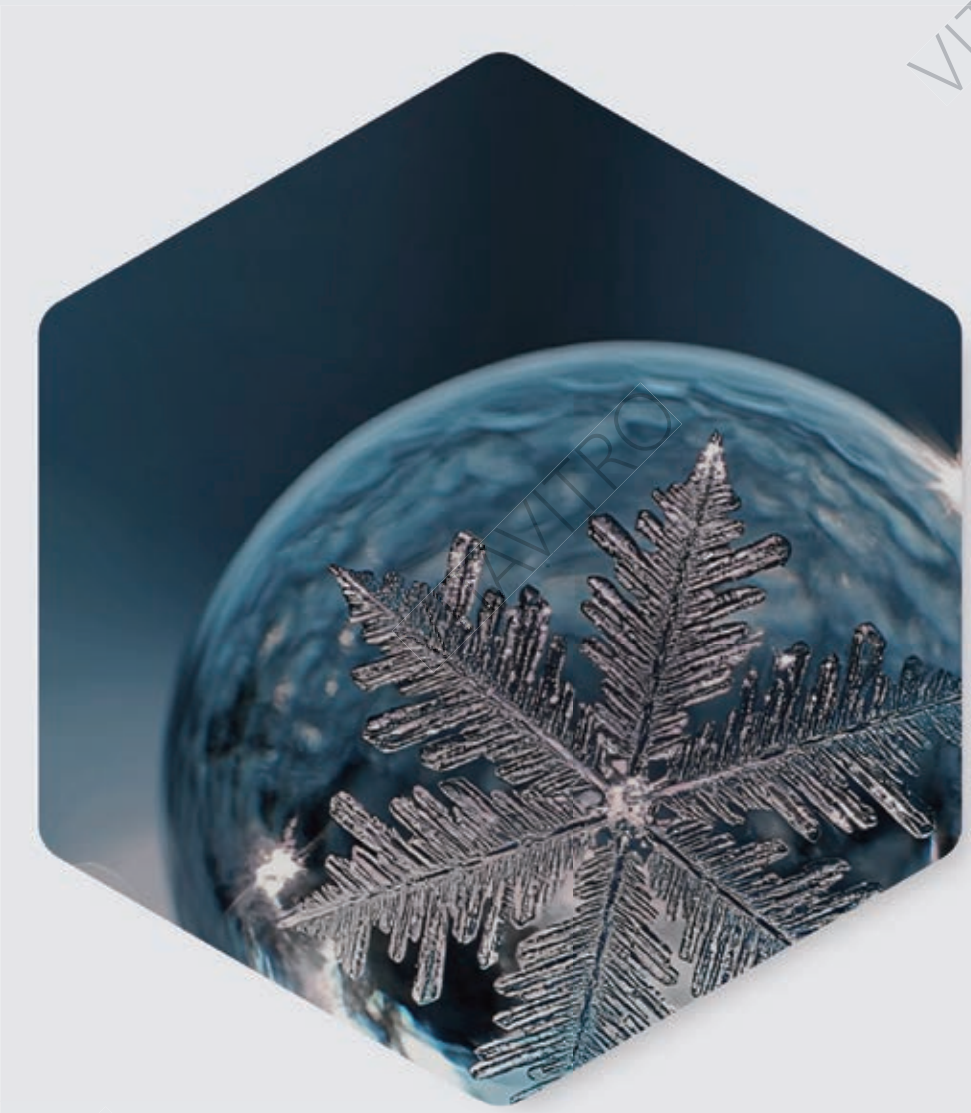
VitaVitro

WHITEPAPER



Towards a New Era of Universal, Efficient, and Safe Warming

A Solution Whitepaper Based on European and Chinese RCT Clinical Data

Introduction

The Evolution of Embryo Warming and Current Challenges

In assisted reproductive technology (ART), vitrification and warming of embryos have become critical for ensuring pregnant success rate per cycle and cumulative live birth rate. However, the growing globalization and cross-institutional collaboration among fertility centers have posed significant practical challenges for laboratories:

1. Complex inventory management of embryos cryopreserved with different brand kits.
2. Conventional warming protocols involve numerous steps and require high technical proficiency, which may introduce human variability.
3. Switching or mixing media brands often creates a practical bottleneck in identifying an appropriate and reliable warming protocol.

A “one-to-one” matching strategy for each brand increases reagent costs and management burdens. Furthermore, in emergencies or resource-limited situations it can even lead to an inability to perform immediate warming.Thus, the industry is in urgent need of a more streamlined, efficient, and universal warming solution—one that maximizes embryo survival rate and developmental potential.

Our Solution:

VitaVitro Ultra-Fast Warming Protocol

Suitable for Oocytes and Blastocysts

To address these challenges, VitaVitro has integrated cryobiology expertise with formulation optimization to introduce an innovative ultra-fast one-step warming method. At the core of this solution is a precisely engineered warming medium formulation, which enables the warming process to replace multiple buffer steps and gradual dilutions with a single-step rehydration.

Extreme Efficiency

This method drastically streamlines the traditional multi-step warming process, significantly improving laboratory workflow efficiency.

Excellent Safety

Minimizes oocytes/blastocysts exposure to non-physiological conditions, fundamentally mitigating the risks of osmotic shock and recrystallization, providing a gentler and more stable recovery environment for oocytes/blastocysts.

Broad Compatibility (Universality)

The media formulation is designed to be compatible with vitrification solutions from multiple brands, aiming to serve as a truly universal warming protocol in practice.

Stable and Reliable

The streamlined process reduces operator variability, enhancing consistency and reproducibility while ensuring consistently high survival rates and reliable subsequent clinical treatment outcomes.

Clinical Data Validation:
Building a Robust Evidence Chain

Universality Validation

Demonstrates the applicability and equivalence of this universal warming strategy across different brands of vitrification media.

Technical Extension Validation

Shows the potential of the rapid warming concept applied to more complex tissues (e.g., human ovarian tissue).

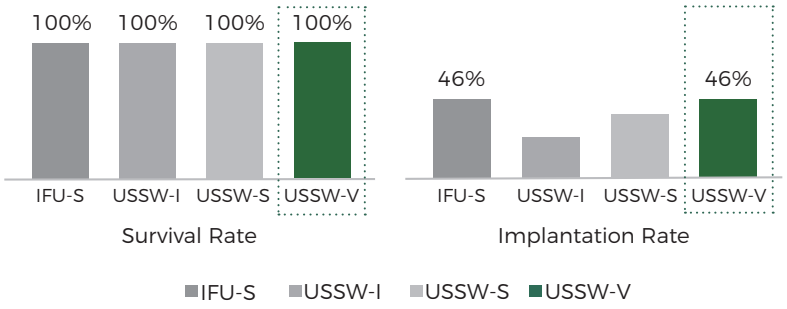
Compelling Performance Validation

Prospective randomized controlled trials (RCTs) comparing clinical outcomes, providing the highest level of clinical evidence.

Universality Validation:
One-Step Warming as a Universal Protocol Publication

A large 2025 retrospective study by Lodovico Parmegiani et al. (involving 3,071 blastocysts) provided a complete evidence chain in two parts:

1. Universality Foundation (CS1 – Traditional Multi-Step Method): The study confirmed that using a multi-step warming protocol with 1M sucrose can successfully warm blastocysts vitrified by different brands, achieving excellent live birth rates (27.0%–34.9%).
2. Process Innovation (CS2 – Ultra-Short Single-Step Warming, USSW): More importantly, it was the first demonstration that an extremely simplified one-step, short-duration rehydration (USSW) protocol can also achieve universal warming. Using the USSW protocol to warm blastocysts from different brands yielded survival rates up to 99.5%–100% and clinical pregnancy rates of 34.5%–47.0%, with no statistically significant differences between groups. All results were excellent.



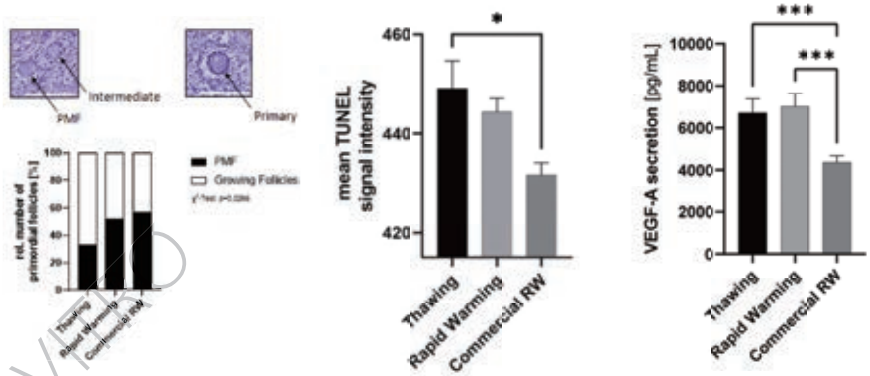
Notably, the study revealed performance differences between brands under the USSW protocol:
Blastocysts warmed with VitaVitro Warming Kit have a higher implantation rate in the one-step protocol than those using other brands, and comparable implantation rates to the traditional multi-step protocol. This suggests that on the basis of universal warming, the VitaVitro Warming Kit offers even greater clinical potential.

Reference:
Parmegiani L, Vajta G, Lynch C, Arnone A, Bernardi S, Maccarini AM, et al. Universal post-warming dilution of vitrified embryos: impact of different vitrification/warming kits, warming volume and rapid dilution/rehydration steps on survival and clinical outcomes. Reprod Biomed Online. 2025 Sep;51(3).

Technical Outlook:
Demonstrating Technical Potential and Safety in Ovarian Tissue Warming

Our technical advantage extends beyond embryos. A 2025 study on human ovarian tissue warming also confirms the advanced nature and reliability of the "rapid warming" concept. This study applied a rapid-warming method (with 1M sucrose) to traditionally slow-frozen ovarian tissue samples. The results show:

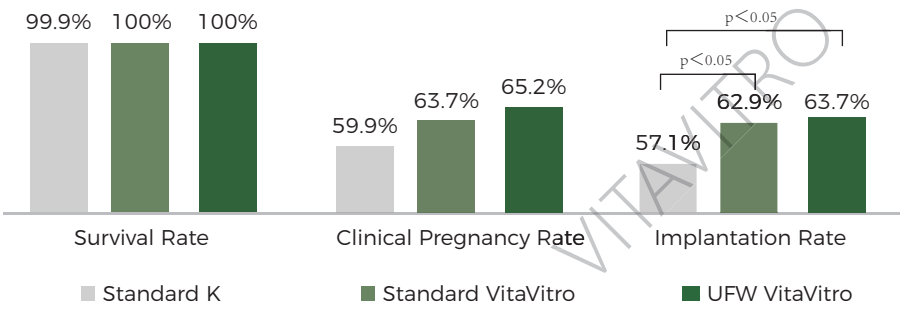
1. **Significantly higher primordial follicle survival:**
   In the conventional slow-warming group, only 33% of primordial follicles survived. In the group using VitaVitro Warming Kit, survival was as high as 57% (p=0.0266).
2. **Greatly reduced tissue damage:**
   Post-thaw, apoptosis levels were significantly lower (TUNEL assay, p=0.014) in the VitaVitro Warming Kit. VEGF-A stress secretion was lowest, indicating minimal tissue damage during warming.
3. **Standardized, highly reliable protocol:**
   The study used a traditional multi-step warming method with VitaVitro Warming Kit. The process was stable and reproducible, providing a ready, efficient, and standardized solution for ovarian tissue warming.



Reference:
Färber CM, Einenkel R, Emrich NLA, Kestermann EZ, Parmegiani L, Schallmoser A, et al. Towards a universal rapid warming protocol for cryopreserved human ovarian tissue. Reprod Biomed Online. 2025 Jul 14 [Online ahead of print].

Prospective RCT:
Clinical Performance of the VitaVitro Warming Group

The most compelling evidence comes from the first rigorously designed prospective randomized controlled trial (RCT) in China. This study involved 2242 blastocyst warming cycles. All blastocysts were vitrified using K-brand vitrification reagents, ensuring consistency in the freezing phase and precisely focusing the comparison on the warming protocols.



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The core conclusions were:

1. Superior Performance
Survival rates reached nearly 100% across all groups. Notably, the groups warmed with the VitaVitro Warming Kit achieved higher clinical pregnancy and implantation rates compared to the Brand K traditional warming group, with the improvement in implantation rate being statistically significant.

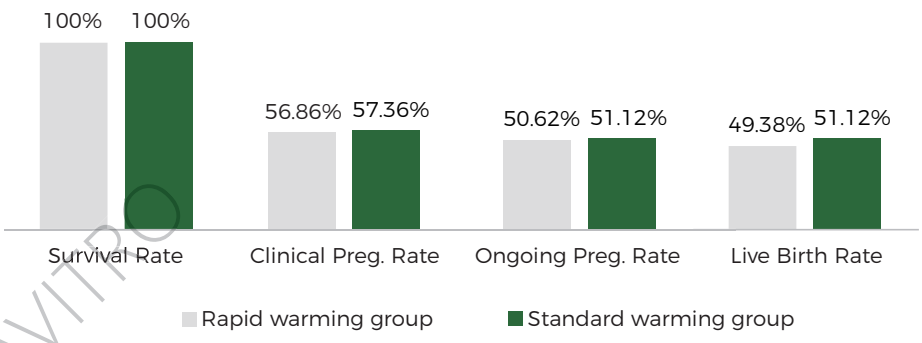
2. Process Advantage
Under identical freezing and warming procedures, the implantation rate with VitaVitro's traditional method was still significantly higher than that of Brand K. This confirms that superior manufacturing processes and formula purity are key enablers of these additional performance gains.

3. Efficiency Revolution
VitaVitro's ultra-fast warming protocol maintained or improved clinical outcomes while reducing steps and time by about 80%, substantially enhancing operational efficiency.

Safety and Sucrose Advantage:
Sucrose-Based Safety Foundation

Safety is paramount for any technological innovation. Recent large-scale international clinical studies have consistently demonstrated that a rapid, single-step warming protocol using 1 M sucrose significantly improves laboratory efficiency while delivering safety and clinical outcomes comparable to conventional multi-step warming methods. These findings provide a robust scientific rationale for adopting this approach in clinical practice.

- **Liebermann et al.(2025)-Retrospective Study:**
  Analyzed the health of 1,266 infants born after the 1-minute, 1M sucrose one-step warming of vitrified blastocysts. Key indicators — mean gestational age (37.6 weeks), birth weight (3,267 g), sex ratio, and congenital anomaly rate — showed no significant differences compared to infants born from traditional multi-step warming. All met healthy-term newborn standards.
- **Karagianni et al.(2025)-Prospective Cohort Study:**
  Conducted at Embryolab Fertility Clinic (Thessaloniki, Jan 2023–Jun 2024), including 802 frozen embryo transfer cycles (1,182 embryos). Patients were divided into two groups: an experimental group with fast warming (embryos warmed in 37˚C 1M sucrose for 1 minute then placed in culture) and a control group with standard warming. The results were highly consistent: both groups had 100% survival rates, and there were no statistically significant differences in clinical pregnancy rate (56.86% vs. 57.36%), ongoing pregnancy rate (50.62% vs. 51.12%), live birth rate (49.38% vs. 51.12%), or any other key outcome measures.



References:
1. Liebermann J, Brohammer R, Wagner Y, Parus A, Macias C, Suda N, et al. Fast and furious: gestational age, birth weight and sex of 1266 healthy infants born after a one-step warming of vitrified human blastocysts. Reprod Biomed Online. 2025 Aug 31 [Online ahead of print].
2. Karagianni M, Papatheodorou A, Oraiopoulou C, Papadopoulou MI, Thivaiou L, Katsakoglou N, et al. Effect of a one-step fast warming protocol on reproductive outcomes of vitrified-warmed blastocysts. Fertil Steril. 2025 Jul 10 [Online ahead of print].

Conclusion and Outlook

In summary, extensive clinical evidence provides a complete and logical validation:
Universality, Ultra-Efficiency, and Ultra-Safety represent the inevitable future of the warming technology.

Universality

Validated by studies involving over 3,000 embryos, solving the pain point of "what to use for warming."

Ultra-Efficiency

Proven by RCT data, the single-step method saves significant time while improving clinical outcomes, solving the pain point of "how to be faster and better."

Ultra-Safety

Validated by data from 1266 healthy infants, addressing the core concern of "whether it is safe."

VitaVitro Vitrification and Warming system and ultra-fast warming protocol are poised to become standardized solutions for simplifying laboratory workflows, helping to improve overall ART success rates and bringing tangible clinical benefits to more families.

VitaVitro

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