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Failed thaw cycles as a key performance indicator: Evaluating the progress of frozen embryo transfers in USA

Kelly A. Wirka,[1] Mary C. Mahony,[2] Brooke Hayward,[1] Fabrício Collares,[1] Allison B. Catherino[1]

[1]EMD Serono, Inc., Rockland, MA, USA
[2]Independent Scientific Affairs Consultant, Virginia Beach, VA, USA

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CONCLUSION

- **An analysis of Society for Assisted Reproductive Technology (SART) data from 2014 to 2019 showed that the percentage of failed thaw cycles (FThC; ie, thaw procedures that failed to produce any embryos suitable for transfer) significantly decreased across all ages and infertility diagnoses, even as the number of frozen embryo transfer (FET) cycles increased**
  - **This likely reflects the evolution of freezing criteria, procedures, and clinical/laboratory decisions that positively impact the live birth rate (LBR)**
- **A lower percentage of FThC and improved LBRs over time, together with fewer embryos transferred, may also reflect the impact of pre-implantation genetic testing and increased use of freezing all embryos ("freeze-all")**
  - **Additional analyses are underway to study these potential influences further**
- **Key performance indicators (KPIs) are important to provide best-in-class care to patients. Laboratories should monitor their rates of FThC over time and consider improving techniques as vitrification continues to be a viable clinical strategy for successful *in vitro* fertilization cycles**

INTRODUCTION

- KPIs are important measures in assisted reproductive technology for the evaluation of a technique or process and quality management, as well as benchmarking and quality improvement[1]
- Embryo cryosurvival rate (number of viable embryos thawed/total number of embryos frozen) is a recommended KPI to use as a benchmark in embryo cryopreservation[1,2]
- Lower success rates in FET cycles could be attributed to embryo transfer decisions and freezing procedures, including minimal standards in cryopreservation
- The percentage of FThC stratified by age and diagnosis could be used as a surrogate for laboratory competency in freezing/thawing procedures and thus, aid in establishing new KPI competencies and benchmark values
- The SART database captures real-world data related to the practice of assisted reproductive technologies (including patient care) in the USA[3]
- Here, the SART database was analysed to assess FThC and the progress of FET in the USA

OBJECTIVE

- To evaluate FThC as a KPI and related FET outcomes across SART age groups and infertility diagnoses over 6 years

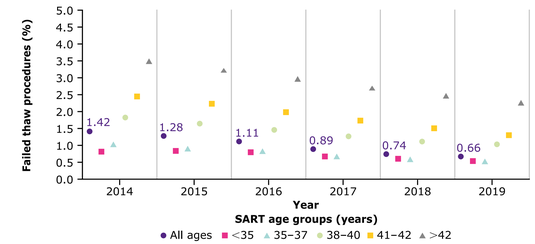
METHODS

- A total of 262,818 FETs were available between 2014 and 2019 in the SART database for analysis
  - First FETs (defined as those ⩾12 months after retrieval) and second or later FETs were included
  - Cycles involving donor embryos were excluded
- Outcomes included:
  - Percentage of failed thaws
  - Mean number of embryos transferred
  - LBRs
- Changes in outcomes over time were estimated using regression models, adjusting for age and infertility diagnosis

RESULTS

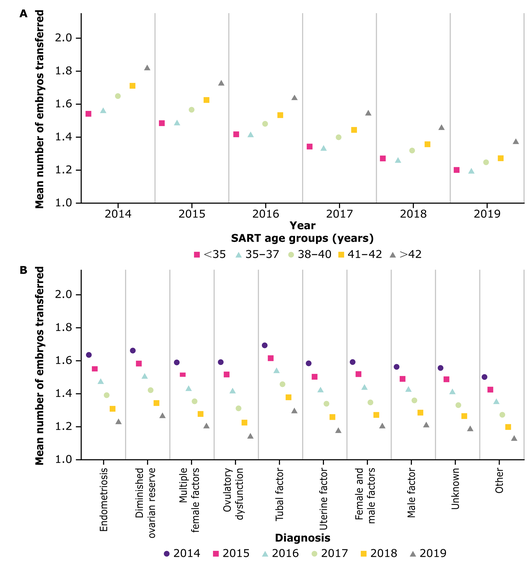
- From 2014 to 2019, the number of FET thaw procedures increased from 32,381 to 57,019 (15.2% per year) and FThC decreased from 1.47% to 0.67% (all age groups combined)
- The proportion of FThC declined for all SART age groups combined, by −0.28% per year (p<0.0001; **Figure 1**)
  - The greatest change was observed for ages 41–42 years, which decreased from 2.45% in 2014 to 0.96% in 2019, corresponding to a 61% improvement
- The decrease in the percentage of failed thaws was independent of infertility diagnosis (**Table 1**)
  - The decrease was statistically significant for female and male factors, male factor alone, and unknown diagnosis

Figure 1. Percentage of failed thaw procedures over time by SART age groups (fitted)



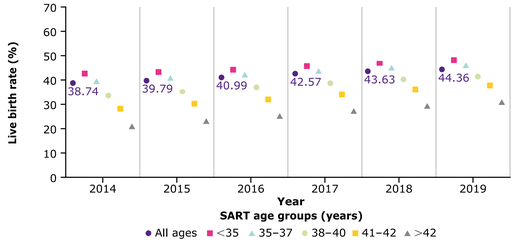
- The estimated change in mean number of embryos transferred by SART age group was −0.09 per year from 2014 to 2019 and +0.12 for each advance in SART age group (both p<0.0001; **Figure 2a**)
- Estimated change in mean number of embryos transferred by infertility diagnosis was −0.08 per year from 2014 to 2019 (p<0.0001; **Figure 2b**)
  - The decrease was independent of infertility diagnosis (**Table 1**)

Figure 2. Mean number of embryos transferred over time by (a) SART age groups (fitted) and (b) infertility diagnosis (fitted)



- LBR across all SART age groups and all infertility diagnoses was increased by 2.17% per year from 2014 to 2019 (both p<0.0001; **Figure 3**)
  - An overall improvement of 11% and 13% was observed for ages 41–42 and >42, respectively, and an improvement of 5–7% was observed in the younger groups (5% for ages ⩽37; 7% for ages 38–40)
  - The increase in LBR per year was significant, ranging from 1.14% (diminished ovarian reserve) to 3.53% (ovulatory dysfunction; all p<0.01; **Table 1**), except for uterine factors (p=0.1552)

Figure 3. LBR over time by SART age groups (fitted)



- From 2014 to 2019, in all age groups, the mean number of embryos transferred was reduced, while the percentage of failed thaw procedures was decreased and LBR was increased (**Figure 4**)

Figure 4. Changes in (a) the mean number of embryos transferred, (b) percentage of failed thaw procedures, and (c) LBR by SART age group

A

Mean number of embryos transferred	<35	35–37	38–40	41–42	>42
2014	1.6	1.6	1.6	1.8	1.9
2015	1.5	1.5	1.5	1.6	1.7
2016	1.4	1.4	1.4	1.5	1.6
2017	1.3	1.3	1.4	1.4	1.5
2018	1.3	1.2	1.3	1.3	1.5
2019	1.2	1.2	1.2	1.3	1.4

B

Failed thaw procedures (%)	<35	35–37	38–40	41–42	>42
2014	1.1	1.5	1.5	2.4	3.3
2015	1.0	1.1	1.5	1.4	3.4
2016	0.8	0.9	1.4	1.6	3.2
2017	0.6	0.7	1.1	1.6	3.1
2018	0.4	0.6	0.9	2.1	2.9
2019	0.4	0.6	0.8	1.0	2.4

C

LBR (%)	<35	35–37	38–40	41–42	>42
2014	42.8	39.6	33.6	27.5	19.6
2015	44.5	40.1	34.8	30.1	24.1
2016	44.9	41.9	36.9	32.4	23.9
2017	45.9	42.8	38.5	34.7	28.6
2018	47.0	44.7	40.9	35.7	28.3
2019	47.6	44.6	40.7	38.6	32.1

Table 1. Change per year in percentage of failed thaw procedures, mean number of embryos transferred, and LBR by infertility diagnosis (2014–2019)

	FThC		Mean number of embryos transferred		LBR	
	Change per year (%)	p-value	Change per year (n embryos)	p-value	Change per year (%)	p-value
All diagnoses	−0.28	<0.0001	−0.09	<0.0001	2.17	<0.0001
Endometriosis	−0.38	0.0716	−0.09	<0.0001	2.72	0.0005
Diminished ovarian reserve	−0.07	0.4035	−0.05	<0.0001	1.14	0.0074
Multiple female factors	−0.20	0.113	−0.11	<0.0001	1.85	<0.0001
Ovulatory dysfunction	0.45	0.1928	−0.09	0.0002	3.53	0.0067
Tubal factor	−0.09	0.6299	−0.09	<0.0001	1.29	0.0027
Uterine factor	−0.05	0.7977	−0.11	<0.0001	0.99	0.1552
Female and male factors	−0.37	<0.0001	−0.09	<0.0001	2.09	<0.0001
Male factor	−0.35	0.0003	−0.10	<0.0001	2.35	<0.0001
Unknown	−0.33	0.0001	−0.12	<0.0001	2.11	<0.0001
Other	−0.30	0.0637	−0.11	<0.0001	2.44	<0.0001

Parameter estimates and p-values for year of thaw procedure, from linear regression models adjusted for year, number of embryos transferred, and SART age group (overall infertility diagnoses and for each diagnosis)

Abbreviations: FET, frozen embryo transfer; **FThC**, failed thaw cycles; **KPI**, key performance indicator; **LBR**, live birth rate; **SART**, Society for Assisted Reproductive Technology

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DISCLOSURES

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