VIA MEDICA

ORIGINAL PAPER / GYNECOLOGY

Ginekologia Polska
2021, vol. 92, no. 1, 7–15

ISSN 0017–0011

DOI 10.5603/GP.a2020.0142

Assisted reproductive medicine in Poland, 2013–2016: Polish Society of Reproductive Medicine and Embryology (PTMRiE) and Fertility and Sterility Special Interest Group of the Polish Society of Gynaecologists and Obstetricians (SPiN PTGiP) report

Anna Janicka[1], Robert Z. Spaczynski[2], Katarzyna Koziol[3], Michal Radwan[4], Rafal Kurzawa[1, 2, 5]

[1]*Vitrolive, The Fertility Partnership, Szczecin, Poland*
[2]*Division of Infertility and Reproductive Endocrinology, Poznan University of Medical Sciences, Poznan, Poland*
[3]*Novum, Warsaw, Poland*
[4]*Gameta, Rzgow, Poland*
[5]*Department of Gynaecology and Reproductive Health of the Pomeranian Medical University, Szczecin, Poland*

ABSTRACT

Objectives: The purpose of this publication is to present data on the results and complications associated with infertility treatment using assisted reproductive technology (ART) and intrauterine insemination (IUI) in Poland between 2013 and 2016.

Material and methods: The report was prepared by the Polish Society of Reproductive Medicine and Embryology (PTMRiE) and the Fertility and Sterility Special Interest Group of the Polish Society of Gynaecologists and Obstetrics (SPiN PTGiP) as a part of the European IVF Monitoring program (EIM) for the European Society of Human Reproduction and Embryology (ESHRE). Reporting was voluntary and the data was not subject to external control. The report presents the availability and structure of infertility treatment services, the number of procedures, their effectiveness and complications.

Results: Between 2013 and 2016, a total of 106,718 treatment cycles using ART [64,413 classical *in vitro* fertilization and *in vitro* fertilization with intracytoplasmic sperm injection (IVF + ICSI), 36,041 frozen embryo replacements (FER)] and 51,405 IUI were recorded. The clinical pregnancy rates per embryo transfer in IVF, ICSI and FER were 38.3%, 38.1% and 32.4%, respectively. The effectiveness of IUI with husband/partner's semen (IUI-H) was 11.1% and with donor semen (IUI-D) 16.7%. Multiple delivery rates were 11.3% and 6.2% in IVF + ICSI and IUI, respectively. The most common complication was the ovarian hyperstimulation syndrome (OHSS) (0.34%).

Conclusions: PTMRiE and SPiN PTGiP report is the only national study documenting Polish reproductive medicine. The results of infertility treatment effectiveness in Poland are comparable with the European data, complications are less frequent than in other countries. The low percentage of multiple pregnancies, and so perinatal complications, is especially valuable. However, due to the lack of a central database and register, the possibility of external control and monitoring of pregnancies and births is limited. Thus, a fully reliable assessment of the treatment quality in our country is not possible.

Key words: PTMRiE and SPiN PTGiP report; infertility treatment; assisted reproduction techniques; IVF; ICSI; IUI

Ginekologia Polska 2021; 92, 1: 7–15

INTRODUCTION

Infertility is a disease and a social condition, defined by the World Health Organization (WHO) as the inability to get pregnant or carry the pregnancy to term after a year of regular intercourse without using contraceptive methods. It is estimated that in Poland about 1.2 million couples face subfertility or absolute infertility. Annually, approximately 2%, *i.e.*, 24 000 couples, require treatment using assisted reproductive technology (ART). WHO warns that the problem of infertility will continue to grow and gain in importance, which means that the percentage of couples who, despite their efforts, cannot have their desired child will be even greater in the future.

Corresponding author:
Anna Janicka
Vitrolive Sp. z o. o, al. Wojska Polskiego 103, 70–483 Szczecin, Poland
Phone +48 691 676 305, Fax +48 91 88 69 138
e-mail: anna.janicka@vitrolive.pl

The methods used to treat infertility, and especially ART, have been evaluated for many years for their safety and effectiveness. In Poland, it is the Polish Society of Reproductive Medicine and Embryology (PTMRiE) and the Fertility and Sterility Special Interest Group of the Polish Society of Gynaecologists and Obstetricians (SPiN PTGiP) who are responsible for collecting and processing this data. The reports are made available to the European Society of Human Reproduction and Embryology (ESHRE) as part of the international project — European IVF Monitoring (EIM), and then published in the Human Reproduction [1–19]. The first report was published in 2001 and depicted data for 1997 [1]. The last one was published in February 2020 and presents data for 2015 [19]. Poland has participated in the EIM Program continuously for 18 years, providing data for the years 1999–2016. The last three years of this reporting period (2013–2016) are a breakthrough period for the development of assisted reproductive medicine in Poland:

1. Health program funded by the Polish Ministry of Health "Infertility Treatment by the in vitro fertilization method for the years 2013–2016" reimbursed IVF procedures and increased the availability of ART methods making it accessible to the couples who withhold the therapies because of financial difficulties [20],
2. Some local governments decided to partially reimburse the costs of ART treatment financially supporting the therapy of their residents,
3. On 25th of June 2015, the Act on infertility treatment entered into force, thereby regulating the legal aspects of infertility treatment, including donations of gametes and embryos [21],
4. A national register of medically assisted procreation centres and reproductive cell and embryo banks were established, listing the sites authorized by the Ministry of Health to conduct activities in the field of infertility treatment using ART [22].

OBJECTIVES

The aim of the publication is to present data on the use of assisted reproduction techniques in Poland between 2013 and 2016, including the number of performed procedures, their effectiveness and the most common complications. The collected data is particularly important in the aspect of health policy planning and is also the basis for comparing the quality of treatment in Poland and other European countries.

MATERIAL AND METHODS

The data was made available by 41 centres of medically assisted procreation and included the following methods of infertility treatment:

— classical *in vitro* fertilization (IVF) and *in vitro* fertilization with intracytoplasmic sperm injection (ICSI)
— frozen embryo replacement (FER)
— preimplantation genetic testing (PGT)
— *in vitro* maturation (IVM)
— frozen oocyte replacement (FOR)
— egg donation (ED)
— embryo donation
— intrauterine insemination using husband/partner's semen (IUI-H) or donor's semen (IUI-D).

The report concerns infertility treatment procedures that began between January 1, 2013 and December 31, 2016 and is a continuation of the report with data for 2012, published in 2015 [23]. Data regarding pregnancies and deliveries is derived from observations of the procedures carried out in the above period. The data collection schedule is consistent with the EIM Program, run under the patronage of ESHRE.

Data reporting was voluntary. Clinics were not obliged to participate in the report, and the submitted data was not subject to external control and verification. Only the completeness and mathematical convergence of data between the tables were checked. If an inconsistency was found, the clinic was contacted to make a correction. Based on individual data, a summary report for Poland was prepared, which was sent to ESHRE using dedicated Dynamic Solutions software. Individual data of individual centres remain confidential.

The terminology used in the report is consistent with that proposed by the International Committee for Monitoring Assisted Reproductive Technology (ICMART) [24].

RESULTS

Availability of assisted reproduction methods and number of treatment cycles

The list of IVF and IUI centres that participated in the report is presented in Annex to this publication. Compared to data from 2012 over the following four years, the number of IVF clinics reporting has increased (from 33 in 2012 to 39 in 2016, +18.2%) as well as the total number of ART[1] procedures performed (from 16,849 in 2012 to 31,613 in 2016, +87.6%) [23]. In total, 219 879 IVF + ICSI cycles have been recorded since the beginning of the EIM data collection, of which almost half in the period 2013–2016 — 107,881 (Fig. 1). 17,865 fresh IVF + ICSI cycles were performed in 2016, 67% more than in 2012 (10,714 cycles).

There was also an increase in the number of IUI centres that participated in the report (from 31 in 2012 to 38 in 2016), however, the number of IUI decreased (from 14,727 in 2012 to 13,202 in 2016, –10.4%).

In the years 2013–2016, the most popular techniques were: ICSI (60,440 cycles, 56%) and FER (36,041, 33.4%).

1 ART methods include the following procedures: IVF, ICSI, FER, PGT, ED, IVM, FOR and prenatal adoption

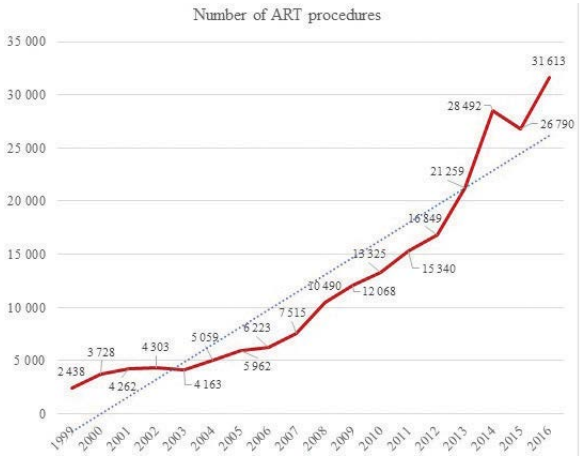

Figure 1. Number of ART treatment cycles in Poland, 1999–2016

Compared to 2012, the number of IVF, PGT, ED, FOR cycles also increased, while the number of IVM procedures decreased (Tab. 1). Of all fresh treatments (IVF + ICSI), 93.8% were cycles using ICSI. The number of ICSI procedures has slightly decreased in the considered period, as compared to the year before, when it amounted to 95.7% (2012).

Availability of advanced infertility treatment increased as demonstrated by the rise in numbers of ART cycles per million inhabitants in Poland from 437 cycles in 2012 to 810 cycles in 2016 (Table 1). As a result, the percentage of newborns born through *in vitro* methods increased from 4,694 in 2012 to 6,484 in 2016. This data is not complete since the course of 627 (in 2012) and 2157 (in 2016) clinical pregnancies[2] is unknown (11.5% and 22.7% of all pregnancies, in 2012 and 2016 respectively). For deliveries with an unknown result, single delivery was used for the calculation (146 deliveries after ART in 2012 and 695 in 2016).

2 Clinical pregnancy based on clinical and ultrasound parameters according to WHO / ICMART definition (fetal vesicle visible in ultrasound), including ectopic pregnancy

Efficiency of treatment

IVF, ICSI, FER

Clinical pregnancy rates per cycle during IVF and ICSI procedures in the years 2013-2016 were comparable and amounted to 28.8% and 29.0%, respectively, and 38.3% and 38.1% per transfer. For frozen embryo replacement (FER), the clinical pregnancy rate was 32.4%. An increase in the effectiveness of FER was recorded in the following years: from 29.1% in 2013 to 36.1% in 2016. Detailed data is presented in Table 2.

In 17.8% of fresh IVF + ICSI cycles (5,912/33,297), the decision was made to freeze all embryos. More than one percent of the cycles ended in freezing of all egg cells (410/33,297).

The effectiveness of treatment based on the percentage of children born after the use of assisted reproductive techniques is not possible to determine due to incomplete pregnancy monitoring, which for IVF, ICSI and FER in the years 2013-2016 amounted to: 10.4% (119/1,143), 20.9% (3,666/17,532), and 19.6% (2,266/11,533). According to the data in the report, there were 142 miscarriages after IVF (12.4%), 2,448 after ICSI (14%) and 1,980 after FER (17.2%). However, it cannot be excluded that the percentage of pregnancy losses is higher. Incomplete monitoring is the reason for the lack of reliable assessment of this phenomenon.

IVF with egg donation (ED)

The effectiveness of treatment using donor eggs, expressed as the percentage of clinical pregnancies per embryo(s) transfer in 2013-2016 was significantly higher when using freshly collected oocytes (46.8%, 599/1,281) than thawed ones (FOR-ED) (34.5%, 427/1,239). The efficiency of transfers of stored embryos derived from freshly collected oocytes (FER-ED) was also higher (41.5%, 592/1,425). Despite the lower efficiency, the number of FOR-ED cycles has increased significantly in recent years - from 65 transfers in 2012 to 505 in 2016 (+677%).

Table 1. Number of ART procedures in Poland, 2012–2016

Year	Number of reporting IVF centres	IVF	ICSI	FER	PGT	ED	IVM	FOR	All	Number of cycles/ million inhabitants
2012	33	461	10 253	4 969	237	713	70	139	16 842	437
2013	34	884	12 525	6 151	253	895	56	197	20 961	545
2014	36	1 158	16 549	9 057	320	934	24	141	28 183	732
2015	33	1 050	14 382	9 458	355	1 031	30	124	26 430	688
2016	39	881	16 984	11 375	487	1 085	33	299	31 144	810
2013–2016		3 973	60 440	36 041	1 415	3 945	143	761	106 718	

IVF — *in vitro* fertilization; ICSI — intracytoplasmic sperm injection; FER — frozen embryo replacements; PGT — preimplantation genetic testing (PGT); ED — egg donation; IVM — *in vitro* maturation; FOR — frozen oocyte replacement

Table 2. Results of ART procedures in Poland, 2013–2016

	2013	2014	2015	2016	2013–2016
	Clinical Pregnancy Rates, CPR [%]	Clinical Pregnancy Rates, CPR [%]	Clinical Pregnancy Rates, CPR [%]	Clinical Pregnancy Rates, CPR [%]	Clinical Pregnancy Rates, CPR [%]
IVF					
Cycle	29.0	29.4	28.3	28.4	28.8
Egg collection	29.6	29.8	29.4	28.6	29.4
Transfer	36.1	37.6	41.0	38.5	38.3
ICSI					
Cycle	32.8	30.9	27.3	25.8	29.0
Egg collection	33.1	31.8	27.7	25.8	29.4
Transfer	38.5	38.9	37.5	37.4	38.1
FER					
Transfer	29.1	30.5	32.0	36.1	32.4

CPR — clinical pregnancy rates; IVF — *in vitro* fertilization; ICSI — intracytoplasmic sperm injection; FER — frozen embryo replacements

Table 3. Results according to the patient's age, 2013–2016

	IVF		ICSI		FER		ED	
Age	Clinical pregnancies/ Egg collection	Clinical Pregnancy Rates, CPR [%]	Clinical pregnancies/ Egg collection	Clinical Pregnancy Rates, CPR [%]	Clinical pregnancies/ Thawing	Clinical Pregnancy Rates, CPR [%]	Clinical pregnancies/ Transfer	Clinical Pregnancy Rates, CPR [%]
≤ 34	794/2511	31.6	10878/32551	33.4	7040/20660	34.1	375/847	44.3
35–39	315/1154	27.3	5697/20421	27.9	3673/11922	30.8	531/1206	44
≥ 40	34/213	16	940/6587	14.3	812/3687	22	711/1878	37.9
unknown	0/12	0	17/55	30.9	8/39	20.5	1/14	7.1

IVF — *in vitro* fertilization; ICSI — intracytoplasmic sperm injection; FER — frozen embryo replacements; ED — egg donation; CPR — clinical pregnancy rates

Age vs effectiveness of treatment

The largest group of patients receiving treatment using IVF, ICSI and FER techniques were patients before 35 years of age (64.7%, 54.7% and 57.0% respectively). ED procedures were performed mainly to older patients over 40 years of age (47.8%).

There was a well-known negative correlation between the patient's age and treatment efficiency in IVF and ICSI procedures. The highest effectiveness was recorded in the group of young patients (≤ 34 years of age) and it was 31.6% for IVF and 33.4% for ICSI. The lowest effectiveness was found in the group of women over 40 years of age — 16% and 14.3% respectively.

A similar relationship was observed for FER; however, the baseline data was higher than in fresh cycles: 34.1% (≤ 34 years of age), 22% (≥ 40 years of age). The results in fresh and frozen cycles are difficult to compare due to the different way of testing the effectiveness — in IVF + ICSI cycles, the effectiveness of treatment was determined upon the percentage of clinical pregnancies calculated per ovarian puncture, and in FER — calculated per embryo(s) transfer.

In ED procedures, age was of not of such significance. Effectiveness of treatment expressed as a percentage of clinical pregnancies per transfer in a group of patients ≤ 34 years of age and in the age of 35–39 years was similar and amounted respectively to 44.3% and 44.0%, and in the group of women ≥ 40 years of age was slightly lower (37.9%).

Detailed data is presented in Table 3.

Number of embryos transferred vs multiple pregnancy

In most cases one or two embryos were transferred in IVF and ICSI cycles (98.9% of fresh transfers performed in 2013–2016). The transfer of a single embryo was reported on average in 53.1% of procedures (42.2% in 2013, 54.4% in 2014, 63.0% in 2015 and 52.8% in 2016) and was more frequent than in previous years (20% in 2011, 24.7% in 2012).

A similar transfer policy applied to FER - in most procedures one (65.9% cycles) or two embryos (32.7%) were transferred. In the subsequent years, an increase in the percentage of transfers using one embryo was observed (from 43.6% in 2013 to 72.7% in 2016). For comparison, in 2012, only 29% of FER cycles were conducted with the

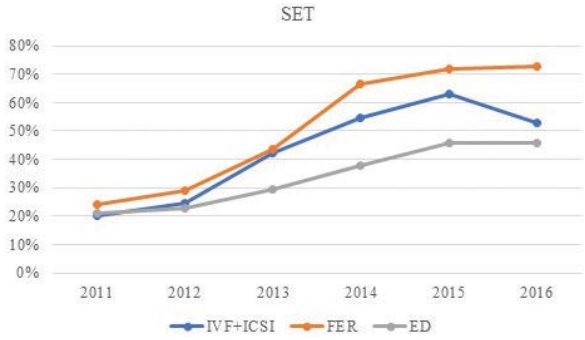

Figure 2. Percentage of single embryo transfers (SETs) after in vitro fertilization and *in vitro* fertilization with intracytoplasmic sperm injection (IVF + ICSI), frozen embryo replacements (FER) and egg donation (ED), 2011–2016

transfer of a single embryo, in 2011 — 23.9%. In egg donation procedures, the proportion of 1, 2, 3 and ≥ 4 transferred embryos within the considered period was, respectively: 40.1%, 58.2%, 1.7%, 0.1%. The percentages of single embryo transfers (SET) in IVF + ICSI, FET and ED cycles in the years 2011-2016 are presented in Figure 2.

As a result of SET, 6,216 children were born after fresh IVF + ICSI cycles, of which 98.2% were single births. The number of multiple deliveries increased with the number of embryos transferred. The percentage of twin and triplet births after the transfer of two embryos (DET) totalled 21.1% and of three embryos — 33.1%. In total, the percentage of multiple deliveries in IVF + ICSI procedures in 2013-2016 was 11.3%.

Adverse events

Preterm delivery

In the years 2013–2016, data on the time of 5,052 deliveries after IVF + ICSI and 2,836 deliveries after FET were collected. According to them, the frequency of preterm births (between 20 and 36 weeks of pregnancy) was in the case of single birth: 27.1% for IVF + ICSI and 23.2% for FET, in the case of twins: 63.5% for fresh cycles and 55% for FET, in the case of triplets: 100% for fresh cycles and 66.7% for FET. Delivery on time (between 37 and 41 weeks of gestation) occurred in 69.6% of single births after IVF + ICSI and in 73% of single births after FET, in 33.6% twin births after IVF + ICSI and in 40.5% after FET, and in 33,3% triplet births after FET.

Other complications

The most common complication in the treatment course was the ovarian hyperstimulation syndrome (OHSS). In total, 228 severe cases of OHSS were reported in 2013-2016, representing 0.34% of all stimulated cycles. A decrease in the percentage of severe OHSS cases was observed in subsequent years, from 0.63% in 2013 to 0.16% in 2016. The most common adverse event associated with the ovarian puncture was bleeding (n = 157, 0.24%) and infections (n = 17, 0.03%).

Intrauterine inseminations

Data on the number, type and effectiveness of intrauterine insemination (IUI) treatment was submitted by 38 clinics. According to the results of reports for the years 2013–2016, a total of 51,405 insemination procedures were performed in these centres, including 43,474 using husband/partner's semen (IUI-H) and 7,931 using donor's semen (IUI-D). Most of the procedures were performed to women under 40 years of age (90.4%).

Treatment effectiveness, defined as the clinical pregnancy rate per cycle, was:

— when husband/partner's semen was used: 11.1% (11.5% in the group of women < 35 years of age, 10% in the group of women aged 35–39 years and 7.4% in the group of women ≥ 40 years)
— when using donor's semen: 16.7% (17.1% in the group of women < 35 years of age, 15% in the group of women aged 35–39 years and 11.5% in the group of women ≥ 40 years of age).

The course of 3,906 clinical pregnancies is known: 93.8% of them ended in a single delivery. The percentage of multiple pregnancies was 6.2%.

DISCUSSION

The effectiveness, safety and availability of assisted reproduction techniques have been monitored in Poland as part of the EIM Program for 18 years continuously. Data from 1999–2015 together with data from other European countries were published in Human Reproduction [1–19]. Data regarding treatment in 2011 and 2012 solely for Poland was also published in 2014 and 2015 [23, 25]. For the first time, in 2019, all Polish centres that performed *in vitro* fertilization procedures in 2016 joined the EIM report (n = 39). Full identification of IVF clinics was possible thanks to the central registry of medically assisted procreation centres and reproductive cell and embryo banks [22]. Unfortunately, the number of centres performing IUI is still difficult to determine — according to the Act of 25th of June 2015 on infertility treatment, the use of procedures that do not require gamete and/or embryo freezing by healthcare entities performing medical services such as stationary and round-the-clock health services does not require the permission of the Ministry of Health [21]. Thus, IUI with "fresh" husband/partner's semen can be performed by centres that are not listed in the central register.

The years 2013–2016 were a period of rapid increase in the number of ART[3] procedures performed. In 2016, their number was by 87.6% higher than in 2012 (31,613 vs

3 IVF (classical in vitro fertilization), ICSI (intracytoplasmic sperm injection), FER (frozen embryo replacement), ED (in vitro fertilization with egg donation), IVM (in vitro maturation), FOR (procedures using frozen egg cells) and PGT (preimplantation genetic testing)

16,849). There was 67% increase in fresh IVF + ICSI cycles (17,865 vs 10,714), most likely thanks to the healthcare program of the Ministry of Health "Infertility Treatment by In vitro Fertilization Method for 2013–2016", which began in July 2013 and ended in June 2016. The program guaranteed free access to treatment using IVF/ICSI for couples who met the qualification criteria, i.e. have already exhausted other methods of infertility treatment during preceding at least 12 months or were diagnosed with the an absolute indication for ART. Exclusion criteria included the woman's age (≥ 40 years) and the potential risk of a lack of proper response to ovulation stimulation (follicle stimulating hormone, FSH > 15 mU/mL on day 2–3 of the cycle, or anti-Mullerian hormone, AMH < 0.5 ng/mL) [20].

Thus, the Ministerial reimbursement program created the possibility of treatment with ART methods for those couples for whom the only reason for delaying the decision about therapy was the financial aspect. This healthcare program also exposed the scale of the problem and the real need for infertility treatment using ART. According to the report of the Ministry of Health of March 5, 2020, 26,062 clinical pregnancies were recorded, and 22,131 children were born. These numbers are constantly increasing due to the ongoing transfers of cryopreserved embryos.

The increase in the number of in vitro fertilization cycles, and thus the number of children born as a result of them meet demographic trends. Poland is one of the countries with the lowest fertility rates (TFR was 1.26, 1.29, 1.29 and 1.36[4] in the subsequent years, from 2013 to 2016) [26]. Since 1980, the number of live births has decreased by 45% (from 695,8 thousand to 382,3 thousand in 2016). This data is worrisome. The low number of deliveries is largely the result of problems with getting pregnant, while the percentage of children born in Poland as a result of ART is still not sufficient, in 2016 it was only 1.7%. For comparison, in Denmark or Spain it amounted to as much as 6.6% and 7.1%, respectively, in Europe it is on average 2.3% [19]. Interestingly, the number of assisted reproduction procedures performed in our country is high. Poland, carrying out 31,613 ART cycles in 2016, took 7th place, after Spain, Russia (which performed over 100,000 procedures), Germany, France, Italy and Great Britain. However, considering the number of inhabitants, Poland is at the end of the list. According to the current report, the number of procedures ART in Poland per million inhabitants in 2016 was 810 cycles. According to data estimated by the ESHRE Capri Group the overall demand for assisted reproduction techniques is almost twice as high and amounts to 1500 cycles per million inhabitants [27]. This fact may constitute an important argument in discussions with the authorities at the national and local level on taking actions to improve access to infertility treatment. The highest application of ART procedures is observed in Denmark and Belgium (over 2500 treatment cycles per million inhabitants), the lowest in Malta (727 treatment cycles per million inhabitants) [19].

Most of the treatment procedures in 2013–2016, as in previous years, were performed by intracytoplasmic sperm injection, classic IVF is performed marginally. However, a slight increase in the number of IVF procedures was observed compared to the previous period (6.2% in 2016 vs 4.3% in 2012). This fact may be related to the implementation of the Ministry of Health program, the regulations of which strictly defined the situations in which ICSI may be performed (male infertility factor, endometriosis, idiopathic infertility). The advantage of ICSI over conventional IVF is evident throughout Europe. The European average in 2015 was: 71.2% for ICSI and 28.8% for IVF. There is also a trend to postpone transfers and freeze all embryos in the so-called 'freeze all' procedures (6.4% of all IVF + ICSI procedures in Europe and 17.8% in Poland) [19].

Poland is a country with one of the highest rates of a single embryo transfer (SET). According to this report, SET has been performed in more than 53% of IVF + ICSI procedures. There is also a steady increase in the number of SETs performed in Europe (from 11.5% in 1997 to 37.7% in 2015). Most SETs are performed in the Scandinavian countries: in Sweden and Finland over 80% of "fresh" *in vitro* cycles end with a transfer of a single embryo. The lowest rates for SET are in Albania - only 5.8% of IVF + ICSI cycles [19].

The policy of transferring a single embryo is a proof of the maturity of Polish ART centres. Such a procedure significantly reduces the risk of multiple pregnancy, and thus allows the achievement of the primary goal of ESHRE, which is to significantly increase the safety of *in vitro* procedures for both mother and child. The most commonly reported complications that occur in newborns from multiple births are malformations and prematurity. According to the presented report, over 63% of twin pregnancies and all triplet pregnancies ended prematurely, i.e., before 37 weeks of pregnancy. SET minimizes the risk of multiple pregnancy. In Poland, in the years 2013-2016 after IVF + ICSI, the percentage of such pregnancies after SET was only 1.8%, while for DET already 21.1%, and in the case of transfer ≥ 3 embryos — 33.1%.

The observed rapid increase in the number of SET in the years 2013-2016 is a result of increased awareness and the development of new therapeutic standards, but also the impact of the government program, which forced the implementers to transfer a single embryo, recommending DET only in clinically justified situations and in patients over 35 years of age [20].

4 The fertility rate that guarantees simple replacement of generations is 2.1-2.15

Single embryo transfer and freezing of all remaining embryos for future use helps to avoid multiple pregnancy - the most important problem of fertility treatment using ART, while not reducing the effectiveness of treatment. The cumulative pregnancy rate resulting from SET and subsequent transfer of the cryopreserved embryo is comparable to the results achieved with DET [28, 29]. According to this report, infertility treatment is highly effective in Poland. The percentage of clinical pregnancies in the analysed period calculated per transfer was on average 38.3% in IVF cycles, 38.1% in ICSI cycles and 32.4% in FER and was dependent on the age of the woman. Comparable data for Europe (available for 2015) showed lower efficiency of 34.6%, 33.2% and 30.4% respectively for IVF, ICSI and FER [19].

The most serious complication during ovarian stimulation was OHSS. However, it was very rare, accounting for only 0.34% of all treatment cycles initiated in the period 2013-2016. During ovarian puncture, the most common complication was vaginal bleeding (0.24%) and infection (0.03%).

In the years 2013–2016 a decrease in the number of *in vitro* fertilization procedures with the use of 'fresh' donor egg cells in favour of thawed cells was observed. Although these procedures are less effective, the availability of this form of treatment has increased because the recipient is prepared for embryo(s) transfer regardless of the donor's procedure - no synchronization of the cycles of both women is required. Undoubtedly, the Act of 25th June 2015 on infertility treatment had an impact on changing the approach of IVF centres to IVF procedures using donor egg cells. The Act introduced a ban on non-anonymous donation and the lack of compensation for the so-called hardships related to treatment [21]. As a result, there was a decrease in interest from altruistic female donors (women who underwent hormonal stimulation and ovarian puncture for the sole purpose of transferring all donated eggs to couples with infertility problems) and development of cooperation between IVF centres and foreign gamete banks. Thus, the transport of frozen egg cells intended for donation in Poland increased. In 2016, the percentage of FOR-ED procedures was 46.5%, FER-ED 40.6%, and fresh ED cycles accounted for only 12.8%. For comparison, in 2012, the number of all *in vitro* procedures with the donor's egg cell was 34.3% lower (713 vs 1085 in 2016), of which FOR-ED cycles only accounted for 9.1% [23]. Procedures with gamete and embryo donation are becoming increasingly available and acceptable in Poland. The largest number of oocyte donation procedures is carried out in Spain — in 2015 over 34,000 such treatments were reported [19].

When discussing the efficiency and safety of infertility treatment, IUI should not be overlooked. Intrauterine insemination is a relatively simple procedure that does not require highly specialized laboratory and medical equipment; therefore, it is widely used. The lack of a central register of all centres offering this therapeutic method does not allow the assessment of the actual scale of IUI use in infertility treatment in Poland. However, the results, based on 51,405 reported treatment cycles, allow an assessment of the effectiveness of this method. A higher percentage of clinical pregnancies was obtained, as expected, in procedures with donor sperm than with husband/partner's semen (16.7% vs 11.1%). The percentage of multiple pregnancies was 6.2%.

CONCLUSIONS

This PTMRiE and SPiN PTG report is the first to be joined by all IVF clinics active in 2016 and is still the only study summarizing the number of ART procedures performed in Poland, their effectiveness and safety. Data obtained thanks to the EIM program show that infertility treatment in Poland using highly specialized assisted reproduction methods is at a high level. Changes in medical standards observed over the years (*e.g.*, increase in SET cycles and cycles ending with freezing of all embryos) have resulted in a low risk of multiple pregnancies and complications while maintaining high effectiveness of treatment. This is an evidence of a conscious and mature approach of IVF centres to conducted ART therapies.

Infertility treatment using *in vitro* methods is becoming more common. The number of ART procedures in Poland is increasing every year, but it is still insufficient. The health program of the Ministry of Health exposed the real need for *in vitro* fertilization procedures and pointed out the main factor limiting access to this method of treatment — the financial factor. Over 17,000 couples were qualified to the Program, and thanks to it more than 22,000 children were born. Significant interest and overwhelming participation in this Program as well as participation in subsequent programs of local governments shows the need for partial or total reimbursement of ART procedures in Poland.

The main weakness of the report is the different quality of data collected by the centres, the inability to verify them externally, and the numerous gaps in monitoring of pregnancy and delivery. The introduction of mandatory electronic databases with real-time reporting should be considered as the necessary solution.

Acknowledgments

We would like to thank all the clinics participating in the report for their cooperation, trust and commitment, as well as for submitting the data constituting the basis for the preparation of this publication [Annex].

ANNEX

I. Centres participating in the report and data of persons who represent them:

1. AB OVO Sp. z o.o. NZOZ Centrum Zdrowia Rodziny, ul. Relaksowa 26, 20-819 Lublin, **Magdalena Gierszon-Komoń**
2. ANGELIUS Szpital Angelius PROVITA, ul. Fabryczna 13d, 40–611 Katowice, **dr Mariusz Kiecka**
3. ANTRUM, Centrum Medyczne ANTRUM Laboratorium DEMETER Stanisław Horák, ul. Olimpijska 5, 41–902 Bytom, **dr hab. Stanisław Horák**
4. ARTVIMED Centrum Medycyny Rozrodu – ARTVIMED, Spółka z o.o. Spółka komandytowa, ul. Legendy 3/1, 30–147 Kraków, **dr Zbigniew Braszkiewicz**
5. BOCIAN Klinika Leczenia Niepłodności, Ginekologii i Położnictwa, ul. Akademicka 26, 15–267 Białystok, **dr Grzegorz Mrugacz**
6. BOCIAN Klinika Leczenia Niepłodności, Ginekologii i Położnictwa (wcześniej: IVITA), ul. Jana Henryka Dąbrowskiego 77A, 60–529 Poznań, **Krzysztof Mrugacz**
7. BOCIAN Klinika Leczenia Niepłodności, Ginekologii i Położnictwa, ul. Stawki 2a, 00–193 Warszawa, **dr Grzegorz Mrugacz**
8. FERTIMEDICA Centrum Płodności Sp. z o.o., Sp. k., ul. J.P. Woronicza 31/8U, 02–640 Warszawa, **Marta Van der Toolen**
9. FERTINA Sp. z o.o. Sp. k., ul. Dzika 15/C/U/4, 00–172 Warszawa, **lek. Alicja Bednarowska-Flisiak**
10. GAMETA Szpital Rzgów, ul. Rudzka 34/36, 95–030 Rzgów, **prof. Michał Radwan**
11. GAMETA Kielce Centrum Zdrowia, Podzamcze 45, 26–060 Chęciny, **prof. Michał Radwan**
12. GAMETA Gdynia Centrum Zdrowia, ul. Św. Piotra 21, 81-347 Gdynia, **dr Dariusz Wójcik**
13. GENESIS Klinika Leczenia Niepłodności NZOZ Centrum Medyczne, ul. Waleniowa 24, 85–435 Bydgoszcz, **dr hab. Marek Szymański**
14. GRAVIDA Sp. z o.o., ul. Armii Krajowej 21, 09–410 Płock, **dr Klaudiusz Ciepliński**
15. GRAVITA Diagnostyka i Leczenie Niepłodności, ul. gen. Karola Kniaziewicza 20a, 91–347 Łódź, **dr Wojciech Gontarek**
16. GYNCENTRUM Sp. z o.o. Klinika Leczenia Niepłodności i Diagnostyki Prenatalnej, ul. Żelazna 1, 40–851 Katowice, **dr Anna Bednarska-Czerwińska**
17. INVICTA, ul. Rajska 10, 80–850 Gdańsk, **prof. Krzysztof Łukaszuk**
18. INVICTA, ul. Złota 6, 00–019 Warszawa, **prof. Krzysztof Łukaszuk**
19. INVICTA, ul. Grabiszyńska 186/1B, 53–235 Wrocław, **prof. Krzysztof Łukaszuk**
20. InviMed Europejskie Centrum Macierzyństwa Gdynia, ul. 10 Lutego 16, 81–364 Gdynia, **Agnieszka Górtowska, dr Marta Wojciechowska**
21. InviMed Europejskie Centrum Macierzyństwa Poznań, ul. Strzelecka 49, 61–846 Poznań, **Beata Pawłowska**
22. InviMed Europejskie Centrum Macierzyństwa Warszawa, ul. Rakowiecka 36, 02–532 Warszawa, **Elżbieta Britmann**
23. InviMed Europejskie Centrum Macierzyństwa Wrocław, ul. Dąbrowskiego 44, 50–457 Wrocław, **Wiesława Malinowska-Mielnik, Bartłomiej Wojtasik**
24. InviMed Katowice, ul. Piotrowicka 83, 40–724, Katowice, **Beata Cenkalik**
25. Klinika Niepłodności i Endokrynologii Rozrodu Uniwersytet Medyczny im. Karola Marcinkowskiego w Poznaniu, ul. Polna 33, 60–535 Poznań, **prof. Leszek Pawelczyk**
26. KRIOBANK Centrum Leczenia Niepłodności Małżeńskiej, ul. Stołeczna 11, 15–879 Białystok, **prof. Waldemar Kuczyński**
27. MACIERZYŃSTWO Centrum Medyczne Sp. z o.o., ul. Białoprądnicka 7A, 31–221 Kraków, **dr Marta Sikora-Polaczek**
28. MedART Ośrodek Diagnostyki i Leczenia Niepłodności, ul. Janiny Omańkowskiej 51, 60–465 Poznań, **dr Tomasz Żak**
29. NOVOMEDICA Centrum Leczenia Niepłodności, ul. Ks. N. Bończyka 34, 41–400 Mysłowice, **dr Piotr Miciński**
30. nOvum Przychodnia Lekarska, ul. Bociania 13, 02–807 Warszawa, **lek. Katarzyna Kozioł, lek. Piotr Lewandowski**
31. OVUM Specjalistyczne Centrum Medyczne, ul. Konopnica 85F, 21–030 Motycz, **dr Artur Mroczkowski**
32. PARENS Centrum Leczenia Niepłodności, al. 29 Listopada 155c, 31–406 Kraków, **dr n. med. Jarosław Janeczko**
33. PARENS Ośrodek Leczenia Niepłodności Sp. z o.o. ul. Juliana Tuwima 1, 45–551 Opole (wcześniej: GMW – Embrio Sp. z o.o.), **dr Marek Tomala**
34. PARENS Rzeszów Sp. z o.o., ul. Podwisłocze 21, 35–309 Rzeszów, **Tadeusz Mazurek, dr Jarosław Janeczko**
35. POLMEDIS POLAK sc. NZOZ, ul. Partynicka 45, 53–031 Wrocław, **dr Artur Polak**
36. SALVE–MEDICA Sławomir Sobkiewicz, ul. Szparagowa 10, 91–211 Łódź, **dr Sławomir Sobkiewicz**
37. Uniwersyteckie Centrum Zdrowia Kobiety i Noworodka WUM, I Klinika Położnictwa i Ginekologii Warszawskiego Uniwersytetu Medycznego, pl. Starynkiewicza 1/3, 02–015 Warszawa, **dr hab. Barbara Grzechocińska**
38. Uniwersytecki Szpital Kliniczny w Białymstoku, Klinika Rozrodczości i Endokrynologii Ginekologicznej, ul. Marii Skłodowskiej–Curie 24A, 15–276 Białystok, **prof. Sławomir Wołczyński**
39. Vitrolive Sp. z o.o. Centrum Ginekologii i Leczenia Niepłodności Vitrolive, ul. Wojska Polskiego 103, 70–483 Szczecin, **prof. Rafał Kurzawa**

40. Zdrówko Klinika s.c. Iwona Adamczak, Rafał Adamczak, ul. Aleja Adama Mickiewicza 23, 86–032 Niemcz, **dr Rafał Adamczak**
41. Zięba Clinic, ul. Tadeusza Kościuszki 255A, 40–608 Katowice — Piotrowice, **dr Małgorzata Zięba**

II. Management Board of PTMRiE:

President: lek. Katarzyna Kozioł, Vice-President: prof. Rafał Kurzawa, Members: dr Anna Janicka, prof. Waldemar Kuczyński, dr hab. Joanna Liss, prof. Krzysztof Łukaszuk, dr hab. Krzysztof Papis.

III. Management Board of SPiN PTGiP:

President: prof. Michał Radwan, Members: prof. Robert Jach, dr Anna Janicka, prof. Jarosław Kalinka, prof. Waldemar Kuczyński, prof. Piotr Laudański, prof. Grzegorz Polak, dr Anna Rosner-Tenerowicz.

REFERENCES

1. programme TEm. Assisted reproductive technology in Europe, 1997. Results generated from European registers by ESHRE. Hum Reprod. 2001; 16(2): 384–391, doi: 10.1093/humrep/16.2.384.
2. Nygren KG, Andersen AN. European IVF-monitoring programme (EIM). Assisted reproductive technology in Europe, 1998. Results generated from European registers by ESHRE. European Society of Human Reproduction and Embryology. Hum Reprod. 2001; 16(11): 2459–2471, doi: 10.1093/humrep/16.11.2459, indexed in Pubmed: 11679538.
3. Nygren KG, Andersen AN. Assisted reproductive technology in Europe, 1999. Results generated from European registers by ESHRE. Hum Reprod. 2002; 17(12): 3260–3274, doi: 10.1093/humrep/17.12.3260, indexed in Pubmed: 12456634.
4. Nyboe Andersen A, Gianaroli L, Nygren KG, et al. European IVF-monitoring programme, European Society of Human Reproduction and Embryology. Assisted reproductive technology in Europe, 2000. Results generated from European registers by ESHRE. Hum Reprod. 2004; 19(3): 490–503, doi: 10.1093/humrep/deh129, indexed in Pubmed: 14998942.
5. Andersen NA, Gianaroli L, Felberbaum R, et al. Assisted reproductive technology in Europe, 2001. Results generated from European registers by ESHRE. Hum Reprod. 2005; 20(5): 1158–1176, doi: 10.1093/humrep/deh755.
6. Andersen AN, Gianaroli L, Felberbaum R, et al. Assisted reproductive technology in Europe, 2002. Results generated from European registers by ESHRE. Hum Reprod. 2006; 21(7): 1680–1697, doi: 10.1093/humrep/del075.
7. Andersen AN, Goossens V, Gianaroli L, et al. Assisted reproductive technology in Europe, 2003. Results generated from European registers by ESHRE. Hum Reprod. 2007; 22(6): 1513–1525, doi: 10.1093/humrep/dem053, indexed in Pubmed: 17470881.
8. Andersen AN, Goossens V, Ferraretti AP, et al. European IVF-monitoring (EIM) Consortium, European Society of Human Reproduction and Embryology (ESHRE). Assisted reproductive technology in Europe, 2004: results generated from European registers by ESHRE. Hum Reprod. 2008; 23(4): 756–771, doi: 10.1093/humrep/den014, indexed in Pubmed: 18281243.
9. Nyboe Andersen A, Goossens V, Bhattacharya S, et al. European IVF-monitoring (EIM) Consortium, for the European Society of Human Reproduction and Embryology (ESHRE). Assisted reproductive technology and intrauterine inseminations in Europe, 2005: results generated from European registers by ESHRE: ESHRE. The European IVF Monitoring Programme (EIM), for the European Society of Human Reproduction and Embryology (ESHRE). Hum Reprod. 2009; 24(6): 1267–1287, doi: 10.1093/humrep/dep035, indexed in Pubmed: 19225009.
10. de Mouzon J, Goossens V, Bhattacharya S, et al. European IVF-monitoring (EIM) Consortium, for the European Society of Human Reproduction and Embryology (ESHRE). Assisted reproductive technology in Europe, 2006: results generated from European registers by ESHRE. Hum Reprod. 2010; 25(8): 1851–1862, doi: 10.1093/humrep/deq124, indexed in Pubmed: 20570973.
11. Mouzon Jde, Goossens V, Bhattacharya S, et al. Assisted reproductive technology in Europe, 2007: results generated from European registers by ESHRE. Hum Reprod. 2012; 27(4): 954–966, doi: 10.1093/humrep/des023.
12. Ferraretti AP, Goossens V, Mouzon Jde, et al. Assisted reproductive technology in Europe, 2008: results generated from European registers by ESHRE†. Hum Reprod. 2012; 27(9): 2571–2584, doi: 10.1093/humrep/des255.
13. Ferraretti AP, Goossens V, Kupka M, et al. Assisted reproductive technology in Europe, 2009: results generated from European registers by ESHRE†. Hum Reprod. 2013; 28(9): 2318–2331, doi: 10.1093/humrep/det278.
14. Kupka MS, Ferraretti AP, de Mo, et al. Assisted reproductive technology in Europe, 2010: results generated from European registers by ESHRE. Hum Reprod. 2014; 29(10): 2099–2113.
15. Kupka MS, D'Hooghe T, Ferraretti AP, et al. European IVF-Monitoring Consortium (EIM), European Society of Human Reproduction and Embryology (ESHRE). Assisted reproductive technology in Europe, 2011: results generated from European registers by ESHRE. Hum Reprod. 2016; 31(2): 233–248, doi: 10.1093/humrep/dev319, indexed in Pubmed: 26740578.
16. Calhaz-Jorge C, De Geyter C, Kupka MS, et al. European IVF-monitoring Consortium (EIM), European Society of Human Reproduction and Embryology (ESHRE), European IVF-Monitoring Consortium (EIM) for the European Society of Human Reproduction and Embryology (ESHRE). Assisted reproductive technology in Europe, 2012: results generated from European registers by ESHRE. Hum Reprod. 2016; 31(8): 1638–1652, doi: 10.1093/humrep/dew151, indexed in Pubmed: 27496943.
17. De Geyter Ch, Calhaz-Jorge C, Kupka MS, et al. European IVF-monitoring Consortium (EIM) for the European Society of Human Reproduction and Embryology (ESHRE), European IVF-monitoring Consortium (EIM), European Society of Human Reproduction and Embryology (ESHRE). Assisted reproductive technology in Europe, 2013: results generated from European registers by ESHRE. Hum Reprod. 2017; 32(10): 1957–1973, doi: 10.1093/humrep/dex264, indexed in Pubmed: 29117383.
18. Geyter ChDe, Calhaz-Jorge C, Kupka MS, et al. ART in Europe, 2014: results generated from European registries by ESHRE†. Hum Reprod. 2018; 33(9): 1586–1601, doi: 10.1093/humrep/dey242.
19. De Geyter C, Calhaz-Jorge C, Kupka MS, et al. European IVF-monitoring Consortium (EIM) for the European Society of Human Reproduction and Embryology (ESHRE), European IVF-monitoring Consortium (EIM)‡ for the European Society of Human Reproduction and Embryology (ESHRE) , European IVF-monitoring Consortium (EIM) for the European Society of Human Reproduction and Embryology (ESHRE) . ART in Europe, 2015: results generated from European registries by ESHRE. Hum Reprod Open. 2020; 2020(1): hoz038, doi: 10.1093/hropen/hoz038, indexed in Pubmed: 32123753.
20. Program – Leczenie Niepłodności Metodą Zapłodnienia Pozaustrojowego na lata 2013 – 2016. Ministerstwo Zdrowia, Warszawa 2013.
21. Ustawa z dnia 25 czerwca 2015 roku o leczeniu niepłodności – The Act on infertility treatment (Dz.U. 2015 poz. 1087).
22. https://roib.rejestrymedyczne.csioz.gov.pl/.
23. Janicka A, Spaczyński RZ, Kurzawa R, et al. SPiN PTG, Fertility Clinics, Polish Gynaecological Society. Assisted reproductive medicine in Poland--Fertility and Sterility Special Interest Group of the Polish Gynaecological Society (SPiN PTG) 2012 report. Ginekol Pol. 2015; 86(12): 932–939, doi: 10.17772/gp/60549, indexed in Pubmed: 26995944.
24. Zegers-Hochschild F, Adamson G, Dyer S, et al. The International Glossary on Infertility and Fertility Care, 2017†‡§. Hum Reprod. 2017; 32(9): 1786–1801, doi: 10.1093/humrep/dex234.
25. Janicka A, Spaczyński RZ, Kurzawa R. [Assisted reproductive medicine in Poland, 2011--SPiN PTG report]. Ginekol Pol. 2014; 85(7): 549–556, doi: 10.17772/gp/1770, indexed in Pubmed: 25118510.
26. Rocznik demograficzny 2017. Główny Urząd Statystyczny, Warszawa 2017.
27. ESHRE Capri Workshop Group. Social determinants of human reproduction. Hum Reprod. 2001; 16(7): 1518–1526, doi: 10.1093/humrep/16.7.1518, indexed in Pubmed: 11425841.
28. McLernon DJ, Harrild K, Bergh C, et al. Clinical effectiveness of elective single versus double embryo transfer: meta-analysis of individual patient data from randomised trials. BMJ. 2010; 341: c6945, doi: 10.1136/bmj.c6945, indexed in Pubmed: 21177530.
29. Gelbaya TA, Tsoumpou I, Nardo LG. The likelihood of live birth and multiple birth after single versus double embryo transfer at the cleavage stage: a systematic review and meta-analysis. Fertil Steril. 2010; 94(3): 936–945, doi: 10.1016/j.fertnstert.2009.04.003, indexed in Pubmed: 19446809.