

Assisted reproductive technologies (ART) in Canada: 2012 results from the Canadian ART Register

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Abstract

In 2012, 32 of 33 Canadian assisted reproductive technology (ART) clinics participated in the Canadian ART Register (CARTR). A total of 27,356 cycles was reported to CARTR, resulting in 8096 clinical pregnancies and at least 6017 deliveries, 5971 live births, 5031 singleton live births, 3921 healthy term singletons, 945 multiple births (including 26 triplet births), and 6988 infants, 27% of whom were from multiple gestations. Birth outcomes were unknown for 462 ongoing pregnancies (7.1%).

In 16,062 IVF/ICSI cycles using the woman's own oocytes, per cycle started, the clinical pregnancy rate was 31.1% (38.8% per embryo transfer), the live birth rate was 23.5%, the singleton live birth rate was 19.6%, and the healthy term singleton rate was 15.3%; the multiple birth rate per delivery was 16.5%, with a triplet birth rate of 0.45%. ICSI was performed in 70% of cycles. One embryo was transferred in 44% of cycles and one or two embryos in 88% of cycles. In 617 IVF/ICSI cycles using donor oocytes, per cycle started, the clinical pregnancy rate was 45.1%, the live birth rate was 35.7%, the singleton live birth rate was 29.2%, and the healthy term singleton rate was 20.4%; the multiple birth rate was 18.4%, with only one triplet birth (0.46%). In 7466 FET cycles using the woman's own oocytes, per cycle started, the clinical pregnancy rate was 29.9%, the live birth rate was 22.1%, the singleton live birth rate was 18.8%, and the healthy term singleton rate was 14.8%; the multiple birth rate was 15.1%, with a triplet birth rate of 0.37%.

The number of ART cycles performed in Canada increased by 14% in 2012 compared with the previous year. In IVF/ICSI cycles, the multiple birth rate was reduced by 4 percentage points compared with 2011, with little change in the clinical pregnancy and live birth rates. In donor oocyte and FET cycles, the multiple birth rates were similar to those of 2011, while the clinical pregnancy and live birth rates stayed about the same in donor oocyte cycles and increased in FET cycles.

INTRODUCTION

The Canadian Assisted Reproductive Technologies Register (CARTR) was first established in 1999 for the collection of treatment cycle data from Canadian fertility centres that were using assisted reproductive technologies (ART), including in vitro fertilization (IVF), intracytoplasmic sperm injection (ICSI), and frozen embryo transfer (FET). The IVF Directors Group of the Canadian Fertility and Andrology Society (CFAS) directs the CARTR programme, which is financially supported by participating ART centres. Participation of ART centres in CARTR is voluntary.

The first report from the Canadian ART Register, describing ART cycles performed in 2001, was published in 2005 (1). Subsequent publications reported on CARTR data from 2002 to 2011 (2-11). This is the twelfth annual report of Canadian ART outcomes.

The purpose of this paper is to report on ART cycles performed in Canadian centres in the 2012 calendar year and submitted to CARTR. Trends in outcomes over four years and comparisons with other countries will also be examined.

MATERIALS & METHODS

Data Collection

For 2012, 14 centres submitted data to CARTR using the CARTR Treatment Outcome Reporting System (CARTR-TORS; CompuArt Technology, Richmond Hill, Ontario) and 18 centres exported data to CARTR from their own clinic database.

Staff at each centre entered information about patient demographics, diagnosis, and obstetrical history; details of treatment; complications; and pregnancy and birth outcomes for each ART treatment cycle initiated. The completed anonymous case records were sent electronically from each ART centre to the CARTR coordinating centre, where they were manually checked for accuracy and completeness. Corrections or clarifications were requested from the centres as necessary. No on-site data validation from source documents was performed. The records from each centre were then aggregated for data analysis using the computer programme Statistical Package for the Social Sciences (SPSS), version 17 (SPSS Inc., Chicago).

Definitions of Outcomes

The definitions established by the International Committee for Monitoring Assisted Reproductive Technology (ICMART) are followed by CARTR (12). A treatment cycle is considered to have “started” when a woman undergoing ovarian stimulation receives the first dose of gonadotropins or, in a non-stimulated cycle (e.g., for FET), when monitoring is begun. A cancelled cycle is one that is stopped before the oocyte retrieval procedure or thawing of embryos or oocytes.

Clinical pregnancy includes intrauterine gestation (presence of a gestational sac on

ultrasonography), ectopic pregnancy, and miscarriage diagnosed by histology. Cycles with only a positive pregnancy test (biochemical pregnancy) are not considered to have a clinical pregnancy. Implantation rate is the number of gestational sacs observed on ultrasonography divided by the number of embryos transferred.

Pregnancy loss includes miscarriage and therapeutic abortion of a clinical intrauterine pregnancy occurring at ≤ 20 weeks' gestation. Any pregnancy termination, either spontaneous or therapeutic, occurring after 20 weeks' gestation with no liveborn infant is considered a stillbirth. A delivery is the birth of one or more infants, either living or not, after 20 weeks' gestation. A live birth is a delivery that results in at least one living infant (but, if a multiple birth, may include one or more stillborn infants). A singleton live birth is the delivery of one baby, born alive. A healthy term singleton birth is defined as one baby born alive at term from a singleton pregnancy, with birth weight >2500 g, no birth defect reported, and no neonatal death. A neonatal death is the death of a liveborn infant in the first 28 days of life. A multiple birth is the delivery of more than one infant, either liveborn or stillborn, including deliveries with all infants stillborn. High-order multiple births (triplets or more) are reported separately. A preterm birth is a delivery at <37 weeks of gestation and a very preterm birth is a delivery at <32 weeks.

Statistical Analysis

The statistics used in this report are mainly descriptive, i.e., rates, proportions, means, and medians. Occasionally, the χ^2 test was used to compare proportions, and t test or ANOVA was used to compare means.

Unless otherwise noted, the clinical pregnancy rate is reported per cycle started. Cycle cancellation, ectopic pregnancy, and other complications are reported per cycle started. The miscarriage or pregnancy loss rate is reported per intrauterine pregnancy. Birth rates are reported per cycle started, excluding from both the numerator and the denominator cycles in which the outcome of the clinical pregnancy has not been reported. Because of these missing data, the birth rates reported may underestimate the true birth rates. The multiple birth rate, which includes stillbirths, is reported per delivery.

These data from CARTR for 2012 were presented at the annual CFAS ART Professionals Day in September 2013 (pregnancy outcomes) and September 2014 (birth outcomes). A brief summary of the national clinical pregnancy and live birth rates was provided to the media immediately after each meeting. As agreed among all IVF Directors, clinic-specific data are not presented to the public or published.

RESULTS

Participating Centres

Of 33 Canadian ART centres operating in 2012, 32 voluntarily contributed to CARTR for that year (listed in the Appendix). Three of the 32 centres reported 2000 or more ART cycles (started cycles of all types) in 2012, five centres reported 1000-1999 cycles, 11 centres reported 500-999 cycles, eight centres reported 200-499 cycles, and five centres reported fewer than 200 cycles. Considering only fresh ART cycles with oocyte retrieval, one centre performed more than 2000 cycles in 2012, four centres performed 1000-1999 cycles, seven centres performed 500-999 cycles, 14 centres performed 200-499 cycles, and six centres performed fewer than 200 cycles.

By province, 40% of reported ART cycles were from Quebec, 36% from Ontario, 10% from British Columbia, 9% from Alberta, 2.4% from Manitoba/Saskatchewan, and 1.6% from Nova Scotia/New Brunswick.

Overall Outcomes

In total, 27,356 treatment cycles involving ART were reported to CARTR for 2012. Overall, 8096 ART cycles (30.3% of cycles started, excluding 670 embryo and oocyte banking cycles) resulted in a clinical pregnancy, with at least 6017 deliveries (22.9% per cycle started), 5971 live births (22.8%), 5031 singleton live births (19.2%), and 3921 healthy term singletons (15.0%). There were 462 cycles with ongoing pregnancies (7.1% of ongoing pregnancies) for which the birth outcome was not reported. Overall, there were at least 945 multiple births (15.7% of known births): 919 twin births (15.3% per birth) and 26 triplet births (0.43% per birth).

A total of 18,995 individual women were treated with ART in 2012: 67% had one treatment cycle, 25% had two cycles, and 8% had three or more cycles (up to seven). Overall, 42.4% of women treated in 2012 became pregnant (with 1.0% having two pregnancies) and 32.0% had a live birth (excluding women who had embryo/oocyte banking only).

The various procedures and their success and adverse outcome rates are described in the following sections. The cycle outcomes of the four most common procedures are summarized in Table 1.

Table 1. 2012 cycle outcomes for the four most common types of ART procedures.

Outcome	IVF/ICSI	IVF/ICSI-DO	FET	FET-DO
Cycles started	16,062	617	7466	623
Cancelled cycles (% of cycles started)	957 (6.0)	8 (1.3)	167 (2.2)	5 (0.8)
Oocyte retrievals (% of cycles started)	15,105 (94.0)	609 (98.7)	7299 (97.8) ^a	618 (99.2) ^a
Embryo transfers (% of cycles started)	12,826 (79.9)	553 (89.6)	6914 (92.6)	610 (97.9)
Clinical pregnancy (% per cycle started) [% per embryo transfer]	4991 (31.1) [38.8]	278 (45.1) [50.3]	2232 (29.9) [32.3]	219 (35.2) [35.9]
Ectopic pregnancy (% per cycle started)	80 (0.5)	2 (0.3)	24 (0.3)	1 (0.2)
Miscarriage (% per IU pregnancy)	880 (17.9)	47 (17.0)	418 (18.9)	39 (17.9)
Therapeutic abortion (% per IU pregnancy)	33 (0.7)	2 (0.7)	12 (0.5)	1 (0.5)
Delivery ^b (% per cycle started)	3740 (23.7)	217 (35.7)	1632 (22.3)	170 (27.6)
Live birth ^b (% per cycle started) [% per embryo transfer]	3708 (23.5) [29.4]	217 (35.7) [40.0]	1621 (22.1) [24.0]	170 (27.6) [28.2]
Singleton live birth ^b (% per cycle started)	3096 (19.6)	177 (29.2)	1376 (18.8)	154 (25.0)
Healthy term singleton ^b (% per cycle started)	2422 (15.3)	124 (20.4)	1082 (14.8)	106 (17.2)
Singleton delivery (% of deliveries)	3124 (83.5)	177 (81.6)	1386 (84.9)	154 (90.6)
Twin delivery (% of deliveries)	599 (16.0)	39 (18.0)	240 (14.7)	16 (9.4)
Triplet delivery (% of deliveries)	17 (0.45)	1 (0.46)	6 (0.37)	0

^a Cycles with embryos thawed.

^b Cycles with unknown delivery status omitted: 258 IVF/ICSI, 10 IVF/ICSI-DO, 146 FET, 8 FET-DO

IVF/ICSI with Own Oocytes

IVF, including ICSI, using the woman's own oocytes, was the most common procedure performed, with 16,062 cycles reported. Per IVF/ICSI cycle started, the clinical pregnancy rate was 31.1%, the live birth rate was 23.5%, the singleton live birth rate was 19.6%, and the healthy term singleton rate was 15.3%. Donated sperm was used in 5.5% of cycles with oocytes retrieved. There were 80 ectopic pregnancies (0.5% per cycle started), plus two heterotopic pregnancies, one that resulted in miscarriage of twins and one that resulted in a singleton live birth. The pregnancy loss rate was 18.6% of clinical intrauterine pregnancies (miscarriage 17.9%, therapeutic abortion 0.7%). Of the 3740 known births, 16.5% were multiple births (16.0% twins and 0.45% triplets). Included in these figures are 12 pregnancies, one ectopic pregnancy, two miscarriages, and six singleton and one twin live births (two birth outcomes were not reported) that resulted from intrauterine insemination performed after the IVF/ICSI cycle was cancelled.

Rates for IVF and ICSI separately can only be provided per successful retrieval (i.e., one or more oocytes retrieved) because the decision to use ICSI might not be made until the sperm and oocytes are assessed in the embryology laboratory (Table 2). Of 14,969 IVF/ICSI cycles with a successful retrieval, 29% had insemination by standard IVF (including 58 cycles with failed fertilization that had ICSI performed the next day [rescue ICSI]), 66% by ICSI, and 3.4% by IVF/ICSI split (some oocytes inseminated by each method). The clinical pregnancy rates per successful retrieval were 32.4% for standard IVF (20.7% for the rescue ICSI cycles), 33.6% for ICSI, and 44.2% for IVF/ICSI split. Including the IVF/ICSI split cycles in the ICSI group, the clinical pregnancy rates per retrieval were 32.4% for IVF and 34.1% for ICSI, and the live birth rates per retrieval were 23.9% and 26.0%, respectively. The ectopic pregnancy rate per retrieval was 0.4% with IVF and 0.6% with ICSI, and the pregnancy loss rates per intrauterine pregnancy were 19.9% (miscarriage 19.2%, therapeutic abortion 0.8%) and 18.0% (miscarriage 17.4%, therapeutic abortion 0.6%), respectively. Of 1043 known births after IVF, 16.5% were multiple births (16.0% twins and 0.48% triplets); of 2690 known births after ICSI, 16.5% were multiple births (16.0% twins and 0.45% triplets).

Table 2. 2012 clinical pregnancy and birth outcomes by type of insemination method in IVF/ICSI cycles with successful retrieval.

Insemination method	No. of cycles (% of all retrieval cycles) ^a	No. of pregnancies (% per retrieval)	No. of singleton live births (% per retrieval) ^b	No. of multiple births (% per birth)	No. of triplet births (% per birth)
IVF	4397 (29.4)	1423 (32.4)	861 (19.9)	172 (16.5)	5 (0.48)
IVF/ICSI split	511 (3.4)	226 (44.2)	145 (29.0)	27 (15.5)	0
ICSI	9917 (66.3)	3329 (33.6)	2084 (21.4)	416 (16.5)	12 (0.48)

^a 137 cycles that did not have insemination and 7 cycles that had ICSI on day 1 omitted.

^b 256 cycles with unknown delivery status omitted.

IVF/ICSI with Oocyte Donation

IVF/ICSI using donor oocytes (IVF/ICSI-DO) was reported in 617 cycles in 2012. In IVF/ICSI-DO cycles, per cycle started, the clinical pregnancy rate was 45.1%, the live birth rate was 35.7%, the singleton live birth rate was 29.2%, and the healthy term singleton rate was 20.4%. Donated sperm was used in 12.0% of cycles with oocytes donated. There were two ectopic pregnancies (0.3% per cycle started). The pregnancy loss rate was 17.8% per intrauterine pregnancy (miscarriage 17.0%, therapeutic abortion 0.7%). Of 217 known births, 18.4% were multiple births (18.0% twins and 0.46% triplets).

Of 606 cycles with a successful retrieval, 23% had insemination by standard IVF (including 1 cycle that used rescue ICSI), 68% by ICSI, and 8.6% by IVF/ICSI split. The clinical pregnancy rates per successful retrieval were 44.3%, 45.7%, and 51.9%, respectively.

Information about the oocyte donor's age was available for all cycles. Donor age was <30 years in 59% of cycles, 30-34 years in 30%, 35-39 years in 10%, and ≥40 years in 1%. The clinical pregnancy rates per cycle started were 48.4%, 44.8%, 27.4%, and 33.3%, respectively.

FET with Own Oocytes

In 2012, 7466 cycles of FET, using cryopreserved embryos created from the woman's own oocytes, were reported. Per cycle started, the clinical pregnancy rate was 29.9%, the live birth rate was 22.1%, the singleton live birth rate was 18.8%, and the healthy term singleton rate was 14.8%. There were 26 ectopic pregnancies (0.3% per cycle started), including two heterotopic pregnancies that resulted in one miscarriage and one unknown birth outcome. The pregnancy loss rate was 19.5% per intrauterine pregnancy (miscarriage 18.9%, therapeutic abortion 0.5%). Of 1632 known births, 15.1% were multiple births (14.7% twins and 0.37% triplets).

FET with Oocyte or Embryo Donation

The category FET-DO includes transfer of cryopreserved embryos created from donor oocytes in a previous IVF/ICSI-DO cycle (537 cycles) and cryopreserved donated embryos (86 cycles). In this category, per cycle started, the clinical pregnancy rate was 35.2%, the live birth rate was 27.6%, the singleton live birth rate was 25.0%, and the healthy term singleton rate was 17.2%. There was one ectopic pregnancy (0.2% per cycle started). The pregnancy loss rate was 18.3% per intrauterine pregnancy (miscarriage 17.9%, therapeutic abortion 0.5%). Of 170 known births, 9.4% were multiple births (all twins).

Information about the oocyte donor's age was available for 97% of cycles. Donor age was <30 years in 63% of cycles, 30-34 years in 28%, 35-39 years in 8%, and ≥40 years in 1%. The clinical pregnancy rates per cycle started were 35.9%, 36.3%, 29.4%, and 16.7%, respectively.

Gestational Carrier Cycles

There were 390 cycles in which embryos were transferred into the uterus of a woman other than the one who intended to raise the child. Gestational carriers were used in 73 IVF/ICSI and 116 FET cycles with the parenting woman's own oocytes, 64 IVF/ICSI and 136 FET cycles with donated oocytes or embryos, and one cycle using frozen donor oocytes. Use of donated sperm was reported for 9.6% of fresh cycles with oocytes retrieved.

In fresh embryo cycles using a gestational carrier, per cycle started, the clinical pregnancy rate was 40.6% and the live birth rate was 33.1%; in frozen embryo cycles, the rates were 36.1% and 26.9%, respectively. There was one ectopic pregnancy (0.3% per cycle started). In the 146 clinical intrauterine pregnancies in gestational carriers, the pregnancy loss rate was 19.2% (all miscarriages). Of 113 known births (including 1 stillbirth), 16.8% were multiple births (15.9% twins and 0.9% triplets).

Other Cycle Types

Several other types of ART procedures that did not fit into the categories previously described were reported to CARTR for 2012. Natural (unstimulated) IVF was performed in 1216 cycles, with clinical pregnancy rates of 12.7% per cycle started and 28.1% per embryo transfer (ET), and live birth rates of 8.0% and 18.4%, respectively; there was one twin birth (1.0%). One hundred and fifty-two cycles were reported in which oocyte retrieval was performed for the sole purpose of freezing oocytes. (Some oocytes were also frozen in 46 IVF/ICSI or in vitro maturation cycles.) In 75 cycles, previously frozen oocytes were thawed and inseminated, with a clinical pregnancy rate per cycle started of 30.7% and a live birth rate per cycle started of 21.3%; of 16 births, two were twins (12.5%) and one was triplets (6.3%). One hundred and fifty-six cycles of in vitro oocyte maturation were reported, with a clinical pregnancy rate per cycle started of 19.9% and a live birth rate per cycle started of 13.5%; of 21 births, two were twins (9.5%). Five hundred and eighteen cycles were performed for the purpose of embryo banking (including four cycles in which oocytes were also frozen). Nineteen cycles classified as "other", including six research cycles and 13 cycles of mixed ART types, resulted in five pregnancies, with two singleton and one twin live births. One cycle using fresh donor embryos did not result in a pregnancy.

Preimplantation genetic diagnosis (PGD) was performed (or planned) in 50 cycles using fresh embryos (including 8 cycles that also involved frozen embryos), and 11 cycles using frozen embryos only, resulting in 15 pregnancies (24.6% per cycle started), eight live births (13.1% per cycle started, 7 singleton and 1 twin live births), and one singleton stillbirth. In addition, preimplantation genetic screening (PGS) for aneuploidy was reported for 115 IVF/ICSI cycles, seven FET cycles, five IVF/ICSI-DO cycles, 17 embryo banking cycles, one research cycle, and one gestational carrier cycle, resulting in 35 pregnancies (24.0% per cycle started) and 30 live births (20.5% per cycle started; 26 singleton and 4 twin births).

Birth Outcomes for All ART Procedures

At least 6017 deliveries resulted in at least 6988 infants born from all types of ART cycles started in 2012 in Canada: 5072 infants from 5072 singleton births (72.6% of infants), 1838 infants from 919 twin births (26.3%), and 78 infants from 26 triplet births (1.1%). Thus, 27% of infants were born from multiple gestations. An additional 462 pregnancies had no delivery information reported. Of these pregnancies, 371 had one viable fetus, 64 had two viable fetuses, 6 had three viable fetuses, and 1 had 4 viable fetuses at last report; thus, as many as 521 additional babies may have been born.

Of the 5072 infants born as singletons, there were 41 stillbirths and 9 neonatal deaths, a total perinatal mortality rate of 1.0% per infant. The median gestational age at birth was 39 weeks (range, 21-44 wk) for liveborn infants and 24 weeks (range, 20-39 wk) for stillborn infants. Preterm delivery (<37 weeks) occurred in 16.5% of births and very preterm delivery (<32 weeks) in 2.6% of births. Birth weight was normal (>2500 g) for 92.1% of liveborn singletons, low (1500-2500 g) for 6.4%, and very low (<1500 g) for 1.5%. Some type of birth defect was reported for 99 infants (2.0% of infants).

Of the 1838 infants born as twins, there were 23 stillbirths and 18 neonatal deaths, a total perinatal mortality rate of 2.2% per infant. The median gestational age at birth was 36 weeks (range, 19-41 wk) for live births and 23 weeks (range, 21-34 wk) for stillbirths. Preterm delivery occurred in 69.3% of births and very preterm delivery in 11.1% of births. Birth weight was >2500 g for 45.5% of liveborn twins, 1500-2500 g for 47.2%, and <1500 g for 7.3%. Some type of birth defect was reported for 30 infants (1.6% of infants).

Of the 78 infants born as triplets, there was no stillbirth or neonatal death. The gestational age at birth was median 32 weeks (range, 24-36 wk). Preterm delivery occurred in 100% of births and very preterm delivery in 57.7% of births. Birth weight was >2500 g for 3.8% of liveborn infants, 1500-2500 g for 59.0%, and <1500 g for 37.2%. Some type of birth defect was reported for seven infants (9.0% of infants).

Results for deliveries by multiplicity are summarized in Table 3 and for infants by multiplicity in Table 4.

Table 3. 2012 birth outcomes per delivery by multiplicity.

Multiplicity	Number of deliveries (%)	Live birth (%)	Median gestational age at live birth (wks)	Preterm birth (%) ^a	
				<37 weeks	<32 weeks
Singleton	5072 (84.3)	99.2	38.7	16.5	2.6
Twins	919 (15.3)	99.5	36.1	69.3	11.1
Triplets	26 (0.4)	100	31.8	100	57.7

^a Gestational age missing for 24 births.

Table 4. 2012 infant outcomes by multiplicity.

Multiplicity	Infants, n (%)	Stillborn/neonatal death, n/n (% perinatal death)	Birth weight, live births, n (%) ^a			Birth defect, n (%)
			>2500 g	1500-2500 g	<1500 g	
Singleton	5072 (72.6)	41/9 (1.0)	4540 (92.1)	317 (6.4)	73 (1.5)	99 (2.0)
Twins	1838 (26.3)	23/18 (2.2)	794 (45.5)	824 (47.2)	128 (7.3)	30 (1.6)
Triplets	78 (1.1)	0/0	3 (3.8)	46 (59.0)	29 (37.2)	7 (9.0)

^a Birth weight missing for 101 singletons and 69 twins.

Information on sex of the infant was available for 98% of babies: 51.2% were male and 48.8% were female.

The information provided on birth defects was limited. Overall, some type of birth defect was reported for 136 infants (1.9% of infants): 38 cases of cardiac defect (two stillbirths and four neonatal deaths), 14 cases of chromosome aneuploidy (three stillbirths and one neonatal death), three cases of gastrointestinal defect (one stillbirth), 11 cases of limb defect, five cases of urogenital defect, five cases of metabolic disorder (1 stillbirth), one case of neural tube defect (stillbirth), five cases of cleft lip or palate, and 54 cases of other unspecified defects (three stillbirths).

Of 1290 multiple pregnancies, 99 were reported to be monochorionic: 6% of twin pregnancies, 37% of triplet pregnancies, and 50% of quadruplet pregnancies. Miscarriage was more than four times more likely to occur in monochorionic multiple pregnancies (22.2% vs. 4.9%, $P=0.001$) but rates of pregnancy reduction (either spontaneous or therapeutic) were similar (20.2% vs. 16.4%). In multiple pregnancies that resulted in a birth, monochorionic and non-monochorionic multiple pregnancies had similar rates of multiple birth (80% vs. 84%) and perinatal death of at least one infant (4.5% vs. 2.6%). Stratified by number of babies born, monochorionic multiple pregnancies were not significantly more likely to result in preterm birth <37 weeks or very preterm birth <32 weeks, except for twins at <32 weeks (25.0% vs 10.4%, $P=0.003$).

The risk of a couple experiencing perinatal death was related to multiple birth. Perinatal death of one or more infants occurred in 1.0% of singleton deliveries and 3.2% of multiple deliveries (risk ratio, 3.2, 95% confidence interval, 2.1 to 5.0; $P<0.0001$, multiple vs. singleton). Perinatal death of all infants occurred in 1.0% and 1.2% of deliveries, respectively ($P=0.62$, multiple vs. singleton).

Effect of Female Age

The clinical pregnancy and birth outcomes for women categorized into three age groups are given in Table 5. The mean female age was 36 years in IVF/ICSI cycles, 35 years in FET cycles, and 41 years in DO cycles. The proportion of cycles in women aged 40 years and older was 23% in IVF/ICSI cycles, 15% in FET cycles, and 69% in DO cycles. In IVF/ICSI and FET cycles, the clinical pregnancy and live birth rates declined with female age, especially after age 40 years. In DO cycles, pregnancy rates did not show this trend but live birth rates did. Multiple birth rates were similar across age groups in IVF/ICSI and FET cycles; in DO cycles, the highest rate was in women aged 35-39 years.

In IVF/ICSI cycles using the woman's own oocytes, the age-related decline in ART success can be attributed to suboptimal outcomes at several steps in the process. The proportion of started cycles with successful retrieval decreased with age (96% for women aged <35 years, 93% for those aged 35-39 years, and 89% for those aged ≥ 40 years, $P < 0.001$), as did the mean number of oocytes retrieved (12.9, 10.2, and 8.2, respectively, $P < 0.001$). In women who had one or more embryos replaced, the mean implantation rate per embryo transferred declined with increasing female age (39%, 29%, and 13%, $P < 0.001$), as did the clinical pregnancy rate per ET (47%, 39%, and 24%, $P < 0.001$), even though older women had more embryos transferred (mean, 1.5, 1.7, and 2.2, $P < 0.001$). The proportion of women having ET who had surplus embryos available for cryopreservation gradually decreased from the younger to older women (58%, 42%, and 21%, $P < 0.001$). In women who achieved a clinical intrauterine pregnancy, the pregnancy loss rate per intrauterine pregnancy became higher as women aged (12%, 21%, and 36%, $P < 0.001$). The risks of adverse birth outcomes, such as preterm birth and perinatal death, were similar across age groups in singleton and multiple births.

Table 5. 2012 clinical pregnancy and birth outcomes by female age for the three most common ART procedures.

Outcome/female age group	IVF/ICSI	IVF/ICSI -DO	FET
Mean female age, years (range)	36 (19-48)	41 (22-55)	35 (21-53)
Cycles started, n (% of cycles within procedure)			
<35	6444 (40.1)	85 (13.8)	3485 (46.7)
35-39	5912 (36.8)	107 (17.3)	2832 (37.9)
≥40	3706 (23.1)	425 (68.9)	1149 (15.4)
Clinical pregnancy, n (% per cycle started) [% per ET]			
<35	2460 (38.2) [46.7]	40 (47.1) [52.6]	1166 (33.5) [36.1]
35-39	1864 (31.5) [38.7]	45 (42.1) [49.5]	799 (28.2) [30.6]
≥40	667 (18.0) [24.0]	193 (45.4) [50.0]	267 (23.2) [24.9]
Pregnancy loss, n (% per intrauterine pregnancy) ^a			
<35	297 (13.0)	5 (13.5)	210 (19.6)
35-39	380 (21.7)	4 (9.3)	147 (19.9)
≥40	236 (38.2)	40 (21.5)	73 (29.3)
Live birth, n (% per cycle started) [% per ET] ^a			
<35	1966 (31.2) [38.4]	32 (38.6) [43.2]	857 (25.2) [27.2]
35-39	1365 (23.4) [28.8]	39 (37.1) [43.8]	588 (21.1) [23.0]
≥40	377 (10.3) [13.8]	146 (34.8) [38.4]	176 (15.5) [16.7]
Singleton live birth, n (% per cycle started) ^a			
<35	1637 (26.0)	28 (33.7)	725 (21.3)
35-39	1140 (19.5)	26 (24.8)	504 (18.1)
≥40	319 (8.7)	123 (29.4)	147 (13.0)
Healthy term singleton, n (% per cycle started) ^a			
<35	1306 (20.7)	17 (20.5)	574 (16.9)
35-39	882 (15.1)	19 (18.1)	396 (14.2)
≥40	234 (6.4)	88 (21.0)	111 (9.8)
Multiple birth, n (% per delivery)			
<35	333 (16.8)	4 (12.5)	133 (15.4)
35-39	225 (16.4)	13 (33.3)	84 (14.2)
≥40	58 (15.2)	23 (15.8)	29 (16.5)

^a414 cycles with unknown delivery status omitted.

Effect of Infertility Diagnosis

In IVF/ICSI cycles, the reason for ART treatment was most commonly a single female infertility factor (34% of cycles) or male factor infertility (28%). Idiopathic or unexplained infertility was the diagnosis in 16% of cycles. Both female and male infertility factors were diagnosed in 17% of cycles and more than one female factor in 5%. Mean female age, use of ICSI, and the clinical pregnancy rate per cycle started varied across diagnostic categories (Table 6).

Table 6. 2012 clinical pregnancy and birth outcomes by infertility diagnosis category in IVF/ICSI cycles.^a

Diagnostic Category	No. of cycles (% of all IVF/ICSI cycles)	Mean female age (years)	Proportion of cycles^c using ICSI (%)	No. of pregnancies (% per cycle started)	No. of live births (% per cycle started)^d
Idiopathic	2568 (16.4)	35.8	59	910 (35.4)	698 (27.7)
Male factor only	4326 (27.6)	34.0	90	1517 (35.1)	1169 (27.5)
Male + female factor	2672 (17.1)	36.1	83	762 (28.5)	553 (20.9)
Tubal factor only	1152 (7.4)	35.5	40	333 (28.9)	228 (20.4)
Endometriosis only	794 (5.1)	34.3	52	244 (30.7)	179 (22.9)
Ovulatory disorder only ^b	842 (5.4)	33.8	53	301 (35.7)	220 (26.6)
Other female factor only	1047 (6.7)	37.7	69	308 (29.4)	221 (21.3)
Diminished ovarian reserve only	1423 (9.1)	38.4	67	281 (19.7)	193 (13.7)
>1 female factor	829 (5.3)	36.3	47	208 (25.1)	157 (19.2)

^a 409 cycles with unknown diagnosis omitted. Categories are mutually exclusive.

^b Including polycystic ovarian syndrome.

^c Cycles with insemination done.

^d 250 cycles with unknown delivery status omitted.

Pregnancy rates per cycle started were highest when ovulatory disorder (35.7%), idiopathic infertility (35.4%), or male factor infertility (35.1%) was the only diagnosis. In couples with other single female infertility factors, the clinical pregnancy rate varied from 30.7% with endometriosis to 19.7% with diminished ovarian reserve. Pregnancy rates were reduced in the presence of both female and male infertility factors (28.5%) and multiple female infertility factors without male factor (25.1%). These differences across diagnostic groups were statistically significant ($P < 0.001$).

Effect of Number of Embryos Transferred

The number of embryos transferred in IVF/ICSI cycles ranged from one to six with a mean of 1.71. A single embryo was transferred in 44% of transfer cycles, two embryos in 44%, three embryos in 10%, and four or more embryos in 2.5%. More embryos were transferred in older women: the mean age of women receiving four or more embryos was 41 years, compared with 39 years for those receiving three embryos, 36 years for those receiving two embryos, and 34 years for those receiving one embryo.

Overall, the clinical pregnancy rate was 38.8% per ET. Clinical pregnancy and birth outcomes by number of embryos transferred are shown in Table 7. The clinical pregnancy rate was higher when two embryos were transferred (42.0% per ET) than when one embryo was transferred (36.6% per ET). Transferring three or more embryos resulted in clinical pregnancy rates similar to that of single embryo transfer. The mean implantation rate per embryo transferred decreased with increasing number of embryos transferred: 36% with one embryo, 27% with two embryos, 16% with three embryos, and 11% with four or more embryos.

Table 7. 2012 clinical pregnancy and birth outcomes by number of embryos transferred in IVF/ICSI cycles.

No. of embryos transferred	No. of ETs (% of all ET cycles)	No. of pregnancies (% per ET)	No. of singleton live births (% per ET) ^a	No. of multiple births (% per birth)	No. of triplet births (% per birth)
1	5611 (43.7)	2051 (36.6)	1507 (27.4)	26 (1.7)	0
2	5641 (44.0)	2368 (42.0)	1298 (23.5)	497 (27.5)	8 (0.4)
3	1253 (9.8)	442 (35.3)	229 (18.5)	78 (25.2)	8 (2.6)
4 or more	321 (2.5)	118 (36.8)	56 (17.6)	14 (20.0)	1 (1.4)

^a 256 cycles with unknown delivery status omitted.

One-embryo transfers were performed on day 5 after oocyte retrieval in 54% of transfers and on day 3 in 31%; clinical pregnancy rates per ET were 46.6% and 27.6%, respectively. Two-embryo transfers were performed on day 5 in 35% of transfers and on day 3 in 55%; clinical pregnancy rates per ET were 50.5% and 39.2%, respectively. In contrast, only 17% of three-embryo transfers and 17% of \geq four-embryo transfers were performed on day 5.

Although IVF/ICSI cycles with only one embryo transferred had a clinical pregnancy rate lower than that of cycles with two embryos transferred, the singleton live birth rate was higher (27.4% vs. 23.5% per ET). The multiple birth rate per known birth was higher with two embryos (27.5%) than with three or more embryos (24.2%) (Table 7). The triplet birth rate was 2.4% when three or more embryos were transferred. Of note, 81% of multiple births and 47% of triplet births in IVF/ICSI cycles resulted from cycles with two embryos transferred.

When the effect of number of embryos transferred was examined by female age group, different patterns emerged, for both the distribution of number of embryos transferred and the

resulting clinical pregnancy, singleton live birth, and multiple birth rates (Table 8). Almost half (48%) of multiple births in IVF/ICSI cycles occurred in women aged <35 years who had two embryos transferred; the multiple birth rate in that group was 33.5%, double the average.

Table 8. 2012 clinical pregnancy and birth outcomes by female age and number of embryos transferred in IVF/ICSI cycles.

Female age group (years)	No. of embryos transferred	No. of ETs (% within age group)	No. of pregnancies (% per ET)	No. of singleton live births (% per ET) ^a	No. of multiple births (% per birth)
<35	1 ^b	3042 (57.8)	1325 (43.6)	1028 (34.7)	20 (1.9)
	2	2092 (39.8)	1083 (51.8)	582 (28.6)	296 (33.5)
	3	121 (2.3)	47 (38.8)	24 (20.0)	16 (39.0)
	4 or more	7 (0.1)	2 (28.6)	2 (28.6)	0
35-39	1 ^b	1901 (39.6)	636 (33.5)	437 (23.3)	6 (1.3)
	2	2323 (48.4)	978 (42.1)	569 (25.0)	173 (23.2)
	3	529 (11.0)	223 (42.2)	120 (22.9)	44 (26.5)
	4 or more	44 (0.9)	20 (45.5)	10 (22.7)	2 (16.7)
≥40	1 ^b	668 (24.1)	90 (13.5)	42 (6.3)	0
	2	1226 (44.3)	307 (25.0)	147 (12.2)	28 (15.6)
	3	603 (21.8)	172 (28.5)	85 (14.4)	18 (17.5)
	4 or more	270 (9.8)	96 (35.6)	44 (16.4)	12 (21.4)

^a 256 cycles with unknown delivery status omitted.

^b Proportion of one-embryo transfers that were elective single embryo (eSET): 64% in <35, 47% in 35-39, and 16% in ≥40.

The number of thawed embryos transferred in FET cycles ranged from one to seven, with a mean of 1.58. A single embryo was transferred in 50% of cycles, two embryos in 44%, three embryos in 6%, and four or more embryos in 1%. Overall, the clinical pregnancy rate was 32.3% per ET. Clinical pregnancy and birth outcomes by number of embryos transferred are shown in Table 9. In FET cycles, clinical pregnancy rate per ET was lowest when one embryo (28.8%) or four or more embryos (29.2%) were transferred and highest when two embryos were transferred (36.3%). Mean implantation rate per embryo transferred was highest when one embryo was transferred (28%), compared with 23% with two embryos, 14% with three embryos, and 9% with four or more embryos. The singleton live birth rates per ET were similar when one or two embryos were transferred. The multiple birth rates were similar when two or more than two embryos were transferred. The triplet birth rate was 2.9% when three or more embryos were transferred.

Table 9. 2012 clinical pregnancy and birth outcomes by number of embryos transferred in FET cycles.

No. of embryos transferred	No. of ETs (% of all FET cycles)	No. of pregnancies (% per ET)	No. of singleton live births (% per ET) ^a	No. of multiple births (% per birth)	No. of triplet births (% per birth)
1	3427 (49.6)	986 (28.8)	692 (20.7)	16 (2.2)	0
2	3016 (43.6)	1094 (36.3)	607 (20.5)	203 (24.9)	3 (0.4)
3	423 (6.1)	138 (32.6)	70 (16.6)	26 (26.8)	3 (3.1)
4 or more	48 (0.7)	14 (29.2)	7 (14.9)	1 (12.5)	0

^a 146 cycles with unknown delivery status omitted.

Effect of Day of Embryo Transfer

In IVF/ICSI cycles, ET was performed on day 2 (after oocyte retrieval) in 9% of transfers, day 3 in 46%, and day 5 in 41%. The mean female age was 38 years for transfers done on day 2, 36 years on day 3, and 34 years on day 5. More embryos were transferred to each woman on day 3 (mean, 1.95) than on day 2 and day 5 (mean, 1.67 and 1.49). The proportion of cycles with one/two embryos transferred was 48/40% on day 2, 29/52% on day 3, and 57/38% on day 5. Only 1.5% of transfers done on day 2 had surplus embryos available (which allows the best embryos to be selected for transfer), compared with 35% of day 3 transfers and 64% of day 5 transfers. Table 10 shows results by day of embryo transfer.

Table 10. 2012 clinical pregnancy and birth outcomes by day of embryo transfer in IVF/ICSI cycles.

Day of embryo transfer	No. of ETs (% of all ET cycles)	No. of pregnancies (% per ET)	No. of singleton live births (% per ET) ^a	No. of multiple births (% per birth)	No. of triplet births (% per birth)
2	1132 (8.8)	225 (19.9)	123 (10.9)	22 (14.7)	0
3	5958 (46.5)	2089 (35.1)	1225 (21.0)	266 (17.7)	6 (0.4)
4	76 (0.6)	26 (34.2)	16 (21.6)	1 (5.9)	0
5	5312 (41.4)	2544 (47.9)	1662 (31.9)	323 (16.2)	11 (0.6)
6 or 7	346 (2.7)	94 (27.2)	63 (18.6)	3 (4.5%)	0

^a 256 cycles with unknown delivery status omitted.

Clinical pregnancy rate per ET was higher for transfers done on day 5 (47.9%) than for transfers done on day 3 (35.1%) or day 2 (19.9%). The multiple birth rate was slightly lower for transfers done on day 5 (16.2%) than on day 3 (17.7%). The mean implantation rates were 14% on day 2, 23% on day 3, 27% on day 4, 41% on day 5, and 23% on day 6/7.

Table 11 shows clinical pregnancy rates and birth outcomes for ET days 2, 3, and 5 by number of embryos transferred. These rates are confounded by both female age and the availability of surplus embryos. The highest clinical pregnancy rates per ET were achieved when one (46.6%) or two (50.5%) embryos were transferred on day 5. The highest singleton live birth rate per ET was achieved when one embryo was transferred on day 5 (36.1%); this rate was lower with two embryos transferred on day 5 (27.4%) because of a very high multiple birth rate (33.5% per birth).

Table 11. 2012 clinical pregnancy and birth outcomes by ET day and number of embryos transferred in IVF/ICSI cycles.

ET day	No. of embryos transferred	Mean female age (years)	Surplus embryos available (% of ETs)	No. of ETs (% within ET day)	No. of pregnancies (% per ET)	No. of singleton live births (% per ET) ^a	No. of multiple births (% per birth)
2	1 ^b	37.6	2	538 (47.5)	76 (14.1)	46 (8.6)	0
	2	38.6	2	453 (40.0)	115 (25.4)	59 (13.1)	18 (22.5)
	3	40.6	0	118 (10.4)	27 (22.9)	13 (11.0)	4 (23.5)
	4 or more	42.6	0	23 (2.0)	7 (30.4)	5 (21.7)	0
3	1 ^b	34.8	36	1740 (29.2)	480 (27.6)	330 (19.5)	4 (1.2)
	2	35.6	38	3083 (51.7)	1207 (39.2)	681 (22.6)	207 (23.1)
	3	38.8	27	899 (15.1)	314 (34.9)	171 (19.3)	46 (20.9)
	4 or more	40.9	21	236 (4.0)	88 (37.3)	43 (18.4)	9 (17.3)
5	1 ^b	33.0	74	3046 (57.3)	1420 (46.6)	1078 (36.1)	21 (1.9)
	2	35.5	55	1992 (37.5)	1005 (50.5)	532 (27.4)	270 (33.5)
	3	38.5	34	218 (4.1)	98 (45.0)	44 (20.7)	28 (38.9)
	4 or more	41.0	18	56 (1.1)	21 (37.5)	8 (14.3)	4 (33.3)

^a 247 cycles with unknown delivery status omitted.

^b Proportion of one-embryo transfers that were elective single embryo (eSET): 2% in day 2, 36% in day 3, and 74% in day 5.

Effect of Surplus Embryos, eSET and eDET

In IVF/ICSI cycles, the clinical pregnancy rate per ET was 30.8% when all available embryos were transferred (56% of transfers, mean female age 36.6 years) and 49.2% when surplus embryos were available (44% of transfers, mean female age 34.0 years). The mean implantation rates per embryo transferred were 21% and 41%, respectively. Surplus embryos were available in 58% of transfer cycles in women aged <35 years, 42% of cycles in women 35-39 years, and 21% of cycles in women ≥40 years.

In Canada in 2012, a single embryo was transferred by choice (elective SET or eSET) in 2940 IVF/ICSI cycles (52% of single ETs and 23% of all transfer cycles). The clinical pregnancy rate per ET was 47.9% in eSETs, compared with 24.1% when only one embryo was available. Some of this difference can be explained by female age, as 66% of eSETs were performed in

women <35 years and only 3.6% in women ≥40 years. Looking at it another way, when a single embryo was transferred, it was eSET in 64% of women <35 years and 47% of women 35-39 years, but only 16% of women ≥40 years. The clinical pregnancy rate per ET was 35.6% when eSET was done on day 3 (21% of eSETs) and 51.5% when it was done on day 5 (76% of eSETs).

Double embryo transfer (two embryos) was performed by choice (elective DET or eDET) in 2288 IVF/ICSI cycles (41% of double ETs and 18% of all transfer cycles). In these cycles, the clinical pregnancy rate per ET was 51.9%, compared with 35.2% when only two embryos were available. Again, female age was a factor in this result: 46% of eDETs were performed in women <35 years and only 13% in women ≥40 years. When two embryos were transferred, it was eDET in 50% of women <35 years and 41% of women 35-39 years, but only 24% of women ≥40 years. The clinical pregnancy rate per ET was 46.0% when eDET was done on day 3 (51% of transfers) and 58.6% when it was done on day 5 (48% of transfers). The multiple birth rate per known birth was 32.9% with eDET and 21.7% when only two embryos were available.

Results for elective and non-elective SET and DET by female age group are shown in Table 12. In all age groups, despite careful patient selection, clinical pregnancy rates with eSET were lower than those with eDET; however, in the two younger age groups, singleton live birth rates were higher with eSET because of the very high multiple birth rates with eDET. Also, the freezing of more excess embryos after eSET increases the chance for a pregnancy after frozen embryo transfer.

Table 12. 2012 clinical pregnancy and birth outcomes by female age in elective and non-elective single and double embryo transfer IVF/ICSI cycles.

Female age group (years)	Type of embryo transfer ^a	No. of ETs (% of all ETs within age group)	No. of pregnancies (% per ET)	No. of singleton live births (% per ET) ^b	No. of multiple births (% per birth)
<35	eSET	1947 (37.0)	970 (49.8)	763 (40.6)	13 (1.7)
	neSET	1095 (20.8)	355 (32.4)	265 (24.5)	7 (2.6)
	eDET	1045 (19.9)	609 (58.3)	311 (30.4)	195 (38.3)
	neDET	1047 (19.9)	474 (45.3)	271 (26.8)	101 (26.9)
35-39	eSET	886 (18.5)	406 (45.8)	282 (32.5)	4 (1.4)
	neSET	1015 (21.2)	230 (22.7)	155 (15.4)	2 (1.2)
	eDET	951 (19.8)	473 (49.7)	266 (28.7)	97 (26.6)
	neDET	1372 (28.6)	505 (36.8)	303 (22.4)	76 (20.0)
≥40	eSET	107 (3.9)	31 (29.0)	14 (13.1)	0
	neSET	561 (20.3)	59 (10.5)	28 (5.0)	0
	eDET	292 (10.6)	106 (36.3)	43 (15.2)	15 (25.0)
	neDET	934 (33.8)	201 (21.5)	104 (11.3)	13 (10.9)

^a eSET, eDET = elective single or double embryo transfer (surplus embryos available); neSET, neDET = non-elective single or double embryo transfer (all available embryos were transferred).

^b 237 cycles with unknown delivery status omitted.

Complications and Fetal Reduction

Complications were reported in 179 IVF/ICSI cycles (1.1% per cycle started). There were 110 cases of moderate ovarian hyperstimulation syndrome (0.7% per cycle started), 13 of which (12%) required hospitalization, and 38 cases of severe ovarian hyperstimulation syndrome (0.2% per cycle started), 14 of which (37%) required hospitalization. Also reported were 14 complications related to medications (one hospitalization), two complications related to procedures (one hospitalization), one psychological complication, and 14 other unspecified complications (one hospitalization). No maternal death was reported.

Of 1290 multiple pregnancies from all types of ART cycles, outcomes were known for 1219 multiple pregnancies. Of these, 214 (17.6%) had fetal reduction (loss of one or more, but not all fetuses) following ultrasonographic confirmation of fetal viability at 6-8 weeks' gestation; the reduction was spontaneous in 188 cases (88%) and therapeutic in 26 cases (12%). Of 1154 pregnancies that were originally twins, reduction to one fetus occurred spontaneously in 14.6% and therapeutically in 0.5%, and loss of the whole pregnancy occurred in 7.4%, including five therapeutic abortions; 77% of viable twin gestations resulted in a twin birth. Of 62 pregnancies that were originally triplets, reduction to two fetuses occurred spontaneously in 21.0% and therapeutically in 16.1%; reduction to one fetus occurred spontaneously in 8.1% and therapeutically in 12.9%; loss of the whole pregnancy did not occur in triplets. Thus, only 42% of viable triplet pregnancies resulted in a triplet birth. Of four pregnancies that originally had four viable fetuses, one spontaneously reduced to two fetuses, one was therapeutically reduced to two fetuses, one was therapeutically reduced to one fetus, and one underwent therapeutic reduction but the birth result was not reported.

Trends over Time

Table 13 compares the major outcomes from CARTR over a 4-year period (2009-2012) for IVF/ICSI, FET, and IVF/ICSI-DO cycles. Continuing increases were seen in the number of cycles submitted to CARTR and, in IVF/ICSI cycles, proportion of cycles with transfer of a single embryo and day 5 embryo transfer. In IVF/ICSI cycles, the 2012 clinical pregnancy, live birth, and singleton live birth rates were similar to those in 2011, halting the trend of decreasing rates seen in the previous two years. Efforts to reduce multiple birth rates by transferring fewer embryos and increasing eSET use, particularly in Quebec (13,14), continue to produce the desired effect, since the multiple birth rate in IVF/ICSI cycles was significantly reduced by 3.9 percentage points in 2012 compared with 2011, and by 12.2 percentage points compared with 2009. In FET cycles, success rates in 2012 were higher than those of 2011, with a continuing downward trend in multiple birth rates. In IVF/ICSI-DO cycles, the 2012 clinical pregnancy, live birth, singleton live birth, and multiple birth rates were similar to those of 2011.

Table 13. Comparison of cycle outcomes from CARTR for the years 2009 to 2012.

Outcome	CARTR 2009 (9)	CART 2010 (10)	CARTR 2011 (11)	CARTR 2012	P value 2012 vs. 2011
No. of clinics participating (%)	28 (100)	28 (100)	31 (97)	32 (97)	
Total no. of ART cycles reported	16,315	18,454	23,997	27,356	
IVF/ICSI cycles					
No. of cycles reported	10,532	11,806	14,866	16,062	
Cycles in women aged ≥ 40 y (%)	19	21	24	23	
Cycles with 1 embryo transferred (%)	13	24	36	44	
Embryo transfers done on day 5 (%)	26	31	35	41	
Clinical pregnancy rate per cycle (%)	37.6	34.9	31.0	31.1	0.96
Live birth rate per cycle (%)	30.2	27.2	23.9	23.5	0.32
Singleton live birth rate per cycle (%)	21.5	20.8	19.0	19.6	0.23
Multiple birth rate per delivery (%)	28.7	23.8	20.4	16.5	<0.001
Triplet or more rate per delivery (%)	1.0	0.8	0.5	0.5	0.89
FET cycles					
No. of cycles reported	4223	4640	5886	7466	
Clinical pregnancy rate per cycle (%)	26.4	26.7	27.1	29.9	<0.001
Live birth rate per cycle (%)	19.8	20.3	19.1	22.1	<0.001
Singleton live birth rate per cycle (%)	15.6	16.7	15.9	18.8	<0.001
Multiple birth rate per delivery (%)	20.9	17.7	16.8	15.1	0.21
Triplet or more rate per delivery (%)	0.7	0.6	0.4	0.4	0.96
IVF/ICSI-DO cycles					
No. of cycles reported	486	508	647	617	
Clinical pregnancy rate per cycle (%)	49.6	49.8	45.7	45.1	0.81
Live birth rate per cycle (%)	41.5	39.9	37.7	35.7	0.48
Singleton live birth rate per cycle (%)	28.0	27.7	30.4	29.2	0.64
Multiple birth rate per delivery (%)	32.8	30.9	19.6	18.4	0.75
Triplet or more rate per delivery (%)	1.5	0.5	0	0.5	0.29

Comparisons with Other Countries

Table 14 provides a comparison of selected outcomes from CARTR 2012 with those of the USA (2012), Australia/New Zealand (2011), and four European countries (Belgium, Germany, Sweden, and the UK, 2010) taken from the most recent published reports. Slight differences among countries in the outcome measured or the denominator used are indicated in the footnotes of the table.

Of all the countries examined, Canada had the second lowest total number of ART cycles and IVF/ICSI cycles performed, after Sweden. Clinical pregnancy rates in IVF/ICSI cycles were highest in the USA (36.0%), a bit lower in Canada (31.0%), and varying from 29.5% to 22.2% in the other countries. Multiple birth rates in IVF/ICSI cycles were higher in Germany (32.5%), the USA (27.4%), and the UK (19.9%) than in Canada (16.5%); very low rates were achieved by Australia/New Zealand (6.9%) and Sweden (5.9%). The latter two countries used single embryo transfer in >70% of transfer cycles, compared with 44% in Canada and 14% in Germany. In the USA, eSET was used in 10% of IVF/ICSI cycles, compared with 23% in Canada (eSET rates were not available for the other countries). The triplet birth rate was 3.9% in Germany, but $\leq 1\%$ in the other countries, and only 0.1% in Sweden and Australia/New Zealand.

In FET cycles, except for the USA, Canada had the highest clinical pregnancy and live birth rates, and a multiple birth rate lower than that of the USA, the UK, and Germany.

Acknowledgment: Thanks to the personnel from each centre responsible for data entry for CARTR for their hard work and devotion to detail.

Table 14. Comparisons between Canada and other countries.

Country, Year (reference)	USA 2012 (15)	Canada 2012	Sweden 2010 (16)	UK 2010 (16)	Australia/ New Zealand 2011 (17)	Belgium 2010 (16)	Germany 2010 (16)
No. of clinics participating (%)	456 (95)	31 (97)	16 (100)	72 (100)	79 (100)	18 (100)	114 (92)
Total no. of ART cycles reported	176,247	27,356	17,628	57,856	66,347	31,436	73,563
IVF/ICSI cycles							
No. of cycles reported	99,665 ^a	16,062	11,592	44,642	40,696 ^b	20,572	55,687
Cycles with ICSI (%)	68	70	50	52	68	74	79
Cycles in women aged ≥40 y (%)	24	23	12	18	28	-	20
Cycles with 1 embryo transferred [eSET] (%)	- [10]	44 [23]	73	30	73 ^c	50	14
Cycles with ≤2 embryos transferred (%)	-	88	100	95	99 ^c	90	82
Clinical pregnancy rate per cycle (%)	36.0	31.1	29.5	29.2	22.4	22.4	22.2
Live birth rate per cycle (%)	29.4	23.5	22.8 ^d	25.8 ^e	17.0	16.1 ^e	15.8 ^e
Singleton live birth rate per cycle (%)	21.3	19.6	21.5 ^d	20.7 ^e	15.8	14.2 ^e	10.6 ^e
Multiple birth rate per delivery (%)	27.4 ^f	16.5	5.9	19.9	6.9 ^g	11.3	32.5
Triplet or more rate per delivery (%)	1.0 ^f	0.5	0.1	0.3	0.1 ^g	0.2	3.9
FET cycles							
No. of cycles reported	38,150	7,466	5,520	10,476	22,368	8,815	17,876
Clinical pregnancy rate per thaw (%)	47.2 ^h	30.6	25.0	21.9	25.2	18.3	19.2
Live birth rate per thaw (%)	37.5 ^h	22.7	19.0 ^d	19.4 ^e	19.2	12.7 ^e	12.3 ^e
Singleton live birth rate per thaw (%)	29.2 ^h	19.2	18.1 ^d	16.0 ^e	-	11.1 ^e	9.9 ^e
Multiple birth rate per delivery (%)	22.1 ^f	15.1	4.9	17.2	-	12.0	16.1
Triplet or more rate per delivery (%)	0.8 ^f	0.4	0.2	0	-	0.2	1.1

^a includes a small number of natural IVF, gestational carrier, PGD, GIFT, and ZIFT cycles

^b includes 486 natural IVF cycles

^c includes FET cycles

^d delivery (including stillbirths)

^e delivery (including stillbirths), omitting pregnancies lost to follow-up from the denominator

^f livebirths only

^g rate for all ART cycles

^h per ET

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Note: If the reader cannot access the above hyperlinks for the CARTR Annual Reports, the reports are available on the CFAS website, www.cfas.ca, under Public Affairs & News, Canadian ART Register, CARTR Annual Reports.

Appendix – 32 Canadian ART Centres Reporting Data to CARTR for 2012

Western Canada

Victoria Fertility Centre, Victoria, British Columbia
 Genesis Fertility Centre, Vancouver, British Columbia
 Grace Fertility Centre, Vancouver, British Columbia
 Pacific Centre for Reproductive Medicine, Burnaby, British Columbia
 Regional Fertility Programme, Calgary, Alberta
 Edmonton Fertility & Women's Endocrine Clinic, Edmonton, Alberta
 Assisted Reproductive Technology at University of Saskatchewan (ARTUS), Saskatoon,
 Saskatchewan
 Heartland Fertility Clinic, Winnipeg, Manitoba

Ontario

The Fertility Clinic at London Health Sciences Centre, London, Ontario
 Ontario Network of Experts in (ONE) Fertility, Burlington, Ontario
 ISIS Regional Fertility Centre, Mississauga, Ontario
 Astra Fertility Centre, Mississauga, Ontario
 NewLife Fertility Centre, Mississauga, Ontario
 CReATe IVF Programme, Toronto, Ontario
 LifeQuest Centre for Reproductive Medicine, Toronto, Ontario
 Mt. Sinai Centre for Fertility and Reproductive Health, Toronto, Ontario
 Toronto Centre for Advanced Reproductive Technology (TCART), Toronto, Ontario
 Toronto Institute for Reproductive Medicine (ReproMed), Toronto, Ontario
 IVF Canada & LIFE Programme, Scarborough, Ontario
 Nahal Fertility Programme, Richmond Hill, Ontario
 Procrea Fertility Centre, Vaughan, Ontario
 Markham Fertility Centre, Markham, Ontario
 Ottawa Fertility Centre, Ottawa, Ontario

Quebec

McGill University Reproductive Centre, Montreal, Quebec
 Montreal Fertility Centre, Montreal, Quebec
 OVO Fertility Clinic, Montreal, Quebec
 Montreal Reproductive Centre, Montreal, Quebec
 Clinique de Procréation Assistée du CHUM, Montreal, Quebec
 Procrea, Montreal, Quebec
 Procrea, Quebec, Quebec

Atlantic Canada

Conceptia Clinic, Moncton, New Brunswick
 Atlantic Assisted Reproductive Therapies (AART), Halifax, Nova Scotia