Assisted reproductive technologies (ART) in Canada: 2010 results from the Canadian ART Register

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Abstract

All 28 Canadian assisted reproductive technology (ART) clinics participated in the Canadian ART Register (CARTR) for 2010. A total of 18,454 cycles was reported to CARTR, resulting in 5950 clinical pregnancies and at least 4621 deliveries, 4571 live births, 3533 singleton live births, 2741 healthy term singletons, 1052 multiple births (including 33 high-order multiple births), and 5707 infants, 37% of whom were from multiple gestations. Birth outcomes were unknown for 191 ongoing pregnancies (4.0%).

In 11,806 IVF/ICSI cycles using the woman's own oocytes, per cycle started, the clinical pregnancy rate was 34.9% (40.2% per embryo transfer), the live birth rate was 27.2%, the singleton live birth rate was 20.8%, and the healthy term singleton rate was 16.2%; the multiple birth rate per delivery was 23.8%, with a high-order multiple birth rate of 0.8%. ICSI was performed in 71% of cycles. One or two embryos were transferred in 76% of cycles. In 508 IVF/ICSI cycles using donor oocytes, per cycle started, the clinical pregnancy rate was 49.8%, the live birth rate was 39.9%, the singleton live birth rate was 27.7%, and the healthy term singleton rate was 20.6%; the multiple birth rate was 30.9%, with a high-order multiple birth rate of 0.5%. In 4640 FET cycles using the woman's own oocytes, per cycle started, the clinical pregnancy rate was 26.7%, the live birth rate was 20.3%, the singleton live birth rate was 16.7%, and the healthy term singleton rate was 13.1%; the multiple birth rate was 17.7%, with a high-order multiple birth rate of 0.6%.

The number of ART cycles performed in Canada continued to increase in 2010 compared with previous years. In IVF/ICSI cycles, the multiple birth rate was reduced by 5 percentage points compared with 2009; in consequence, the clinical pregnancy and live birth rates were also lower. In donor oocyte and FET cycles, the multiple birth rates were also lower than in 2009 and the clinical pregnancy and live birth rates remained about the same.

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 2009 (2-9). This is the tenth annual report of Canadian ART outcomes.

The purpose of this paper is to report on ART cycles performed in Canadian centres in the 2010 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 2010, 13 centres submitted data to CARTR using the CARTR Treatment Outcome Reporting System (CARTR-TORS; CompuArt Technology, Richmond Hill, Ontario) and 15 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 (10). 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 2010 were presented at the annual CFAS ART Professionals Day in September 2011 (pregnancy outcomes) and September 2012 (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

All 28 Canadian ART centres operating in 2010 voluntarily contributed to CARTR for that year (listed in the Appendix). Two of the 28 centres reported more than 1500 ART cycles (started cycles of all types) in 2010, five centres reported 1000-1500 cycles, seven centres reported 500-1000 cycles, 11 centres reported 200-500 cycles, and three centres reported fewer than 200 cycles. Considering only fresh ART cycles with oocyte retrieval, two centres performed more than 1000 cycles in 2010, seven centres performed 500-1000 cycles, 14 centres performed 200-500 cycles, and five centres performed fewer than 200 cycles.

Overall Outcomes

In total, 18,454 treatment cycles involving ART were reported to CARTR for 2010. Overall, 5950 ART cycles (32.8% of cycles started, excluding 338 embryo and oocyte banking cycles) resulted in a clinical pregnancy, with at least 4621 deliveries (25.8% per cycle started), 4571 live births (25.5%), 3533 singleton live births (19.7%), and 2741 healthy term singletons (15.3%). There were 191 cycles with ongoing pregnancies (4.0% of ongoing pregnancies) for which the birth outcome was not reported. Overall, there were at least 1052 multiple births (22.8% of known births): 1019 twin births (22.1% per birth), 32 triplet births (0.7% per birth), and 1 quadruplet birth.

A total of 13,713 individual women were treated with ART in 2010: 73% had one treatment cycle, 21% had two cycles, and 6% had three or more cycles (up to eight). Overall, 42.9% of women treated in 2010 became pregnant (with 1.0% having two pregnancies) and 33.7% 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. 2010 cycle outcomes for the four most common types of ART procedures.

Outcome	**IVF/ICSI**	**IVF/ICSI-DO**	**FET**	**FET-DO**
Cycles started	11,806	508	4640	433
Cancelled cycles (% of cycles started)	929 (7.9)	13 (2.6)	176 (3.8)	6 (1.4)
Oocyte retrievals (% of cycles started)	10,877 (92.1)	495 (97.4)	4464 (96.2)[a]	427 (98.6)[a]
Embryo transfers (% of cycles started)	10,199 (86.4)	481 (94.7)	4319 (93.1)	418 (96.5)
Clinical pregnancy (% per cycle started) [% per embryo transfer]	4121 (34.9) [40.2]	253 (49.8) [52.6]	1237 (26.7) [28.6]	137 (31.6) [32.8]
Ectopic pregnancy (% per cycle started)	73 (0.6)	5 (1.0)	24 (0.5)	1 (0.2)
Miscarriage (% per IU pregnancy)	673 (16.6)	40 (16.1)	234 (19.2)	24 (17.6)
Therapeutic abortion (% per IU pregnancy)	21 (0.5)	2 (0.8)	4 (0.3)	3 (2.2)
Delivery[b] (% per cycle started)	3212 (27.5)	204 (40.3)	944 (20.5)	107 (24.8)
Live birth[b] (% per cycle started) [% per embryo transfer]	3174 (27.2) [31.4]	202 (39.9) [42.2]	934 (20.3) [21.8]	107 (24.8) [25.6]
Singleton live birth[b] (% per cycle started)	2424 (20.8)	140 (27.7)	767 (16.7)	90 (20.9)
Healthy term singleton[b] (% per cycle started)	1888 (16.2)	104 (20.6)	601 (13.1)	66 (15.3)
Singleton delivery[b] (% of deliveries)	2449 (76.2)	141 (69.1)	777 (82.3)	90 (84.1)
Twin delivery[b] (% of deliveries)	738 (23.0)	62 (30.4)	161 (17.1)	16 (15.0)
Triplet or more delivery[b] (% of deliveries)	25 (0.8)	1 (0.5)	6 (0.6)	1 (0.9)

[a] Cycles with embryos thawed.

[b] Cycles with unknown delivery status omitted: 145 IVF/ICSI, 2 IVF/ICSI-DO, 35 FET, 2 FET-DO

IVF/ICSI with Own Oocytes

IVF, including ICSI, using the woman's own oocytes, was the most common procedure performed, with 11,806 cycles reported. Per IVF/ICSI cycle started, the clinical pregnancy rate was 34.9%, the live birth rate was 27.2%, the singleton live birth rate was 20.8%, and the healthy term singleton rate was 16.2%. Donated sperm was used in 4.7% of cycles with oocytes retrieved. There were 73 ectopic pregnancies (0.6% per cycle started), including three heterotopic pregnancies that resulted in two miscarriages and one singleton live birth. The pregnancy loss rate was 17.1% of clinical intrauterine pregnancies (miscarriage 16.6%, therapeutic abortion 0.5%). Of the 3212 known births, 23.8% were multiple births (23.0% twins and 0.8% high-order multiples including one set of quadruplets). Included in these figures are 18 pregnancies, three miscarriages, one ectopic, 10 singleton live births, three twin live births, and one triplet live birth that resulted from natural conception or 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 10,820 IVF/ICSI cycles with a successful retrieval, 29.0% had insemination by standard IVF (including 79 cycles with failed fertilization that had ICSI performed the next day [rescue ICSI]), 66.5% by ICSI, and 3.9% by IVF/ICSI split (some oocytes inseminated by each method). The clinical pregnancy rates per successful retrieval were 38.8% for standard IVF (20.3% for the rescue ICSI cycles), 37.7% for ICSI, and 39.8% for IVF/ICSI split. Including the IVF/ICSI split cycles in the ICSI group, the clinical pregnancy rates per retrieval were 38.8% for IVF and 37.8% for ICSI, and the live birth rates per retrieval were 30.4% and 29.4%, respectively. The ectopic pregnancy rate per retrieval was 0.6% with IVF and 0.7% with ICSI, and the pregnancy loss rates per intrauterine pregnancy were 16.9% (miscarriage 16.3%, therapeutic abortion 0.6%) and 17.2% (miscarriage 16.7%, therapeutic abortion 0.5%), respectively. Of 956 known births after IVF, 26.4% were multiple births (25.8% twins and 0.5% triplets); of 2242 known births after ICSI, 22.6% were multiple births (21.8% twins and 0.8% triplets).

Table 2. 2010 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)[b]**	**No. of triplet births (% per birth)[b]**
IVF	3136 (29.0)	1216 (38.8)	694 (22.4)	252 (26.4)	5 (0.5)
IVF/ICSI split	427 (3.9)	170 (39.8)	106 (25.7)	22 (17.1)	0
ICSI	7200 (66.5)	2714 (37.7)	1612 (22.7)	485 (23.0)	19 (0.9)

[a] 42 cycles that did not have insemination and 15 cycles that had ICSI on day 1 omitted.
[b] 145 cycles with unknown delivery status omitted.

IVF/ICSI with Oocyte Donation

IVF/ICSI using donor oocytes (IVF/ICSI–DO) was reported in 508 cycles in 2010. In IVF/ICSI-DO cycles, per cycle started, the clinical pregnancy rate was 49.8%, the live birth rate was 39.9%, the singleton live birth rate was 27.7%, and the healthy term singleton rate was 20.6%. Donated sperm was used in 8.9% of cycles with oocytes donated. There were five ectopic pregnancies (1.0% per cycle started). The pregnancy loss rate was 16.9% per intrauterine pregnancy (miscarriage 16.1%, therapeutic abortion 0.8%). Of 204 known births, 30.9% were multiple births (30.4% twins, 0.5% triplets).

Of 495 cycles with a successful retrieval, 21.8% had insemination by standard IVF (including 2 cycles that used rescue ICSI), 72.9% by ICSI, and 5.3% by IVF/ICSI split. The clinical pregnancy rates per successful retrieval were 42.6%, 52.6%, and 65.4%, respectively.

Information about the oocyte donor's age was available for all cycles. Donor age was <30 years in 65% of cycles, 30-34 years in 22%, 35-39 years in 11%, and ≥40 years in 1.4%. The clinical pregnancy rates per cycle started were 52.7%, 48.7%, 37.9%, and 28.6%, respectively.

FET with Own Oocytes

In 2010, 4640 cycles of FET, using cryopreserved embryos created from the woman's own oocytes, were reported. Per cycle started, the clinical pregnancy rate was 26.7%, the live birth rate was 20.3%, the singleton live birth rate was 16.7%, and the healthy term singleton rate was 13.1%. There were 24 ectopic pregnancies (0.5% per cycle started), including four heterotopic pregnancies that resulted in one miscarriage and three singleton live births. The pregnancy loss rate was 19.6% per intrauterine pregnancy (miscarriage 19.2%, therapeutic abortion 0.3%). Of 944 known births, 17.7% were multiple births (17.1% twins and 0.6% high-order multiples).

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 (381 cycles) and cryopreserved donated embryos (52 cycles). In this category, per cycle started, the clinical pregnancy rate was 31.6%, the live birth rate was 24.8%, the singleton live birth rate was 20.9%, and the healthy term singleton rate was 15.3%. There was one ectopic pregnancy (0.2% per cycle started). The pregnancy loss rate was 19.9% per intrauterine pregnancy (miscarriage 17.6%, therapeutic abortion 2.2%). Of 107 known births, 15.9% were multiple births (15.0% twins, 0.9% triplets).

Information about the oocyte donor's age was available for 98% of cycles. Donor age was <30 years in 59% of cycles, 30-34 years in 28%, 35-39 years in 10%, and ≥40 years in 1%. The clinical pregnancy rates per cycle started were 30.9%, 32.5%, 31.8%, and 66.7%, respectively.

Gestational Carrier Cycles

There were 285 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 77 IVF/ICSI and 80 FET cycles with the parenting woman's own oocytes, 47 IVF/ICSI and 77 FET cycles with donated oocytes or embryos, and four cycles using other types of ART. Use of donated sperm was reported for eight cycles (6.5% of fresh cycles with oocytes retrieved).

In fresh embryo cycles using a gestational carrier, per cycle started, the clinical pregnancy rate was 45.2% and the live birth rate was 32.5%; in frozen embryo cycles, the rates were 29.3% and 22.9%, respectively. Of the 103 clinical intrauterine pregnancies in gestational carriers, 8.4% ended in miscarriage. Of 78 known births (all live births), 32.1% were multiple births (all twins).

Other Cycle Types

Several other types of ART procedures that did not fit into the categories previously described were reported to CARTR for 2010. Natural (unstimulated) IVF was performed in 216 cycles, with clinical pregnancy rates of 13.0% per cycle started and 27.2% per embryo transfer (ET), and live birth rates of 10.2% and 21.6%, respectively; there was one twin birth (4.5%). Ninety-five cycles were reported in which oocyte retrieval was performed for the sole purpose of freezing oocytes. In 31 cycles, previously frozen oocytes were thawed and inseminated, with a clinical pregnancy rate per cycle started of 29.0% and a live birth rate per cycle started of 25.8%; of eight births, two were twins (25.0%). One hundred and twelve cycles of in vitro oocyte maturation were reported, with a clinical pregnancy rate per cycle started of 24.1% and a live birth rate per cycle started of 15.7%; of 17 births, six were twins (35.3%). Two hundred and forty-three cycles were performed for the purpose of embryo banking. Twenty cycles classified as "other", including 14 research cycles and six cycles of mixed ART types, resulted in six pregnancies, with five singleton and one twin live births.

Preimplantation genetic diagnosis (PGD) was performed in 61 cycles using fresh embryos (including six cycles that also involved frozen embryos), three cycles using frozen embryos only, and one cycle using frozen oocytes, resulting in 27 pregnancies and 23 live births (16 singleton and 7 twin births). In addition, preimplantation genetic screening (PGS) for aneuploidy was reported for 67 IVF/ICSI cycles, one FET cycle, one IVF/ICSI-DO cycle, and five embryo banking cycles, resulting in 26 pregnancies and 22 live births (18 singleton and 4 twin births).

Birth Outcomes for All ART Procedures

At least 4621 deliveries resulted in at least 5707 infants born from all types of ART cycles started in 2010 in Canada: 3569 infants from 3569 singleton births (62.5% of infants), 2038 infants from 1019 twin births (35.7%), 96 infants from 32 triplet births (1.7%), and 4 infants from 1 quadruplet birth (0.07%). Thus, 37% of infants were born from multiple gestations. An additional 191 pregnancies had no delivery information reported. Of these

pregnancies, 146 had one viable fetus, 39 had two viable fetuses, and 1 had three viable fetuses at last report; thus, as many as 227 additional babies may have been born.

Of the 3569 infants born as singletons, there were 36 stillbirths and 13 neonatal deaths, a total perinatal mortality rate of 1.4% per infant. The median gestational age at birth was 39 weeks (range, 22-44 wk) for liveborn infants and 24 weeks (range, 20-40 wk) for stillborn infants. Preterm delivery (<37 weeks) occurred in 15.1% of births and very preterm delivery (<32 weeks) in 2.8% of births. Birth weight was normal (>2500 g) for 91.0% of liveborn singletons, low (1500-2500 g) for 7.2%, and very low (<1500 g) for 1.7%. Some type of birth defect was reported for 76 infants (2.1% of infants).

Of the 2038 infants born as twins, there were 37 stillbirths and 13 neonatal deaths, a total perinatal mortality rate of 2.5% per infant. The median gestational age at birth was 36 weeks (range, 22-42 wk) for live births and 23 weeks (range, 20-38 wk) for stillbirths. Preterm delivery occurred in 69.4% of births and very preterm delivery in 10.2% of births. Birth weight was >2500 g for 46.1% of liveborn twins, 1500-2500 g for 46.5%, and <1500 g for 7.4%. Some type of birth defect was reported for 42 infants (2.1% of infants).

Of the 100 infants born as triplets or quadruplets, there were two stillbirths and two neonatal deaths, a total perinatal mortality rate of 4.0% per infant. The gestational age at birth was median 31 weeks (range, 25-36 wk) for triplet live births and 25 weeks for the one quadruplet live birth. Preterm delivery occurred in 100% of births and very preterm delivery in 57.6% of births. Birth weight was >2500 g for 4.2% of liveborn infants, 1500-2500 g for 48.4%, and <1500 g for 47.4%. Some type of birth defect was reported for five infants (5.0% of infants).

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

Table 3. 2010 birth outcomes per delivery by multiplicity.

Multiplicity	**Deliveries, n (%)**	**Live birth, n (%)**	**Median gestational age at live birth (wks)[a]**	**Preterm birth, n (%)[a]**	
				<37 weeks	**<32 weeks**
Singleton	3569 (77.2)	3533 (99.0)	38.9	537 (15.1)	101 (2.8)
Twins	1019 (22.1)	1005 (98.6)	36.1	707 (69.4)	104 (10.2)
Triplets	32 (0.7)	32 (100)	31.4	32 (100)	18 (56.3)
Quads	1 (0.02)	1 (100)	25.0	1 (100)	1 (100)

[a] Gestational age missing for 7 births.

Table 4. 2010 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	3569 (62.5)	36/13 (1.4)	3130 (91.0)	249 (7.2)	59 (1.7)	76 (2.1)
Twins	2038 (35.7)	37/13 (2.5)	897 (46.1)	903 (46.5)	144 (7.4)	42 (2.1)
Triplets	96 (1.7)	0/2 (2.1)	4 (4.2)	46 (49.5)	43 (46.2)	5 (5.2)
Quads	4 (0.07)	2/0 (50)	0	0	2 (100)	0

[a] Birth weight missing for 155 live born infants.

Information on sex of the infant was available for 98% of babies: 50.1% were male and 49.9% were female.

The information provided on birth defects was limited. Overall, some type of birth defect was reported for 123 infants (2.2% of infants): 29 cases of cardiac defect (three stillbirths), six cases of chromosome aneuploidy (one stillbirth), eight cases of gastrointestinal defect, five cases of limb defect, eight cases of urogenital defect, five cases of metabolic disorder (one neonatal death), five cases of neural tube defect, three cases of cleft lip or palate, and 54 cases of other unspecified defects (six stillbirths and seven neonatal deaths).

Of 1352 multiple pregnancies, 69 were reported to be monochorionic: 3.6% of twin pregnancies, 25% of triplet pregnancies, and 80% of quadruplet pregnancies. Miscarriage was five times more likely to occur in monochorionic multiple pregnancies (22% vs. 4.4%, $P<0.0001$), but the rate of pregnancy reduction (either spontaneous or therapeutic) was similar (19% vs. 16%). In multiple pregnancies that resulted in a birth, monochorionic multiple pregnancies had a similar rate of multiple birth (83% vs. 85%). The proportion of births in which at least one infant suffered a perinatal death was twice as high in monochorionic multiple pregnancies (5.6% vs. 2.7%, $P=0.22$). Stratified by number of babies born, monochorionic multiple pregnancies were more likely to result in preterm birth <37 weeks when only one baby was born (56% vs. 17%, $P=0.004$), but not when 2 or more babies were born; rates of very preterm birth <32 weeks were not higher for monochorionic multiple pregnancies.

The risk of a couple experiencing perinatal death was related to multiple birth. Perinatal death of one or more infants occurred in 1.4% of singleton deliveries, 3.0% of twin deliveries, and 6.1% of triplet or quadruplet deliveries (risk ratio, 2.3, 95% confidence interval, 1.5 to 3.5; $P=0.0001$, multiple vs. singleton). Perinatal death of all infants occurred in 1.4%, 1.9%, and 0% of deliveries, respectively ($P=0.28$, 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 21% in IVF/ICSI cycles, 14% in FET cycles, and 68% 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, live birth rates increased with female age. The multiple birth rates declined with age 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 (94.3% for women aged <35 years, 91.3% for those aged 35-39 years, and 87.2% for those aged ≥40 years, $P<0.001$), as did the mean number of oocytes retrieved (13.1, 10.8, and 8.6, 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 (37.7%, 25.8%, and 10.4%, $P<0.001$), as did the clinical pregnancy rate per ET (49.4%, 40.0%, and 22.1%, $P<0.001$), even though older women had more embryos transferred (mean, 1.8, 2.1, and 2.7, $P<0.001$). The proportion of women having ET who had surplus embryos available for cryopreservation gradually decreased from the younger to older women (59.2%, 41.7% and 20.1%, $P<0.001$). In women who achieved a clinical intrauterine pregnancy, the pregnancy loss rate per intrauterine pregnancy became higher as women aged (10.6%, 20.8%, and 34.1%, $P<0.001$). The risks of adverse birth outcomes, such as preterm birth and perinatal death, were similar across age groups in singleton births; in multiple births, there were trends towards lower risks in older women.

Table 5. 2010 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 (20-50)	41 (24-54)	35 (21-51)
Cycles started, n (% of cycles within procedure)			
<35	4701 (39.8)	65 (12.8)	2126 (45.8)
35-39	4574 (38.7)	98 (19.3)	1872 (40.3)
≥40	2531 (21.4)	345 (67.9)	642 (13.8)
Clinical pregnancy, n (% per cycle started) [% per ET]			
<35	2081 (44.3) [49.4]	29 (44.6) [50.0]	611 (28.7) [30.9]
35-39	1584 (34.6) [40.0]	55 (56.1) [59.8]	505 (27.0) [28.9]
≥40	456 (18.0) [22.1]	169 (49.0) [51.1]	121 (18.8) [20.4]
Pregnancy loss, n (% per intrauterine pregnancy)			
<35	218 (10.6)	5 (17.2)	97 (16.2)
35-39	325 (20.8)	14 (25.5)	106 (21.3)
≥40	151 (34.1)	23 (14.0)	35 (29.2)
Live birth, n (% per cycle started) [% per ET][a]			
<35	1741 (37.6) [41.9]	24 (36.9) [41.4]	480 (22.7) [24.4]
35-39	1161 (25.7) [29.8]	37 (38.5) [41.1]	371 (20.0) [21.5]
≥40	272 (10.8) [13.3]	141 (40.9) [42.6]	83 (13.0) [14.0]
Singleton live birth, n (% per cycle started)[a]			
<35	1304 (28.1)	18 (27.7)	384 (18.2)
35-39	900 (19.9)	21 (21.9)	309 (16.7)
≥40	220 (8.8)	101 (29.3)	74 (11.6)
Healthy term singleton, n (% per cycle started)[a]			
<35	1033 (22.3)	12 (18.5)	300 (14.2)
35-39	690 (15.3)	19 (19.8)	247 (13.3)
≥40	165 (6.6)	73 (21.2)	54 (8.4)
Multiple birth, n (% per delivery)[a]			
<35	449 (25.4)	6 (25.0)	96 (19.7)
35-39	262 (22.3)	17 (43.6)	62 (16.6)
≥40	52 (19.1)	40 (28.4)	9 (10.8)

[a]182 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 (32% of cycles) or male factor infertility (28%). Idiopathic or unexplained infertility was the diagnosis in 20% of cycles. Both female and male infertility factors were diagnosed in 15% 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. 2010 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	2275 (19.6)	35.8	55	852 (37.5)	653 (29.1)
Male factor only	3307 (28.5)	34.4	94	1318 (39.9)	1062 (32.5)
Male + female factor	1798 (15.5)	35.8	88	572 (31.8)	430 (24.1)
Tubal factor only	1004 (8.7)	35.5	36	321 (32.0)	234 (23.6)
Endometriosis only	619 (5.3)	34.7	48	216 (34.9)	170 (28.1)
Ovulatory disorder only[b]	685 (5.9)	34.6	57	288 (42.0)	233 (34.4)
Other female factor only	592 (5.1)	37.7	64	175 (29.6)	119 (20.6)
Diminished ovarian reserve only	766 (6.6)	38.7	73	161 (21.0)	112 (14.7)
>1 female factor	558 (4.8)	36.3	52	165 (29.6)	122 (22.1)

[a] 202 cycles with unknown diagnosis omitted. Categories are mutually exclusive.
[b] Including polycystic ovarian syndrome.
[c] Cycles with insemination done.
[d] 142 cycles with unknown delivery status omitted.

Pregnancy rates per cycle started were highest when ovulatory disorder (42.0%) or male factor infertility (39.9%) was the only diagnosis. Couples with idiopathic infertility had a clinical pregnancy rate of 37.5%. In couples with other single female infertility factors, the clinical pregnancy rate varied from 34.9% with endometriosis to 21.0% with diminished ovarian reserve. Pregnancy rate was reduced in the presence of both female and male infertility factors (31.8%) or multiple female infertility factors without male factor (29.6%). 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 ten with a mean of 2.1. A single embryo was transferred in 24% of transfer cycles, two embryos in 52%, three embryos in 17%, and four or more embryos in 7%. More embryos were transferred in older women: the mean age of women receiving four or more embryos was 40 years, compared with 38 years for those receiving three embryos, 35 years for those receiving two embryos, and 34 years for those receiving one embryo.

Overall, the clinical pregnancy rate was 40.2% 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 (44.3% per ET) than when one embryo was transferred (35.7% per ET). Transferring three or more embryos did not increase the clinical pregnancy rate; indeed, it declined to 37.8% per ET with three embryos and 30.6% per ET with four or more embryos. The mean implantation rate per embryo transferred decreased with increasing number of embryos transferred: 35.2% with one embryo, 29.8% with two embryos, 17.3% with three embryos, and 9.5% with four or more embryos.

Table 7. 2010 clinical pregnancy and birth outcomes by number of embryos transferred in IVF/ICSI cycles.

No. of embryos transferred	No. of cycles (% of all ET cycles)	No. of pregnancies (% per ET)	No. of singleton live births (% per ET)[a]	No. of multiple births (% per birth)[a]	No. of high-order multiple births (% per birth)[a]
1	2446 (24.0)	874 (35.7)	694 (28.7)	16 (2.2)	0
2	5333 (52.3)	2365 (44.3)	1275 (24.4)	592 (31.5)	9 (0.5)
3	1721 (16.9)	650 (37.8)	346 (20.3)	119 (25.3)	13 (2.8)
4 or more	699 (6.9)	214 (30.6)	99 (14.2)	32 (24.4)	2 (1.5)

[a] 145 cycles with unknown delivery status omitted.

One-embryo transfers were performed on day 5 after oocyte retrieval in 42% of transfers and on day 3 in 43%; clinical pregnancy rates per ET were 51.7% and 24.8%, respectively. Two-embryo transfers were performed on day 5 in 34% of transfers and on day 3 in 60%; clinical pregnancy rates per ET were 51.2% and 42.6%, respectively. In contrast, only 13% of three-embryo transfers and 10% of ≥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 (28.7% vs. 24.4% per ET). The multiple birth rate per known birth was higher with two embryos (31.5%) than with three or more embryos (25.1%) (Table 7). The high-order multiple birth rate was 2.5% when three or more embryos were transferred. Of note, 78% of multiple births and 38% of high-order multiple births (including one quadruplet birth) 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). A majority of multiple births (51%) and 25% of high-order multiple births in IVF/ICSI cycles occurred in women aged <35 years who had two embryos transferred.

Table 8. 2010 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 cycles (% within age group)	No. of pregnancies (% per ET)	No. of singleton live births (% per ET)[a]	No. of multiple births (% per birth)[a]
<35	1[b]	1324 (31.6)	615 (46.5)	506 (38.6)	13 (2.5)
	2	2535 (60.5)	1301 (51.3)	705 (28.3)	388 (35.2)
	3	292 (7.0)	134 (45.9)	74 (26.0)	40 (35.1)
	4 or more	38 (0.9)	18 (47.4)	11 (28.9)	4 (26.7)
35-39	1[b]	807 (20.4)	234 (29.0)	172 (21.6)	3 (1.7)
	2	2078 (52.6)	909 (43.7)	495 (24.3)	183 (26.8)
	3	887 (22.5)	372 (41.9)	203 (23.0)	65 (23.7)
	4 or more	175 (4.4)	65 (37.1)	28 (16.1)	11 (28.2)
≥40	1[b]	315 (15.3)	25 (7.9)	16 (5.1)	0
	2	720 (34.9)	155 (21.5)	75 (10.5)	21 (21.9)
	3	542 (26.3)	144 (26.6)	69 (12.9)	14 (16.9)
	4 or more	486 (23.6)	131 (27.0)	60 (12.4)	17 (22.1)

[a] 145 cycles with unknown delivery status omitted.
[b] Proportion of one-embryo transfers that were elective single embryo (eSET): 67% in <35, 41% in 35-39, and 7% in ≥40.

The number of thawed embryos transferred in FET cycles ranged from one to nine, with a mean of 1.9. A single embryo was transferred in 30% of cycles, two embryos in 51%, three embryos in 15%, and four or more embryos in 3%. Overall, the clinical pregnancy rate was 28.6% 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 was transferred (21.6%) and highest when two embryos were transferred (32.6%). Mean implantation rate per embryo transferred was highest when one (21.5%) or two (20.3%) embryos were transferred, compared with 12.4% with three embryos, and 9.8% with four or more embryos. Both the singleton live birth rate per ET and the multiple birth rate per birth were highest when two embryos were transferred. The high-order multiple birth rate was 1.2% when three or more embryos were transferred. Four of six triplet births in FET cycles resulted when two embryos were transferred.

Table 9. 2010 clinical pregnancy and birth outcomes by number of embryos transferred in FET cycles.

No. of embryos transferred	No. of cycles (% of all FET cycles)	No. of pregnancies (% per ET)	No. of singleton live births (% per ET)[a]	No. of multiple births (% per birth)[a]	No. of triplet births (% per birth)[a]
1	1305 (30.2)	282 (21.6)	209 (16.1)	5 (2.3)	0
2	2214 (51.3)	722 (32.6)	426 (19.4)	131 (23.3)	4 (0.7)
3	663 (15.4)	192 (29.0)	110 (16.7)	27 (19.4)	2 (1.4)
4 or more	137 (3.2)	41 (29.9)	22 (16.2)	4 (14.8)	0

[a] 35 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 7% of transfers, day 3 in 60%, and day 5 in 31%. The mean female age was 38.0 years for transfers done on day 2, 35.7 years on day 3, and 34.4 years on day 5. More embryos were transferred to each woman on day 3 (mean, 2.3) than on day 2 and day 5 (mean, 2.0 and 1.8). The proportion of cycles with one or two embryos transferred was 74% on day 2, 69% on day 3, and 91% on day 5. Only 1% of transfers done on day 2 had surplus embryos available (which allows the best embryos to be selected for transfer), compared with 39% of day 3 transfers and 64% of day 5 transfers. Table 10 shows results by day of embryo transfer.

Table 10. 2010 clinical pregnancy and birth outcomes by day of embryo transfer in IVF/ICSI cycles.

Day of embryo transfer	No. of cycles (% of all ET cycles)	No. of pregnancies (% per ET)	No. of singleton live births (% per ET)[a]	No. of multiple births (% per birth)[a]	No. of high-order multiple births (% per birth)[a]
2	690 (6.8)	140 (20.3)	78 (11.4)	14 (14.7)	0
3	6160 (60.4)	2312 (37.5)	1345 (22.1)	433 (24.2)	13 (0.7)
4	76 (0.7)	24 (31.6)	12 (15.8)	6 (33.3)	1 (5.6)
5	3128 (30.7)	1571 (50.2)	936 (30.6)	301 (24.1)	9 (0.7)
6 or 7	145 (1.4)	56 (38.6)	43 (29.9)	5 (10.4)	1 (2.1)

[a] 145 cycles with unknown delivery status omitted.

Clinical pregnancy rate per ET was higher for transfers done on day 5 (50.2%) than for transfers done on day 3 (37.5%) or day 2 (20.3%). The multiple birth rate was similar for transfers done on day 5 (24.1%) and day 3 (24.2%), and lower on day 2 (14.7%). The mean implantation rates per embryo transferred were 12.5% on day 2, 25.1% on day 3, 21.7% on day

4, 39.5% on day 5, and 32.9% 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 (51.7%) or two (51.2%) embryos were transferred on day 5. The highest singleton live birth rate per ET was achieved when one embryo was transferred on day 5 (42.7%); this rate was much lower with two embryos transferred on day 5 (25.7%) because of a very high multiple birth rate (36.8% per birth).

Table 11. 2010 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 cycles (% within ET day)	No. of pregnancies (% per ET)	No. of singleton live births (% per ET)[a]	No. of multiple births (% per birth)[a]
2	1	37.3	1	243 (35.2)	39 (16.0)	29 (11.9)	0
	2	38.1	1	268 (38.8)	56 (20.9)	27 (10.2)	8 (22.2)
	3	38.3	1	121 (17.5)	34 (28.1)	19 (16.1)	5 (20.0)
	4 or more	39.8	2	58 (8.4)	11 (19.0)	3 (5.2)	1 (25.0)
3	1	35.1	31	1056 (17.1)	262 (24.8)	196 (18.8)	2 (1.0)
	2	34.3	49	3174 (51.5)	1353 (42.6)	777 (24.8)	313 (28.6)
	3	37.5	30	1362 (22.1)	515 (37.8)	285 (21.0)	90 (23.8)
	4 or more	40.0	25	568 (9.2)	182 (32.0)	87 (15.3)	28 (24.3)
5	1	32.5	81	1039 (33.2)	537 (51.7)	440 (42.7)	13 (2.9)
	2	34.8	60	1804 (57.7)	924 (51.2)	450 (25.7)	266 (36.8)
	3	38.3	33	217 (6.9)	91 (41.9)	37 (17.7)	20 (33.9)
	4 or more	40.7	24	68 (2.2)	19 (27.9)	9 (13.4)	2 (18.2)

[a] 144 cycles with unknown delivery status omitted.

Effect of Surplus Embryos

The clinical pregnancy rate per ET was 31.7% when all available embryos were transferred (55% of transfers, mean female age 36.6 years) and 50.8% when surplus embryos were available (45% of transfers, mean female age 34.0 years). The mean implantation rates per embryo transferred were 19.5% and 37.7%, respectively. Surplus embryos were available in 59% of transfer cycles in women aged <35 years, 42% of cycles in women 35-39 years, and 20% of cycles in women ≥40 years.

In Canada in 2010, a single embryo was transferred by choice (elective SET or eSET) in 1242 IVF/ICSI cycles (51% of single ETs and 12.2% of all transfer cycles). The clinical pregnancy rate per ET was 49.6% in eSETs, compared with 21.5% when only one embryo was available. Some of this difference can be explained by female age, as 72% of eSETs were

performed in women <35 years and only 1.9% in women ≥40 years. Looking at it another way, when a single embryo was transferred, it was eSET in 67% of women <35 years and 41% of women 35-39 years, but only 7% of women ≥40 years. The clinical pregnancy rate per ET was 39.6% when eSET was done on day 3 (26% of eSETs) and 54.0% when it was done on day 5 (68% of eSETs).

Double embryo transfer (two embryos) was performed by choice (elective DET or eDET) in 2651 IVF/ICSI cycles (50% of double ETs and 26% of all transfer cycles). In these cycles, the clinical pregnancy rate per ET was 53.2%, compared with 35.6% when only two embryos were available. Again, female age was a factor in this result: 55% of eDETs were performed in women <35 years and only 7% in women ≥40 years. When two embryos were transferred, it was eDET in 58% of women <35 years and 48% of women 35-39 years, but only 25% of women ≥40 years. The clinical pregnancy rate per ET was 51.2% when eDET was done on day 3 (58% of transfers) and 56.2% when it was done on day 5 (41% of transfers). The multiple birth rate per known birth was 34.8% with eDET and 26.2% 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 women aged <35 years, the clinical pregnancy rate per ET was only slightly lower with eSET (53.3%) than with eDET (56.6%), but the singleton live birth rate per ET was much higher (44.8% vs 30.3%) because of a multiple birth rate of 37.8% in the eDET group. In the two older age groups, despite careful patient selection, clinical pregnancy rates with eSET were about 10 percentage points lower than those with eDET; however, the singleton live birth rates were higher with eSET than with eDET.

Table 12. 2010 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 cycles (% within age group)	No. of pregnancies (% per ET)	No. of singleton live births (% per ET)[b]	No. of multiple births (% per birth)[b]
<35	eSET	892 (21.3)	475 (53.3)	396 (44.8)	13 (3.1)
	neSET	431 (10.3)	140 (32.5)	110 (25.8)	0
	eDET	1471 (35.1)	832 (56.6)	438 (30.3)	269 (37.8)
	neDET	1064 (25.4)	469 (44.1)	267 (25.6)	119 (30.5)
35-39	eSET	327 (8.3)	136 (41.6)	109 (33.5)	2 (1.8)
	neSET	479 (12.1)	98 (20.5)	63 (13.3)	1 (1.6)
	eDET	1003 (25.4)	525 (52.3)	285 (29.1)	124 (30.2)
	neDET	1073 (27.2)	384 (35.8)	210 (19.9)	59 (21.6)
≥40	eSET	23 (1.1)	5 (21.7)	4 (17.4)	0
	neSET	290 (14.1)	20 (6.9)	12 (4.2)	0
	eDET	177 (8.6)	53 (29.9)	26 (14.9)	9 (25.7)
	neDET	541 (26.2)	101 (18.7)	49 (9.2)	12 (19.7)

[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] 124 cycles with unknown delivery status omitted.

Complications and Fetal Reduction

Complications were reported in 157 IVF/ICSI cycles (1.3% per cycle started). There were 99 cases of moderate ovarian hyperstimulation syndrome (0.8% per cycle started), 23 of which (23%) required hospitalization, and 31 cases of severe ovarian hyperstimulation syndrome (0.3% per cycle started), 14 of which (45%) required hospitalization. Also reported were nine complications related to medications, six complications related to procedures (four hospitalizations), two cases of infection, one case of psychological complications, and nine other unspecified complications (five hospitalizations). No maternal death was reported.

Of 1352 multiple pregnancies from all types of ART cycles, outcomes were known for 1312 multiple pregnancies. Of these, 217 (16.5%) 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 189 cases (87%) and therapeutic in 28 cases (13%). Of 1227 pregnancies that were originally twins, reduction to one fetus occurred spontaneously in 13.0% and therapeutically in 0.8%, and loss of the whole pregnancy occurred in 5.6%, including three therapeutic abortions; 81% of viable twin gestations resulted in a twin birth. Of 80 pregnancies that were originally triplets, reduction to two fetuses occurred spontaneously in 23.8% and therapeutically in 11.3%; reduction to one fetus occurred spontaneously in 11.3% and therapeutically in 8.8%; and loss of the whole pregnancy occurred in 5.0%. Thus, only 40% of viable triplet pregnancies resulted in a triplet birth. Of five pregnancies that originally had four viable fetuses, one was spontaneously reduced to two fetuses, two were therapeutically reduced to two fetuses, one miscarried, and one resulted in a quadruplet birth.

Trends over Time

Table 13 compares the major outcomes from CARTR over a 4-year period (2007-2010) 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, the proportions of women ≥40 years and cycles with one or two embryos transferred. In IVF/ICSI cycles, the clinical pregnancy, live birth, and singleton live birth rates were lower in 2010 than in the previous year, for the first time since CARTR began in 1999. However, this was due to efforts, particularly in Quebec (11), to reduce multiple birth rates by transferring fewer embryos and increasing eSET use. These efforts began to produce the desired effect, since the multiple birth rate in IVF/ICSI cycles was reduced by almost five percentage points in 2010 compared with 2009, from 28.7% to 23.8%. In FET cycles, success rates in 2010 were similar to those of 2009, with a small increase in the singleton live birth rate, due to a more than three percentage point decrease in multiple birth rate. In IVF/ICSI-DO cycles, the 2010 clinical pregnancy, live birth, and singleton live birth rates were similar to those of 2009, with a slight decrease in the multiple birth rate.

Table 13. Comparison of cycle outcomes from CARTR for the years 2007 to 2010.

Outcome	**CARTR 2007** (7)	**CARTR 2008** (8)	**CARTR 2009** (9)	**CARTR 2010**	***P* value 2010 vs. 2009**
No. of clinics participating (%)	26 (100)	28 (100)	28 (100)	28 (100)	
Total no. of ART cycles reported	13,482	15,000	16,315	18,454	
IVF/ICSI cycles					
No. of cycles reported	8972	9904	10,532	11,806	
Cycles with ICSI (%)	68	71	72	71	
Cycles in women aged ≥40 y (%)	17	19	19	21	
Cycles with ≤2 embryos transferred (%)	69	69	71	76	
Clinical pregnancy rate per cycle (%)	35.6	36.5	37.6	34.9	<0.0001
Live birth rate per cycle (%)	28.6	29.1	30.2	27.2	<0.0001
Singleton live birth rate per cycle (%)	20.0	20.7	21.5	20.8	0.17
Multiple birth rate per delivery (%)	30.2	28.9	28.7	23.8	<0.0001
Triplet or more rate per delivery (%)	1.1	1.0	1.0	0.8	0.40
FET cycles					
No. of cycles reported	3224	3738	4223	4640	
Clinical pregnancy rate per cycle (%)	23.7	26.0	26.4	26.7	0.70
Live birth rate per cycle (%)	17.8	19.8	19.8	20.3	0.57
Singleton live birth rate per cycle (%)	13.5	15.7	15.6	16.7	0.20
Multiple birth rate per delivery (%)	24.1	20.3	20.9	17.7	0.08
Triplet or more rate per delivery (%)	0.2	0.9	0.7	0.6	0.83
IVF/ICSI-DO cycles					
No. of cycles reported	404	431	486	508	
Clinical pregnancy rate per cycle (%)	44.6	49.7	49.6	49.8	0.95
Live birth rate per cycle (%)	36.1	39.8	41.5	39.9	0.61
Singleton live birth rate per cycle (%)	26.4	24.7	28.0	27.7	0.91
Multiple birth rate per delivery (%)	26.5	37.4	32.8	30.9	0.60
Triplet or more rate per delivery (%)	0	1.1	1.5	0.5	0.37

Comparisons with Other Countries

Table 14 provides a comparison of selected outcomes from CARTR 2010 with those of the USA, Australia/New Zealand, and four European countries (Belgium, Germany, Sweden, and the UK). Data from the other countries are from 2009 or 2008, which are 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 lowest total number of ART cycles performed, and a number of IVF/ICSI cycles similar to Sweden. Clinical pregnancy rates in IVF/ICSI cycles were highest in the USA (36.9%), slightly lower in Canada (34.9%), and varying from 31.3% to 23.6% in the other countries. Australia/New Zealand had the lowest rate, but they had a very high proportion (27%) of cycles in women aged ≥40 years. Multiple birth rates in IVF/ICSI cycles were higher in the USA (30.5%) and the UK (24.9%) than in Canada (23.8%), and lower in Germany (21.7%); very low rates were achieved by Belgium (11.7%), Australia/New Zealand (8.2%), and Sweden (7.1%). The latter two countries used single embryo transfer in 70% of transfer cycles, compared with 24% of cycles in Canada. The triplet birth rate was 1.6% in the USA, but less than 1% in the other countries, and only 0.1% in Sweden.

In FET cycles, except for the USA, Canada had the highest clinical pregnancy and live birth rates, but also the highest multiple birth rates.

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Table 14. Comparisons between Canada and other countries.

Country, Year (reference)	**USA 2009** (12)	**Canada 2010**	**UK 2008** (13)	**Sweden 2008** (13)	**Belgium 2008** (13)	**Germany 2008** (13)	**Australia/ New Zealand 2009** (14)
No. of clinics participating (%)	441 (91)	28 (100)	70 (100)	16 (100)	18 (100)	120 (100)	84 (100)
Total no. of ART cycles reported	146,244	18,454	50,555	21,164	28,751	69,902	70,541
IVF/ICSI cycles							
No. of cycles reported	102,478[a]	11,806	39,476	11,010	19,061	50,828	43,352[b]
Cycles with ICSI (%)	73	71	50	47	75	76	66
Cycles in women aged ≥40 y (%)	22	21	18	11	-	14	27
Cycles with 1 embryo transferred (%)	14	24	15	70	50	13	70[c]
Cycles with ≤2 embryos transferred (%)	65	76	95	100	90	80	99[c]
Clinical pregnancy rate per cycle (%)	36.9	34.9	31.3[d]	29.2[d]	27.3[d]	26.8[d]	23.6
Live birth rate per cycle (%)	33.8	27.2	27.5[e]	23.1[e]	19.2[e]	16.8[e]	18.0
Singleton live birth rate per cycle (%)	23.5	20.8	20.7[e]	21.5[e]	17.0[e]	13.2[e]	16.5
Multiple birth rate per delivery (%)	30.5[f]	23.8	24.9	7.1	11.7	21.7	8.2[g]
Triplet or more rate per delivery (%)	1.6[f]	0.8	0.4	0.1	0.2	0.9	0.2[g]
FET cycles							
No. of cycles reported	26,069	4,640	8,957	4,733	8,870	17,646	23,877
Clinical pregnancy rate per thaw (%)	30.3	27.7	20.8	23.4	17.5	17.3	21.8
Live birth rate per thaw (%)	30.8[h]	21.1	18.2[i]	18.0[i]	12.1[i]	13.5[i]	16.5
Singleton live birth rate per thaw (%)	23.6[h]	17.3	15.5[i]	17.0[i]	10.4[i]	11.4[i]	-
Multiple birth rate per delivery (%)	23.4[f]	17.7	15.0	5.3	13.7	15.2	-
Triplet or more rate per delivery (%)	1.1[f]	0.6	0.1	0.1	0.4	0.4	-

[a] includes a small number of natural IVF, gestational carrier, PGD, GIFT, and ZIFT cycles
[b] include 499 natural IVF cycles
[c] includes FET cycles
[d] per retrieval
[e] delivery (including stillbirths) per retrieval
[f] livebirths only
[g] rate for all ART cycles
[h] per ET
[i] delivery (including stillbirths)

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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 – 28 Canadian ART Centres Reporting Data to CARTR for 2010

Western Canada

Victoria Fertility Centre, Victoria, British Columbia
British Columbia Women's Centre for Reproductive Health, Vancouver, British Columbia
Genesis 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
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
Procrea, Montreal and Quebec, Quebec

Atlantic Canada

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