Assisted reproductive technologies (ART) in Canada: 2011 results from the Canadian ART Register

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Abstract

In 2011, 31 of 32 Canadian assisted reproductive technology (ART) clinics participated in the Canadian ART Register (CARTR). A total of 23,997 cycles was reported to CARTR, resulting in 7030 clinical pregnancies and at least 5329 deliveries, 5276 live births, 4253 singleton live births, 3317 healthy term singletons, 1030 multiple births (including 21 high-order multiple births), and 6381 infants, 33% of whom were from multiple gestations. Birth outcomes were unknown for 251 ongoing pregnancies (4.5%).

In 14,866 IVF/ICSI cycles using the woman's own oocytes, per cycle started, the clinical pregnancy rate was 31.0% (37.6% per embryo transfer), the live birth rate was 23.9%, the singleton live birth rate was 19.0%, and the healthy term singleton rate was 14.7%; the multiple birth rate per delivery was 20.5%, with a high-order multiple birth rate of 0.5%. ICSI was performed in 71% of cycles. One embryo was transferred in 36% of cycles and one or two embryos in 84% of cycles. In 647 IVF/ICSI cycles using donor oocytes, per cycle started, the clinical pregnancy rate was 45.7%, the live birth rate was 37.7%, the singleton live birth rate was 30.4%, and the healthy term singleton rate was 24.5%; the multiple birth rate was 19.6%, with no high-order multiple birth. In 5886 FET cycles using the woman's own oocytes, per cycle started, the clinical pregnancy rate was 27.1%, the live birth rate was 19.1%, the singleton live birth rate was 15.9%, and the healthy term singleton rate was 12.7%; the multiple birth rate was 16.8%, with a high-order multiple birth rate of 0.4%.

The number of ART cycles performed in Canada increased by 30% in 2011 compared with the previous year. In IVF/ICSI cycles, the multiple birth rate was reduced by 3.3 percentage points compared with 2010; 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 2010, while 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 2010 (2-10). This is the eleventh annual report of Canadian ART outcomes.

The purpose of this paper is to report on ART cycles performed in Canadian centres in the 2011 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 2011, 14 centres submitted data to CARTR using the CARTR Treatment Outcome Reporting System (CARTR-TORS; CompuArt Technology, Richmond Hill, Ontario) and 17 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 (11). 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 2011 were presented at the annual CFAS ART Professionals Day in September 2012 (pregnancy outcomes) and September 2013 (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 32 Canadian ART centres operating in 2011, 31 voluntarily contributed to CARTR for that year (listed in the Appendix). Three of the 31 centres reported more than 2000 ART cycles (started cycles of all types) in 2011, four centres reported 1000-2000 cycles, 12 centres reported 500-1000 cycles, seven centres reported 200-500 cycles, and five centres reported fewer than 200 cycles. Considering only fresh ART cycles with oocyte retrieval, two centres performed more than 2000 cycles in 2011, two centres performed 1000-2000 cycles, five centres performed 500-1000 cycles, 15 centres performed 200-500 cycles, and seven centres performed fewer than 200 cycles.

By province, 39% of reported ART cycles were from Ontario, 36% from Quebec, 10% from British Columbia, 10% from Alberta, 2.6% from Manitoba/Saskatchewan, and 2.0% from Nova Scotia/New Brunswick.

Overall Outcomes

In total, 23,997 treatment cycles involving ART were reported to CARTR for 2011. Overall, 7030 ART cycles (29.8% of cycles started, excluding 440 embryo and oocyte banking cycles) resulted in a clinical pregnancy, with at least 5329 deliveries (22.9% per cycle started), 5276 live births (22.6%), 4253 singleton live births (18.2%), and 3317 healthy term singletons (14.2%). There were 251 cycles with ongoing pregnancies (4.5% of ongoing pregnancies) for which the birth outcome was not reported. Overall, there were at least 1030 multiple births (19.3% of known births): 1009 twin births (18.9% per birth), 20 triplet births (0.4% per birth), and 1 quadruplet birth.

A total of 16,817 individual women were treated with ART in 2011: 69% had one treatment cycle, 23% had two cycles, and 8% had three or more cycles (up to seven). Overall, 40.9% of women treated in 2011 became pregnant (with 0.9% having two pregnancies) and 31.4% 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. 2011 cycle outcomes for the four most common types of ART procedures.

Outcome	**IVF/ICSI**	**IVF/ICSI-DO**	**FET**	**FET-DO**
Cycles started	14,866	647	5886	594
Cancelled cycles (% of cycles started)	1162 (7.8)	15 (2.3)	172 (2.9)	16 (2.7)
Oocyte retrievals (% of cycles started)	13,704 (92.2)	632 (97.7)	5714 (97.1)[a]	578 (97.3)[a]
Embryo transfers (% of cycles started)	12,237 (82.3)	590 (91.2)	5434 (92.3)	569 (95.8)
Clinical pregnancy (% per cycle started) [% per embryo transfer]	4614 (31.0) [37.6]	296 (45.7) [50.2]	1597 (27.1) [29.4]	195 (32.8) [34.3]
Ectopic pregnancy (% per cycle started)	76 (0.5)	1 (0.2)	28 (0.5)	2 (0.3)
Miscarriage (% per IU pregnancy)	791 (17.4)	44 (14.9)	378 (24.0)	31 (16.0)
Therapeutic abortion (% per IU pregnancy)	41 (0.9)	1 (0.3)	6 (0.4)	1 (0.5)
Delivery[b] (% per cycle started)	3553 (24.2)	245 (38.2)	1123 (19.3)	153 (26.2)
Live birth[b] (% per cycle started) [% per embryo transfer]	3518 (23.9) [29.0]	242 (37.7) [41.4]	1111 (19.1) [20.7]	152 (26.0) [27.1]
Singleton live birth[b] (% per cycle started)	2796 (19.0)	195 (30.4)	923 (15.9)	125 (21.4)
Healthy term singleton[b] (% per cycle started)	2163 (14.7)	157 (24.5)	738 (12.7)	89 (15.2)
Singleton delivery[b] (% of deliveries)	2826 (79.5)	197 (80.4)	934 (83.2)	126 (82.4)
Twin delivery[b] (% of deliveries)	710 (20.0)	48 (19.6)	185 (16.5)	27 (17.6)
Triplet or more delivery[b] (% of deliveries)	17 (0.5)	0	4 (0.4)	0

[a] Cycles with embryos thawed.

[b] Cycles with unknown delivery status omitted: 154 IVF/ICSI, 5 IVF/ICSI-DO, 65 FET, 9 FET-DO

IVF/ICSI with Own Oocytes

IVF, including ICSI, using the woman's own oocytes, was the most common procedure performed, with 14,866 cycles reported. Per IVF/ICSI cycle started, the clinical pregnancy rate was 31.0%, the live birth rate was 23.9%, the singleton live birth rate was 19.0%, and the healthy term singleton rate was 14.7%. Donated sperm was used in 4.9% of cycles with oocytes retrieved. There were 76 ectopic pregnancies (0.5% per cycle started), including one heterotopic pregnancy that resulted in miscarriage. The pregnancy loss rate was 18.3% of clinical intrauterine pregnancies (miscarriage 17.4%, therapeutic abortion 0.9%). Of the 3553 known births, 20.5% were multiple births (20.0% twins and 0.5% high-order multiples including one set of quadruplets). Included in these figures are 14 pregnancies, two miscarriages, 10 singleton live births, and two twin live births 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 13,599 IVF/ICSI cycles with a successful retrieval, 29.1% had insemination by standard IVF (including 73 cycles with failed fertilization that had ICSI performed the next day [rescue ICSI]), 67.0% by ICSI, and 3.1% by IVF/ICSI split (some oocytes inseminated by each method). The clinical pregnancy rates per successful retrieval were 32.5% for standard IVF (20.5% for the rescue ICSI cycles), 34.6% for ICSI, and 37.7% for IVF/ICSI split. Including the IVF/ICSI split cycles in the ICSI group, the clinical pregnancy rates per retrieval were 32.5% for IVF and 34.7% for ICSI, and the live birth rates per retrieval were 25.3% and 26.7%, respectively. The ectopic pregnancy rate per retrieval was 0.6% with IVF and 0.6% with ICSI, and the pregnancy loss rates per intrauterine pregnancy were 18.1% (miscarriage 17.1%, therapeutic abortion 0.9%) and 18.5% (miscarriage 17.6%, therapeutic abortion 0.9%), respectively. Of 1001 known births after IVF, 21.7% were multiple births (21.5% twins and 0.2% triplets); of 2543 known births after ICSI, 20.0% were multiple births (19.4% twins and 0.6% high-order multiples, including 1 set of quadruplets).

Table 2. 2011 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 or more births (% per birth)[b]**
IVF	3960 (29.1)	1288 (32.5)	779 (19.9)	217 (21.7)	2 (0.2)
IVF/ICSI split	424 (3.1)	160 (37.7)	99 (23.7)	22 (17.9)	1 (0.8)
ICSI	9113 (67.0)	3154 (34.6)	1911 (21.2)	486 (20.1)	14 (0.6)

[a] 100 cycles that did not have insemination and 2 cycles that had ICSI on day 1 omitted.
[b] 152 cycles with unknown delivery status omitted.

IVF/ICSI with Oocyte Donation

IVF/ICSI using donor oocytes (IVF/ICSI–DO) was reported in 647 cycles in 2011. In IVF/ICSI-DO cycles, per cycle started, the clinical pregnancy rate was 45.7%, the live birth rate was 37.7%, the singleton live birth rate was 30.4%, and the healthy term singleton rate was 24.5%. Donated sperm was used in 12.1% of cycles with oocytes donated. There was one ectopic pregnancy (0.2% per cycle started). The pregnancy loss rate was 15.3% per intrauterine pregnancy (miscarriage 14.9%, therapeutic abortion 0.3%). Of 245 known births, 19.6% were multiple births (all twins).

Of 630 cycles with a successful retrieval, 21.1% had insemination by standard IVF (including 2 cycles that used rescue ICSI), 72.9% by ICSI, and 5.9% by IVF/ICSI split. The clinical pregnancy rates per successful retrieval were 33.8%, 49.9%, and 59.5%, respectively.

Information about the oocyte donor's age was available for all cycles. Donor age was <30 years in 61% of cycles, 30-34 years in 24%, 35-39 years in 13%, and ≥40 years in 1.7%. The clinical pregnancy rates per cycle started were 49.2%, 48.1%, 29.3%, and 9.1%, respectively.

FET with Own Oocytes

In 2011, 5886 cycles of FET, using cryopreserved embryos created from the woman's own oocytes, were reported. Per cycle started, the clinical pregnancy rate was 27.1%, the live birth rate was 19.1%, the singleton live birth rate was 15.9%, and the healthy term singleton rate was 12.7%. There were 28 ectopic pregnancies (0.5% per cycle started), including three heterotopic pregnancies that resulted in one miscarriage and two singleton live births. The pregnancy loss rate was 24.4% per intrauterine pregnancy (miscarriage 24.0%, therapeutic abortion 0.4%). Of 1123 known births, 16.8% were multiple births (16.5% twins and 0.4% 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 (541 cycles) and cryopreserved donated embryos (53 cycles). In this category, per cycle started, the clinical pregnancy rate was 32.8%, the live birth rate was 26.0%, the singleton live birth rate was 21.4%, and the healthy term singleton rate was 15.2%. There were two ectopic pregnancies (0.3% per cycle started), including 1 heterotopic pregnancy with unknown outcome. The pregnancy loss rate was 16.5% per intrauterine pregnancy (miscarriage 16.0%, therapeutic abortion 0.5%). Of 153 known births, 17.6% were multiple births (all twins).

Information about the oocyte donor's age was available for 99% of cycles. Donor age was <30 years in 69% of cycles, 30-34 years in 20%, 35-39 years in 8%, and ≥40 years in 2.2%. The clinical pregnancy rates per cycle started were 33.4%, 28.3%, 42.2%, and 23.1%, respectively.

Gestational Carrier Cycles

There were 364 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 81 IVF/ICSI and 93 FET cycles with the parenting woman's own oocytes, 70 IVF/ICSI and 115 FET cycles with donated oocytes or embryos, and five cycles using other types of ART. Use of donated sperm was reported for ten cycles (6.8% of fresh cycles with oocytes retrieved).

In fresh embryo cycles using a gestational carrier, per cycle started, the clinical pregnancy rate was 41.7% and the live birth rate was 35.8%; in frozen embryo cycles, the rates were 35.6% and 27.5%, respectively. There was one ectopic pregnancy (0.3% per cycle started). In the 139 clinical intrauterine pregnancies in gestational carriers, the pregnancy loss rate was 17.3% (16.5% miscarriage, 0.7% therapeutic abortion). Of 113 known births (including 1 stillbirth), 23.9% 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 2011. Natural (unstimulated) IVF was performed in 902 cycles, with clinical pregnancy rates of 13.3% per cycle started and 29.7% per embryo transfer (ET), and live birth rates of 9.8% and 22.3%, respectively; there was one twin birth (1.1%). One hundred and 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 49 cycles, previously frozen oocytes were thawed and inseminated, with a clinical pregnancy rate per cycle started of 24.5% and a live birth rate per cycle started of 14.6%; of seven births, one was twins (14.3%). One hundred and one cycles of in vitro oocyte maturation were reported, with a clinical pregnancy rate per cycle started of 21.8% and a live birth rate per cycle started of 19.0%; of 20 births, six were twins (30.0%). Three hundred and thirty-eight cycles were performed for the purpose of embryo banking (including one cycle in which oocytes were also frozen). Thirty-two cycles classified as "other", including 26 research cycles and six cycles of mixed ART types, resulted in three pregnancies, with three singleton live births. Five cycles using fresh donor embryos resulted in 2 pregnancies, with one singleton live birth.

Preimplantation genetic diagnosis (PGD) was performed in 99 cycles using fresh embryos (including six cycles that also involved frozen embryos), and 12 cycles using frozen embryos only, resulting in 29 pregnancies (26.1% per cycle started) and 24 live births (21.6% per cycle started, 20 singleton and 4 twin births). In addition, preimplantation genetic screening (PGS) for aneuploidy was reported for 100 IVF/ICSI cycles, three FET cycles, two IVF/ICSI-DO cycles, 13 embryo banking cycles, 15 research cycles, and 7 gestational carrier cycles, resulting in 35 pregnancies (25.0% per cycle started), 25 live births (17.9% per cycle started), and 2 stillbirths (23 singleton and 4 twin births).

Birth Outcomes for All ART Procedures

At least 5329 deliveries resulted in at least 6381 infants born from all types of ART cycles started in 2011 in Canada: 4299 infants from 4299 singleton births (67.4% of infants), 2018 infants from 1009 twin births (31.6%), 60 infants from 20 triplet births (0.9%), and 4 infants from 1 quadruplet birth (0.06%). Thus, 33% of infants were born from multiple gestations. An additional 251 pregnancies had no delivery information reported. Of these pregnancies, 197 had one viable fetus, 49 had two viable fetuses, and 2 had three viable fetuses at last report; thus, as many as 301 additional babies may have been born.

Of the 4299 infants born as singletons, there were 46 stillbirths and 7 neonatal deaths, a total perinatal mortality rate of 1.2% per infant. The median gestational age at birth was 39 weeks (range, 21-43 wk) for liveborn infants and 24 weeks (range, 20-41 wk) for stillborn infants. Preterm delivery (<37 weeks) occurred in 15.4% of births and very preterm delivery (<32 weeks) in 2.6% of births. Birth weight was normal (>2500 g) for 91.3% of liveborn singletons, low (1500-2500 g) for 7.3%, and very low (<1500 g) for 1.4%. Some type of birth defect was reported for 85 infants (2.0% of infants).

Of the 2018 infants born as twins, there were 32 stillbirths and 12 neonatal deaths, a total perinatal mortality rate of 2.2% per infant. The median gestational age at birth was 36 weeks (range, 20-40 wk) for live births and 22 weeks (range, 20-26 wk) for stillbirths. Preterm delivery occurred in 70.7% of births and very preterm delivery in 12.2% of births. Birth weight was >2500 g for 46.3% of liveborn twins, 1500-2500 g for 45.5%, and <1500 g for 8.3%. Some type of birth defect was reported for 47 infants (2.3% of infants).

Of the 64 infants born as triplets or quadruplets, there were two stillbirths and three neonatal deaths, a total perinatal mortality rate of 7.8% per infant. The gestational age at birth was median 34 weeks (range, 20-37 wk) for triplet live births and 31 weeks for the one quadruplet live birth. Preterm delivery occurred in 100% of births and very preterm delivery in 38.1% of births. Birth weight was >2500 g for 5.0% of liveborn infants, 1500-2500 g for 61.7%, and <1500 g for 33.3%. Some type of birth defect was reported for three infants (4.7% of infants).

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

Table 3. 2011 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	4299 (80.7)	4253 (98.9)	38.7	662 (15.4)	110 (2.6)
Twins	1009 (18.9)	984 (97.5)	36.1	711 (70.7)	123 (12.2)
Triplets	20 (0.4)	20 (100)	34.3	20 (100)	7 (35.0)
Quads	1 (0.02)	1 (100)	30.9	1 (100)	1 (100)

[a] Gestational age missing for 12 births.

Table 4. 2011 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	4299 (67.4)	46/7 (1.2)	3811 (91.3)	306 (7.3)	59 (1.4)	85 (2.0)
Twins	2018 (31.6)	32/12 (2.2)	901 (46.3)	886 (45.5)	161 (8.3)	47 (2.3)
Triplets	60 (0.9)	2/3 (8.3)	3 (5.4)	34 (60.7)	19 (33.9)	3 (5.0)
Quads	4 (0.06)	0/0 (0)	0	3 (75.0)	1 (25.0)	0

[a] Birth weight missing for 117 live born infants.

Information on sex of the infant was available for 98% of babies: 51.3% were male and 48.7% were female.

The information provided on birth defects was limited. Overall, some type of birth defect was reported for 135 infants (2.1% of infants): 27 cases of cardiac defect (two neonatal deaths), 13 cases of chromosome aneuploidy (two stillbirths), five cases of gastrointestinal defect, nine cases of limb defect, nine cases of urogenital defect, three cases of metabolic disorder, four cases of neural tube defect (one stillbirth), 11 cases of cleft lip or palate, and 54 cases of other unspecified defects (four stillbirths and three neonatal deaths).

Of 1350 multiple pregnancies, 77 were reported to be monochorionic: 4% of twin pregnancies, 37% of triplet pregnancies, and 20% of quadruplet pregnancies. Miscarriage was three times more likely to occur in monochorionic multiple pregnancies (15.6% vs. 5.3%, P=0.001) and pregnancy reduction (either spontaneous or therapeutic) was also more frequent (26.0% vs. 15.3%, P=0.01). In multiple pregnancies that resulted in a birth, monochorionic and non-monochorionic multiple pregnancies had similar rates of multiple birth (81% vs. 85%) and perinatal death of at least one infant (4.8% vs. 3.0%). Stratified by number of babies born, monochorionic multiple pregnancies were not more likely to result in preterm birth <37 weeks or very preterm birth <32 weeks.

The risk of a couple experiencing perinatal death was related to multiple birth. Perinatal death of one or more infants occurred in 1.2% of singleton deliveries, 3.1% of twin deliveries, and 14.3% of triplet or quadruplet deliveries (risk ratio, 2.7, 95% confidence interval, 1.8 to 4.1; P<0.0001, multiple vs. singleton). Perinatal death of all infants occurred in 1.2%, 1.3%, and 4.8% of deliveries, respectively (P=0.74, 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 24% in IVF/ICSI cycles, 14% in FET cycles, and 67% 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 and live birth rates were highest in the two older age groups. The multiple birth rates declined with age in DO and FET cycles; in IVF/ICSI 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% for women aged <35 years, 91% for those aged 35-39 years, and 87% for those aged ≥40 years, $P<0.001$), as did the mean number of oocytes retrieved (13.0, 10.3, 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 (38%, 27%, and 11%, $P<0.001$), as did the clinical pregnancy rate per ET (46%, 38%, and 21%, $P<0.001$), even though older women had more embryos transferred (mean, 1.6, 1.9, and 2.4, $P<0.001$). The proportion of women having ET who had surplus embryos available for cryopreservation gradually decreased from the younger to older women (61%, 43%, and 19%, $P<0.001$). In women who achieved a clinical intrauterine pregnancy, the pregnancy loss rate per intrauterine pregnancy became higher as women aged (13%, 20%, and 35%, $P<0.001$). The risks of adverse birth outcomes, such as preterm birth and perinatal death, were similar across age groups in singleton births; in multiple births, risks were lower in older women.

Table 5. 2011 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 (20-51)	41 (21-54)	35 (21-51)
Cycles started, n (% of cycles within procedure)			
<35	5700 (38.3)	86 (13.3)	2816 (47.8)
35-39	5660 (38.1)	127 (19.6)	2259 (38.4)
≥40	3506 (23.6)	434 (67.1)	811 (13.8)
Clinical pregnancy, n (% per cycle started) [% per ET]			
<35	2256 (39.6) [46.4]	33 (38.4) [42.3]	800 (28.4) [30.7]
35-39	1784 (31.5) [38.0]	61 (48.0) [53.5]	645 (28.6) [30.9]
≥40	574 (16.4) [21.0]	202 (46.5) [50.8]	152 (18.7) [20.4]
Pregnancy loss, n (% per intrauterine pregnancy)			
<35	281 (12.7)	4 (12.1)	166 (21.0)
35-39	356 (20.3)	11 (18.0)	162 (25.4)
≥40	196 (34.5)	30 (14.9)	56 (38.9)
Live birth, n (% per cycle started) [% per ET][a]			
<35	1831 (32.6) [38.4]	27 (31.8) [35.1]	581 (20.9) [22.7]
35-39	1332 (23.8) [28.7]	49 (38.9) [43.4]	450 (20.1) [21.8]
≥40	355 (10.2) [13.0]	166 (38.5) [42.0]	80 (10.0) [10.8]
Singleton live birth, n (% per cycle started)[a]			
<35	1454 (25.9)	20 (23.5)	477 (17.2)
35-39	1030 (18.4)	38 (30.2)	378 (16.9)
≥40	312 (8.9)	137 (31.8)	68 (8.5)
Healthy term singleton, n (% per cycle started)[a]			
<35	1126 (20.1)	17 (20.0)	384 (13.8)
35-39	803 (14.3)	30 (23.8)	296 (13.2)
≥40	234 (6.7)	110 (25.5)	58 (7.2)
Multiple birth, n (% per delivery)[a]			
<35	381 (20.6)	7 (25.0)	104 (17.7)
35-39	303 (22.5)	11 (22.4)	73 (16.0)
≥40	43 (12.0)	30 (17.9)	12 (14.8)

[a]224 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 (29%). Idiopathic or unexplained infertility was the diagnosis in 18% 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. 2011 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	2550 (17.7)	36.0	56	857 (33.6)	661 (26.2)
Male factor only	4137 (28.7)	34.3	94	1494 (36.1)	1163 (28.4)
Male + female factor	2120 (14.7)	36.2	90	671 (31.7)	525 (25.0)
Tubal factor only	1192 (8.3)	35.7	39	361 (30.3)	276 (23.4)
Endometriosis only	740 (5.1)	34.5	51	233 (31.5)	167 (22.9)
Ovulatory disorder only[b]	827 (5.7)	34.0	54	299 (36.2)	227 (27.6)
Other female factor only	867 (6.0)	37.8	63	218 (25.1)	164 (19.0)
Diminished ovarian reserve only	1232 (8.5)	38.9	65	195 (15.8)	133 (10.8)
>1 female factor	765 (5.3)	36.5	49	199 (26.0)	148 (19.4)

[a] 436 cycles with unknown diagnosis omitted. Categories are mutually exclusive.
[b] Including polycystic ovarian syndrome.
[c] Cycles with insemination done.
[d] 140 cycles with unknown delivery status omitted.

Pregnancy rates per cycle started were highest when ovulatory disorder (36.2%) or male factor infertility (36.1%) was the only diagnosis. Couples with idiopathic infertility had a clinical pregnancy rate of 33.6%. In couples with other single female infertility factors, the clinical pregnancy rate varied from 31.5% with endometriosis to 15.8% with diminished ovarian reserve. Pregnancy rate was average in the presence of both female and male infertility factors (31.7%) but reduced in couples with multiple female infertility factors without male factor (26.0%). 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 1.85. A single embryo was transferred in 36% of transfer cycles, two embryos in 48%, three embryos in 13%, and four or more embryos in 3%. 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 37.6% 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 (41.5% per ET) than when one embryo was transferred (34.6% per ET). Transferring three or more embryos did not increase the clinical pregnancy rate; indeed, it declined to 33.8% per ET with three embryos and 28.9% per ET with four or more embryos. The mean implantation rate per embryo transferred decreased with increasing number of embryos transferred: 34% with one embryo, 28% with two embryos, 15% with three embryos, and 10% with four or more embryos.

Table 7. 2011 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	4406 (36.0)	1524 (34.6)	1149 (26.4)	20 (1.7)	0
2	5839 (47.7)	2424 (41.5)	1294 (22.5)	592 (31.2)	9 (0.5)
3	1574 (12.9)	532 (33.8)	299 (19.2)	90 (23.0)	8 (2.0)
4 or more	418 (3.4)	121 (28.9)	46 (11.1)	23 (32.9)	0

[a] 152 cycles with unknown delivery status omitted.

One-embryo transfers were performed on day 5 after oocyte retrieval in 45% of transfers and on day 3 in 40%; clinical pregnancy rates per ET were 49.5% and 24.1%, respectively. Two-embryo transfers were performed on day 5 in 34% of transfers and on day 3 in 57%; clinical pregnancy rates per ET were 50.6% and 39.6%, respectively. In contrast, only 15% of three-embryo transfers and 14% 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 (26.4% vs. 22.5% per ET). The multiple birth rate per known birth was higher with two embryos (31.2%) than with three or more embryos (24.5%) (Table 7). The high-order multiple birth rate was 1.7% when three or more embryos were transferred (although, this year, there was no high-order multiple birth in 70 births after the transfer of four or more embryos). Of note, 82% of multiple births and 53% of high-order multiple births in IVF/ICSI cycles resulted from cycles with two embryos transferred. The one quadruplet birth resulted from transfer of three embryos.

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 (47%) of multiple births in IVF/ICSI cycles occurred in women aged <35 years who had two embryos transferred.

Table 8. 2011 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]	2408 (49.6)	988 (41.0)	773 (32.6)	17 (2.1)
	2	2257 (46.5)	1180 (52.3)	634 (28.7)	341 (34.7)
	3	170 (3.5)	78 (45.9)	43 (25.4)	19 (30.6)
	4 or more	17 (0.4)	6 (35.3)	3 (17.6)	3 (50.0)
35-39	1[b]	1471 (31.5)	476 (32.4)	343 (23.6)	2 (0.6)
	2	2458 (52.6)	1013 (41.2)	524 (21.6)	233 (30.7)
	3	660 (14.1)	262 (39.7)	148 (22.6)	59 (28.2)
	4 or more	82 (1.8)	26 (31.7)	10 (12.3)	8 (42.1)
≥40	1[b]	527 (19.4)	60 (11.4)	33 (6.3)	1 (2.9)
	2	1124 (41.4)	231 (20.6)	136 (12.2)	18 (11.6)
	3	744 (27.4)	192 (25.8)	108 (14.7)	12 (9.9)
	4 or more	319 (11.8)	89 (27.9)	33 (10.4)	12 (26.7)

[a] 152 cycles with unknown delivery status omitted.
[b] Proportion of one-embryo transfers that were elective single embryo (eSET): 67% in <35, 45% in 35-39, and 9% in ≥40.

The number of thawed embryos transferred in FET cycles ranged from one to seven, with a mean of 1.73. A single embryo was transferred in 39% of cycles, two embryos in 51%, three embryos in 8%, and four or more embryos in 2%. Overall, the clinical pregnancy rate was 29.4% 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 (22.2%) and similar when two, three, or four or more embryos were transferred (32.6-34.6%). Mean implantation rate per embryo transferred was highest when one (22%) or two (21%) embryos were transferred, compared with 15% with three embryos, and 10% with four or more embryos. The singleton live birth rate per ET was highest when two embryos were transferred. The multiple birth rates were similar when more than two embryos were transferred. The high-order multiple birth rate was 2.3% when three or more embryos were transferred.

Table 9. 2011 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	2140 (39.4)	476 (22.2)	326 (15.4)	2 (0.6)	0
2	2743 (50.5)	932 (34.0)	501 (18.5)	155 (23.3)	1 (0.2)
3	456 (8.4)	158 (34.6)	81 (18.1)	27 (25.0)	3 (2.8)
4 or more	95 (1.7)	31 (32.6)	15 (16.0)	5 (25.0)	0

[a] 65 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 8% of transfers, day 3 in 54%, and day 5 in 35%. The mean female age was 39 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, 2.03) than on day 2 and day 5 (mean, 1.76 and 1.62). The proportion of cycles with one/two embryos transferred was 44/39% on day 2, 27/51% on day 3, and 47/47% 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 40% of day 3 transfers and 63% of day 5 transfers. Table 10 shows results by day of embryo transfer.

Table 10. 2011 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	1001 (8.2)	162 (16.2)	102 (10.2)	8 (7.1)	1 (0.9)
3	6576 (53.7)	2234 (34.0)	1270 (19.6)	385 (23.1)	9 (0.5)
4	94 (0.8)	27 (28.7)	17 (18.3)	2 (10.5)	0
5	4283 (35.0)	2106 (49.2)	1358 (32.1)	326 (19.2)	7 (0.4)
6 or 7	282 (2.3)	72 (25.5)	41 (15.0)	4 (8.7)	0

[a] 152 cycles with unknown delivery status omitted.

Clinical pregnancy rate per ET was higher for transfers done on day 5 (49.2%) than for transfers done on day 3 (34.0%) or day 2 (16.2%). The multiple birth rate was lower for transfers done on day 5 (19.2%) than on day 3 (23.1%), and lowest on day 2 (7.1%). The mean implantation rates per embryo transferred were 11% on day 2, 23% on day 3, 19% on day 4, 41%

on day 5, and 22% 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 (49.5%) or two (50.6%) embryos were transferred on day 5. The highest singleton live birth rate per ET was achieved when one embryo was transferred on day 5 (40.0%); this rate was much lower with two embryos transferred on day 5 (25.9%) because of a very high multiple birth rate (36.0% per birth).

Table 11. 2011 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[b]	38.0	1	438 (43.8)	55 (12.6)	30 (6.9)	0
	2	39.2	0	392 (39.2)	63 (16.1)	41 (10.5)	4 (8.7)
	3	40.8	1	152 (15.2)	39 (25.7)	27 (17.8)	4 (12.9)
	4 or more	41.8	0	19 (1.9)	5 (26.3)	4 (21.1)	0
3	1[b]	34.7	39	1755 (26.7)	423 (24.1)	296 (17.2)	7 (2.3)
	2	35.1	44	3332 (50.7)	1321 (39.6)	722 (22.0)	296 (28.9)
	3	38.5	31	1155 (17.6)	397 (34.4)	221 (19.3)	65 (22.6)
	4 or more	40.6	25	334 (5.1)	93 (27.8)	31 (9.3)	17 (34.7)
5	1[b]	32.7	75	1993 (46.5)	987 (49.5)	790 (40.0)	13 (1.6)
	2	35.4	56	1998 (46.6)	1010 (50.6)	509 (25.9)	288 (36.0)
	3	39.0	37	233 (5.4)	89 (38.2)	50 (21.7)	19 (27.1)
	4 or more	40.3	24	59 (1.4)	20 (33.9)	9 (15.3)	6 (40.0)

[a] 149 cycles with unknown delivery status omitted.
[b] Proportion of one-embryo transfers that were elective single embryo (eSET): 1% in day 2, 39% in day 3, and 75% in day 5.

Effect of Surplus Embryos, eSET and eDET

The clinical pregnancy rate per ET was 28.4% when all available embryos were transferred (55% of transfers, mean female age 36.9 years) and 49.0% when surplus embryos were available (45% of transfers, mean female age 33.9 years). The mean implantation rates per embryo transferred were 19% and 39%, respectively. Surplus embryos were available in 61% of transfer cycles in women aged <35 years, 43% of cycles in women 35-39 years, and 19% of cycles in women ≥40 years.

In Canada in 2011, a single embryo was transferred by choice (elective SET or eSET) in 2312 IVF/ICSI cycles (52% of single ETs and 19% of all transfer cycles). The clinical pregnancy

rate per ET was 44.6% in eSETs, compared with 23.6% when only one embryo was available. Some of this difference can be explained by female age, as 69% of eSETs were performed in women <35 years and only 2.1% 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 45% of women 35-39 years, but only 9% of women ≥40 years. The clinical pregnancy rate per ET was 28.9% when eSET was done on day 3 (30% of eSETs) and 52.8% when it was done on day 5 (65% of eSETs).

Double embryo transfer (two embryos) was performed by choice (elective DET or eDET) in 2612 IVF/ICSI cycles (45% of double ETs and 21% of all transfer cycles). In these cycles, the clinical pregnancy rate per ET was 53.9%, compared with 31.5% when only two embryos were available. Again, female age was a factor in this result: 50% of eDETs were performed in women <35 years and only 9% in women ≥40 years. When two embryos were transferred, it was eDET in 57% of women <35 years and 44% of women 35-39 years, but only 21% of women ≥40 years. The clinical pregnancy rate per ET was 51.2% when eDET was done on day 3 (56% of transfers) and 58.3% when it was done on day 5 (43% of transfers). The multiple birth rate per known birth was 37.2% with eDET and 21.9% 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, the 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. 2011 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	1602 (33.0)	736 (45.9)	582 (37.0)	13 (2.2)
	neSET	806 (16.6)	252 (31.3)	191 (24.0)	4 (2.0)
	eDET	1293 (26.6)	761 (58.9)	378 (29.9)	262 (40.6)
	neDET	963 (19.8)	419 (43.5)	256 (27.2)	79 (23.4)
35-39	eSET	661 (14.2)	276 (41.8)	199 (30.6)	2 (1.0)
	neSET	809 (17.3)	200 (24.7)	144 (17.9)	0
	eDET	1087 (23.3)	557 (51.2)	285 (26.5)	155 (35.1)
	neDET	1369 (29.3)	456 (33.3)	239 (17.7)	78 (24.6)
≥40	eSET	49 (1.8)	18 (36.7)	12 (25.0)	0
	neSET	477 (17.6)	41 (8.6)	20 (4.2)	1 (4.8)
	eDET	232 (8.5)	89 (38.4)	52 (22.5)	12 (18.8)
	neDET	890 (32.8)	141 (15.8)	84 (9.5)	6 (6.6)

[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] 136 cycles with unknown delivery status omitted.

Complications and Fetal Reduction

Complications were reported in 241 IVF/ICSI cycles (1.6% per cycle started). There were 144 cases of moderate ovarian hyperstimulation syndrome (1.0% per cycle started), 15 of which (10%) required hospitalization, and 69 cases of severe ovarian hyperstimulation syndrome (0.5% per cycle started), 33 of which (48%) required hospitalization. Also reported were 15 complications related to medications, four complications related to procedures (three hospitalizations), and nine other unspecified complications (two hospitalizations). No maternal death was reported.

Of 1350 multiple pregnancies from all types of ART cycles, outcomes were known for 1299 multiple pregnancies. Of these, 214 (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 181 cases (85%) and therapeutic in 33 cases (15%). Of 1229 pregnancies that were originally twins, reduction to one fetus occurred spontaneously in 12.9% and therapeutically in 1.1%, and loss of the whole pregnancy occurred in 6.3%, including five therapeutic abortions and one miscarriage after a therapeutic reduction; 80% of viable twin gestations resulted in a twin birth. Of 65 pregnancies that were originally triplets, reduction to two fetuses occurred spontaneously in 20.0% and therapeutically in 18.5%; reduction to one fetus occurred spontaneously in 13.8% and therapeutically in 6.2%; and loss of the whole pregnancy occurred in 10.8%. Thus, only 39% 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, three were therapeutically reduced to two fetuses, and one resulted in a quadruplet birth.

Trends over Time

Table 13 compares the major outcomes from CARTR over a 4-year period (2008-2011) 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, cycles with one embryo transferred, and embryo transfers done on day 5. In IVF/ICSI cycles, the clinical pregnancy, live birth, and singleton live birth rates were lower in 2011 than in the previous year, for the second year in a row. However, this was due to efforts, particularly in Quebec (12, 13), to reduce multiple birth rates by transferring fewer embryos and increasing eSET use. These efforts have begun to produce the desired effect, since the multiple birth rate in IVF/ICSI cycles was reduced by 3.3 percentage points in 2011 compared with 2010 and by 8.2 percentage points compared with 2009. In FET cycles, success rates in 2011 were similar to those of 2010, with a continuing downward trend in multiple birth rates. In IVF/ICSI-DO cycles, the 2011 clinical pregnancy, live birth, and singleton live birth rates were similar to those of 2010, with a significant decrease of more than 11 percentage points in the multiple birth rate.

Table 13. Comparison of cycle outcomes from CARTR for the years 2008 to 2011.

Outcome	**CARTR 2008** (8)	**CARTR 2009** (9)	**CARTR 2010** (10)	**CARTR 2011**	***P* value 2011 vs. 2010**
No. of clinics participating (%)	28 (100)	28 (100)	28 (100)	31 (97)	
Total no. of ART cycles reported	15,000	16,315	18,454	23,997	
IVF/ICSI cycles					
No. of cycles reported	9,904	10,532	11,806	14,866	
Cycles in women aged ≥40 y (%)	19	19	21	24	
Cycles with 1 embryo transferred (%)	12	13	24	36	
Embryo transfers done on day 5 (%)	24	26	31	35	
Clinical pregnancy rate per cycle (%)	36.5	37.6	34.9	31.0	<0.0001
Live birth rate per cycle (%)	29.1	30.2	27.2	23.9	<0.0001
Singleton live birth rate per cycle (%)	20.7	21.5	20.8	19.0	0.0003
Multiple birth rate per delivery (%)	28.9	28.7	23.8	20.5	0.009
Triplet or more rate per delivery (%)	1.0	1.0	0.8	0.5	0.12
FET cycles					
No. of cycles reported	3738	4223	4640	5886	
Clinical pregnancy rate per cycle (%)	26.0	26.4	26.7	27.1	0.59
Live birth rate per cycle (%)	19.8	19.8	20.3	19.1	0.13
Singleton live birth rate per cycle (%)	15.7	15.6	16.7	15.9	0.27
Multiple birth rate per delivery (%)	20.3	20.9	17.7	16.8	0.61
Triplet or more rate per delivery (%)	0.9	0.7	0.6	0.4	0.53
IVF/ICSI-DO cycles					
No. of cycles reported	431	486	508	647	
Clinical pregnancy rate per cycle (%)	49.7	49.6	49.8	45.7	0.17
Live birth rate per cycle (%)	39.8	41.5	39.9	37.7	0.44
Singleton live birth rate per cycle (%)	24.7	28.0	27.7	30.4	0.32
Multiple birth rate per delivery (%)	37.4	32.8	30.9	19.6	0.006
Triplet or more rate per delivery (%)	1.1	1.5	0.5	0	0.45

Comparisons with Other Countries

Table 14 provides a comparison of selected outcomes from CARTR 2011 with those of the USA (2011), Australia/New Zealand (2011), and four European countries (Belgium, Germany, Sweden, and the UK, 2009), 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 (35.8%), quite a bit lower in Canada (31.0%), and varying from 29.1% to 22.4% in the other countries. Australia/New Zealand had the lowest pregnancy rate, but they had a very high proportion (28%) of cycles in women aged ≥40 years, especially compared with the European countries. Multiple birth rates in IVF/ICSI cycles were higher in the USA (28.8%) and the UK (22.4%) than in Canada (20.5%), and slightly lower in Germany (20.1%); very low rates were achieved by Belgium (11.7%), Australia/New Zealand (6.9%), and Sweden (5.9%). The latter two countries used single embryo transfer in >70% of transfer cycles, compared with 36% in Canada, 17% in the USA, and 13% in Germany. The triplet birth rate was 1.3% in the USA, but <1% in the other countries, and only 0.1% in Australia/New Zealand.

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

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Table 14. Comparisons between Canada and other countries.

Country, Year (reference)	**USA 2011**(14)	**Canada 2011**	**UK 2009** (15)	**Sweden 2009** (15)	**Germany 2009** (15)	**Belgium 2009** (15)	**Australia/ New Zealand 2011** (16)
No. of clinics participating (%)	451 (94)	31 (97)	70 (100)	16 (100)	121 (100)	18 (100)	79 (100)
Total no. of ART cycles reported	151,923	23,997	54,314	16,714	67,349	27,674	66,347
IVF/ICSI cycles							
No. of cycles reported	101,213[a]	14,866	42,634	11,564	50,128	20,436	40,696[b]
Cycles with ICSI (%)	67	71	56	50	76	75	68
Cycles in women aged ≥40 y (%)	24	24	17	12	15	-	28
Cycles with 1 embryo transferred (%)	17	36	23	71	13	49	73[c]
Cycles with ≤2 embryos transferred (%)	71	84	95	100	81	90	99[c]
Clinical pregnancy rate per cycle (%)	35.8	31.0	29.1	28.3	26.4	22.7	22.4
Live birth rate per cycle (%)	29.2	23.9	25.4[d]	22.3[e]	14.5[d]	16.3[d]	17.0
Singleton live birth rate per cycle (%)	20.8	19.0	19.6[d]	21.0[e]	11.5[d]	14.4[d]	15.8
Multiple birth rate per delivery (%)	28.8[f]	20.5	22.4	5.9	20.1	11.7	6.9[g]
Triplet or more rate per delivery (%)	1.3[f]	0.5	0.4	0.2	0.8	0.2	0.1[g]
FET cycles							
No. of cycles reported	32,180	5,886	9,405	4,893	17,913	8,409	22,368
Clinical pregnancy rate per thaw (%)	44.6[h]	27.9	21.0	26.0	18.2	17.1	25.2
Live birth rate per thaw (%)	34.5[h]	19.7	18.2[d]	19.7[e]	9.6[d]	12.3[d]	19.2
Singleton live birth rate per thaw (%)	26.8[h]	16.3	15.1[d]	18.6[e]	8.1[d]	10.9[d]	-
Multiple birth rate per delivery (%)	22.5[f]	16.8	17.1	5.3	14.9	11.0	-
Triplet or more rate per delivery (%)	0.9[f]	0.4	0.1	0	0.5	0.2	-

[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), omitting pregnancies lost to follow-up from the denominator
[e] delivery (including stillbirths)
[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 – 31 Canadian ART Centres Reporting Data to CARTR for 2011

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
Procrea, Montreal, Quebec
Procrea, Quebec, Quebec

Atlantic Canada

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