

Assisted reproductive technology in the United States: 1997 results generated from the American Society for Reproductive Medicine/Society for Assisted Reproductive Technology Registry

Society for Assisted Reproductive Technology and American Society for Reproductive Medicine

Birmingham, Alabama

Objective: To summarize the procedures and outcomes of assisted reproductive technology (ART) initiated in the United States in 1997.

Design: Data were collected electronically by using Society for Assisted Reproductive Technology Clinical Outcome Reporting System software and were submitted to the American Society for Reproductive Medicine/Society for Assisted Reproductive Technology Registry.

Participant(s): 335 programs submitted data on procedures performed in 1997. Data were collated after November 1998 so that the outcome of all pregnancies established would be known.

Main Outcome Measure(s): Incidence of clinical pregnancy, ectopic pregnancy, abortion, stillbirth, delivery, and structural and functional abnormalities.

Result(s): Programs reported initiating 73,069 cycles of ART treatment. Of these, 51,344 cycles involved IVF (with and without micromanipulation), with a delivery rate per retrieval of 27.9%; 1,943 were cycles of GIFT, with a delivery rate per retrieval of 30.0%; and 1,104 were cycles of zygote intrafallopian transfer, with a delivery rate per retrieval of 28.0%. The following additional ART procedures were also initiated: 4,616 donor oocyte cycles, with a delivery rate per transfer of 40.0%; 10,181 frozen embryo transfer procedures, with a delivery rate per transfer of 18.8%; 1,584 frozen embryo transfers using donated oocytes, with a delivery rate per transfer of 22.2%; and 600 cycles using a host uterus, with a delivery rate per transfer of 34.6%. Furthermore, 1,173 cycles were reported as combinations or more than one treatment type, 40 cycles as research, 258 as embryo banking, and 226 as other (unclassified) cycle types. As a result of all procedures, 17,311 deliveries resulting in 25,059 babies were reported.

Conclusion(s): In 1997, more programs reported ART treatment and the number of reported cycles increased significantly (10.9%) compared with 1996. In comparable cycle types, the overall success rate (deliveries per retrieval) increased by 1.8%, which represents an increase of 6.9% compared with the success rate for 1996. (Fertil Steril® 2000;74:641–53. ©2000 by American Society for Reproductive Medicine.)

Key Words: Assisted reproductive technology, in vitro fertilization, gamete intrafallopian transfer, zygote intrafallopian transfer, cryopreserved embryos, donor oocytes

In 1988, the Society for Assisted Reproductive Technology (SART) began publishing annual reports of assisted reproductive technology (ART) activities (1). These annual reports were based on voluntary data submissions by programs, and they provided a forum for sharing information early in the development of the technology. In 1992, the U.S. Congress passed the Fertility Clinic Success Rate and Certification Act (2), which requires the Centers for Disease Control and Prevention (CDC) to pub-

lish clinic-specific pregnancy success rates for ART procedures in the United States. Through collaboration with SART and their data collection system, data from 1995 were first collected and published under the Act (3). In addition to producing the annual CDC report, SART has continued to review and analyze annual data to explore trends in ART activities in more detail. The present report summarizes the ART procedures and outcomes in the United States in 1997.

Received and accepted
July 21, 2000.

Reprint requests: American
Society for Reproductive
Medicine, 1209
Montgomery Highway,
Birmingham, Alabama
35216 (FAX: 205-978-5005;
E-mail: jzeit@asrm.org).

0015-0282/00/\$20.00
PII S0015-0282(00)01559-4

The SART has prepared this report in conjunction with the American Society for Reproductive Medicine (ASRM) and the CDC. It represents mandatory reporting by 335 programs offering ART, 323 (96.4%) of which were members of SART. Each clinic's submitted data were tabulated and summarized by SART and were subsequently verified by each clinic's medical director, and all such data were subject to validation through on-site visits and medical record review.

MATERIALS AND METHODS

Data collected retrospectively for ART treatments initiated from January 1, 1997, through December 31, 1997, form the basis for this report. Programs collected patient- and cycle-specific data in electronic form, by the SART Clinical Outcome Reporting System, a personal computer software program designed for ART data collection. The ART programs submitted final data in January 1999 to permit reporting of outcomes of all pregnancies initiated in 1997.

Each reporting clinic submitted an export diskette and a printed clinic summary verified as accurate by the medical director. The export diskette was created by using the SART Clinical Outcome Reporting System and contained demographic characteristics, medical history, and diagnosis for each patient and information on medication, treatment methods, and outcomes for each cycle. Data from patients who underwent more than one cycle of ART were collected and analyzed separately for each cycle. Therefore, the cycle number reported is always equal to or greater than the number of patients. The data were then tabulated by SART and compiled to create the annual clinic data set.

Each clinic was also sent a clinic summary table so that it could reconfirm outcome and treatment data. Analysis was completed in the 10 months after data submission. In addition, the CDC subsidized on-site data validation at 30 randomly selected clinics. Two members of the SART Validation Committee, occasionally accompanied by a CDC observer, verified approximately 25 data elements in each of 50 randomly selected cycles in the medical and laboratory records of each program.

The ART procedures were divided into several categories for reporting purposes: IVF, GIFT, zygote intrafallopian transfer (ZIFT), cryopreserved embryo transfer, donor oocyte, cryopreserved embryo transfer from donor oocytes, and ART cycles for host uterus transfer. Programs also submitted information on cycles in which intracytoplasmic sperm injection (ICSI) was performed.

For reporting purposes, cycles were divided into four categories according to the age of the woman at the time of retrieval: ≤ 34 , 35–37, 38–40, or ≥ 41 years of age. These age groups were further categorized by reported primary diagnosis. Stimulated cycles (during which ovulation induc-

tion medications were used) and unstimulated cycles were combined in each of the categories described above.

A clinical pregnancy was defined as the occurrence of at least one ultrasonography-confirmed gestational sac in the uterus (which excludes ectopic and biochemical pregnancies but includes heterotopic pregnancies). Ectopic pregnancies were reported separately. Pregnancy loss was defined as a clinical pregnancy that did not result in a delivery.

The following definitions were used in measuring outcomes. A live birth was a cycle that resulted in at least one live-born neonate, regardless of the number of other neonates and whether they were live born or stillborn. A stillbirth was a cycle that resulted in no live-born neonates and one or more stillborn neonates. The number of deliveries is equal to the sum of live birth cycles plus stillbirth cycles, which is the same as the sum of cycles that resulted in one or more live-born neonates plus cycles that resulted in all stillborn neonates. A live-born neonate was one that showed signs of life after complete expulsion or extraction from its mother. Signs of life included breathing, beating of the heart, pulsation of the umbilical cord, or definite movement of the voluntary muscles regardless of gestational age at birth. Heartbeats were distinguished from transient cardiac contractions, and respirations were distinguished from fleeting respiratory efforts or gasps. A stillborn neonate was one born at 18 weeks or later from the date of transfer that showed no signs of life after the complete expulsion or extraction from the mother and no certificate of live birth was filed. The number of neonates (infants born) is equal to the sum of live-born neonates plus stillborn neonates. The number of live-born neonates is equal to the sum of normal neonates plus neonates with structural or functional abnormalities plus neonates who had a neonatal death.

Structural or functional abnormalities were reported as follows: none, cleft palate, genetic defect, cardiac defect, limb defect, other, and unknown. Details regarding how programs obtained this information were not collected. Neonates for whom this information was reported as unknown or was not entered were tabulated as normal. The rate of structural or functional abnormalities is equal to the number of infants with at least one structural or functional abnormality per 1,000 neonates.

A neonatal death was any death that occurred before 28 days of life. The neonatal death rate is equal to the number of neonatal deaths per 1,000 live births.

RESULTS

All ART Procedures

In 1997, 335 programs reported initiating a total of 73,069 cycles of ART treatment. Of these cycles, IVF and fresh transfer of embryos derived from the patient's own oocytes (nondonor) were used in 51,344, including 18,312 cycles in which ICSI was used. There were 1,943 cycles of fresh

TABLE 1

Comparison of reported outcomes for ART procedures.^a

	Standard IVF	IVF plus ICSI	GIFT	ZIFT	Donor oocyte transfer ^c	CPE transfer	CPE transfer with donor oocyte	Host uterus transfer
No. of cycles or procedures ^b	33,032	18,312	1,943	1,104	4,616	10,181	1,584	600
Cancellations (%)	21.7	NA	14.4	10.4	6.2	6.0	4.3	6.2
No. of retrievals	25,878	18,292	1,663	989	NA	NA	NA	563
No. of transfers	24,027	17,243	1,640	911	4,122	9,165	1,467	540
Transfers per retrieval (%)	92.8	94.3	98.6	92.1	NA	NA	NA	95.9
No. of clinical pregnancies	8,975	6,072	627	346	1,978	2,185	400	226
Pregnancy loss (%)	18.1	18.5	20.4	19.9	16.6	21.3	18.8	17.3
No. of deliveries	7,353	4,949	499	277	1,650	1,719	325	187
Deliveries per retrieval (%)	28.4	27.1	30.0	28.0	NA	NA	NA	33.2
Singleton (%)	59.6	62.9	66.9	66.4	56.5	74.4	65.8	83.3
No. of ectopic pregnancies (EP)	220	102	16	11	21	60	10	1
EP transfer (%)	0.9	0.6	1.0	1.2	0.5	0.7	0.7	0.2
Abnormal neonates (%) ^e	1.6	1.7	1.9	1.6	1.9	1.8	2.0	1.9

Note: ART = assisted reproductive technology; CPE = cryopreserved embryo; NA = not applicable; ZIFT = zygote intrafallopian transfer. See text for discussion.

^a Except combination (n=1,173), research (n=40), embryo banking (n=258), and other (n=226) cycles.

^b Includes all cycles regardless of maternal age and infertility diagnosis.

^c Includes known or anonymous but not host uterus transfer or surrogate.

^d Cryopreserved embryo transfer cycles not done in combination with fresh embryo transfer and not with donor egg or embryo.

^e Reporting of structural and functional abnormality is problematic. See text for discussion.

Adamson. ASRM/SART registry 1997 results. *Fertil Steril* 2000.

nondonor GIFT and 1,104 cycles of fresh nondonor ZIFT, of which 657 employed ICSI. There were 4,616 cycles involving donor oocytes and fresh embryo transfer and 600 cycles with embryo transfer to a host uterus. In addition, 10,181 nondonor cryopreserved embryo thaw procedures and 1,584 donor oocyte-derived cryopreserved embryo thaw procedures were performed. A total of 1,173 combination cycles were performed, with 149 cycles combining nondonor fresh and cryopreserved embryos, 437 cycles combining multiple transfer methods of fresh nondonor embryos or oocytes, 407 cycles combining fresh and thawed embryos derived from donor oocytes, and 180 cycles combining other treatments. Forty cycles were reported as research, 258 as embryo banking, and 226 as other (unclassified) types. All research cycles had research protocols and consent forms approved in advance by SART.

As a result of all ART procedures and cryopreserved embryo transfers, 17,311 deliveries resulting in the birth of 25,059 babies were reported. Of the deliveries, 10,732 (62.0%) were singleton, 5,491 (31.7%) were twins, 1,010 (5.8%) were triplets, and 78 (0.5%) were of higher order than triplets.

A total of 24,184 neonates were reported as normal (96.5%), 240 as stillborn (10 per 1000 neonates, of which 24 also had a structural or functional abnormality), 411 as having a structural or functional abnormality (16 per 1000 neonates) and 224 as neonatal deaths (9 per 1000 live births).

Summary data are shown in Table 1; IVF and GIFT subsets are compared with 1996 data in Tables 2 and 3.

IVF

All Cycles

Of the 51,344 initiated cycles of IVF (with and without ICSI), 44,170 (86.0%) led to retrieval, for an overall cancellation rate of 14.0%. Of the 44,170 retrievals, 41,270 (93.4%) led to a transfer. A total of 15,047 clinical pregnancies were reported, for a clinical pregnancy rate of 29.3% per initiated cycle, 34.1% per retrieval, and 36.5% per transfer. A total of 12,302 deliveries were reported, for a delivery rate of 24.0% per initiated cycle, 27.9% per retrieval, and 29.8% per transfer. The rate of clinical pregnancy loss was 18.2%. A total of 322 ectopic pregnancies were reported, which represented 2.1% of clinical pregnancies and 0.8% of IVF transfers.

Overall, 60.9% of deliveries were singletons, 32.2% were twins, 6.3% were triplets, and 0.5% were higher-order multiple deliveries. A total of 17,396 IVF babies were reported as normal neonates. One hundred seventy-seven stillborn infants (10 per 1000 neonates) were reported, of which 42 were in singleton deliveries, 96 were in twin deliveries, and 39 were in triplet or higher-order deliveries.

There were 281 neonates with structural or functional defects (16 per 1000 neonates); among these neonates, 168 neonatal deaths were reported, for a rate of 9.5 per 1000 live

TABLE 2

IVF procedures (with and without ICSI) by maternal age group and infertility diagnosis.

Patient category	No. of retrievals	Cancelled cycles (%)	Transfers per retrieval (%)	No. of pregnancies	No. of deliveries	Deliveries per retrieval (%)	Multiple births per delivery (%)
1997 IVF procedures without ICSI							
Women ≤34 years of age, no male factor infertility	14,725	10.2	93.9	5,802	4,988	33.9	44.7
Women 35–37 years of age, no male factor infertility	7,513	14.8	94.4	2,716	2,206	29.4	38.4
Women 38–40 years of age, no male factor infertility	6,257	19.3	93.0	1,763	1,326	21.2	28.6
Women ≥41 years of age, no male factor infertility	3,682	24.4	90.0	591	345	9.4	18.8
1997 IVF procedures with ICSI							
Women ≤34 years of age, male factor infertility	6,118	7.7	94.6	2,407	2,069	33.8	40.5
Women 35–37 years of age, male factor infertility	2,739	11.9	94.0	1,010	840	30.7	34.4
Women 38–40 years of age, male factor infertility	2,130	15.4	91.9	574	425	20.0	28.6
Women ≥41 years of age, male factor infertility	1,006	19.3	89.8	184	103	10.2	25.0
Total procedures							
1997	44,170	14.0	93.4	15,047	12,302	27.9	39.0
1996	38,432	13.9	93.3	11,938	10,011	26.0	39.0

Adamson. ASRM/SART registry 1997 results. *Fertil Steril* 2000.

births. Among singleton pregnancies, 7,293 normal neonates and 117 (16 per 1000) neonates with structural or functional defects were reported. Forty (5 per 1000) neonatal deaths were reported. Among twin pregnancies, 7,634 normal neonates and 123 neonates with structural or functional defects (16 per 1000) were reported. Seventy-nine neonatal deaths (10 per 1000) were reported in twin pregnancies. Among triplet and higher-order pregnancies, 2,469 normal neonates and 41 (16 per 1000) neonates with structural or functional defects were reported. Forty-nine neonatal deaths (19 per 1000) were reported.

IVF Cycles by Age and Male Factor Infertility

All 51,344 IVF cycles were analyzed by age of the woman at the time of retrieval and by presence or absence of

male factor infertility. Overall, 44.8% of all IVF cycles were initiated in women ≤34 years of age, 23.2% in women 35–37 years of age, 20.0% in women 38–40 years of age, and 11.9% in women ≥41 years of age. Male factor diagnosis was reported in 26.3% of all IVF cycles. Table 2 shows results of the analysis for standard IVF cycles, with and without ICSI.

Among women ≤34 years of age without male factor infertility, 16,399 cycles were initiated, with a cancellation rate of 10.2%. The 14,725 retrievals and 13,825 transfers resulted in 5,802 pregnancies and 4,988 deliveries, for a delivery rate of 30.4% per initiated cycle, 33.9% per retrieval, and 36.1% per transfer. The rate of pregnancy loss was 14.0%.

TABLE 3

GIFT procedures by maternal age and infertility diagnosis.

Patient category	No. of retrievals	Cancelled cycles (%)	Transfers per retrieval (%)	No. of pregnancies	No. of deliveries	Deliveries per retrieval (%)	Multiple births per delivery (%)
Women ≤34 years of age, no male factor infertility	611	8.3	98.5	265	232	38.0	39.7
Women 35–37 years of age, no male factor infertility	333	14.8	99.1	134	109	32.7	31.5
Women 38–40 years of age, no male factor infertility	296	21.9	98.6	106	74	25.0	28.4
Women ≥41 years of age, no male factor infertility	250	19.6	98.4	61	39	15.6	15.0
Women ≤34 years of age, male factor infertility	56	1.8	100.0	20	17	30.4	41.2
Women 35–37 years of age, male factor infertility	31	8.8	100.0	13	10	32.3	50.0
Women 38–40 years of age, male factor infertility	46	17.9	93.5	14	8	17.4	0.0
Women ≥41 years of age, male factor infertility	40	18.4	100.0	14	10	25.0	10.0
Total GIFT procedures							
1997	1,663	14.4	98.6	627	499	30.0	33.3
1996	2,409	16.3	98.8	834	698	29.0	34.0

Adamson. ASRM/SART registry 1997 results. *Fertil Steril* 2000.

TABLE 4

IVF according to quartiles for an individual clinic's cycle volume and quartile group's cycle volume.

Clinic quartiles ^a	All cycles				Sample ^b	
	Annual cycle volume	Total cycles in quartile	No. of clinics in quartile	Median no. of cycles per clinic	No. of cycles	Deliveries per cycle (%)
A	<190	18,179	215	112	6,982	27.4
B	190–357	17,054	65	269	5,773	32.5
C	360–778	19,432	40	515	6,197	30.5
D	>786	18,404	15	1,407	5,629	34.3
W	<63	3,152	84	44	1,240	27.1
X	64–125	7,629	84	94	2,996	26.4
Y	126–260	15,683	83	198	5,567	30.7
Z	>263	46,605	84	828	14,778	32.3

^a See text for explanation of quartiles.^b Sample group is IVF treatment of women ≤ 34 years of age with all infertility diagnoses.Adamson. ASRM/SART registry 1997 results. *Fertil Steril* 2000.

There were 8,819 cycles in women 35–37 years of age without male factor infertility, with a cancellation rate of 14.8%. The 7,513 retrievals and 7,094 transfers resulted in 2,716 pregnancies and 2,206 deliveries, for a delivery rate of 25.0% per initiated cycle, 29.4% per retrieval, and 31.1% per transfer. The rate of pregnancy loss rate was 18.8%.

Among women 38–40 years of age without male factor infertility, 7,757 cycles were initiated, with a cancellation rate of 19.3%. The 6,257 retrievals and 5,817 transfers resulted in 1,763 pregnancies and 1,326 deliveries, for a delivery rate of 17.1% per initiated cycle, 21.2% per retrieval, and 22.8% per transfer. The rate of pregnancy loss was 24.8%.

There were 4,871 cycles in women ≥ 41 years of age without male factor infertility, with a cancellation rate of 24.4%. The 3,682 retrievals and 3,313 transfers resulted in 591 clinical pregnancies and 345 deliveries, for a delivery rate of 7.1% per initiated cycle, 9.4% per retrieval, and 10.4% per transfer. The rate of pregnancy loss was 41.6%.

Among women ≤ 34 years of age with male factor infertility, 6,625 cycles were initiated, with a cancellation rate of 7.7%. The 6,118 retrievals and 5,786 transfers resulted in 2,407 pregnancies and 2,069 deliveries, for a delivery rate of 31.2% per initiated cycle, 33.8% per retrieval, and 35.8% per transfer. The rate of pregnancy loss was 14.0%.

There were 3,108 cycles in women 35–37 years of age with male factor infertility, with a cancellation rate of 11.9%. The 2,739 retrievals and 2,575 transfers resulted in 1,010 pregnancies and 840 deliveries, for a delivery rate of 27.0% per initiated cycle, 30.7% per retrieval and 32.6% per transfer. The rate of pregnancy loss was 16.8%. Among women 38–40 years of age with male factor infertility, 2,518 cycles were initiated, with a cancellation rate of 15.4%. The 2,130 retrievals and 1,957 transfers resulted in 574 pregnancies and

425 deliveries, for a delivery rate of 16.9% per initiated cycle, 20.0% per retrieval, and 21.7% per transfer. The rate of pregnancy loss was 26.0%. There were 1,247 cycles in women ≥ 41 years of age with male factor infertility, with a cancellation rate of 19.3%. The 1,006 retrievals and 903 transfers resulted in 184 pregnancies and 103 deliveries, for a delivery rate of 8.3% per initiated cycle, 10.2% per retrieval, and 11.4% per transfer. The rate of pregnancy loss was 44.0%.

Analysis of Clinics by ART Volume

To assess the effect of clinic volume on outcomes, two analyses were performed. To standardize the comparison of clinics, the sample population for these analyses included only women ≤ 34 years of age. In the first analysis, the total number of ART cycles was divided into roughly equal quartiles of approximately 18,000 cycles each. Clinics were then distributed within the quartiles by clinic volume. Thus, quartile A consisted of a large number of the smallest programs and quartile D consisted of a small number of the largest programs. An ART program or clinic was defined as a legal entity practicing under state law, recognizable to the consumer, that provides ART to couples who have experienced infertility or are undergoing ART procedures for other reasons. The number of retrievals and the average delivery rate per cycle were compared among quartiles (Table 4).

In quartile A, 215 clinics performed 18,179 total ART cycles, with a median volume of 112 cycles per clinic. Quartile A clinics reported 6,982 IVF cycles in the sample population, with an average delivery rate of 27.4% per cycle. The 65 clinics that formed quartile B reported 17,054 total cycles, with a median volume of 269 cycles. Quartile B clinics reported 5,773 cycles in the sample population, with 32.5% of cycles resulting in a delivery. In the 40 clinics that made up quartile C, 19,432 cycles were performed. Quartile

C clinics performed 6,197 cycles in the sample population, with an average delivery rate of 30.5% per cycle. A total of 18,404 cycles were performed at the 15 clinics (4.5% of all clinics) included in quartile D; the median volume was 1,407 cycles. In quartile D clinics, 5,629 cycles were performed in the sample population, with an average delivery rate of 34.3% per cycle.

In the second analysis of cycle volume, clinics were divided into four quartiles of approximately 84 clinics each. Quartile W comprised clinics performing <63 cycles. Quartile W clinics performed 3,152 cycles (median volume, 44 cycles) and reported 1,240 cycles in the sample population, with an average delivery rate of 27.1% per cycle. Quartile X comprised clinics that performed 64–125 cycles; these clinics performed a total of 7,629 cycles and a median of 94 cycles. Quartile X clinics performed 2,996 cycles in the sample population, with an average delivery rate of 26.4% per cycle. Clinics performing 126–260 cycles formed quartile Y. In these clinics, a total of 15,683 cycles were performed (median, 198 cycles), and 5,567 cycles were performed in the sample population, with an average delivery rate of 30.7% per cycle. The 84 largest clinics (those that reported >263 cycles) performed 46,605 cycles (63.8% of all cycles). The median cycle volume for quartile Z clinics was 828 cycles. Quartile Z clinics performed 14,778 cycles in the sample population, with an average delivery rate of 32.3% per cycle.

ICSI

A total of 20,932 ART cycles and 19,587 transfers involved embryos fertilized by using ICSI. Overall, 7,083 clinical pregnancies were established, resulting in 5,772 deliveries (62.6% singleton, 31.8% twin, 5.1% triplet, and 0.5% higher-order gestations). The pregnancy loss rate was 18.5%. There were 8,066 normal neonates delivered, 138 neonates with structural or functional abnormalities (17 per 1000 neonates), and 76 neonatal deaths (9 per 1000 live births). One hundred nineteen ectopic pregnancies occurred.

Fertilization with ICSI was done in 18,312 of 51,344 IVF cycles (35.7%). The clinical pregnancy rate for IVF cycles using ICSI was 33.2% per initiated cycle, 33.2% per retrieval, and 35.2% per embryo transfer (compared with 27.2%, 34.7%, and 37.4%, respectively, in IVF cycles without ICSI). The delivery rate for IVF cycles using ICSI was 27.0% per initiated cycle, 27.0% per retrieval, and 28.7% per embryo transfer (compared with 22.3%, 28.4%, and 30.6%, respectively, for cycles without ICSI). In IVF cycles using ICSI, the cancellation rate was zero because the data entry software required reported cycles to progress to retrieval before ICSI could be selected as the cycle type. This policy probably artificially elevated the cancellation rate in non-ICSI IVF cycles (21.7%), because there were probably a number of circumstances in which ICSI was planned but cycles were cancelled.

The average age of female patients undergoing IVF cycles with ICSI was 34.6 years, compared with 35.3 years in women undergoing IVF cycles without ICSI. The rate of structural or functional anomalies for ICSI patients (23 per 1000) did not differ from that among non-ICSI patients (22 per 1000). The rate of neonatal death for ICSI patients (13 per 1000) did not differ from that for non-ICSI patients (14 per 1000). The rate of ectopic pregnancy for ICSI patients was 1.7% per clinical pregnancy, compared with 2.5% for non-ICSI patients.

Of 1,104 initiated ZIFT cycles, 657 (59.5%) were performed with ICSI. The clinical pregnancy rate for ZIFT cycles using ICSI was 37.7% per initiated cycle, 37.7% per retrieval, and 40.3% per embryo transfer (compared with 21.9%, 29.5%, and 33.2%, respectively, in ZIFT cycles without ICSI). The delivery rate for ZIFT cycles using ICSI was 30.0% per initiated cycle, 30.0% per retrieval, and 32.0% per embryo transfer (compared with 17.9%, 24.1%, and 27.1% in cycles without ICSI). In ZIFT cycles using ICSI, the cancellation rate per initiated cycle was zero, compared with 25.7% in ZIFT cycles without ICSI, and the rate of ectopic pregnancy was 2.8% per clinical pregnancy (compared with 4.1% in ZIFT cycles without ICSI). The average age was 33.7 years among women undergoing ZIFT cycles with ICSI and 35.7 years among women undergoing ZIFT cycles without ICSI.

Of 4,616 initiated fresh donor oocyte and fresh donor embryo cycles, 1,351 (29.3% of all donor cycles) were performed with ICSI. The clinical pregnancy rate for donor cycles using ICSI was 46.4% per embryo transfer and the delivery rate was 38.0% per embryo transfer, compared with 48.7% and 41.0%, respectively, in cycles without ICSI. The rate of ectopic pregnancy was 1.2% per clinical pregnancy among donor cycles using ICSI and 1.0% among those without ICSI; the average age was 41.0 years in recipients of donor cycles using ICSI and 40.6 years in recipients of donor cycles without ICSI.

GIFT

All Cycles

One hundred thirty-nine programs reported 1,943 cycles of GIFT. A total of 1,663 retrievals (85.6% of cycles) and 1,640 transfers (98.6% of retrievals) were performed. These resulted in 627 clinical pregnancies, for a clinical pregnancy rate of 32.3% per initiated cycle, 37.7% per retrieval, and 38.2% per gamete transfer. There were 499 deliveries, for a delivery rate of 25.7% per initiated cycle, 30.0% per retrieval, and 30.4% per gamete transfer. Sixteen ectopic pregnancies were reported, representing a rate of 1.0% per transfer and 2.6% per clinical pregnancy.

A total of 683 GIFT infants were born, of which 66.9% were singletons, 29.3% were twins, and 3.8% were triplets. There were 6 stillbirths. Six hundred sixty-three infants were

reported as normal neonates. Thirteen had structural or functional abnormalities (19 per 1000 neonates). One neonatal death was reported (1 per 1000 live births). The incidence of neonates with structural or functional abnormalities and neonatal death did not differ for GIFT compared with IVF.

GIFT Cycles by Age and Male Factor

Cycles of GIFT were stratified according to age of the woman at retrieval and presence or absence of male factor infertility. Overall, 37.2% of GIFT cycles were initiated in women ≤ 34 years of age, 21.9% in women 35–37 years of age, 22.4% in women 38–40 years of age, and 18.5% in women ≥ 41 years of age. Male factor infertility was reported in 10.1% of GIFT cycles. Results in each category are shown in Table 3.

In women ≤ 34 years of age with no male factor infertility, 666 cycles were initiated, with 611 retrievals (8.3% cancellation rate) and 602 gamete transfers; 265 clinical pregnancies and 232 deliveries resulted. The delivery rate in this subgroup was 34.8% per initiated cycle, 38.0% per retrieval, and 38.5% per gamete transfer. The pregnancy loss rate was 12.5%.

In women 35–37 years of age with no male factor infertility, 391 cycles were initiated. There were 333 retrievals (14.8% cancellation rate), and 330 gamete transfers; 134 clinical pregnancies and 109 deliveries resulted. The delivery rate in this subgroup was 27.9% per initiated cycle, 32.7% per retrieval, and 33.0% per gamete transfer. The pregnancy loss rate was 18.7%.

In women 38–40 years of age with no male factor infertility, 379 cycles were initiated. There were 296 retrievals (21.9% cancellation rate) and 292 gamete transfers; 106 clinical pregnancies and 74 deliveries resulted. The delivery rate in this subgroup was 19.5% per initiated cycle, 25.0% per retrieval, and 25.3% per gamete transfer. The pregnancy loss rate was 30.2%.

In women ≥ 41 years of age with no male factor infertility, 311 cycles were initiated. Two hundred fifty retrievals (19.6% cancellation rate) and 246 gamete transfers were performed; 61 clinical pregnancies and 39 deliveries resulted. The delivery rate in this subgroup was 12.5% per initiated cycle, 15.6% per retrieval, and 15.9% per gamete transfer. The pregnancy loss rate was 36.1%.

In women ≤ 34 years of age with male factor infertility, 57 cycles were initiated. Fifty-six retrievals (1.8% cancellation rate) and 56 gamete transfers were done. Twenty clinical pregnancies and 17 deliveries were reported. The delivery rate in this subgroup was 29.8% per initiated cycle, 30.4% per retrieval, and 30.4% per gamete transfer. The pregnancy loss rate was 15.0%.

In women 35–37 years of age with male factor infertility, 34 cycles were initiated and 31 retrievals (8.8% cancellation rate) and 31 gamete transfers were performed. Thirteen clin-

ical pregnancies and 10 deliveries resulted. The delivery rate in the subgroup was 29.4% per initiated cycle, 32.3% per retrieval, and 32.3% per gamete transfer. The pregnancy loss rate was 23.1%.

In women 38–40 years of age with male factor infertility, 56 cycles were initiated and 46 retrievals (17.9% cancellation rate) and 43 gamete transfers were performed. Fourteen clinical pregnancies and 8 deliveries resulted. The delivery rate in the subgroup was 14.3% per initiated cycle, 17.4% per retrieval, and 18.6% per gamete transfer. The pregnancy loss rate was 42.9%.

In women ≥ 41 years of age with male factor infertility, 49 cycles were initiated and 40 retrievals (18.5% cancellation rate) and 40 gamete transfers were performed. Fourteen clinical pregnancies and 10 deliveries were reported. The delivery rate in this subgroup was 20.4% per initiated cycle, 25.0% per retrieval, and 25.0% per gamete transfer. The pregnancy loss rate was 28.6%.

Additional ART

ZIFT

Ninety-three programs reported initiating 1,104 ZIFT cycles, with 989 retrievals, (10.4% cancellation rate) and 911 transfers (92.1% of retrievals). As a result, 346 clinical pregnancies were established and 277 deliveries occurred, for a delivery rate of 25.1% per initiated cycle, 28.0% per retrieval, and 30.4% per zygote transfer. Eleven ectopic pregnancies were reported (1.2% per transfer and 3.2% per clinical pregnancy). Of the deliveries, 66.4% were singletons, 28.5% were twins, 4.7% were triplets, and 0.4% were of a higher order than triplets. A total of 385 live-born infants were reported, 6 of which had structural or functional abnormalities (16 per 1000 neonates). Three neonatal deaths (8 per 1000 live births) were reported. The incidence of neonates with structural or functional abnormalities and neonatal death did not differ for ZIFT and IVF.

Donor Oocytes and Donor Embryos

Two hundred thirty-one programs reported use of donor oocytes. Known and anonymous donor cycles were reported together. A total of 4,616 cycles were initiated and 4,122 transfers were performed. The number of cases in which one donor's oocytes were used for multiple recipients is unknown.

Clinical pregnancies were reported in 1,978 cycles, for a clinical pregnancy rate of 48.0% per embryo transfer. There were 1,650 deliveries, for a delivery rate of 40.0% per transfer. A total of 2,458 live-born infants were reported, of which 56.5% were singleton, 37.5% were twin, 5.8% were triplet, and 0.2% were higher-order deliveries. Twenty-one ectopic pregnancies were reported (0.5% per transfer and 1.1% per clinical pregnancy). Forty-seven infants had structural or functional abnormalities (19 per 1000 neonates), and

24 neonatal deaths (10 per 1000 live births) occurred. The incidence of neonates with structural or functional abnormalities and neonatal death did not differ for donor oocytes and embryos compared with nondonor IVF.

Cryopreserved Embryo Transfer

Three hundred eighteen programs (94.9%) reported transfer of cryopreserved nondonor embryos as a separate procedure using eggs obtained from the intended recipient, for a total of 10,181 thaw and 9,165 transfer procedures (90.0% of thaws resulting in transfer). Clinical pregnancies resulted in 2,185 cycles (21.5% of thaw and 23.8% of transfer procedures) with 1,719 deliveries, for a delivery rate of 16.9% per thaw and 18.8% per transfer procedure. Cryopreserved embryo transfers from donated oocytes were used in 1,584 thaw and 1,467 transfer procedures, resulting in 400 clinical pregnancies (clinical pregnancy rate, 25.3% per thaw and 27.3% per transfer procedure) and 325 deliveries (delivery rate, 20.5% per thaw and 22.2% per transfer procedure). A total of 2,653 live-born infants resulted from 2,044 deliveries with known outcome from all cryopreserved embryo transfers, including donated oocytes. A total of 2,580 normal infants, 49 infants with structural or functional abnormalities (18 per 1000 neonates), and 24 neonatal deaths (9 per 1000 live births) were reported. The incidence of neonates with structural or functional abnormalities and neonatal death did not differ for transfer of cryopreserved embryos compared with nondonor IVF.

Host Uterus Transfer

A total of 123 programs reported performing host uterus cycles, in which embryos generated from the intended parenting couple were placed in a gestational carrier. Six hundred such cycles were initiated, resulting in 540 transfers (transfer rate, 90.0% per cycle). Clinical pregnancies were reported in 226 cycles, for a rate of 37.7% per initiated cycle and 41.9% per embryo transfer. A total of 187 deliveries were reported, which included 59.9% singleton, 36.4% twin, 2.4% triplet, and 0.5% higher-order births. The delivery rate was 31.2% per initiated cycle and 34.6% per transfer. One ectopic pregnancy was reported. Two hundred sixty-five neonates were normal, and 5 had structural or functional abnormalities (19 per 1000 neonates). No neonatal deaths were reported. The incidence of neonates with structural or functional abnormalities and neonatal death did not differ for host uterus transfer and nondonor IVF.

DISCUSSION

The SART, along with the CDC, has attempted to identify all programs in the United States that provide ART services. Of 335 reporting programs, 323 (96.4%) were SART members. It is thought that because of compelling professional, public, and governmental concerns about ART, almost all programs that provide ART services are now reporting their

data. The objective of SART is to collect data from all U.S. ART programs. Annual reporting of data is a requirement of SART membership.

In 1997, the number of programs reporting data to the ASRM/SART Registry increased by 11.7% and the number of procedures reported increased by 10.9% compared with 1996 (4). In contrast, the corresponding values from 1995 to 1996 were a 6.8% increase in reporting clinics and a 11.4% increase in procedures performed (5). In 1997, the number of IVF cycles increased by 15.0%, the number of GIFT cycles decreased by 32.5%, and the number of ZIFT cycles decreased by 8.0% compared with 1996.

The overall success rates of IVF, GIFT, ZIFT, cryopreserved embryo transfer, and donor oocyte transfer (as measured in deliveries per transfer) increased from 26.9% in 1996 to 28.6% in 1997, for a relative increase of 6.3%. The success rate of IVF procedures increased in 1997 compared with 1996, with respective delivery rates per retrieval of 27.9% and 26.0%. Delivery rates for GIFT cycles increased to 30.0% per retrieval in 1997 compared with 29.0% in 1996. The delivery rate for ZIFT declined to 28.0% per retrieval in 1997 from 30.9% in 1996. Therefore, the success rates of IVF and ZIFT in 1997 did not differ meaningfully from each other, in contrast to prior years (4, 5).

Although the success rate of GIFT remained higher than that of IVF in 1997 ($P < .0005$, χ^2 test), no consensus exists on an explanation for this difference. Cycle profiles reveal different age distributions, diagnostic categories, and numbers of gametes or embryos transferred per patient. These and other factors may influence changes in success rates from year to year (6). Of note, because hundreds of statistical calculations are performed in evaluating the registry data, many statistically significant results will occur by chance alone. The SART continues to work with the CDC to standardize definitions, data collection, and analysis wherever possible, so that registry data can be better analyzed from year to year for stability of results and trends. This approach will help SART identify clinically meaningful differences.

Rates of cycle cancellation in 1997 (13.9% of all initiated IVF, GIFT, and ZIFT cycles) did not differ from 1996 rates (14.0% of all initiated IVF, GIFT, and ZIFT cycles). The cancellation rate for IVF procedures (14.0%) in 1997 was similar to the 1996 rate of 13.9% of reported cycles. The highest rate of transfers per retrieval (98.6%) is still seen among GIFT procedures, reflecting the fact that fertilization is not a prerequisite for transfer; in contrast, IVF and ZIFT procedures yielded respective transfer rates of 93.4% and 92.1% per retrieval. Cancellation rates and transfers per retrieval are combined to determine the rate of transfer per initiated cycle. The transfer rate per initiated cycle was higher among GIFT and ZIFT cycles (84.4% and 82.5%, respectively) than among IVF cycles (80.4%).

The current data demonstrate the ongoing profound effect

of age on ART success. In IVF, GIFT, ZIFT, and nondonor cryopreserved embryo transfer cycles, the likelihood of success (measured in deliveries per transfer) for women ≥ 41 years of age was 48.9% lower than that for women 38–40 years of age, 62.8% lower than that for women 35–38 years of age, and 67.2% lower than that for women ≤ 34 years of age. The likelihood of success for women 38–40 years of age was 27.2% lower than that for women 35–37 years of age and 36.9% lower than that for women ≤ 34 years of age. Women 35–37 years of age had a 11.9% lower likelihood of success than women ≤ 34 years of age. The greatest effect of age was seen in IVF cycles: Women >41 years of age experienced a 52.8% lower success rate than women 38–40 years of age. Age was less of a factor in determining success only in donor oocyte cycles (fresh or cryopreserved) and host uterus transfer cycles. The cut-off ages of 35, 38, and 41 years at the time of retrieval were selected arbitrarily; future efforts to analyze data by an individual woman's age will enable more precise determination of probabilities for populations of women at each age.

The effect of male factor infertility on pregnancy rates continues to be less pronounced than before 1995, suggesting that clinics with proficiency in ICSI may be able to mitigate the effects of male factor infertility. This technique was used in approximately 35.7% of all IVF cycles, and 1997 was the third consecutive year of widespread use of this more successful approach to treatment of male factor infertility. When all IVF cycles were classified by male factor and other diagnoses, patients with male factor infertility experienced a higher delivery rate per retrieval (25.5%) than those with other diagnoses (23.4%). Data were not collected on the ability of sperm function assays, morphology assessments, or antibodies to influence ART outcomes. None of these characteristics were included in the definition of male factor infertility for this reporting interval.

The incidence of ectopic pregnancies for all procedures was 0.7% per transfer and 2.1% per clinical pregnancy. These values compare favorably to an estimated overall incidence of ectopic pregnancy in the United States of 2% per reported pregnancy (7).

The incidence of multiple gestations was also determined. When classified by cycle type, the percentage of singleton deliveries ranged from 74.4% for cryopreserved embryo transfer cycles to 56.5% for donor oocyte transfer cycles. Twin deliveries accounted for 82.5% of all multiple deliveries and 32.2% of all deliveries. Higher-order multiples formed the remainder of multiple deliveries. The 781 triplet deliveries accounted for 6.3% of all deliveries and 16.2% of all multiple deliveries; 60 quadruplet deliveries represented 0.5% of all deliveries and 1.2% of all multiple deliveries; and 3 quintuplet deliveries represented $<0.025\%$ of all deliveries. The rate of multiple pregnancy was unchanged for 1995, 1996, and 1997 (3, 4). This incidence of prematurity was not analyzed.

TABLE 5

Structural and functional abnormalities and neonatal deaths.^a

	All deliveries	Singletons	Twins	Triplets and higher-order multiples
Structural and functional abnormality rate (%)	1.6	1.6	1.7	1.7
Neonatal death rate (%)	0.9	0.5	1.0	2.0

^a Reporting of structural and fundamental abnormalities and neonatal deaths is problematic. See text for discussion.

Adamson. ASRM/SART registry 1997 results. *Fertil Steril* 2000.

In IVF cycles, singletons represented 80.1% of deliveries in women ≥ 41 years of age group but only 56.2% of deliveries in women <34 years of age. The average number of embryos transferred was 3.0; this value varied negligibly by age in the three younger age groups. The average number of embryos transferred in women ≥ 41 years of age was 2.7, probably reflecting compromised oocyte production in some of the women.

Concern over the higher incidence of adverse outcomes associated with multiple pregnancy has led SART to establish new guidelines recommending the number of embryos or oocytes to be transferred in certain patient populations (8). These guidelines are based on analysis of the U.S. experience as reported to SART (9). The effect of implementation of these guidelines, which were released in November 1999, will not be known for several years. Whether new technologies, such as blastocyst culture, will substantially affect the incidence of high-order multiple pregnancies is also yet to be determined.

Questions have been raised about rates of congenital anomalies in IVF, especially with ICSI. This issue is difficult to address because of the numerous factors that confound detection and reporting of congenital anomalies. A comprehensive discussion of this issue is beyond the scope of this article. However, while acknowledging significant limitations of the data currently available from SART and others, SART is publishing these data on structural and functional abnormalities and neonatal deaths because of concerns that have been expressed about adverse outcomes associated with ART. SART acknowledges a responsibility to increase awareness of adverse outcomes because such awareness may engender strategies to promote their reduction. The perspective of the CDC on this issue is presented in the Commentary section following the article.

The available SART data on neonatal abnormalities and deaths among singletons, twins and triplets or higher-order pregnancies in 1997 are summarized in Table 5. Because of the method used to collect these data (see Materials and Methods) abnormalities are described as “structural and

functional abnormalities.” This case definition may include some conditions not generally considered birth defects, and exclude others. The definition of an abnormality differs from that of birth defects in population-based monitoring systems, making meaningful comparison of rates difficult, if not impossible. Additionally, when the structural or functional abnormality status was reported as unknown, neonates were categorized as normal. This affected 1,275 of 24,184 (5.3%) normal neonates. If some unknown cases had structural or functional abnormalities this could increase the prevalence rate.

Case ascertainment is problematic because the method of obtaining information about outcomes, including structural and functional abnormalities, was not standardized documented. If programs rely on patient report, under-ascertainment of abnormalities is likely. For example, comparing maternal report regarding birth defects in offspring to data abstracted from the medical records, Rasmussen et al; found that the sensitivity of maternal report was about 60% (10). On the other hand, if reports were not validated by review of medical records, an overestimation of the number of abnormalities may have occurred.

Other variables confounding data collection, analysis, and interpretation include, but are not limited to, effect of racial heterogeneity, socioeconomic factors, relative prevalence of major versus minor malformations, the occurrence of multiple malformations in one child, inclusion or exclusion of abortus and stillbirth anomalies, differences in coding data, and variation in reporting.

The neonatal death rate was 0.9% and the rate of structural and functional abnormalities was 1.6%. Data reported to the National Center for Health Statistics (NCHS) for 1996 showed an infant mortality of 0.72% for the United States general population (11). The National Birth Defects Prevention Network (NBDPN) reported a congenital anomaly rate on 47 specific birth defects for all races at 1.2% (12). However, the NBDPN data did not include all birth defects, but only common birth defects likely to be diagnosed during the birth hospitalization. Given differences in case definitions, ascertainment and socio-demographic characteristics of populations, comparisons between studies may not be valid. It is also not known whether ART and non-ART populations are similar in underlying risk factors for birth defects. The prevalence of structural and functional abnormalities in our population may also be affected by the rate of pregnancy termination for abnormalities, which was not reported (13).

The neonatal death rate for twins is approximately twice that for singletons. For triplets or higher order multiples the neonatal death rate is four times the singleton rate. The abnormality rate in our study was not different for singletons, twins and triplets or high order multiple pregnancies. Other studies have suggested a higher rate of birth defects in multiple pregnancies. Our results could reflect incomplete case ascertainment, differences between ART or non-ART

populations or other confounding factors. The neonatal death rate was 0.9% with ICSI compared to 1.0% for non-ICSI patients. The data also show an abnormality rate for all ages of 1.7% with ICSI and 1.6% for non-ICSI patients. These rates do not appear to be materially different for ICSI and non-ICSI patients. These rates do not appear to be materially different for ICSI and non-ICSI patients. However, certain abnormalities clearly can result from the use of ICSI in selected males with specific genetic conditions that can be transmitted through the ICSI procedure (14). Data from Brussels where ICSI was first developed and where follow-up studies have been performed on the ICSI children revealed 9 sex-chromosomal and 14 autosomal aberrations and 19 inherited structural aberrations in 1,437 fetuses, for a total rate of 2.9%, suggesting a possible increase in selected cases compared to a control population (14). Data on specific abnormalities were not collected in our study. Furthermore, sample sizes for subgroups of patients could be so small that the ability to detect clinically significant differences would be limited.

The Human Fertilization and Embryology Authority (HFEA) in the United Kingdom reported “developmental defects and syndromes” at 1.3% of all ART procedures, and for micromanipulation procedures of 1.6% (15). The French national IVF registry has reported IVF malformations at 2.8% and the general population at 2.1% (16). This report concluded that “the prevalence of congenital malformations is not higher than after natural conception” and the malformation rate was not different that that reported by other similar studies. The singleton stillbirth rate was also not different at 0.60% for IVF patients compared to 0.61% for the general population. The singleton perinatal mortality associated with IVF was 0.65% compared to the general population of 0.64%. Comparison of data from different countries is associated with the potential for national differences in underlying risk factors for birth defects.

Overall, the current data do not suggest a generally higher stillbirth, abnormality or neonatal death rate, but they also do not confirm that there are no untoward effects, especially in selected populations. Further efforts are needed to address limitations of data on birth outcomes. Future studies should include not only IVF and ICSI offspring, but also case-controls from non-ART infertile populations and from populations with normal fertility.

Overall, the data do not suggest generally higher rates of stillbirth, abnormality, or neonatal death, but neither do they confirm that no untoward effects occur, especially in selected populations. The data on ICSI are more problematic, as certain abnormalities clearly can result from the use of ICSI in selected men with specific genetic conditions that can be transmitted through the ICSI procedure (14). Further studies are needed to address in more detail outcomes from IVF and ICSI. Such studies must include not only IVF and ICSI

offspring but also case-controls from non-ART infertile populations and from populations with normal fertility.

SUMMARY

The number of programs reporting data, the number of cycles of ART performed, and the overall probability of success with ART all increased in 1997. The 10.9% increase in number of cycles reported may be attributable to a higher percentage of active clinics reporting data and to the inclusion of data from non-SART members in this report. The increased reporting activity probably relates to the implementation of the federal 1992 Fertility Clinic Success Rate and Certification Act. The 11.7% increase in clinics reporting data may also be attributed to the enforcement of the CDC's definition of a reporting clinic, which requires discrete business entities completing treatments at the same laboratory to report separately. The continued efforts of SART to ease the burden of ART reporting, the requirement of all SART member clinics to report their results, and the requirement to participate in the on-site validation process or lose their SART membership have also probably increased compliance with reporting.

The overall delivery rate per transfer increased from 27.0% in 1996 to 28.7% in 1997. This represents an absolute increase of 1.7 percentage points and a 6.3% relative increase. Combined with a 10.8% increase in transfers, this resulted in 2,609 additional deliveries, a 17.7% increase. The dominant adverse effect of age on outcomes was corroborated, whereas male factor infertility now appears to have a limited effect on outcomes because of the availability of ICSI. The number of couples receiving fresh and frozen oocyte donation and cryopreserved embryo cycles (increases of 44.5%, 22.5%, and 5.9%, respectively) continues to increase. These cycle types also exhibited increases in live birth per transfer success rates of 6.3%, 2.3%, and 11.5% respectively relative to 1996.

Outcomes of IVF pregnancies are adversely affected by multiple pregnancies. Both guidelines for embryo transfer and improved laboratory technology should help ameliorate this problem. Otherwise, outcomes matched for singletons, twins, or higher-order pregnancies appear to be no different than those in the general population; however, good long-term follow-up studies are needed.

COMMENTS

This is the first annual report written by the President of SART and the Chair of the Registry Committee for the year during which the data were actually reported to the SART and CDC, in accordance with recently-enacted SART Executive Council policy. This activity report for the year 1997 is the second report in which ART outcome reporting is compiled solely from patient- and cycle-specific data submitted by ART programs to SART in cooperation with the CDC.

The functions of data collection and future validation will continue to be carried out under the auspices of the SART Executive Council and the CDC, with input from the SART Registry, Validation, Quality Assurance and Research Committees and the National Coalition for the Oversight of ART (NCOART). The ASRM and SART believe that the efforts of the SART Executive Council, SART committees, and the CDC in data reporting and laboratory accreditation will facilitate compliance by ART programs with the Fertility Clinic Success Rate and Certification Act of 1992.

G. David Adamson, M.D.

President, SART 1998–1999

Robert G. Brzyski, M.D., Ph.D.

Chair, Registry Committee 1998–1999

Acknowledgments: SART officers for 1998–1999 were G. David Adamson, M.D., Philip I McNamee, M.D., David I. Hoffman, M.D., James A. Grifo, M.D., Ph.D., and Bill Yee, M.D. The Society for Assisted Reproductive Technology thanks all its committees and the individuals involved in the generation of this report for their hard work and dedication. In particular, Joyce Zeitz, Executive Administrator, Society for Assisted Reproductive Technology; C. Martin Beaird, The November Group, Inc.; Matthew V. Scott and Jun Wang, Redshift Technologies, Inc., and Gary Jeng, Ph.D., Centers for Disease Control and Prevention, are thanked for their invaluable assistance. The data for each reporting program were published separately in the annual Clinic Specific Report for 1997. Programs that submitted data were as follows: Alabama: University of Alabama at Birmingham, Birmingham; ART Program of Alabama, Birmingham; Center for Reproductive Medicine, Mobile; University of South Alabama IVF and ART Program, Mobile. Arizona: Fertility Treatment Center, Chandler; West Valley Fertility Center, Glendale; IVF Phoenix, Arizona Institute of Reproductive Medicine, Ltd., Samaritan Institute of Reproductive Medicine, and Southwest Fertility Center, Phoenix; Mayo Clinic Scottsdale and Arizona Center for Fertility Studies, Scottsdale; Reproductive Endocrinology and Infertility, Tucson. Arkansas: University of Arkansas for Medical Sciences IVF and Intraovaginal Culture Fertilization Program, Little Rock. California: Alta Bates In Vitro Fertilization Program, Berkeley; West Coast Infertility Medical Clinic, Inc., Reproductive Medicine and Surgery Associates, Donald N. Adler, M.D. and Hal C. Danzer, M.D., Beverly Hills; Greater Valley Center for Reproductive Medicine and Gil N. Mileikowsky, M.D., Encino; West Coast Fertility Centers, Fullerton; Werlin-Zarutskie Fertility Centers, Irvine; Scripps Clinic, La Jolla; Jane L. Frederick, M.D., Inc., Laguna Hills; Loma Linda University Center for Fertility and IVF, Loma Linda; University Infertility Associates/CARC, Long Beach; University of California, Los Angeles Fertility Center, and University of Southern California Reproductive Endocrinology and Infertility, Los Angeles; Brian Su, M.D., Monterey Park; Southern California Center for Reproductive Medicine and Reproductive Specialty Institute (formerly CDM Institute), Newport Beach; Northridge Center for Reproductive Medicine, Northridge; Susan P. Willman, M.D., Orinda; Nova In Vitro Fertilization, Palo Alto; Huntington Reproductive Center, Pasadena; Reproductive Sciences Center, Poway; Center for Advanced Reproductive Care and Pacific Coast Reproductive Center, Redondo Beach; Northern California Fertility Medical Center, Roseville; University of California Davis Assisted Reproductive Technology Program, Sacramento; IGO Medical Group of San Diego, Smotrich Center for Reproductive Enhancement, Sharp Fertility Center, and Reproductive Endocrine Associates, San Diego; University of California, San Francisco

In Vitro Fertilization Program, Simon Henderson M.D., Pacific Fertility Center-San Francisco, San Francisco Center for Reproductive Medicine, and Astarte Fertility Center, San Francisco; Fertility and Reproductive Health Institute of Northern California and Carmelo S. Sgarlata, M.D., San Jose; Reproductive Science Center of the Bay Area, San Ramon; Parker-Rosenman-Rodi Gynecology & Infertility Medical Group and Center for Assisted Reproductive Medicine/CFA, Santa Monica; North Bay Fertility Center, Inc., Santa Rosa; Stanford University IVF/ART Program, Stanford; The Fertility Institutes; California, Nevada, Tarzana; Infertility and Gynecology Institute, Valley Center for Reproductive Health, and Center for Human Reproduction, Los Angeles, Tarzana; San Antonio Fertility Center, Upland. Colorado: Colorado Springs Center for Reproductive Health, Colorado Springs; Colorado Reproductive Endocrinology, P.C., Denver; University of Colorado Health Sciences Center—Center for Reproductive Medicine, Denver; The Center for Reproductive Technology, Englewood; Rocky Mountain Center for Reproductive Medicine, Fort Collins; Conceptions Reproductive Associates, Littleton. Connecticut: University of Connecticut Health Center, Farmington; Hartford Fertility and Reproductive Endocrinology, Hartford; Yale University In-Vitro Fertilization Program, New Haven; Michael B. Doyle, M.D., Norwalk; The Stamford Hospital and New England Fertility Institute, Stamford. Delaware: The Center for Human Reproduction—Delaware, P.A., Newark; Reproductive Associates of Delaware, Wilmington. District of Columbia: The George Washington University Medical Center, Reproductive Science Center Walter Reed Army Medical Center, and Columbia Hospital for Women ART Program. Florida: Boca Fertility and Palm Beach Fertility Center, Boca Raton; The Center for Human Reproduction Florida, Clearwater; Specialists In Reproductive Medicine & Surgery, P.A., Fort Myers; University of Florida/Park Avenue Women's Center, Gainesville; Fertility Institute of Northwest Florida, Gulf Breeze; Florida Institute for Reproductive Medicine, Jacksonville; IVF Florida/NW Center for Infertility & Reproduction, Margate; Fertility & IVF Center of Miami, Miami; Center for Infertility & Reproductive Medicine P.A., Reproductive Medicine and Fertility Center, and Arnold Palmer Hospital Fertility Center, Orlando; Center for Advanced Reproductive Endocrinology and Fertility Institute of Fort Lauderdale, Plantation; South Florida Institute for Reproductive Medicine, South Miami; Advanced Reproductive Technologies Program at University Community Hospital, Tampa; Genetics & IVF of Florida, West Palm Beach. Georgia: Emory Center for Reproductive Medicine and Fertility, and Reproductive Biology Associates, Atlanta; Medical College of Georgia and Augusta Reproductive Biology Associates, Augusta. Hawaii: Pacific In Vitro Fertilization Institute, Honolulu; Tripler Army Medical Center, Tripler AMC. Illinois: Rush-Copley Center for Reproductive Health, Aurora; Rush Center for Advanced Reproductive Care, University of Chicago Hospitals, Northwestern University, Center for Human Reproduction, and IVF Illinois, Inc., Chicago; Midwest Fertility Center, Downers Grove; Advanced Fertility Center of Chicago, Gurnee; Highland Park Hospital IVF Center, Highland Park; Hinsdale Center for Reproduction, Hinsdale; Oak Brook Fertility Center and Reena Jabamoni, M.D., Oak Brook; Reproductive Health and Fertility Center and Advanced Reproductive Center, Ltd., Rockford; Rush North Shore Center for Advanced Reproductive Care, Skokie; Reproductive Endocrinology Associates, S.C., and Southern Illinois University Department of Obstetrics and Gynecology, Springfield; Midwest Reproductive Medicine: Champaign/Urbana, Urbana. Indiana: Associated Fertility & Gynecology, Fort Wayne; Midwest Reproductive Medicine, Advanced Fertility Group, Reproductive Endocrinology Associates, and Indiana University Hospital, Indianapolis; Center for Assisted Reproduction, South Bend. Iowa: McFarland Clinic, P.C., Assisted Reproduction, Ames; Center for Advanced Reproductive Care, Iowa City; Mid-Iowa Fertility, P.C., West Des Moines. Kansas: Reproductive Resource Center of Greater Kansas City, Overland Park; The Center for Reproductive Medicine, Wichita. Kentucky: University of Kentucky and Reproductive Endocrine Labs, Lexington; Fertility Program, Louisville. Louisiana: Fertility and Laser Center, Metairie; Fertility Institute of New Orleans, The Center for Fertility and Advanced Reproduction, and Tulane University Hospital and Clinic, New Orleans; Center for Fertility & Reproductive Health, Shreveport. Maryland:

The Johns Hopkins Medical Institute, GBMC Fertility Center, University of Maryland Medical School, Fertility Center of Maryland, and Helix Health ART Program, Baltimore; Mid Atlantic Fertility Centers, Bethesda; Shady Grove Fertility Centers, Rockville. Massachusetts: Brigham & Women's Hospital Center for Assisted Reproduction, Massachusetts General Hospital Vincent IVF Unit, and Faulkner Centre for Reproductive Medicine, Boston; Boston IVF and New England Fertility and Endocrinology Associates, Brookline; Hallmark Health Fertility Services, Malden; Fertility Center of New England, Inc., Reading; Baystate IVF, Springfield; Boston Regional Center for Reproductive Medicine, Stoneham; The Reproductive Science Center of Boston, Waltham. Michigan: University of Michigan, Ann Arbor; Oakwood Hospital Center for Reproductive Medicine, Dearborn; Hutzel Hospital, Detroit; Hurley Medical Center for Reproductive Medicine, Flint; Grand Rapids Fertility/Spectrum Health East and West Michigan Reproductive Institute, P.C., Grand Rapids; Michigan Reproductive & IVF Center, Grand Rapids; Infertility and Gynecology Center of Lansing, P.C., and Michigan State University Center for Assisted Reproductive Technology, Lansing; Beaumont Center for Fertility and Reproductive Medicine, Royal Oak; F.I.R.S.T. IVF, Saginaw; Henry Ford Reproductive Medicine, Troy; Ann Arbor Reproductive Medicine, Ypsilanti. Minnesota: Center for Reproductive Medicine and The Midwest Center for Reproductive Health, P.A., Minneapolis; Mayo Clinic Assisted Reproductive Technologies, Rochester. Mississippi: University of Mississippi Medical Center, Jackson. Missouri: Advanced Reproductive Specialists, St. Luke's Hospital, Chesterfield; University of Missouri-Columbia, Columbia; Reproductive Science Associates, Kansas City; Research Medical Center, Kansas City; Washington University Advanced Assisted Reproductive Technologies Program, Infertility Center of St. Louis, and Infertility & IVF Center, St. Louis. Nebraska: Nebraska Health System Reproductive Endocrinology/Infertility and Reproductive Endocrinology/Infertility, Omaha. Nevada: Fertility Center of Las Vegas and University Institute of Fertility, Las Vegas; Northern Nevada Fertility Center, Reno. New Hampshire: Dartmouth-Hitchcock Medical Center, Lebanon. New Jersey: Reproductive Gynecologists, P.C., Cherry Hill; Center for Advanced Reproductive Medicine & Fertility, Edison; North Hudson I.V.F., Englewood Cliffs; IVF of North Jersey, P.A., Fairlawn; Center for Reproductive Medicine, Hasbrouck Heights; Princeton Center for Infertility & Reproductive Medicine, Lawrenceville; East Coast Infertility and IVF, P.C., Little Silver; The Institute for Reproductive Medicine and Science, Livingston; Cooper Center for IVF, P.C., South Jersey Fertility Center, P.A., and Delaware Valley Institute of Fertility and Genetics, Marlton; Diamond Institute for Infertility, Millburn; Center for Reproductive Endocrinology-Morristown Memorial Hospital, Morristown; Jersey Shore Medical Center IVF Program, Neptune; Robert Wood Johnson Medical School ART Program, New Brunswick; IVF New Jersey, Somerset; Center for Human Reproduction of New Jersey, Westwood. New Mexico: Center for Reproductive Medicine of New Mexico, Albuquerque; Southwest Fertility Services, Albuquerque. New York: Women's Health Center of Albany Medicine, Albany IVF, Fertility and Gynecology, and Leading Institute for Fertility Enhancement (LIFE), Albany; Brooklyn IVF and The Fertility Institute at The Brooklyn Hospital, Brooklyn; IVF Program Children's Hospital of Buffalo, Buffalo; Montefiore's Fertility and Hormone Center, Dobbs Ferry; Garden City Center for Advanced Reproductive Technology and Yu Kang Ying, M.D., Garden City; North Shore University Hospital, Manhasset; Advanced Fertility Services, New York Fertility Institute; Offices for Fertility and Reproductive Medicine, Columbia Presbyterian Medical Center, New York University Medical Center—Program for In Vitro Fertilization, Dr. Lillian D. Nash, Brooklyn Fertility Center, New York Medical Services for Reproductive Medicine, and The Center for Reproductive Medicine & Infertility, New York; Capital Region Genetics & IVF at Bellevue Hospital, Niskayuna; Long Island IVF Associates, Port Jefferson; Strong Infertility and IVF Center and Institute for Reproductive Health and Infertility, Rochester; Division of Reproductive Endocrinology, Stony Brook; CNY Fertility Center, Syracuse; Westchester Fertility & Reproductive Endocrinology, White Plains; Reproductive Medicine/IVF, Williamsville. North Carolina: North Carolina Center for Reproductive Medicine, Cary; University of North Carolina A.R.T. Clinic and

Chapel Hill Fertility Center, Chapel Hill; Institute for Assisted Reproduction and Program for Assisted Reproduction, Carolinas Medical Center, Charlotte; Duke University Medical Center, Durham; East Carolina University, Greenville; Wake Forest University Program for Assisted Reproduction, Winston-Salem. North Dakota: MeritCare Medical Group-Fertility Center, Fargo. Ohio: Akron City Hospital IVF Center and Fertility Unlimited, Inc., Akron; Bethesda Center for Reproductive Health and Fertility, Greater Cincinnati Institute for Reproductive Health, and Center for Reproductive Health, Cincinnati; University Hospitals of Cleveland-IVF Program, MetroHealth Medical Center, and Cleveland Clinic Foundation, Cleveland; University Fertility Institute and Ohio Reproductive Medicine, Columbus; Miami Valley Hospital Fertility Center, Dayton; Fertility Center of Northwestern Ohio, Toledo. Oklahoma: Henry G. Bennett, Jr. Fertility Institute and Center for Reproductive Health, Oklahoma City; Tulsa Center for Fertility & Women's Health, Tulsa. Oregon: University Fertility Consultants—Oregon Health Sciences University and Northwest Fertility Center, Portland. Pennsylvania: Toll Center for Reproductive Sciences, Abington; Reprotech, Inc., and Infertility Solutions, P.C., Allentown; Family Fertility Center, Bethlehem; Geisinger Medical Center Fertility Program, Danville; Penn State Geisinger Health System at Hershey, Hershey; Jenkintown Reproductive Endocrine & Gynecology Associates, P.C., Jenkintown; University of Pennsylvania, Thomas Jefferson IVF Program, and Pennsylvania Reproductive Associates, Philadelphia; Allegheny General Hospital—IVF Program, Pittsburgh; The Fertility Center at St. Clair Hospital and University Women's Health Care Associates, Pittsburgh; Reproductive Endocrinology and Fertility Center, Upland; Reproductive Science Institute—Philadelphia, Wayne; Women's Clinic, Ltd., West Reading. Puerto Rico: Dr. Pedro J. Beauchamp, Bayamon; Rene Fernandez-Pelegrina, Caribbean Fertility Center, Rio Piedras. Rhode Island: Women & Infants Hospital IVF Program, Providence; South Carolina: Medical University of South Carolina, Charleston; University of South Carolina—Columbia, Columbia; Reproductive Endocrinology and Infertility, Greenville; Southeastern Fertility Center, P.A., Mount Pleasant. South Dakota: University Physicians Fertility Specialists, Sioux Falls. Tennessee: University Ob/Gyn Associates, Inc., Chattanooga; Appalachian Fertility and Endocrinology Center, Kingsport; University of Tennessee Fertility Center, Knoxville; University Fertility Associates, Memphis; Nashville Fertility Center and The Center for Reproductive Health, Nashville. Texas: Texas Fertility Center, Harold Brumley, M.D., and Jeffrey Youngkin, M.D., Austin; Center for Assisted Reproduction, Bedford; Trinity In Vitro Fertilization, Carrollton; University of Texas Southwestern Fertility Associates, Presbyterian Hospital of Dallas ARTS Center, Baylor Center for Reproductive Health, and National Fertility Center of Texas, P.A., Dallas; Obstetrical & Gynecological Associates, Center for Reproduction at Gramercy, North Houston Center for Reproductive Medicine, Baylor Assisted Reproductive Technology, and University of Texas Women's Health Center, Houston; Wilford Hall Medical Center, Lackland Air Force Base; Texas Tech University Health Science Center—IVF Program and The Centre for Reproductive Medicine, Lubbock; Fertility Center of San Antonio, and South Texas Fertility Center—Methodist Women's and Children's Hospital, San Antonio; The Center of Reproductive Medicine, Webster. Utah: Utah Center for Reproductive Medicine, Salt Lake City. Vermont: University of Vermont—IVF Program, Burlington. Virginia: The Fertility and Reproductive Health Center, Annandale; Dominion Fertility and Endocrinology, Arlington; University of Virginia ART Program, Charlottesville; Jones Institute for Reproductive Medicine, Norfolk; Richmond Center for Fertility and Endocrinology, Medical College of Virginia/Virginia Commonwealth University IVF/GIFT, Fertility Institute of Virginia, and LifeSource Fertility Center, Richmond; The New Hope Center for Reproductive Medicine, Virginia Beach. Washington: Washington Center for Reproductive Medicine, Bellevue; Bellingham IVF, Bellingham; Olympia Women's Health, Olympia; University of Washington Fertility & Endocrine Center, Virginia Mason Fertility Center, and Pacific Gynecology Specialists, Seattle; GYFT Clinic, P.L.L.C., Tacoma. West Virginia: Center for Reproductive Medicine West Virginia University Health Science Center, Charleston. Wisconsin: Family Fertility Program, Appleton; Gundersen/Lutheran Medical Center, Lacrosse; University of

Wisconsin—Madison, Madison; Advanced Institute of Fertility, Reproductive Specialty Center, and Medical College of Wisconsin Department of Ob/Gyn, Milwaukee; Women's Health Care, S.C., and WomenCare, Waukesha; Clinic of Obstetrics & Gynecology, Ltd., West Allis.

References

1. Medical Research International. The American Fertility Society Special Interest Group. In vitro fertilization/embryo transfer in the United States: 1985 and 1986 results from the National IVF/ET Registry. *Fertil Steril* 1988;42:212–5.
2. Fertility Clinic Success Rate and Certification Act of 1992 (FCSRCA). Publication no. 102—493, October 24, 1992.
3. Centers for Disease Control and Prevention, American Society for Reproductive Medicine, Society for Assisted Reproductive Technology, RESOLVE. 1995 assisted reproductive technology success rates. Atlanta: Centers for Disease Control and Prevention, 1997.
4. Society for Assisted Reproductive Technology and the American Society for Reproductive Medicine. Assisted reproductive technology in the United States: 1996 results generated from the American Society for Reproductive Medicine/Society for Assisted Reproductive Technology Registry. *Fertil Steril* 1999;71:798–807.
5. Society for Assisted Reproductive Technology and the American Society for Reproductive Medicine. Assisted reproductive technology in the United States and Canada: 1995 results generated from the American Society for Reproductive Medicine/Society for Assisted Reproductive Technology Registry. *Fertil Steril* 1998;69:389–98.
6. Chapko K, Weaver M, Chapko MC, Pasta D, Adamson GD. Stability of in vitro fertilization-embryo transfer success rates from the 1989, 1990 and 1991 Clinic Specific Outcome Assessments. *Fertil Steril* 1995;64:757–63.
7. From the Centers for Disease Control and Prevention. Ectopic pregnancy—United States, 1990–1992. *JAMA* 1995;273:533.
8. American Society for Reproductive Medicine. Guidelines on number of embryos transferred. Birmingham, AL: American Society for Reproductive Medicine, 1999.
9. Schieve LA, Peterson HB, Meikle SF, Jeng G, Danel I, Burnett NM, Wilcox LS. Live birth rates and multiple birth risk using in vitro fertilization. *JAMA* 1999;282:1832–8.
10. Rasmussen SA, Mulinare J, Khoury MJ, Maloney EK. Evaluation of birth defect histories obtained through maternal interviews. *Am J Hum Genet* 1990;46(3):478–85.
11. Guyer B, Martin JA, MacDorman MF, Anderson RN, Strobino DM. Annual summary of vital statistics—1996. *Pediatrics* 1997;100:905–18.
12. Table 49. National Vital Statistics Report. 2000;48:83.
13. Roberts HE, Moore CA, Cragan JD, Fernhoff PM, Khoury MJ. Impact of prenatal diagnosis on the birth prevalence of neural tube defects, Atlanta, 1990–1991. *Pediatrics* 1995;96:880–3.
14. Van Steirteghem A. The male: ICSI and beyond. American Society for Reproductive Medicine Annual Meeting SART Postgraduate Course, San Diego, California, October 21 and 22, 2000. Birmingham, AL: American Society for Reproductive Medicine, 2000.
15. www.hfea.gov.uk/annrep99/table417.htm.
16. French In Vitro National (FIVNAT). Pregnancies and births resulting from in vitro fertilization: French national registry, analysis of data 1986 to 1990. *Fertil Steril* 1995;64:746–56.

Commentary

In the preceding article, SART presents population-based data of assisted reproductive technology (ART) procedures performed in the United States in 1997. These data were collected using the Society for Assisted Reproductive Technology (SART) ART reporting system. Since 1995, data from the SART system have been used by the Centers for Disease Control and Prevention (CDC) to calculate pregnancy success rates for ART clinics operating in the United States. As the authors describe, CDC has collaborated with SART in standardizing data collection procedures, case definitions, and data analyses, and has subsidized on-site data