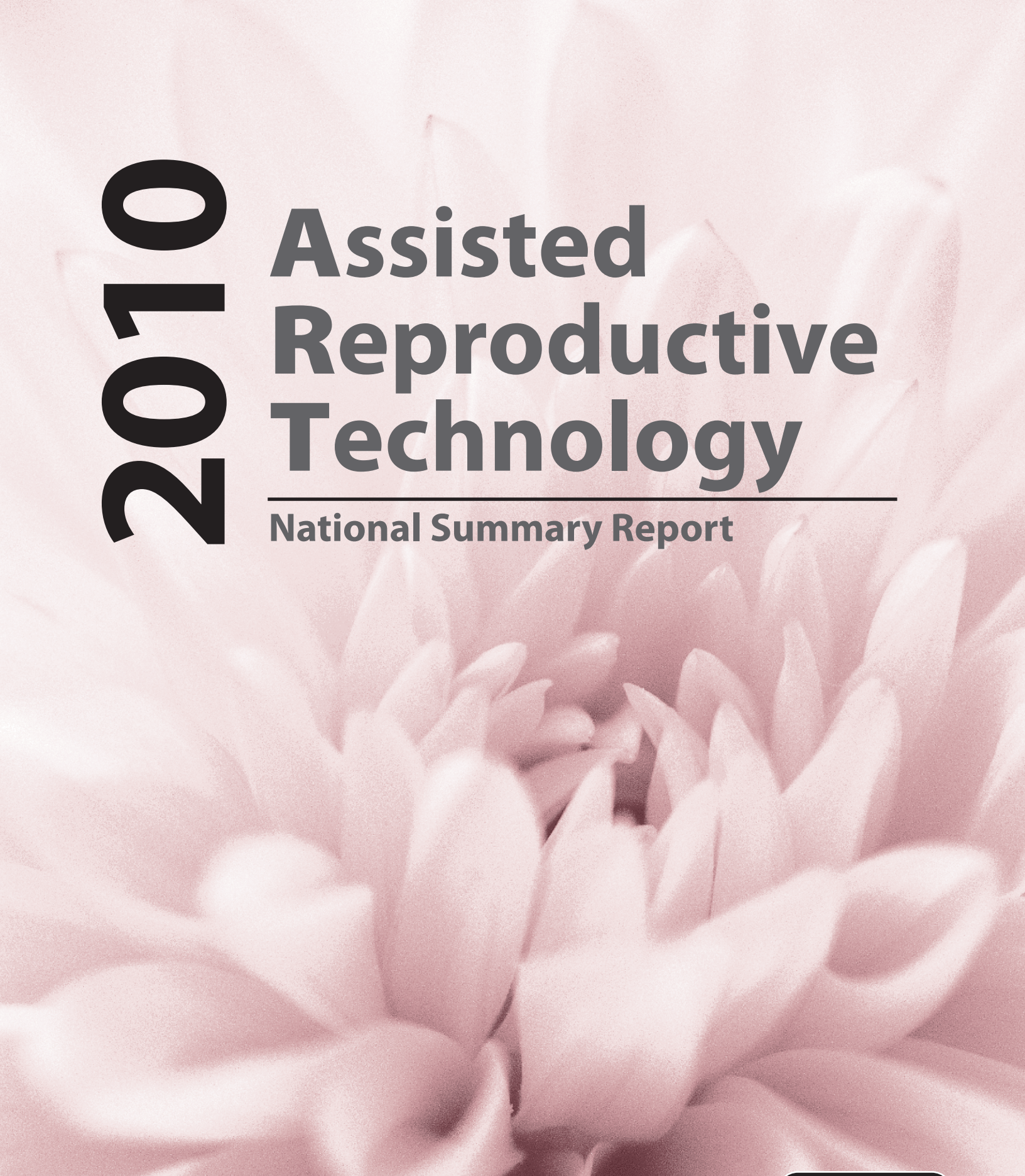
2010

# Assisted Reproductive Technology

## National Summary Report



National Center for Chronic Disease Prevention and Health Promotion
Division of Reproductive Health

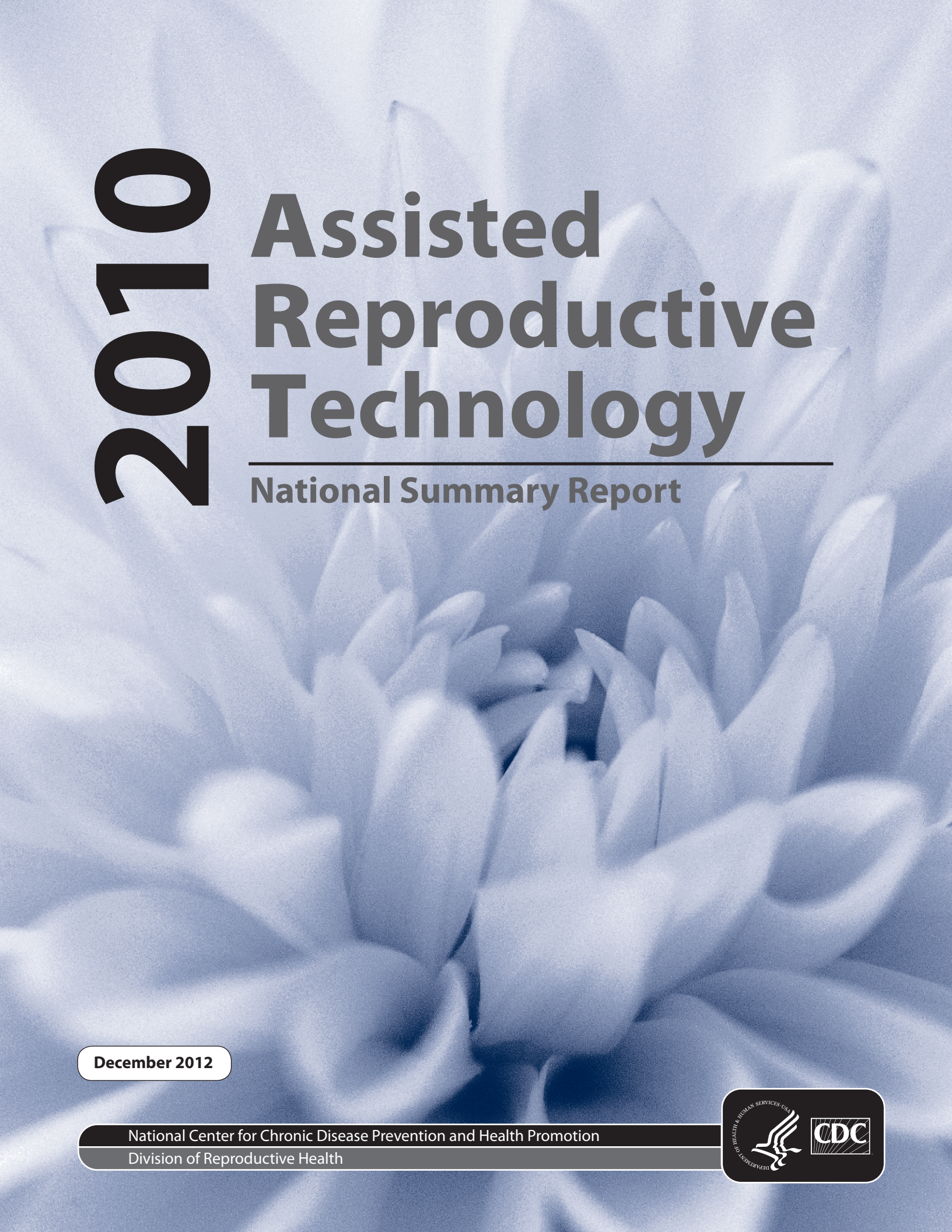
Updates to this report will be posted on the CDC Web site at the following address:

www.cdc.gov/art/ART2010
For additional information, send an e-mail to cdcinfo@cdc.gov (Subject: ART)
Or write to CDC, ATTN: ART Surveillance and Research Team
4770 Buford Highway, N.E.; Mail Stop K-34; Atlanta, GA 30341-3717.

2010

# Assisted Reproductive Technology

## National Summary Report



December 2012

National Center for Chronic Disease Prevention and Health Promotion
Division of Reproductive Health

This publication was developed and produced by the National Center for Chronic Disease Prevention and Health Promotion of the Centers for Disease Control and Prevention in consultation with the American Society for Reproductive Medicine and the Society for Assisted Reproductive Technology.


**Centers for Disease Control and Prevention**

National Center for Chronic Disease Prevention and Health Promotion — Ursula E. Bauer, PhD, MPH, Director

Division of Reproductive Health — CAPT Wanda D. Barfield, MD, MPH, Director; Kelly Brumbaugh, MPH, CHES

Women's Health and Fertility Branch — Denise J. Jamieson, MD, MPH, Chief; Jeani Chang, MPH; Dmitry Kissin, MD, MPH; Aniket D. Kulkarni, MBBS, MPH; Mithi Sunderam, MA, PhD; Daniel Wallace; Yujia Zhang, PhD

**American Society for Reproductive Medicine** — Rogerio A. Lobo, MD, President

**Society for Assisted Reproductive Technology** — Glenn L. Schattman, MD, President; Kelley Jefferson



The data included in this report and publication support were provided by Westat under Contract No. 200-2004-06702 for the National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

**Suggested Citation:** Centers for Disease Control and Prevention, American Society for Reproductive Medicine, Society for Assisted Reproductive Technology. *2010 Assisted Reproductive Technology National Summary Report.* Atlanta: U.S. Department of Health and Human Services; 2012.

# Acknowledgments

The Centers for Disease Control and Prevention, the Society for Assisted Reproductive Technology, and the American Society for Reproductive Medicine thank RESOLVE: The National Infertility Association and The American Fertility Association for their commitment to assisted reproductive technology (ART) surveillance. Their assistance in making this report informative and helpful to people considering an ART procedure is greatly appreciated.

# Table of Contents

2010

# National Report

# INTRODUCTION TO THE 2010 NATIONAL REPORT

Data provided by United States clinics that use assisted reproductive technology (ART) to treat infertility are a rich source of information about the factors that contribute to a successful ART treatment—the delivery of a healthy live-born infant. Pooling the data from all reporting clinics provides an overall national picture that could not be obtained by examining data from an individual clinic.

A woman's chances of having a pregnancy and a live birth when using ART are influenced by many factors, some of which are patient-related and outside a clinic's control (e.g., the woman's age, the cause of infertility). Because the national data set includes information on many of these factors, it can give potential ART users an idea of the average chances of success. Average chances, however, do not necessarily apply to a particular individual or couple. People considering ART should consult their physician to discuss all the factors that apply in their particular case.

The data for this national report come from the 443 fertility clinics in operation in 2010 that provided and verified data on the outcomes of all ART cycles started in their clinics. The 147,260 ART cycles performed at these reporting clinics in 2010 resulted in 47,090 live births (deliveries of one or more living infants) and 61,564 infants. The 2010 National Summary table on page 4 combines data from all clinics included in the *2010 Assisted Reproductive Technology Fertility Clinic Success Rates Report (*hereafter called the *2010 Fertility Clinic Success Rates Report)*. For an explanation of how to read this table, see pages 15–20 of the *2010 Fertility Clinic Success Rates Report* available at www.cdc.gov/art/ARTReports.htm.

The national report consists of graphs and charts that use 2010 data to answer specific questions related to ART success rates. These figures are organized according to the type of ART procedure used. Some ART procedures use a woman's own eggs, and others use donated eggs or embryos. (Although sperm used to create an embryo also may be either from a woman's partner or from a sperm donor, information in this report is presented according to the source of the egg.) In some procedures, the embryos that develop are transferred back to the woman (fresh embryo transfer); in others, the embryos are frozen (cryopreserved) for transfer at a later date. This report includes data on embryos that might have been frozen in previous years, but were thawed and transferred in 2010.

The national report has five sections:

- Section 1 (Figures 1 through 5) presents information from all ART procedures reported.
- Section 2 (Figures 6 through 39) presents information on the ART cycles that used only fresh nondonor eggs or embryos from nondonor eggs or, in a few cases, a mixture of fresh and frozen embryos from nondonor eggs (100,824 cycles resulting in 82,624 transfers).
- Section 3 (Figures 40 through 42) presents information on the ART cycles that used only frozen embryos from nondonor eggs (28,425 cycles resulting in 26,241 transfers).
- Section 4 (Figures 43 through 47) presents information on the ART cycles that used only donated eggs or embryos (18,011 cycles resulting in 16,531 transfers).
- Section 5 (Figures 48 through 60) presents trends in the number of ART procedures and success rates over the past 10 years, from 2001 through 2010.

# 2010 NATIONAL SUMMARY

**For more information on how to interpret the statistics in this table, see pages 15–20, in the *2010 Assisted Reproductive Technology Fertility Clinic Success Rates Report*.**

## 2010 ART CYCLE PROFILE

### Type of ART [a]

| | | | |
|---|---|---|---|
| IVF | >99% | **Procedural Factors:** | |
| GIFT | <1% | With ICSI | 66% |
| ZIFT | <1% | Unstimulated | <1% |
| Combination | <1% | Used gestational carrier | <1% |
| | | Used PGD | 4% |
| | | With eSET | 6% |

### Patient Diagnosis

| | | | |
|---|---|---|---|
| Tubal factor | 7% | Other factor | 7% |
| Ovulatory dysfunction | 7% | Unknown factor | 12% |
| Diminished ovarian reserve | 15% | *Multiple Factors:* | |
| Endometriosis | 4% | Female factors only | 11% |
| Uterine factor | 1% | Female & male factors | 18% |
| Male factor | 17% | | |

## 2010 PREGNANCY SUCCESS RATES

| Type of Cycle | Age of Woman <35 | 35–37 | 38–40 | 41–42 | 43–44 | >44 |
|---|---|---|---|---|---|---|
| **Fresh Embryos from Nondonor Eggs** | | | | | | |
| Number of cycles | 41,744 | 21,369 | 21,741 | 10,122 | 4,501 | 1,347 |
| Percentage of embryos transferred resulting in implantation | 36.5 | 26.9 | 17.7 | 9.6 | 4.2 | 1.7 |
| Percentage of cycles resulting in pregnancies | 47.6 | 38.8 | 29.9 | 19.9 | 10.6 | 3.2 |
| Percentage of cycles resulting in live births [b] | 41.5 | 31.9 | 22.1 | 12.4 | 5.0 | 1.0 |
| Percentage of retrievals resulting in live births [b] | 44.4 | 35.4 | 25.3 | 14.8 | 6.3 | 1.4 |
| Percentage of transfers resulting in live births [b] | 47.6 | 38.3 | 28.1 | 16.7 | 7.4 | 1.8 |
| Percentage of transfers resulting in singleton live births | 31.4 | 27.3 | 21.5 | 13.7 | 6.6 | 1.6 |
| Percentage of cancellations | 6.6 | 9.9 | 12.8 | 16.4 | 20.6 | 25.5 |
| Average number of embryos transferred | 2.0 | 2.2 | 2.6 | 3.0 | 3.2 | 2.7 |
| Percentage of pregnancies with twins | 32.9 | 27.3 | 21.6 | 15.0 | 8.1 | 2.3 |
| Percentage of pregnancies with triplets or more | 2.6 | 3.1 | 3.7 | 3.0 | 0.6 | 2.3 |
| Percentage of live births having multiple infants [b] | 34.0 | 28.7 | 23.3 | 18.0 | 10.2 | 2 / 14 |
| **Frozen Embryos from Nondonor Eggs** | | | | | | |
| Number of transfers | 12,631 | 6,195 | 4,682 | 1,591 | 710 | 432 |
| Percentage of transfers resulting in live births [b] | 38.4 | 34.7 | 28.4 | 21.5 | 16.8 | 13.0 |
| Average number of embryos transferred | 2.0 | 1.9 | 2.1 | 2.2 | 2.2 | 2.0 |

| **Donor Eggs** | All Ages Combined [c] Fresh Embryos | Frozen Embryos |
|---|---|---|
| Number of transfers | 9,866 | 6,665 |
| Percentage of transfers resulting in live births [b] | 55.8 | 34.9 |
| Average number of embryos transferred | 2.0 | 2.0 |

## CURRENT CLINIC SERVICES AND PROFILE

**Total number of reporting clinics:** 443

**Total number of reported cycles:** 147,260 [d]

**Percentage of clinics that offer the following services:**

| | | | |
|---|---|---|---|
| Donor egg | 93% | Gestational carriers | 84% |
| Donor embryo | 69% | Cryopreservation | 99% |
| Single women | 95% | | |

**Clinic profile:**

| | |
|---|---|
| SART member | 85% |
| Verified lab accreditation [e] | |
| Yes | 93% |
| No | 6% |
| Pending | 2% |

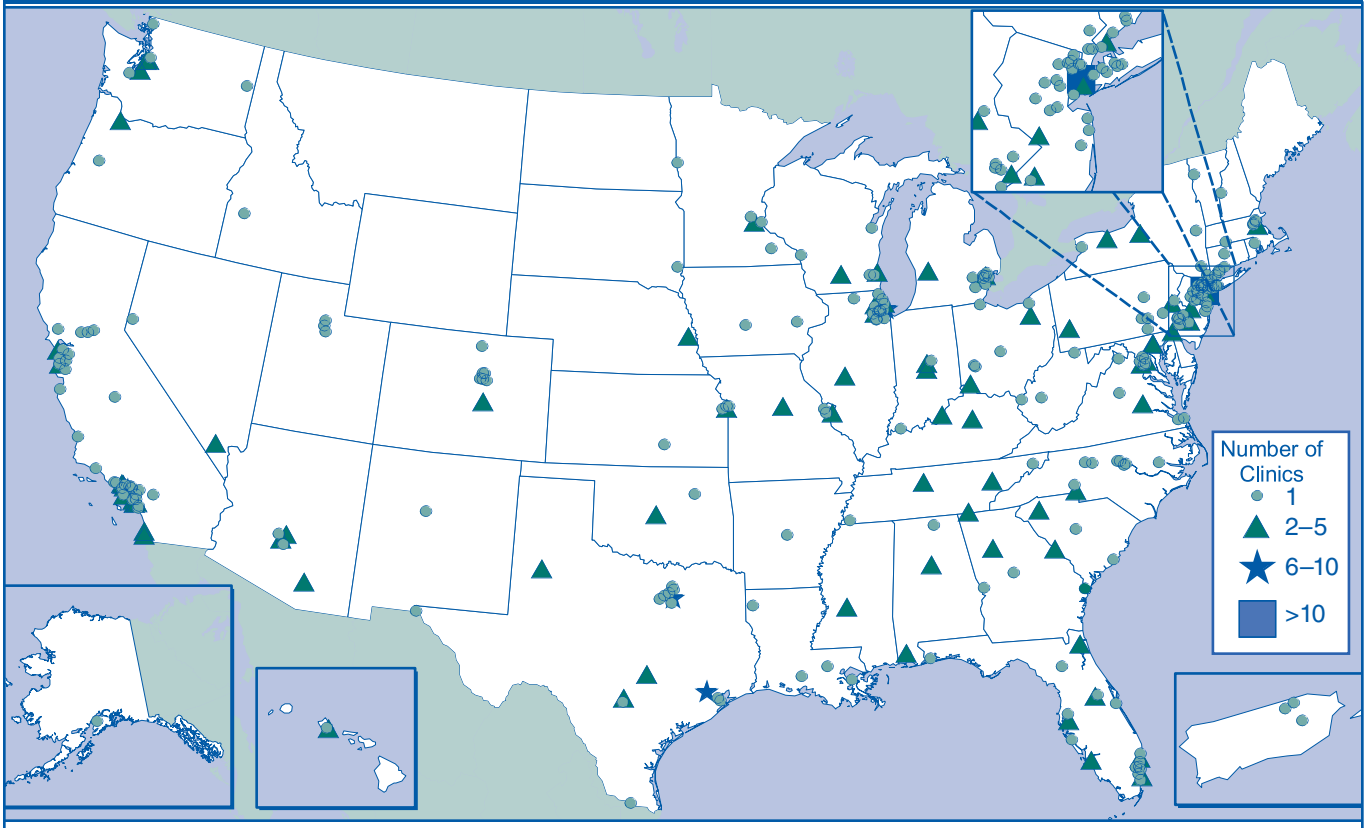
[a] Reflects patient and treatment characteristics of ART cycles performed in 2010 using fresh nondonor eggs or embryos.
[b] A multiple-infant birth is counted as one live birth.
[c] All ages are reported together because previous data show that patient age does not materially affect success with donor eggs.
[d] This is the number of cycles used to calculate national table data. It excludes 4 cycles in which a new procedure was being evaluated.
[e] Total does not equal 100% due to rounding.

# SECTION 1: OVERVIEW

## Where are United States ART clinics located, how many ART cycles did they perform in 2010, and how many infants were born from these ART cycles?

Although ART clinics are located throughout the United States, generally in or near major cities, the greatest number of clinics is in the eastern United States. Figure 1 shows the locations of the 443 reporting clinics. Individual clinic tables with success rates and clinic profiles are published in the *2010 Fertility Clinic Success Rates Report,* arranged in alphabetical order by state, city, and clinic name. The number of clinics, cycles performed, live-birth deliveries, and infants born as a result of ART all have increased steadily since CDC began collecting this information in 1995 (see Section 5, pages 52–64). Because in some cases more than one infant is born during a live-birth delivery (e.g., twins), the total number of infants born is greater than the number of live-birth deliveries. CDC estimates that ART accounts for slightly more than 1% of total U.S. births.

**Figure 1**
Locations of ART Clinics in the United States and Puerto Rico, 2010



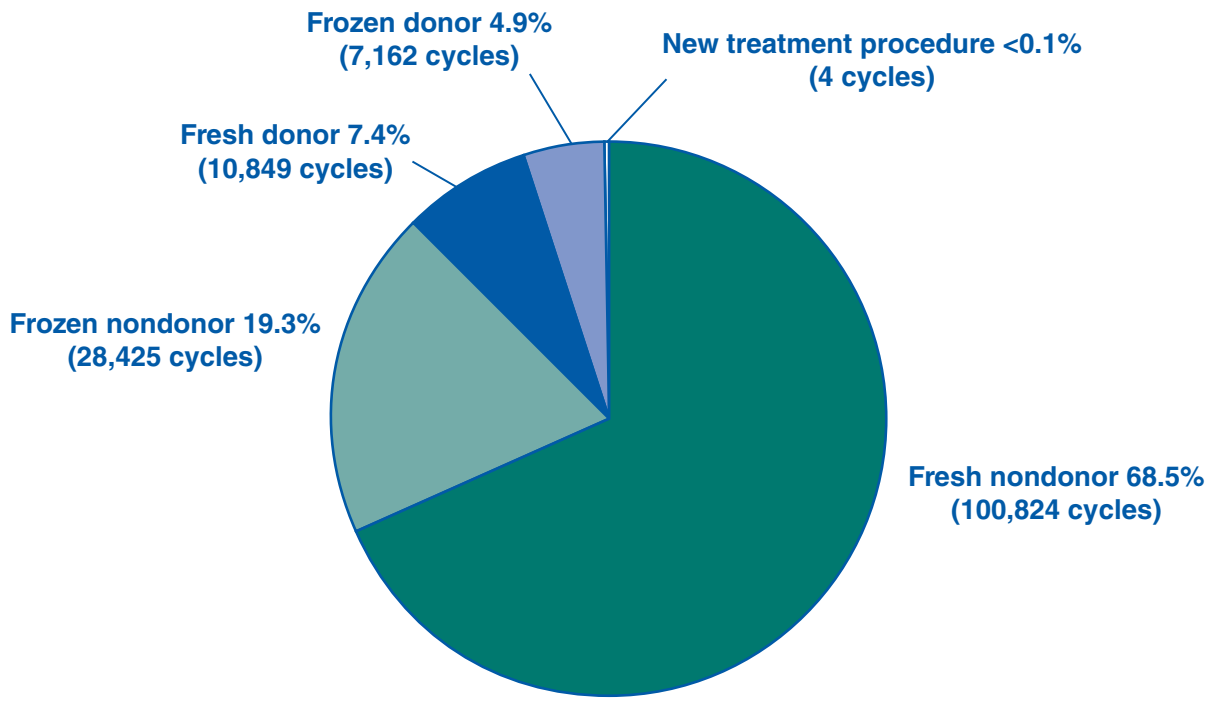

| | |
|---|---|
| Number of ART clinics in the United States in 2010 | 474 |
| Number of ART clinics that submitted data in 2010 | 443 |
| Number of ART cycles reported in 2010 | 147,260* |
| Number of live-birth deliveries resulting from ART cycles started in 2010 | 47,090 |
| Number of infants born as a result of ART cycles performed in 2010 | 61,564 |

*Note: This number does not include 4 cycles in which a new treatment procedure was being evaluated (see Figure 2, page 6).

## What types of ART cycles were performed in the United States in 2010?

Figure 2 shows the types of ART cycles performed in the United States in 2010. For approximately 69% of ART cycles performed in 2010, fresh nondonor eggs or embryos were used. ART cycles that used frozen nondonor embryos were the next most common type, accounting for approximately 19% of the total. In about 12% of cycles, eggs or embryos were donated by another woman or couple. A very small number of cycles (less than 0.1%) involved the evaluation of a new treatment procedure. Cycles in which a new treatment procedure was being evaluated are not included in the total number of cycles reported in this report or the *2010 Fertility Clinic Success Rates Report*. Thus, data in this report presented in subsequent figures and in the National Summary table (see page 4) are based on 147,260 ART cycles.

**Figure 2**
Types of ART Cycles—United States,* 2010

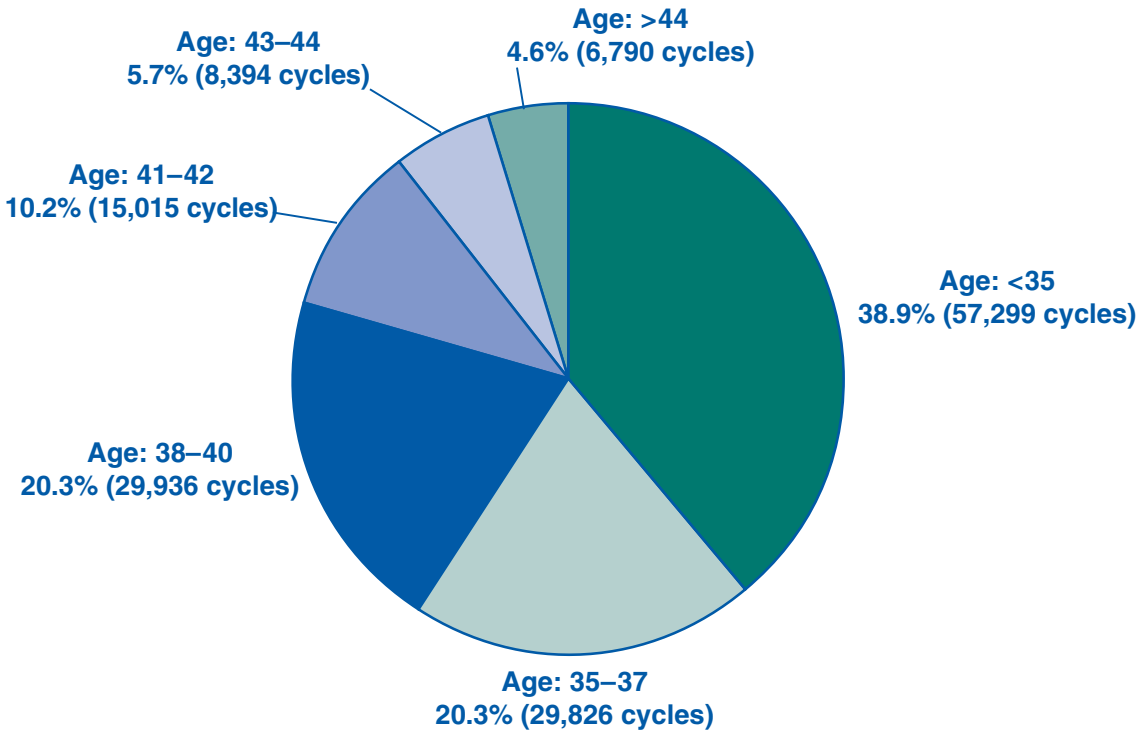



*Total does not equal 100% due to rounding.

## How old were women who used ART in the United States in 2010?

Figure 3 presents ART cycles performed in the United States in 2010 according to the age of the woman who had the procedure. The average age of women using ART services in 2010 was 36. The largest group of women using ART services were women younger than age 35, representing approximately 39% of all ART cycles performed in 2010. Approximately 20% of ART cycles were performed among women aged 35–37, 20% among women aged 38–40, 10% among women aged 41–42, 6% among women aged 43–44, and 5% among women older than age 44.

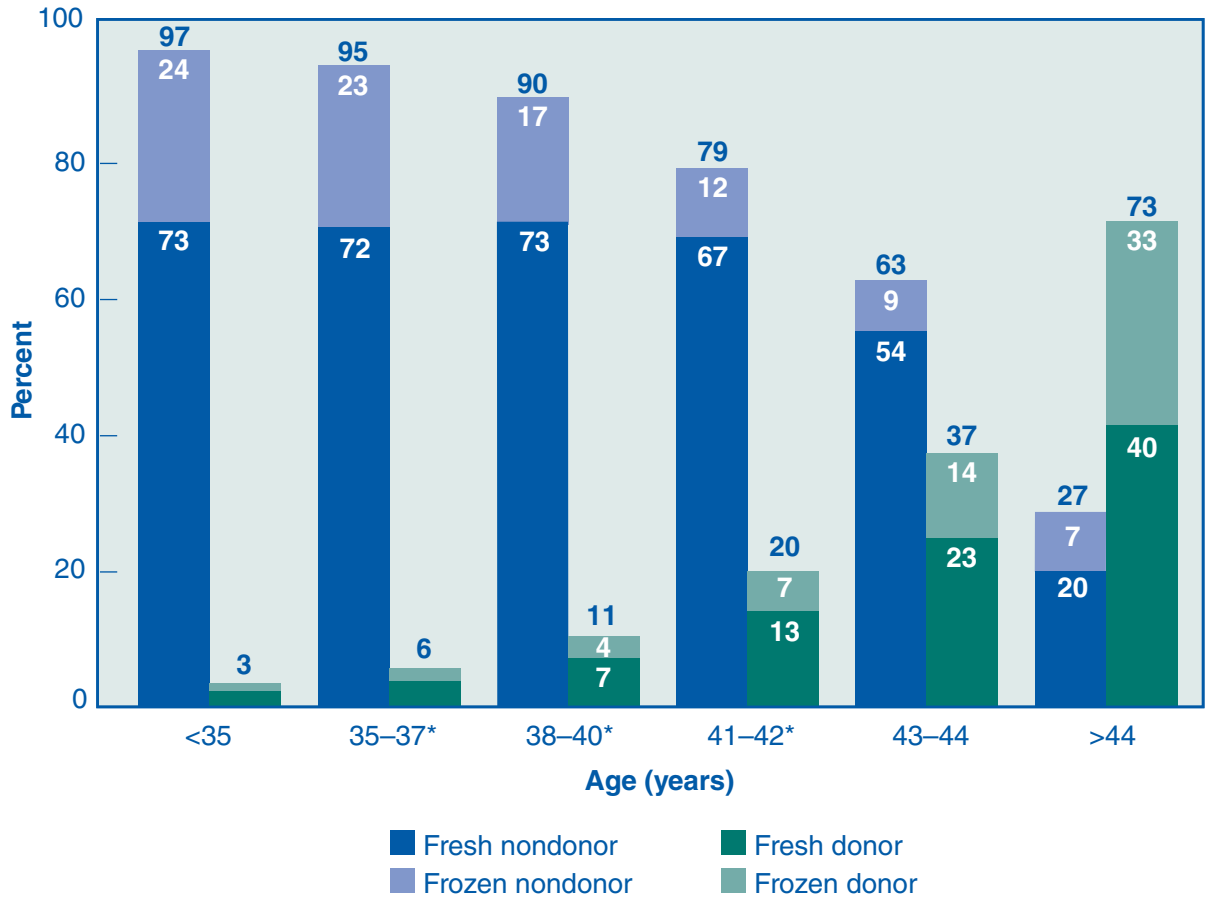
**Figure 3**
ART Use by Age Group—United States, 2010



## How did the types of ART cycles performed in the United States in 2010 differ among women of different ages?

Figure 4 shows that, in 2010, the type of ART cycles varied by the woman's age. The vast majority (97%) of women younger than age 35 used their own eggs, whereas about 3% used donor eggs. In contrast, 37% of women aged 43–44 and 73% of women older than age 44 used donor eggs. Across all age groups, more ART cycles using fresh eggs or embryos were performed than cycles using frozen embryos.

**Figure 4**
Types of ART Cycles by Age Group—United States, 2010



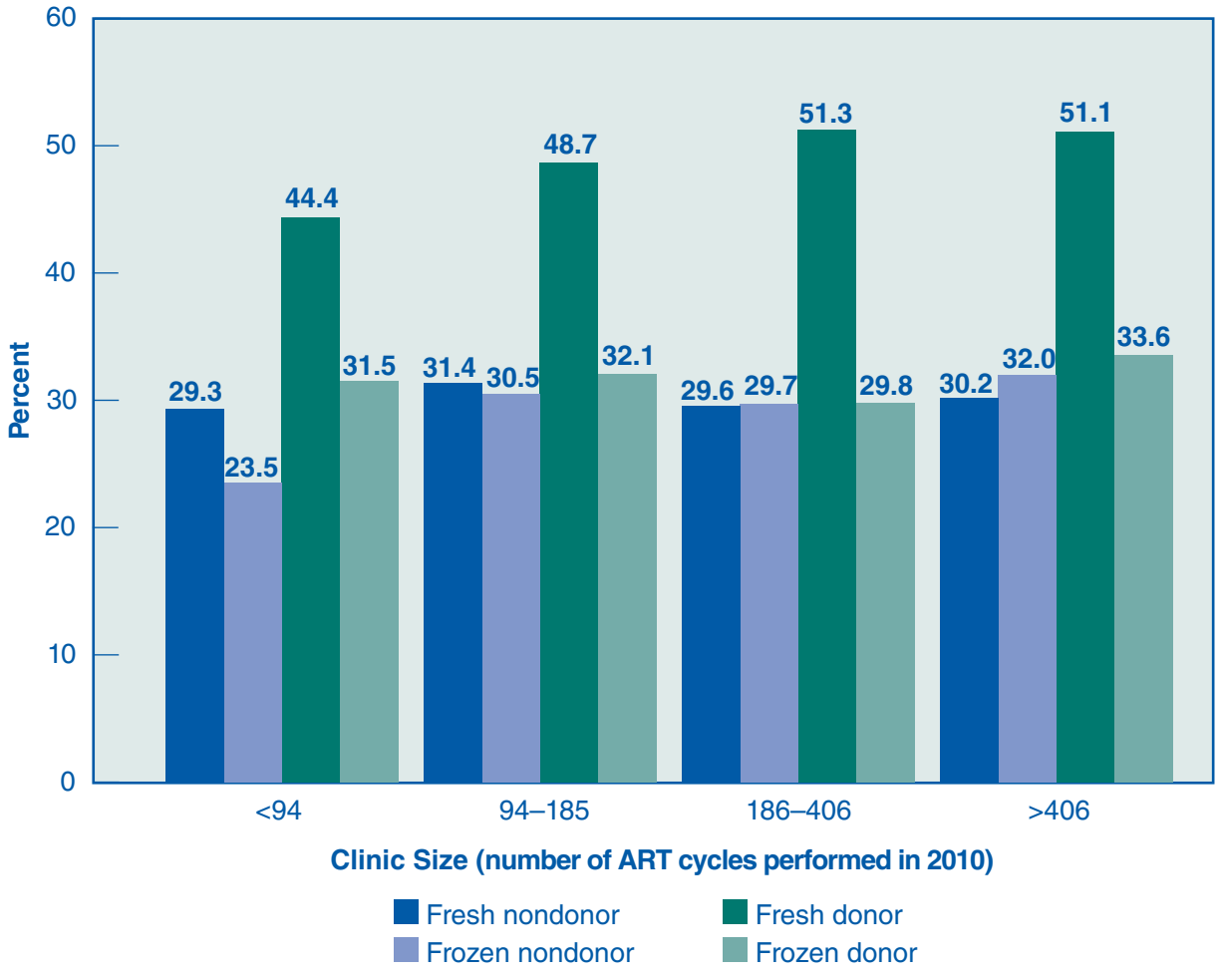

*Total does not equal 100% due to rounding.

## How is clinic size related to percentages of ART cycles performed in the United States in 2010 that resulted in live births?

The number of ART procedures performed every year varies among fertility clinics in the United States. For Figure 5, clinics were divided equally into four groups (called quartiles) based on the number of ART cycles it performed in 2010. The percentage for each quartile by type of ART represents the average percentage of ART cycles that resulted in live births for clinics in that quartile.

In 2010, percentages of ART cycles that resulted in live births using fresh nondonor eggs or embryos were similar regardless of the number of cycles performed in a clinic. However, for fresh donor cycles, the percentage of cycles that resulted in live births generally increased as the clinic size increased. Among frozen nondonor and frozen donor cycles, the percentage of cycles that resulted in live births varied by clinic size.

**Figure 5**
Percentages of ART Cycles That Resulted in Live Births, by Type of ART and Clinic Size—United States, 2010



# SECTION 2: ART CYCLES USING FRESH NONDONOR EGGS OR EMBRYOS

## What are the steps for an ART cycle using fresh nondonor eggs or embryos?

Figure 6 presents the steps for an ART cycle using fresh nondonor eggs or embryos and shows how ART users in 2010 progressed through these stages toward pregnancy and live birth.

An ART **cycle is started** when a woman begins taking medication to stimulate the ovaries to develop eggs or, if no drugs are given, when the woman begins having her ovaries monitored (using ultrasound or blood tests) for natural egg production.

If eggs are produced, the cycle then progresses to **egg retrieval**, a surgical procedure in which eggs are collected from a woman's ovaries.

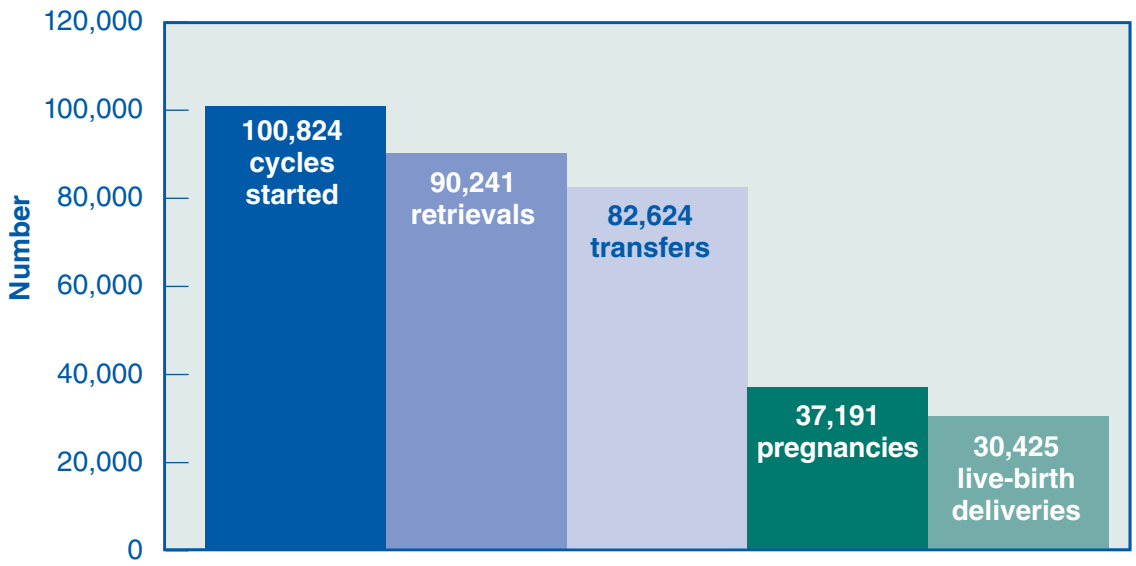
Once retrieved, eggs are combined with sperm in the laboratory. If fertilization is successful, one or more of the resulting embryos are selected for **transfer**, most often into a woman's uterus through the cervix (IVF), but sometimes into the fallopian tubes (GIFT or ZIFT) (see Appendix B: Glossary of Terms on pages 73–75 for descriptions of IVF, GIFT, or ZIFT).

If one or more of the transferred embryos implant within the woman's uterus, the cycle then may progress to clinical **pregnancy**.

Finally, the pregnancy may progress to a **live birth**, the delivery of one or more live-born infants. (The birth of twins, triplets, or more is counted as one live birth.)

A cycle may be discontinued at any step for specific medical reasons (e.g., no eggs are produced, the embryo transfer was not successful) or by patient choice.

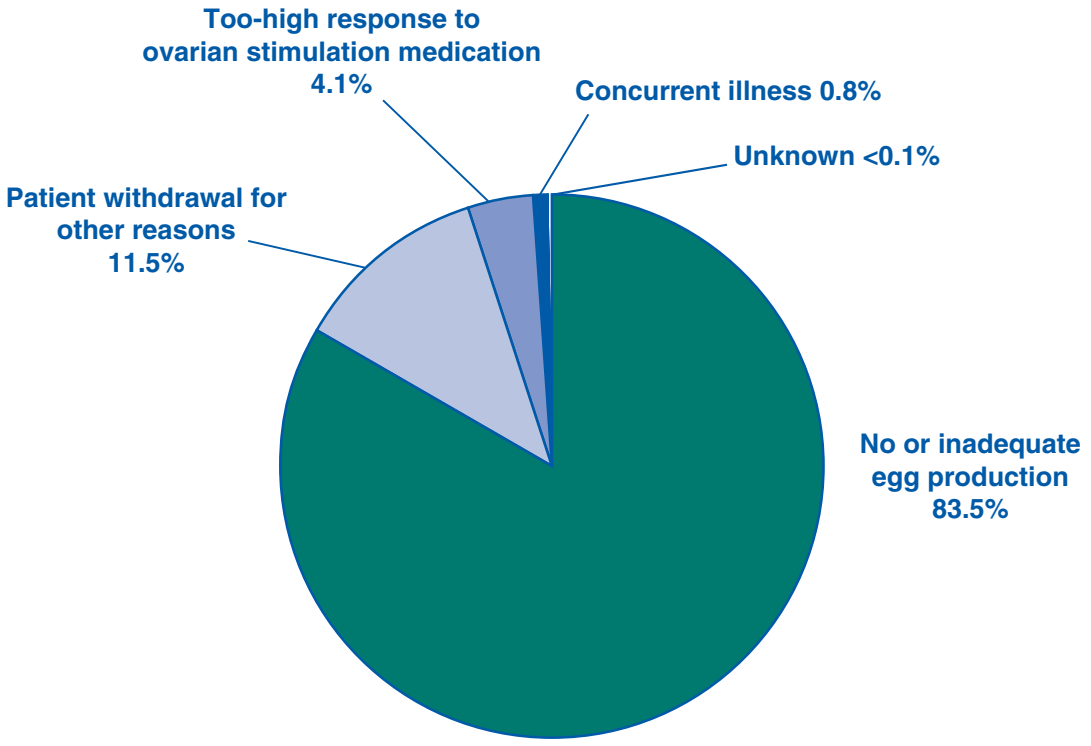
**Figure 6**
Outcomes of ART Cycles Using Fresh Nondonor Eggs or Embryos, by Stage, 2010



## Why are some ART cycles discontinued?

In 2010, 10,583 ART cycles (about 10% out of all 100,824 cycles using fresh nondonor eggs or embryos) were discontinued before the egg retrieval step (see Figure 6, page 10). Figure 7 shows reasons that the cycles were discontinued. For approximately 84% of these cycles, there was no or inadequate egg production. Other reasons included a too-high response to ovarian stimulation medications (i.e., potential for ovarian hyperstimulation syndrome), concurrent medical illness, or a patient withdrawal for other reasons.

**Figure 7**
Reasons ART Cycles Using Fresh Nondonor Eggs or Embryos Were Discontinued,*† 2010



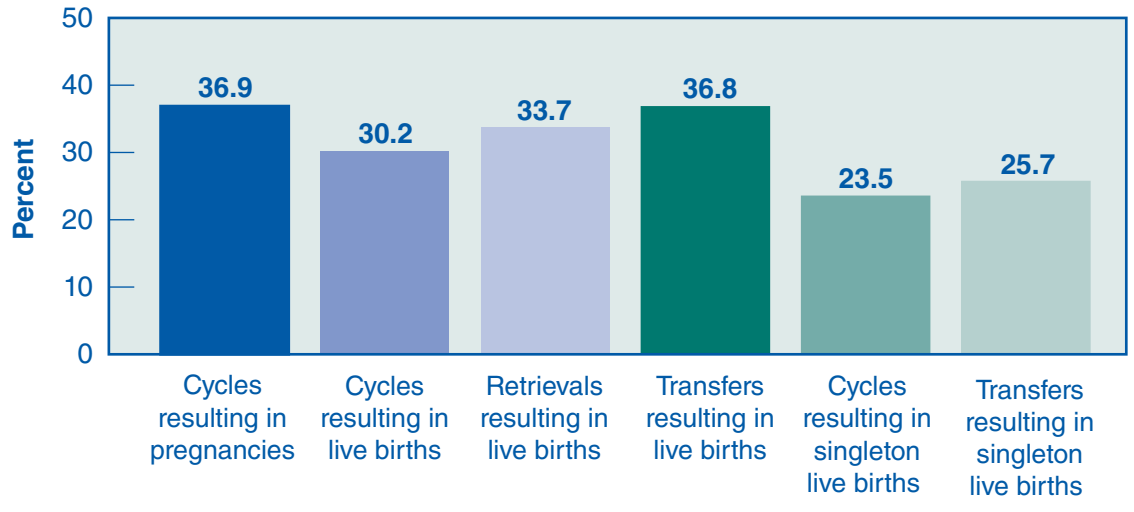

* Based on 10,583 ART cycles.
† Total does not equal 100% due to rounding.

## How are success rates of ART measured?

Figure 8 shows success rates using six different measures for ART cycles using fresh nondonor eggs or embryos in 2010, each providing slightly different information about this complex process. The vast majority of success rates have increased slightly each year since CDC began monitoring them in 1995 (see Section 5, pages 52–64).

- **Percentage of ART cycles started that produced a pregnancy:** This is higher than the percentage of cycles that resulted in a live birth because some pregnancies end in miscarriage, induced abortion, or stillbirth (see Figure 10, page 14).
- **Percentage of ART cycles started that resulted in a live birth (a delivery of one or more live-born infants):** This is the one many people are most interested in because it represents the average chance of having one or more live-born infants by using ART. *This is referred to as the basic live birth rate in the Fertility Clinic Success Rate and Certification Act of 1992.*
- **Percentage of ART cycles in which eggs were retrieved that resulted in a live birth:** This is generally higher than the percentage of cycles that resulted in a live birth because it excludes cycles that were canceled before eggs were retrieved. *This is referred to as the live birth rate per successful oocyte (egg) retrieval in the Fertility Clinic Success Rate and Certification Act of 1992.*
- **Percentage of ART cycles in which an embryo or egg and sperm transfer occurred that resulted in a live birth:** This is one of the highest of these six measures of ART success because it excludes cycles that did not proceed to embryo transfer.
- **Percentage of ART cycles started that resulted in a singleton live birth:** This is important because singleton live births have a much lower risk than multiple-infant births for adverse infant health outcomes, including prematurity, low birth weight, disability, and death.
- **Percentage of ART cycles in which an embryo or egg and sperm transfer occurred that resulted in a singleton live birth:** This is higher than the percentage of ART cycles started that resulted in a singleton live birth because not all ART cycles proceed to embryo transfer.

**Figure 8**
Measures of Success for ART Cycles Using Fresh Nondonor Eggs or Embryos, 2010

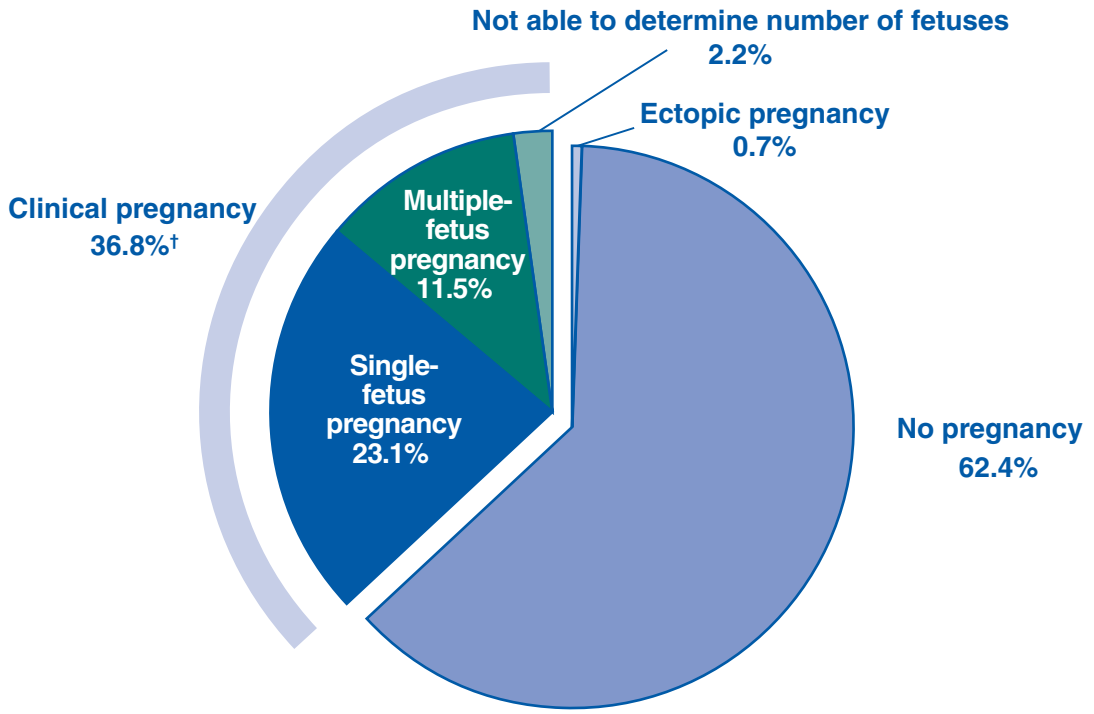


## What percentage of ART cycles result in a pregnancy?

Figure 9 shows the outcomes of ART cycles in 2010 that used fresh nondonor eggs or embryos. Most of these cycles (approximately 62%) did not produce a pregnancy; a very small proportion (less than 1%) resulted in an ectopic pregnancy (the embryo implanted outside the uterus), and about 37% resulted in clinical pregnancy. Clinical pregnancies can be further subdivided as follows:

- 63% of clinical pregnancies resulted in a single-fetus pregnancy.
- 31% resulted in a multiple-fetus pregnancy.
- 6% ended before the number of fetuses could be accurately determined.

**Figure 9**
Outcomes of ART Cycles Using Fresh Nondonor Eggs or Embryos,* 2010



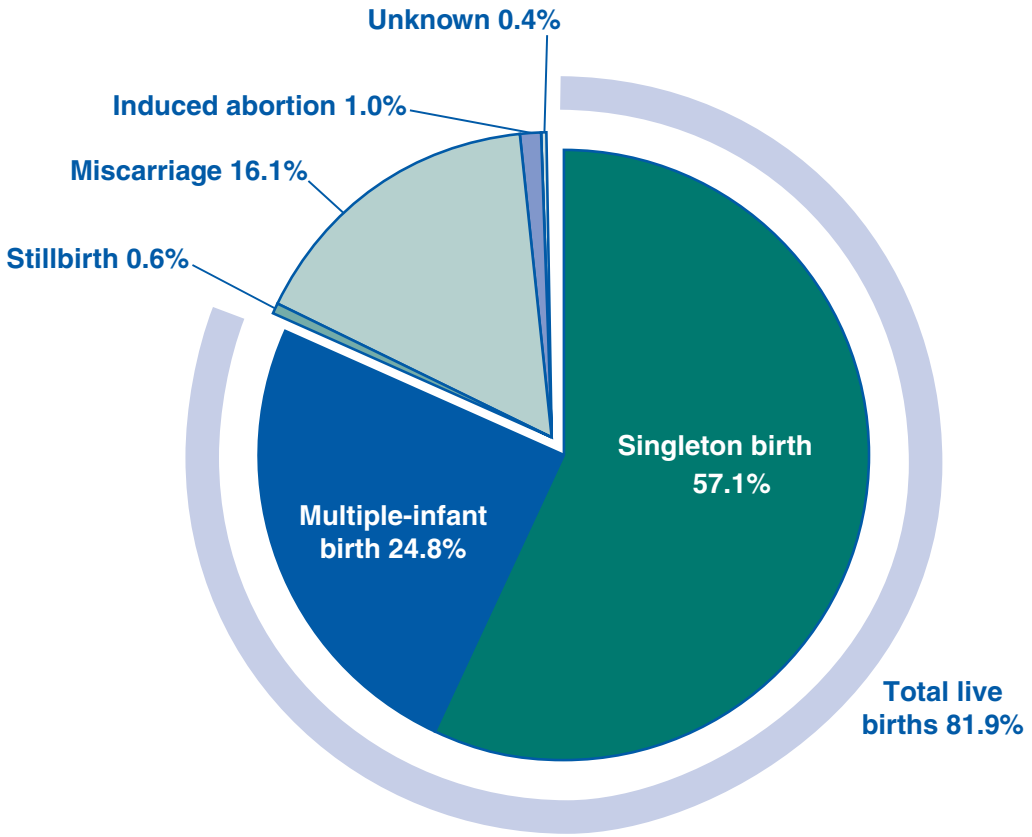

* Total does not equal 100% due to rounding.
† The percentage of clinical pregnancies in Figure 9 is a result of summing rounded data, while the percentage of clinical pregnancies shown in Figure 8 was calculated using raw data.

## Using ART, what percentage of pregnancies result in a live birth?

Figure 10 shows the outcomes of pregnancies resulting from ART cycles using fresh nondonor eggs or embryos in 2010. Approximately 82% of the pregnancies resulted in a live birth (57% in a singleton birth and about 25% in a multiple-infant birth). About 18% of pregnancies resulted in miscarriage, stillbirth, induced abortion, or maternal death prior to birth. For less than 1% of pregnancies, the outcome was unknown.

Although the birth of more than one infant is counted as one live birth, multiple-infant births are presented here as a separate category because they often are associated with problems for both mothers and infants. Infant deaths and birth defects are not included as adverse outcomes because the available information for these outcomes is incomplete.

**Figure 10**
Outcomes of Pregnancies Resulting from ART Cycles Using Fresh Nondonor Eggs or Embryos,* 2010




*Maternal deaths prior to birth are not displayed due to small number (n = 2).

## Using ART, what is the risk of having a multiple-fetus pregnancy or multiple-infant live birth?

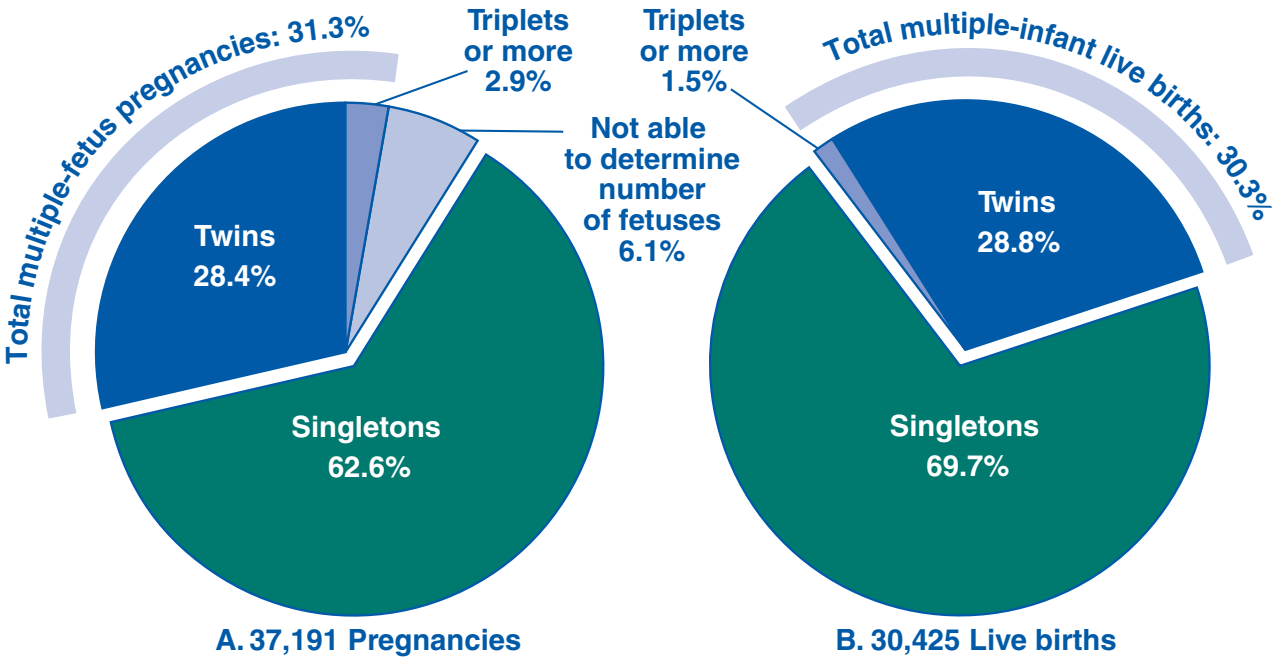
Multiple-infant births are associated with greater problems for both mothers and infants, including higher rates of caesarean section, prematurity, low birth weight, and infant disability or death.

Part A of Figure 11 shows that among the 37,191 pregnancies that resulted from ART cycles using fresh nondonor eggs or embryos, approximately 63% were singleton pregnancies and 31% were multiple-fetus pregnancies (28% were twins and 3% were triplets or more). Approximately 6% of pregnancies ended before the number of fetuses could be accurately determined. Therefore, the percentage of pregnancies with more than one fetus might have been higher than what was reported (about 31%).

In 2010, 6,613 pregnancies resulting from ART cycles ended in either miscarriage, stillbirth, induced abortion, or maternal death, and 153 pregnancy outcomes were not reported. The remaining 30,425 pregnancies resulted in live births. Part B of Figure 11 shows that approximately 30% of these live births produced more than one infant (29% twins and approximately 2% triplets or more). This compares with a multiple-infant birth rate of slightly more than 3% in the general U.S. population.

Although total percentages for multiples were similar for pregnancies and live births, there were more triplet or higher order pregnancies than births. Triplet or higher order pregnancies may be reduced to twins or singletons by the time of birth. This can happen naturally (e.g., fetal death), or a woman and her doctor may decide to reduce the number of fetuses using a procedure called multifetal pregnancy reduction. CDC does not collect information on multifetal pregnancy reductions.

**Figure 11**
Distribution of Multiple-Fetus Pregnancies and Multiple-Infant Live Births from ART Cycles Using Fresh Nondonor Eggs or Embryos, 2010



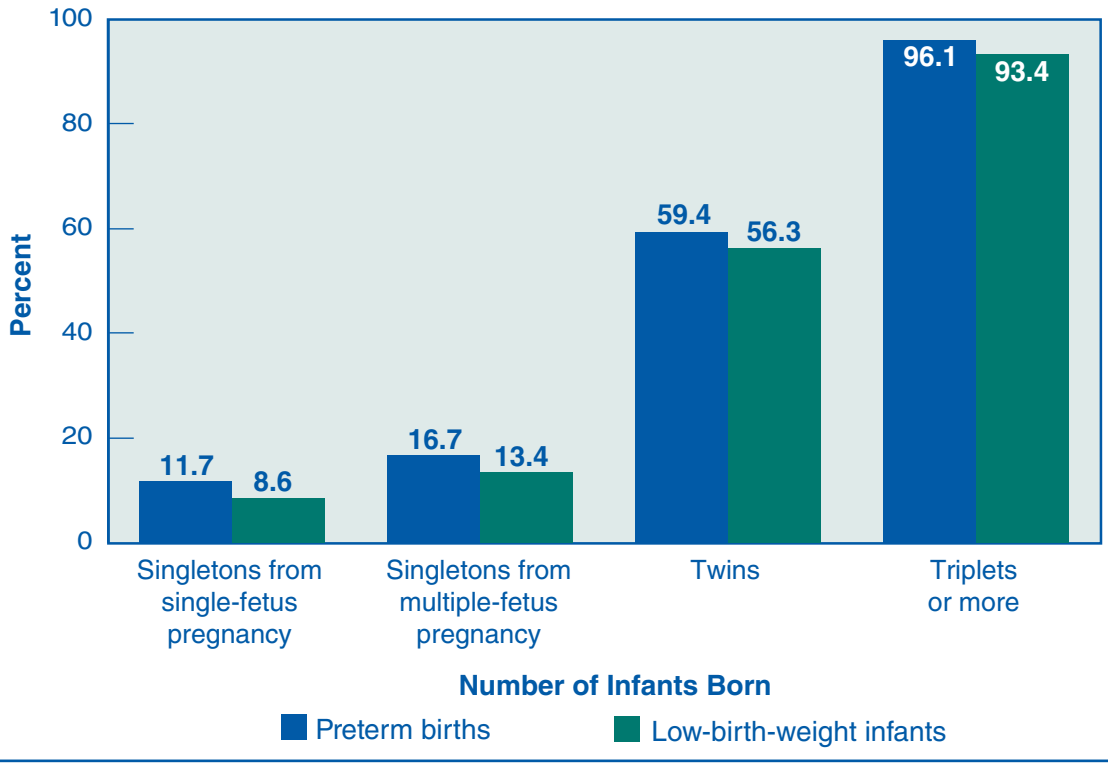
## Using ART, what are the risks of having a preterm birth and low-birth-weight infant?

Preterm birth occurs when a woman gives birth before 37 full weeks of pregnancy. Low-birth-weight infants are born weighing less than 2,500 grams or 5 pounds, 9 ounces. Infants born preterm or with low birth weight are at greater risk of death in the first few days of life, as well as other adverse health outcomes, including visual and hearing impairments, intellectual and learning disabilities, and behavioral and emotional problems throughout life. Preterm births and low-birth-weight infants also cause substantial emotional and economic burdens for families.

Figure 12 shows percentages of preterm births and low-birth-weight infants resulting from ART cycles that used fresh nondonor eggs or embryos in 2010, by number of infants born. For singletons, it shows separately the percentage of preterm birth and low birth weight among infants born from pregnancies that started with one fetus (single-fetus pregnancies) and with more than one fetus (multiple-fetus pregnancies). Among singletons, the percentage of preterm births and low-birth-weight infants was higher for those from multiple-fetus pregnancies. In the general U.S. population, where singletons are almost always the result of a single-fetus pregnancy, 12% were born preterm and 8% had low birth weights in 2008 (most recent available data).

Taking the number of preterm births or low-birth-weight infants in the general population and comparing it with multiple-fetus pregnancies resulting from ART is not meaningful because a substantial proportion of multiple-infant births are due to infertility treatments (both ART and non-ART). These data indicate that the risks of preterm birth and low birth weight are higher among infants conceived through ART than for infants in the general population. The increased risks are due, in large part, to the higher percentage of multiple-fetus pregnancies resulting from ART cycles.

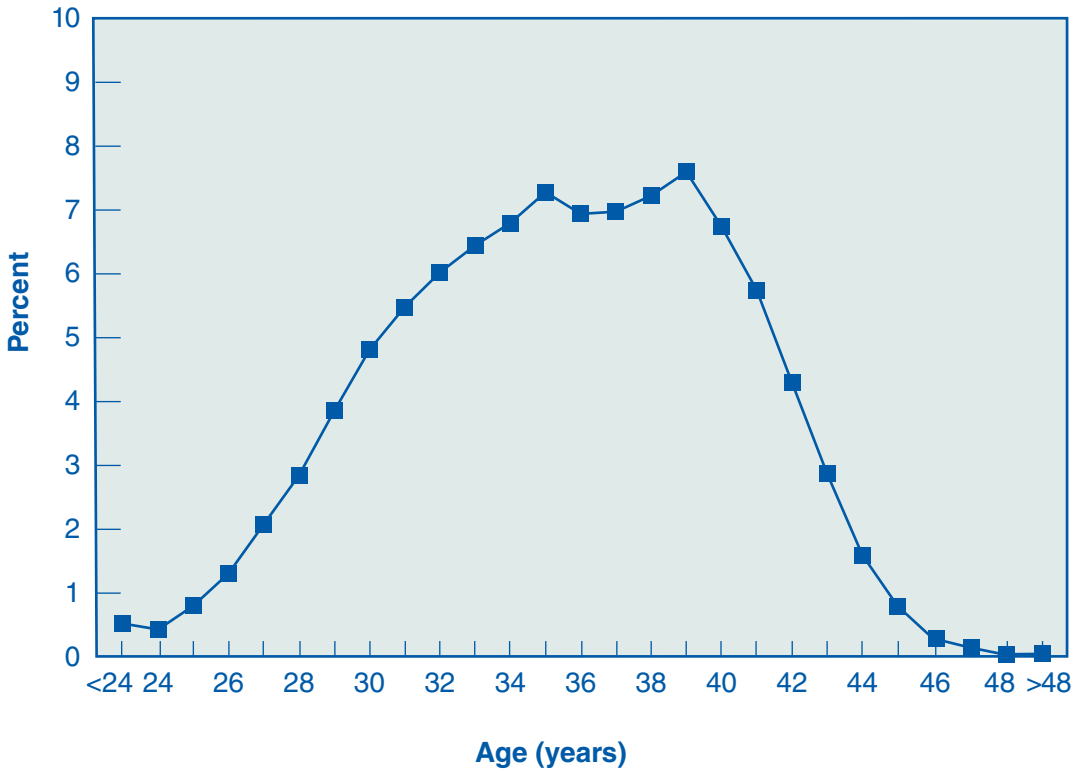
**Figure 12**
Percentages of Births That Are Preterm or Low Birth Weight from ART Cycles Using Fresh Nondonor Eggs or Embryos, by Number of Infants Born, 2010



## What are the ages of women who use ART?

Figure 13 presents ART cycles using fresh nondonor eggs or embryos in 2010 according to the age of the woman who had the procedure. About 12% of these cycles were among women younger than age 30, almost 66% were among women aged 30–39, and approximately 23% were among women aged 40 or older.

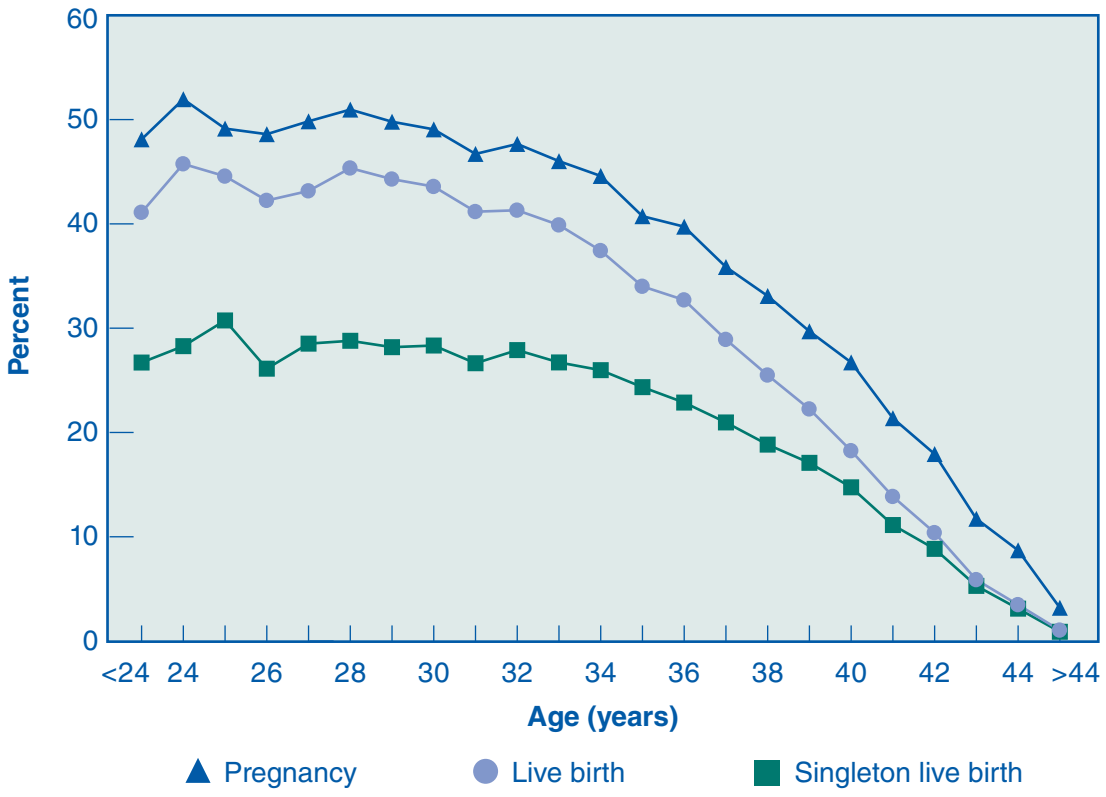
**Figure 13**
Age Distribution of Women Who Had ART Cycles Using Fresh Nondonor Eggs or Embryos, 2010



## Do percentages of ART cycles that result in pregnancies, live births, and singleton live births differ among women of different ages?

A woman's age is the most important factor affecting the chances of a live birth when her own eggs are used. Figure 14 shows percentages of pregnancies, live births, and singleton live births among women of different ages who had ART procedures using fresh nondonor eggs or embryos in 2010. Percentages of ART cycles resulting in live births and singleton live births are different because of the high percentage of multiple-infant deliveries counted among the total live births. The percentage of multiple-infant births is particularly high among women younger than 35 (see Figure 33, page 37). Among women in their 20s, percentages of ART cycles resulting in pregnancies, live births, and singleton live births were relatively stable; however, percentages declined steadily among women in their mid-30s onward. For additional detail on percentages of ART cycles that resulted in pregnancies, live births, and singleton live births among women aged 40 or older, see Figure 15 on page 19.

**Figure 14**
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Pregnancies, Live Births, and Singleton Live Births, by Age of Woman,* 2010

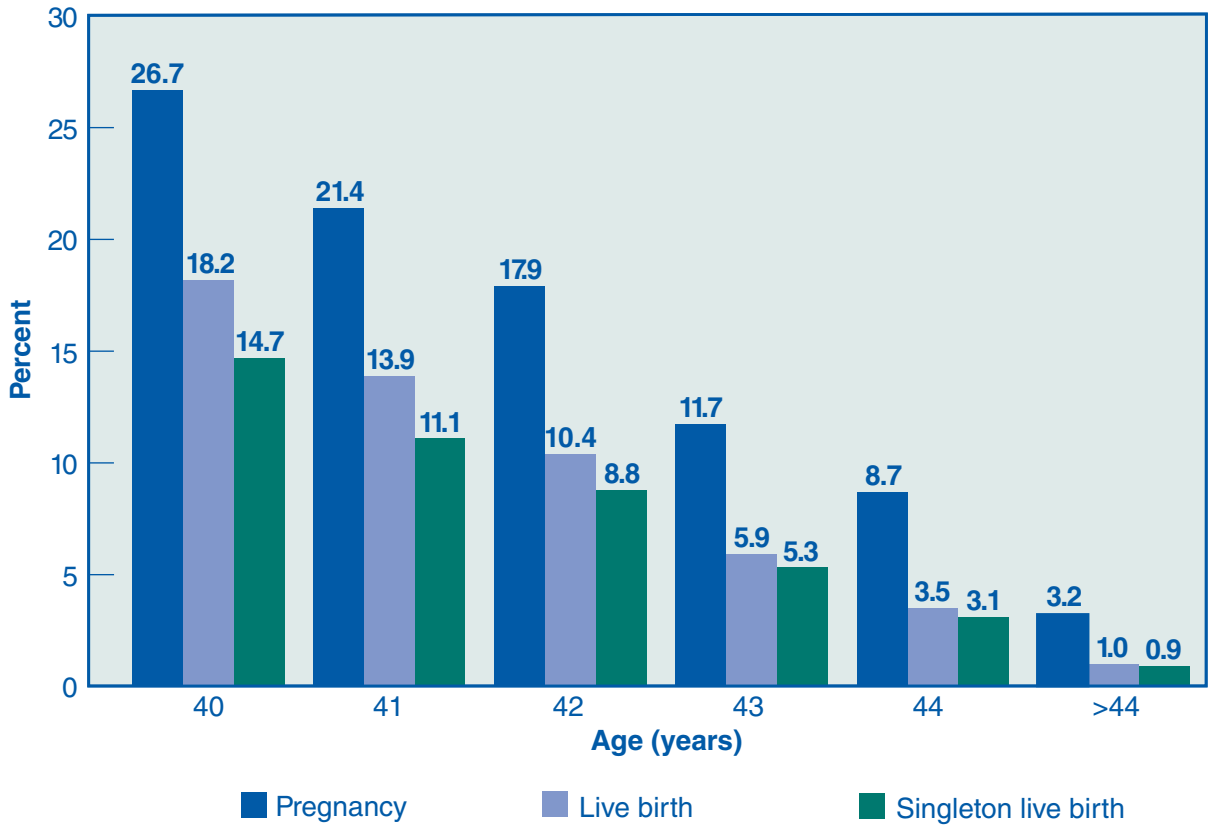



*For consistency, all percentages are based on cycles started.

## How do percentages of ART cycles that result in pregnancies, live births, and singleton live births differ among women aged 40 or older?

Figure 15 shows percentages of pregnancies, live births, and singleton live births among women aged 40 or older who used fresh nondonor eggs or embryos in 2010. The percentage of ART cycles resulting in pregnancy was nearly 27% among women aged 40; the percentage of ART cycles resulting in live births for this age was about 18%, and the percentage of ART cycles resulting in singleton live births was about 15%. All percentages dropped steadily with each 1-year increase in age. Among women older than 44, percentages of live births and singleton live births were both 1% or less. Women aged 40 or older generally have much higher percentages of live births using donor eggs (see Figure 44, page 48).

**Figure 15**
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Pregnancies, Live Births, and Singleton Live Births Among Women Aged 40 or Older,* 2010



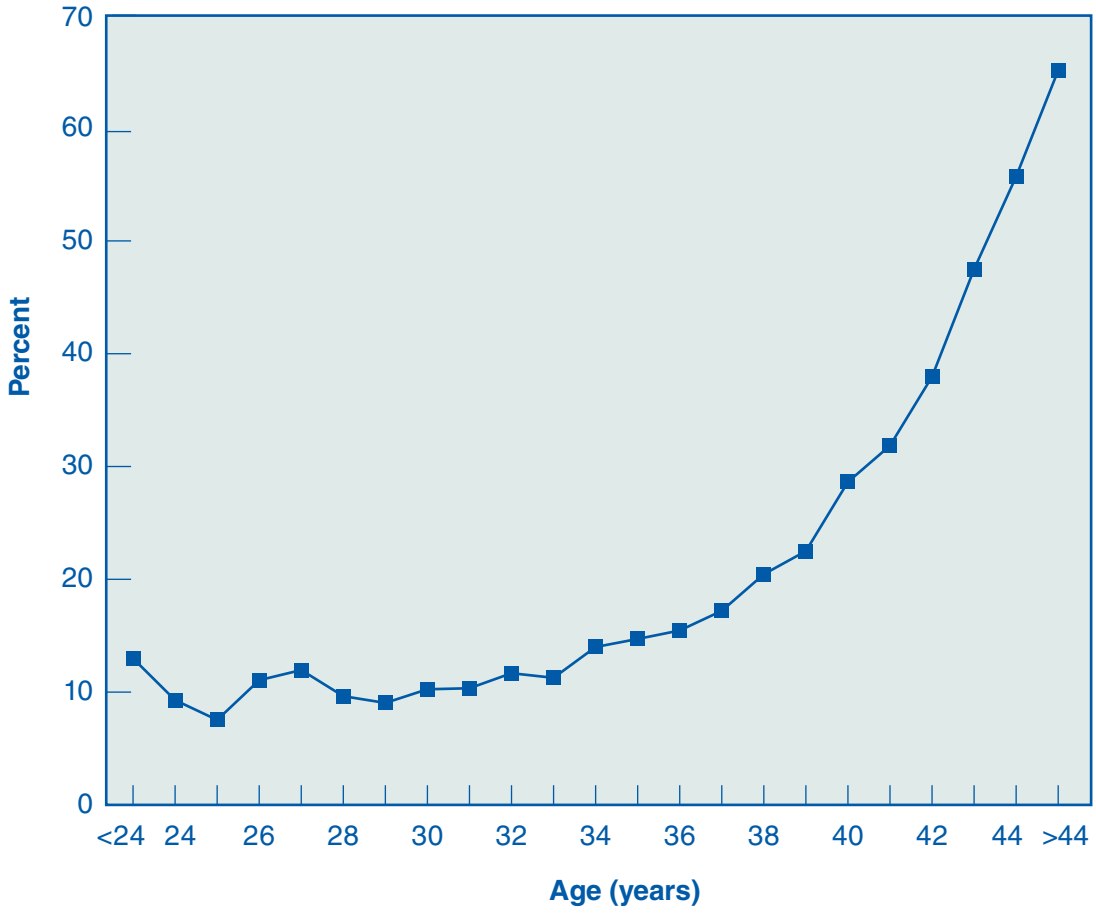

*For consistency, all percentages are based on cycles started.

## How does the risk of miscarriage differ among women of different ages?

A woman's age not only affects the chance for pregnancy when her own eggs are used, but also affects her risk of miscarriage. Figure 16 shows percentages of ART cycles using fresh nondonor eggs or embryos in 2010 that resulted in miscarriage for women of different ages. Percentages of ART cycles that resulted in miscarriage were below 15% among women aged 35 or younger. The percentage of ART cycles that resulted in miscarriages began to increase among women in their mid- to late 30s and continued to increase with age, reaching approximately 29% at age 40 and over 65% among women older than age 44.

The risk of miscarriage among women undergoing ART procedures using fresh nondonor eggs or embryos appears to be similar to those reported in various studies of other pregnant women in the United States.

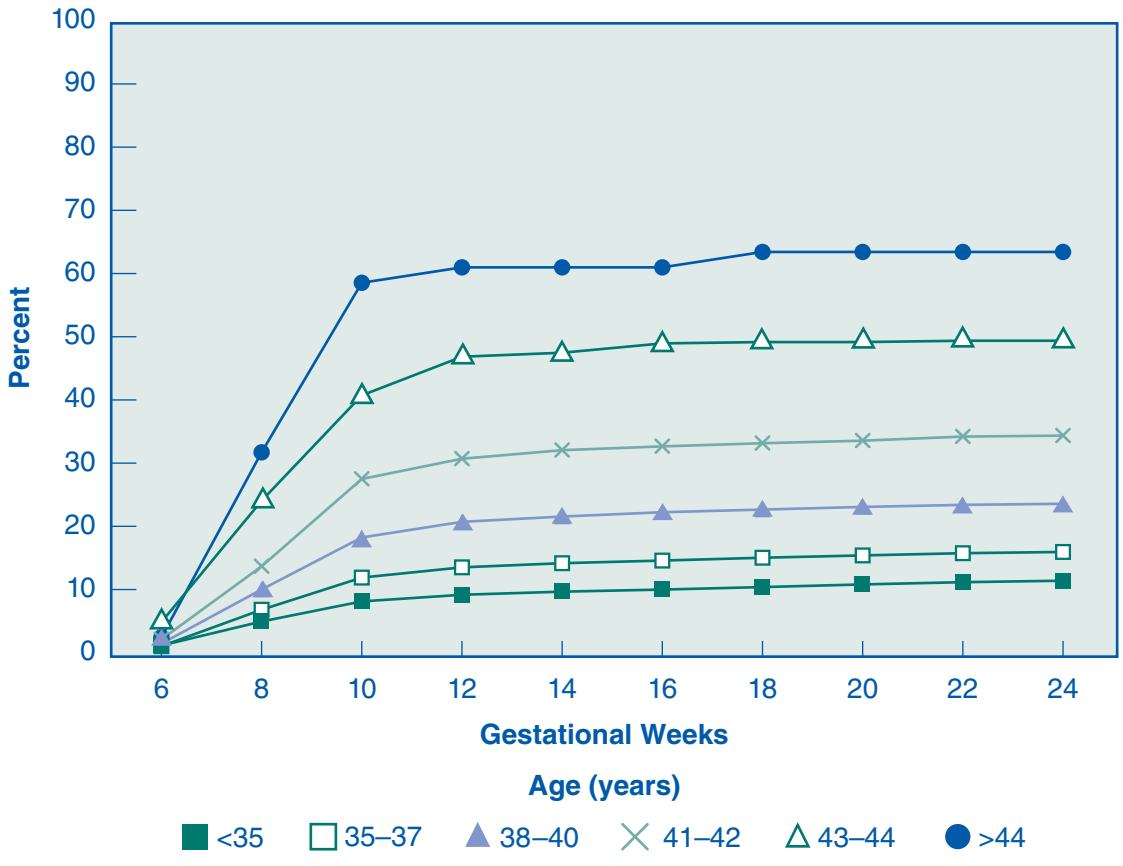
**Figure 16**
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Miscarriage, by Age of Woman, 2010



## How does the risk of pregnancy loss through week 24 vary among women of different ages?

The risk of pregnancy loss (loss of an entire pregnancy or all fetuses in a multiple-fetus pregnancy, including stillbirths and miscarriages) is affected by the duration of a woman's pregnancy and her age. Figure 17 shows that 11% to 63% of pregnancies were lost through 24 weeks gestation, depending on the woman's age. Among women younger than age 35, 11% of pregnancies were lost and 87% continued through week 24. In contrast, among women older than age 44, about 63% of pregnancies were lost and only 34% continued through week 24. In all age groups, most pregnancy losses occurred before week 14 (i.e., during the first trimester). The risk of pregnancy loss after 24 weeks was 1% or less for all age groups because most pregnancies that progress beyond week 24 lead to live births. Note that percentages of pregnancy loss and percentages of pregnancy continuation for each age group may not add up to 100% because some pregnancies resulted in outcomes other than pregnancy loss before week 24 (e.g., live births, induced abortions, or maternal death).

**Figure 17**
Percentages of Pregnancies That Were Lost Through Week 24 Among ART Cycles Using Fresh Nondonor Eggs or Embryos, by Age Group, 2010



## How does a woman's age affect her chances of progressing through the various stages of ART?

In 2010, a total of 100,824 cycles using fresh nondonor eggs or embryos were started:

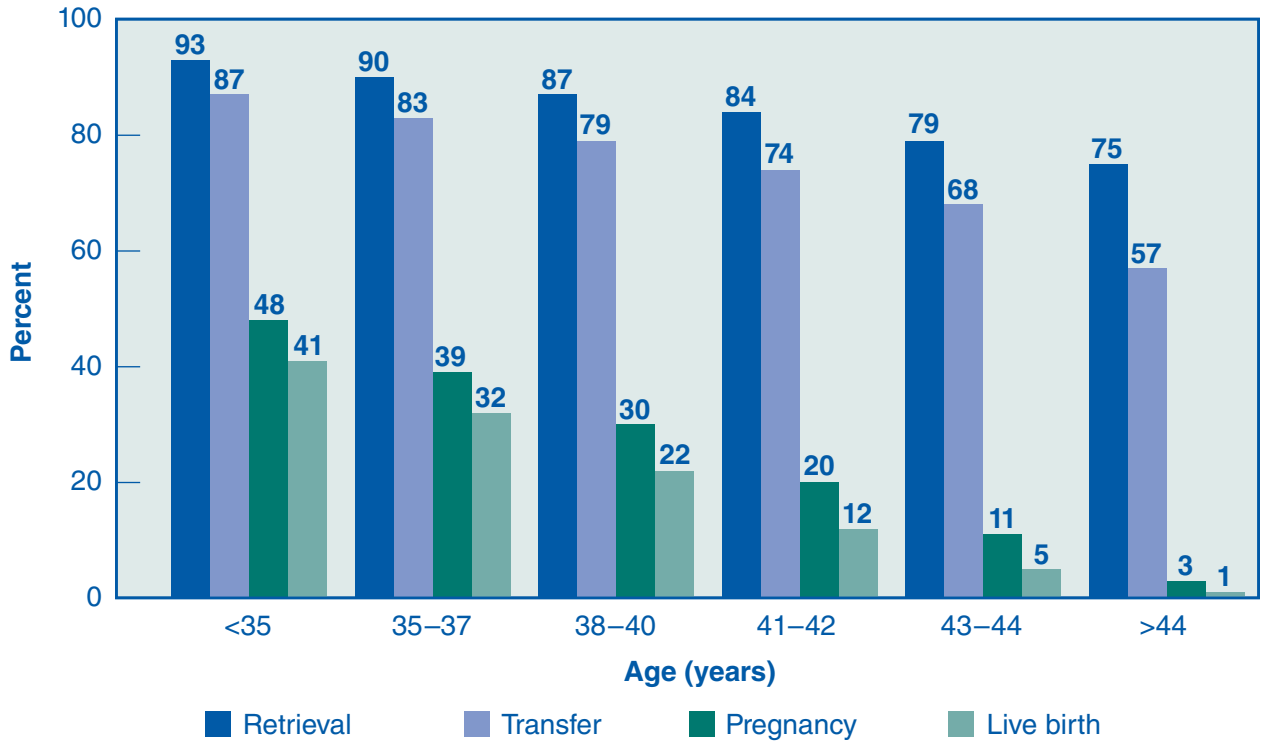
- 41,744 among women younger than age 35
- 21,369 among women aged 35–37 years
- 21,741 among women aged 38–40 years
- 10,122 among women aged 41–42 years
- 4,501 among women aged 43–44 years
- 1,347 among women older than age 44

Figure 18 shows that a woman's chance of progressing from the beginning of ART to pregnancy and live birth (using her own eggs) decreases at every stage of ART as her age increases.

- As women get older, the likelihood of a successful response to ovarian stimulation and progression to **egg retrieval** decreases.
- As women get older, cycles that have progressed to egg retrieval are less likely to reach **transfer**.
- The percentage of cycles that progress from transfer to **pregnancy** also decreases as women get older.
- As women get older, cycles that have progressed to pregnancy are less likely to result in a **live birth** because the risk of miscarriage is greater (see Figure 16, page 20).

Overall, 41% of cycles started in 2010 among women younger than age 35 resulted in live births. This percentage decreased to 32% among women aged 35–37, 22% among women aged 38–40, 12% among women aged 41–42, 5% among women aged 43–44, and 1% among women older than age 44.

**Figure 18**
Outcomes of ART Cycles Using Fresh Nondonor Eggs or Embryos, by Stage and Age Group, 2010

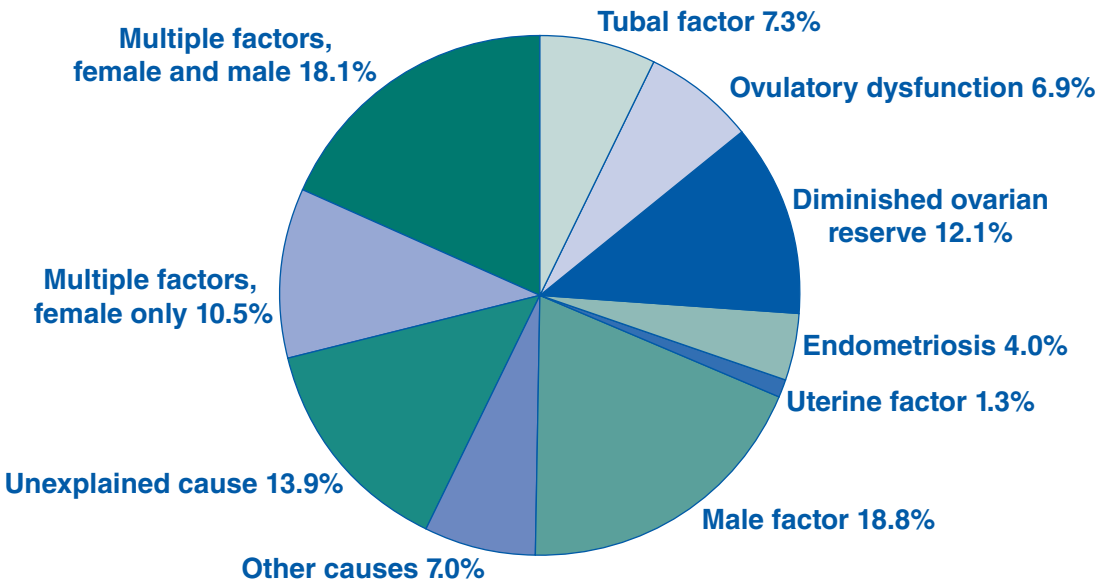


## What are the causes of infertility among users of ART?

Figure 19 shows the infertility diagnoses reported among patients who had an ART procedure using fresh nondonor eggs or embryos in 2010. Diagnoses range from one infertility factor in one partner to one or more multiple infertility factors in the patient or in either one or both partners. However, diagnostic procedures may vary from one clinic to another, so the categorization also may vary.

- **Tubal factor** means that the woman's fallopian tubes are blocked or damaged, making it difficult for the egg to be fertilized or for an embryo to travel to the uterus.
- **Ovulatory dysfunction** means that the ovaries are not producing eggs normally. Such dysfunctions include polycystic ovary syndrome and multiple ovarian cysts.
- **Diminished ovarian reserve** means that the ability of the ovary to produce eggs is reduced. Reasons include congenital, medical, or surgical causes or advanced age.
- **Endometriosis** involves the presence of tissue similar to the uterine lining in abnormal locations. This condition can affect both fertilization of the egg and embryo implantation.
- **Uterine factor** means a structural or functional disorder of the uterus that results in reduced fertility.
- **Male factor** refers to a low sperm count or problems with sperm function that make it difficult for a sperm to fertilize an egg under normal conditions.
- **Other causes** of infertility include immunological problems, chromosomal abnormalities, cancer chemotherapy, and serious illnesses.
- **Unexplained cause** means that no cause of infertility was found in either the woman or the man.
- **Multiple factors, female only,** means that more than one female cause was diagnosed.
- **Multiple factors, female and male,** means that one or more female causes and male factor infertility were diagnosed.

**Figure 19**
Infertility Diagnoses Among Patients Who Had ART Cycles Using Fresh Nondonor Eggs or Embryos*, 2010

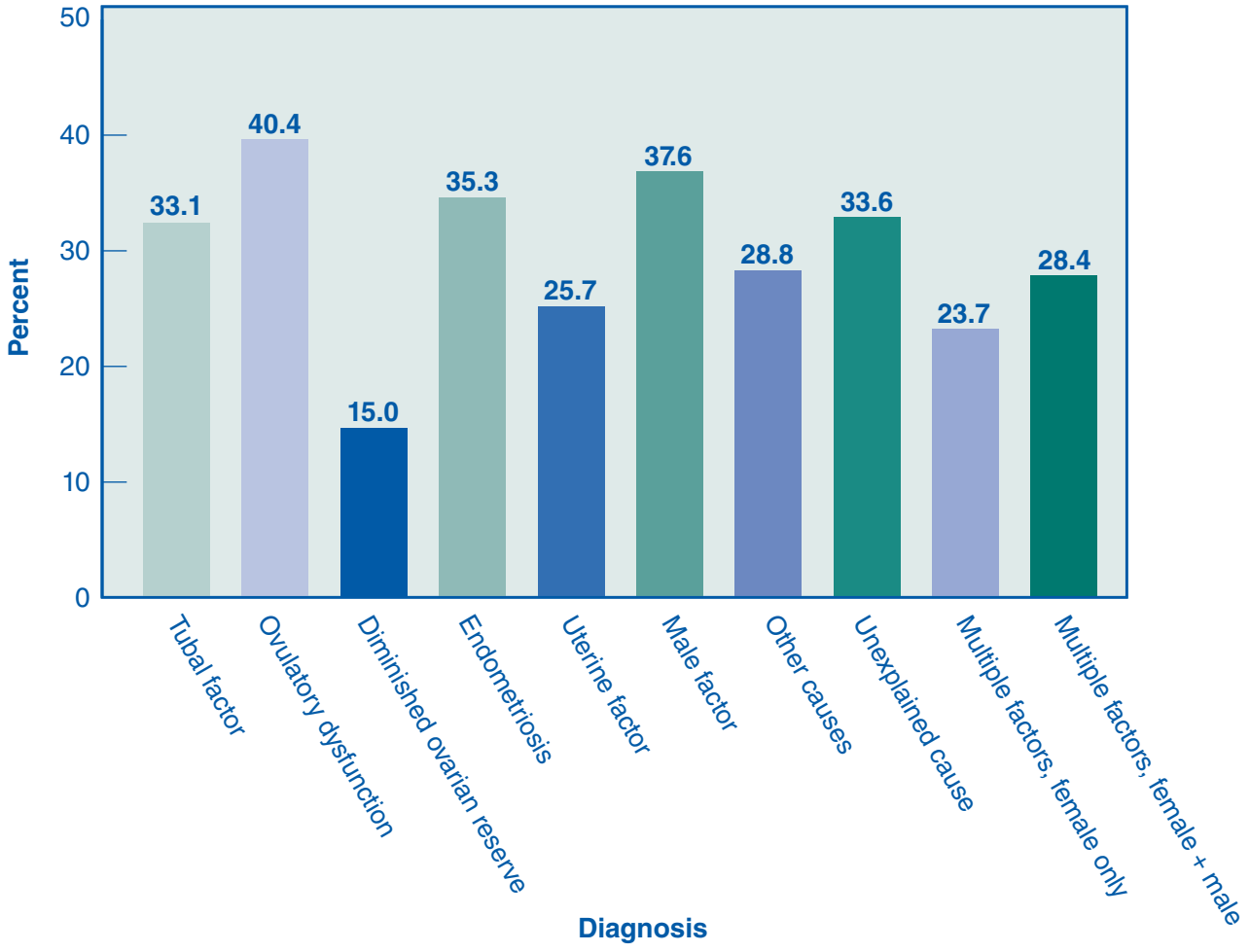



*Total does not equal 100% due to rounding.

## Does the cause of infertility affect the percentage of ART cycles that result in live births?

Figure 20 shows the percentage of ART cycles using fresh nondonor eggs or embryos that resulted in live births according to the causes of infertility. (See Figure 19, page 23, or the Glossary of Terms in Appendix B on pages 73–75 for an explanation of the diagnoses.) Although the national average was 30% in 2010 (see Figure 8, page 12), the percentage of ART cycles that resulted in live births varied somewhat depending on the patient's diagnosis. In 2010, the percentage of ART cycles resulting in live births was higher than the national average for couples with diagnosed tubal factor, ovulatory dysfunction, endometriosis, male factor, or unexplained infertility; it was lower for patients with diagnosed diminished ovarian reserve, uterine factor, "other" causes, or multiple infertility factors. Please note, however, that the definitions of infertility diagnoses may vary from clinic to clinic and that a review of select clinical records revealed that reporting of infertility causes may be incomplete. (See Findings from Validation Visits for 2010 ART Data in Appendix A on pages 67–69 for additional information.) Therefore, differences in success rates by causes of infertility should be interpreted with caution.

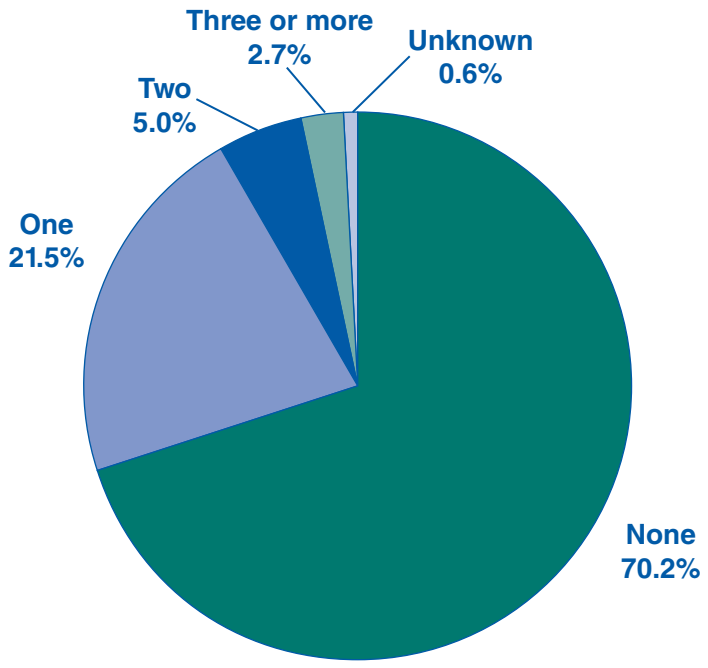
**Figure 20**
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, by Diagnosis, 2010



## What proportion of women who use ART have previously given birth?

Figure 21 shows the number of previous births among women who had ART procedures using fresh nondonor eggs or embryos in 2010. Most ART procedures (70%) were among women who had no previous births, although they may have had a pregnancy that resulted in a miscarriage or an induced abortion. About 22% of ART procedures were among women who reported one previous birth, and about 8% were among women who reported two or more previous births. However, we do not have information about how many of these were births resulting from ART and how many were not. These data nonetheless point out that women who have previously given birth can still face infertility problems.

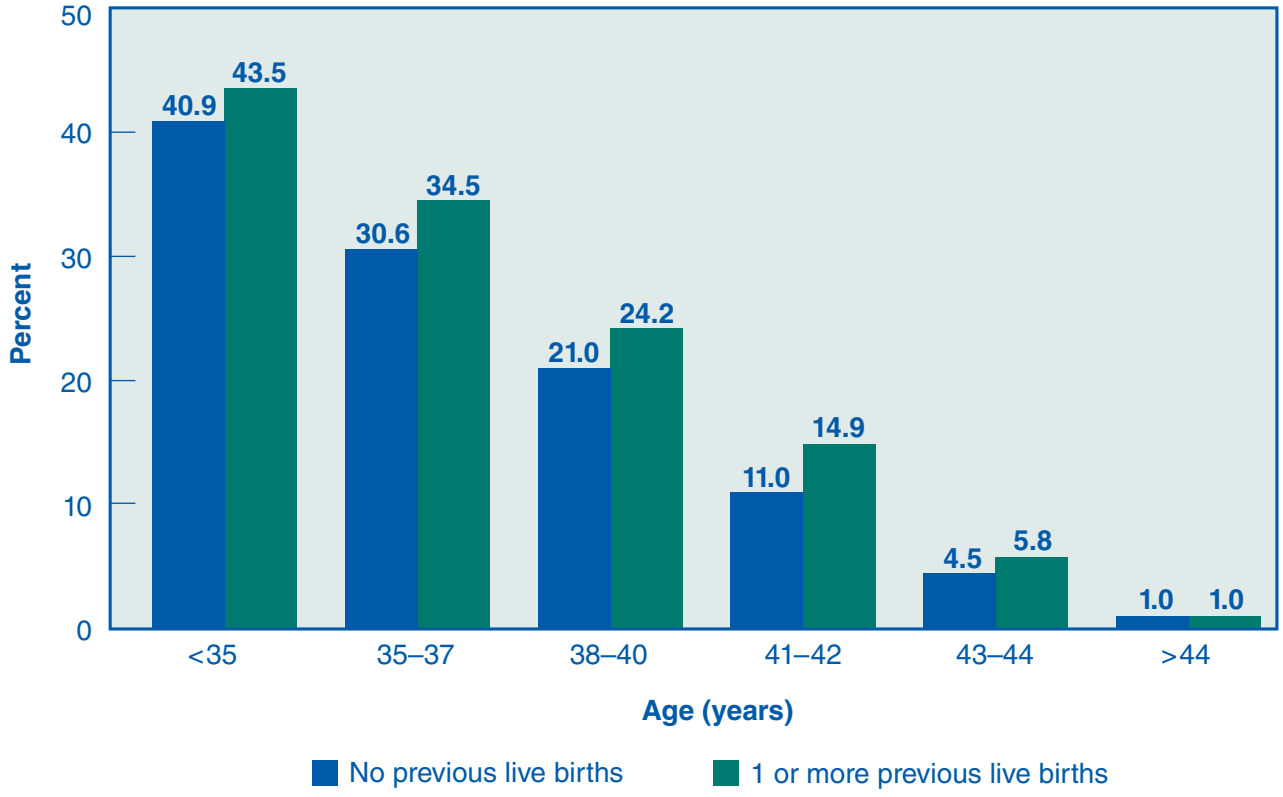
**Figure 21**
Numbers of Previous Births Among Women Who Had ART Cycles Using Fresh Nondonor Eggs or Embryos, 2010



## Do women who have previously given birth have higher percentages of ART cycles that result in live births?

Figure 22 shows the relationship between the success of ART cycles performed in 2010 using fresh nondonor eggs or embryos and a history of previous births. Previous live-born infants were conceived naturally in some cases and through ART in others. In all age groups, percentages of ART cycles that resulted in live births were slightly higher or equal among women who had one or more previous live births compared to those who had no previous live births.

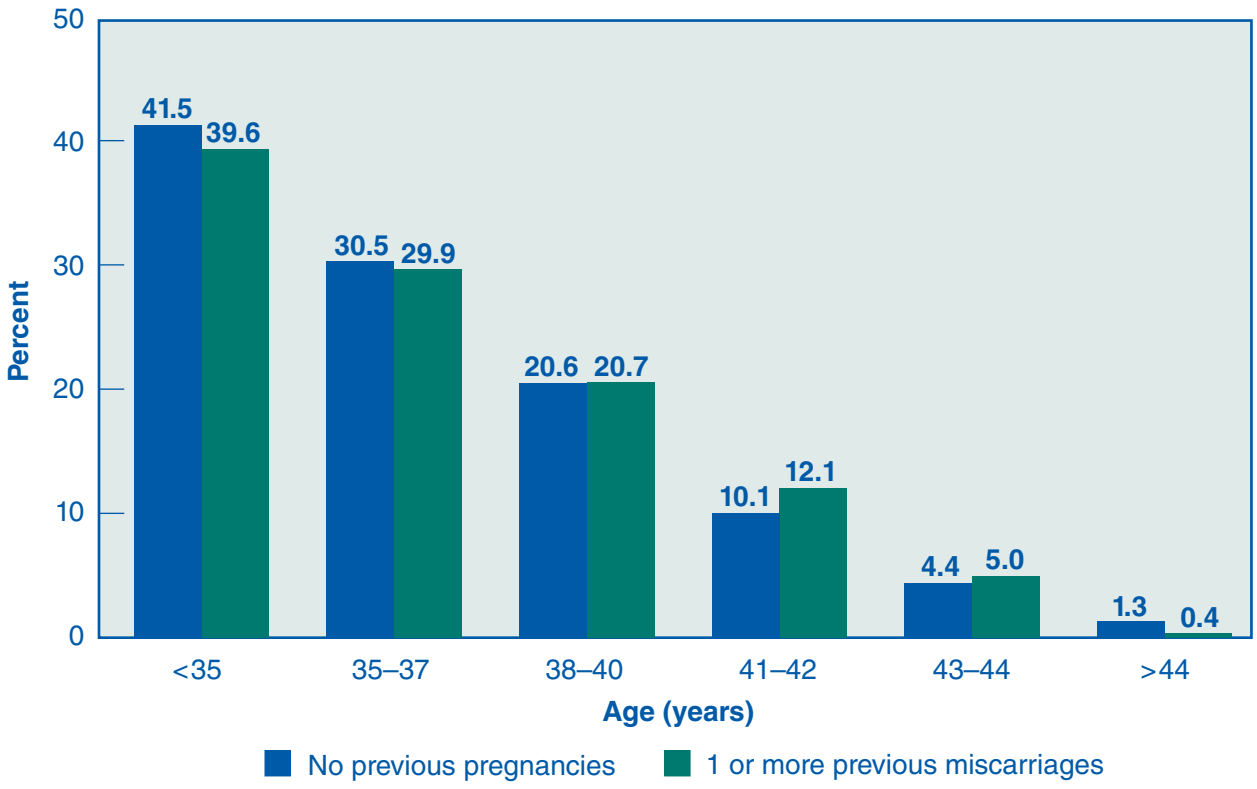
**Figure 22**
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, by Age Group and Number of Previous Live Births, 2010



## Is there a difference in percentages of ART cycles that result in live births between women with previous miscarriages and women who have never been pregnant?

In 2010, 70,817 ART cycles using fresh nondonor eggs or embryos were performed among women who had not previously given birth. However, about 27% of those cycles were reported by women with one or more previous pregnancies that had ended in miscarriage—we do not have information on whether the pregnancies ending in miscarriage were the result of ART or were conceived naturally. Figure 23 shows the relationship between the success of an ART cycle in 2010 and the history of previous miscarriage. In all age groups, percentages of cycles that resulted in live births were similar among women who had one or more previous miscarriages and women who never were pregnant. Thus, a history of unsuccessful pregnancy does not appear to be associated with lower chances for success using ART.

**Figure 23**
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, by Age Group and History of Miscarriage, Among Women with No Previous Births,* 2010

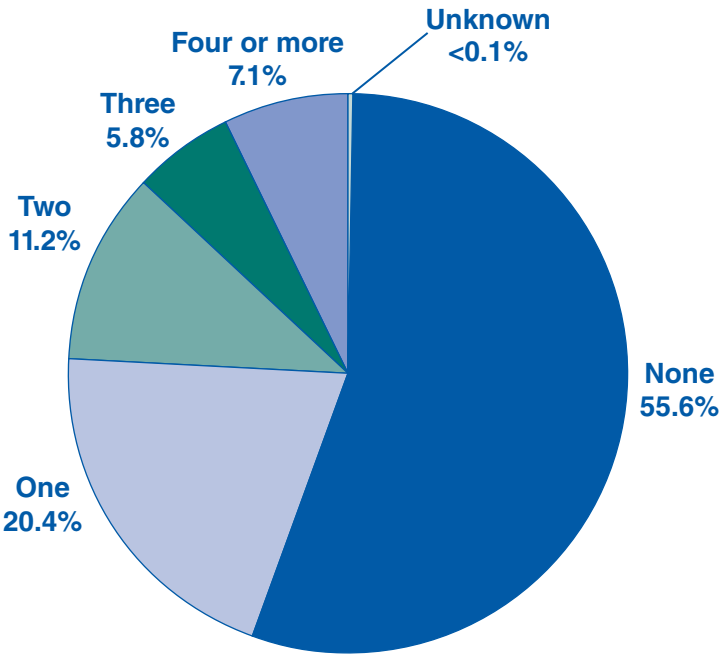



*Women reporting only previous ectopic pregnancies or pregnancies that ended in induced abortion are not included.

## What proportion of current ART users have undergone previous ART cycles?

Figure 24 presents ART cycles that used fresh nondonor eggs or embryos in 2010 according to whether previous ART cycles had been performed. For about 45% of ART procedures performed in 2010, one or more previous cycles were reported. (This percentage includes previous cycles using either fresh or frozen embryos.) This finding illustrates that it is not uncommon for women to undergo multiple ART cycles. We do not have information on when previous cycles were performed, nor do we have information on the outcomes of those previous cycles.

**Figure 24**
Numbers of Previous ART Cycles Among Women Undergoing ART with Fresh Nondonor Eggs or Embryos,* 2010

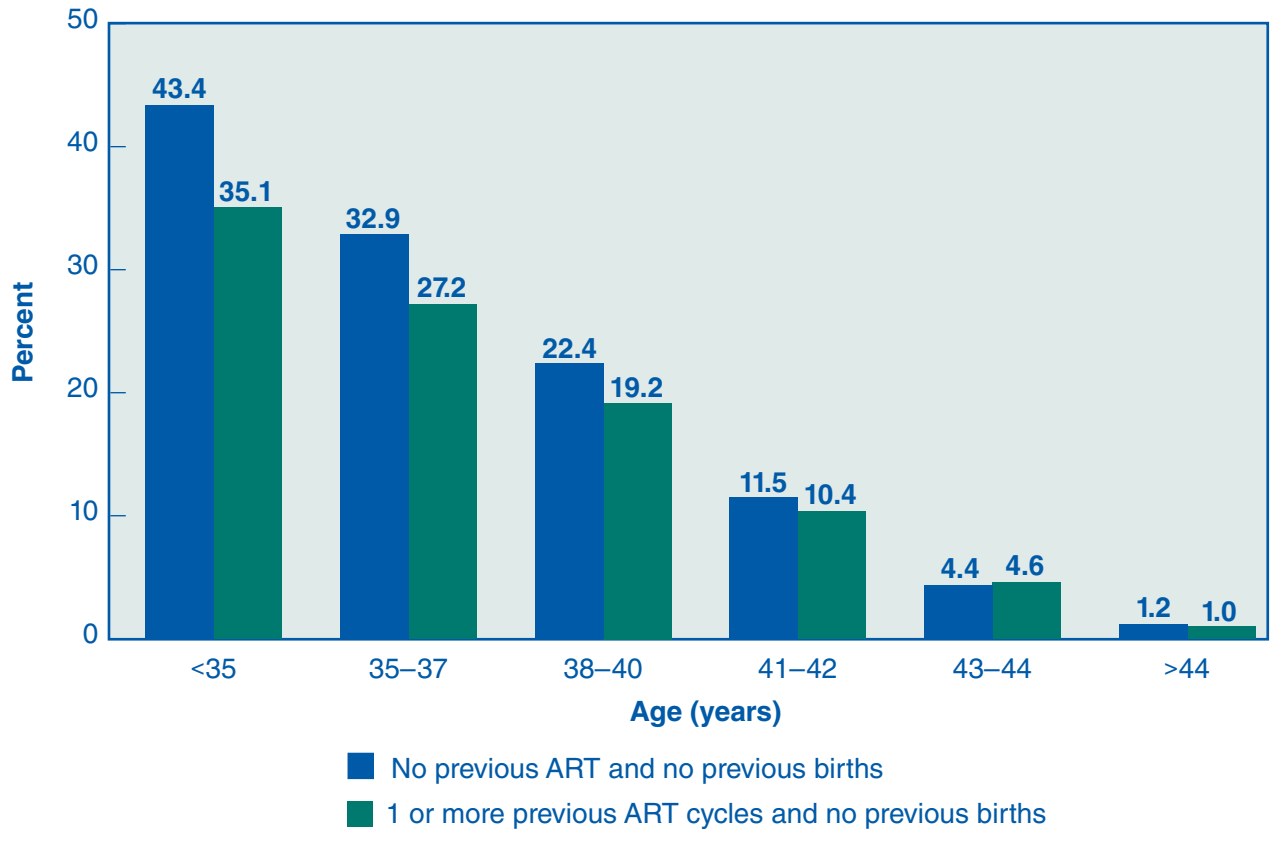



*Total does not equal 100% due to rounding.

## Are percentages of ART cycles that result in live births different for women using ART for the first time and women who previously used ART but did not give birth?

Figure 25 shows the relationship between the success of ART cycles performed in 2010 using fresh nondonor eggs or embryos and a history of previous ART cycles among women with no previous births. In the majority of age groups, percentages of ART cycles that resulted in live births among women who previously had an unsuccessful ART cycle were lower or similar to those among women who had no previous ART cycles and no previous births.

**Figure 25**
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, by Age Group and History of Previous ART Cycles, Among Women with No Previous Births, 2010

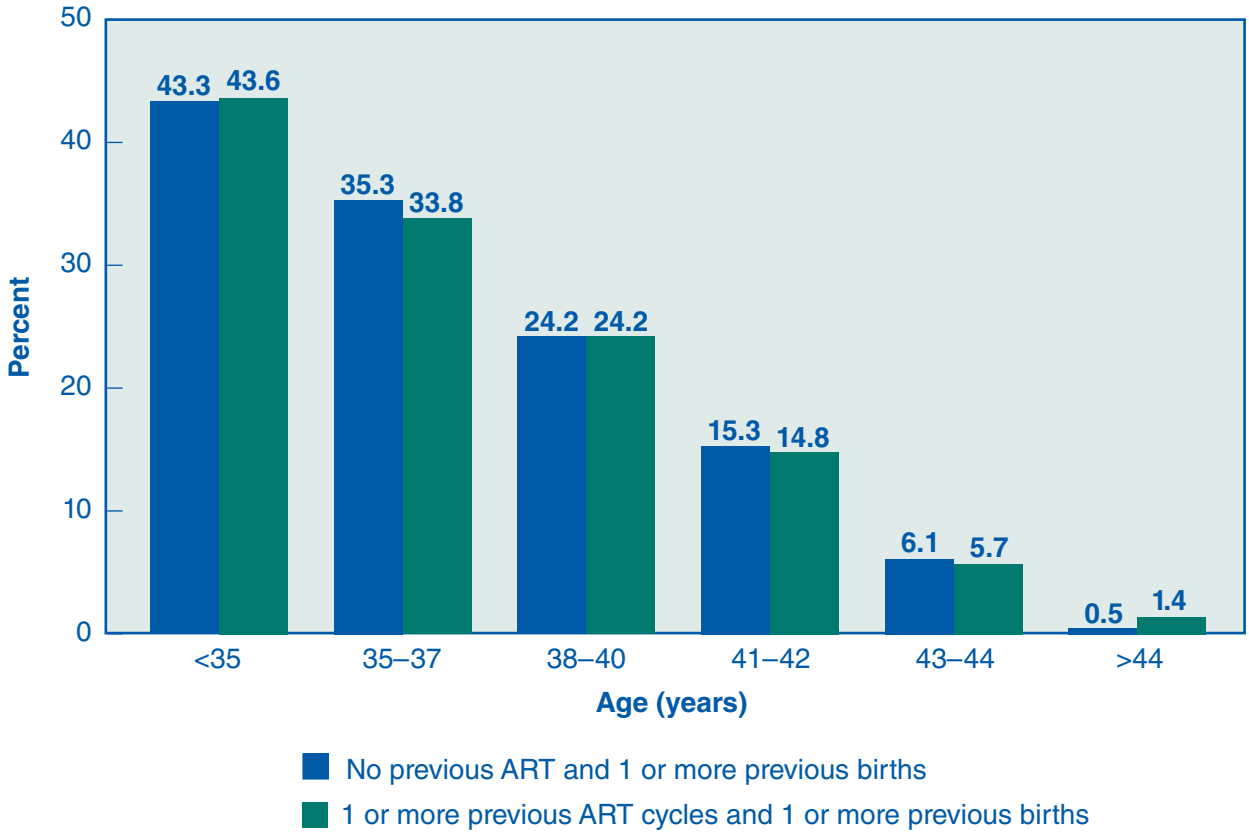


## What is the percentage of ART cycles that result in live births for women who have both previously used ART and previously given birth?

Figure 26 shows the relationship between the success of ART cycles performed in 2010 using fresh nondonor eggs or embryos and a history of both previous ART cycles and previous births. We do not have information on whether the previous births were the result of ART or were conceived naturally. However, among women with previous births, percentages of ART cycles that resulted in live births among women who did not undergo a previous ART procedure were comparable to percentages among women who had undergone previous ART cycles in all age groups.

Figure 25 (see page 29) shows that the percentage of ART cycles resulting in live births decreases with a woman's age and for those women with one or more previous ART cycles among women with no previous births. In Figure 26, for women with one or more previous births, the percentage of live births also decreases with a woman's age, but does not appear to be related to a woman's history of use of ART.

**Figure 26**
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, by Age Group and History of Previous ART Cycles, Among Women with One or More Previous Births, 2010



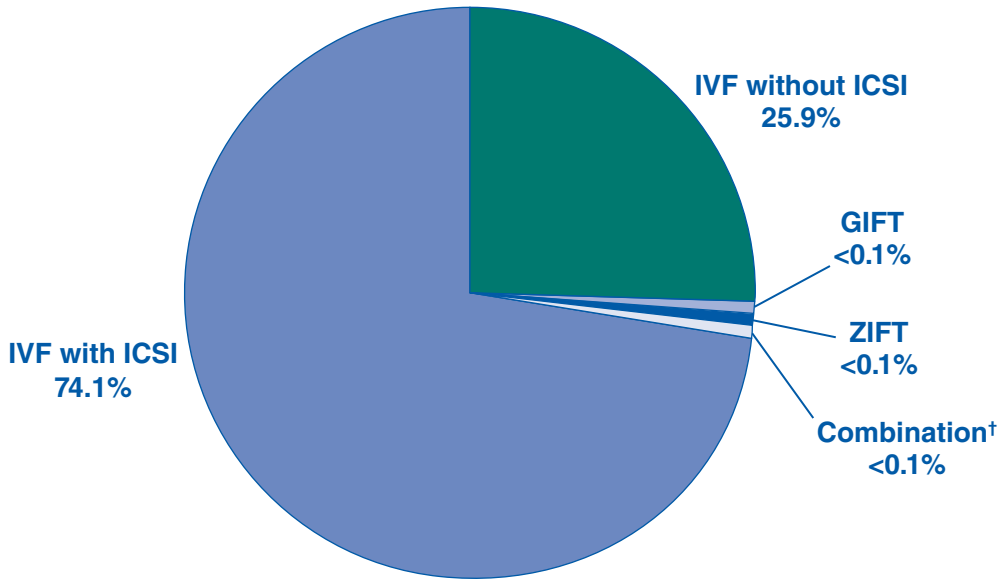
## What are the specific types of ART performed among women who use fresh nondonor eggs or embryos?

Figure 27 presents the types of ART procedures performed among women using fresh nondonor eggs or embryos. For about 26% of ART procedures that progressed to the egg retrieval step, standard IVF (in vitro fertilization) techniques were used: eggs and sperm were combined in the laboratory, the resulting embryos were cultured for 2 or more days, and one or more embryos were then transferred into the woman's uterus through the cervix.

For most of the remaining ART procedures (about 74%), fertilization was accomplished using intracytoplasmic sperm injection (ICSI). This technique involves injecting a single sperm directly into an egg; the embryos are then cultured and transferred as in standard IVF.

For a very small proportion of ART procedures, unfertilized eggs and sperm (gametes) or early embryos (zygotes) were transferred into the woman's fallopian tubes. These procedures are known as gamete and zygote intrafallopian transfer (GIFT and ZIFT, respectively). Some women with tubal infertility are not suitable candidates for GIFT and ZIFT. GIFT and ZIFT are more invasive procedures than IVF because they involve inserting a laparoscope into a woman's abdomen to transfer the embryos or gametes into the fallopian tubes. In contrast, IVF involves transferring embryos or gametes into a woman's uterus through the cervix without surgery.

**Figure 27**
Types of ART Procedures Using Fresh Nondonor Eggs or Embryos,* 2010



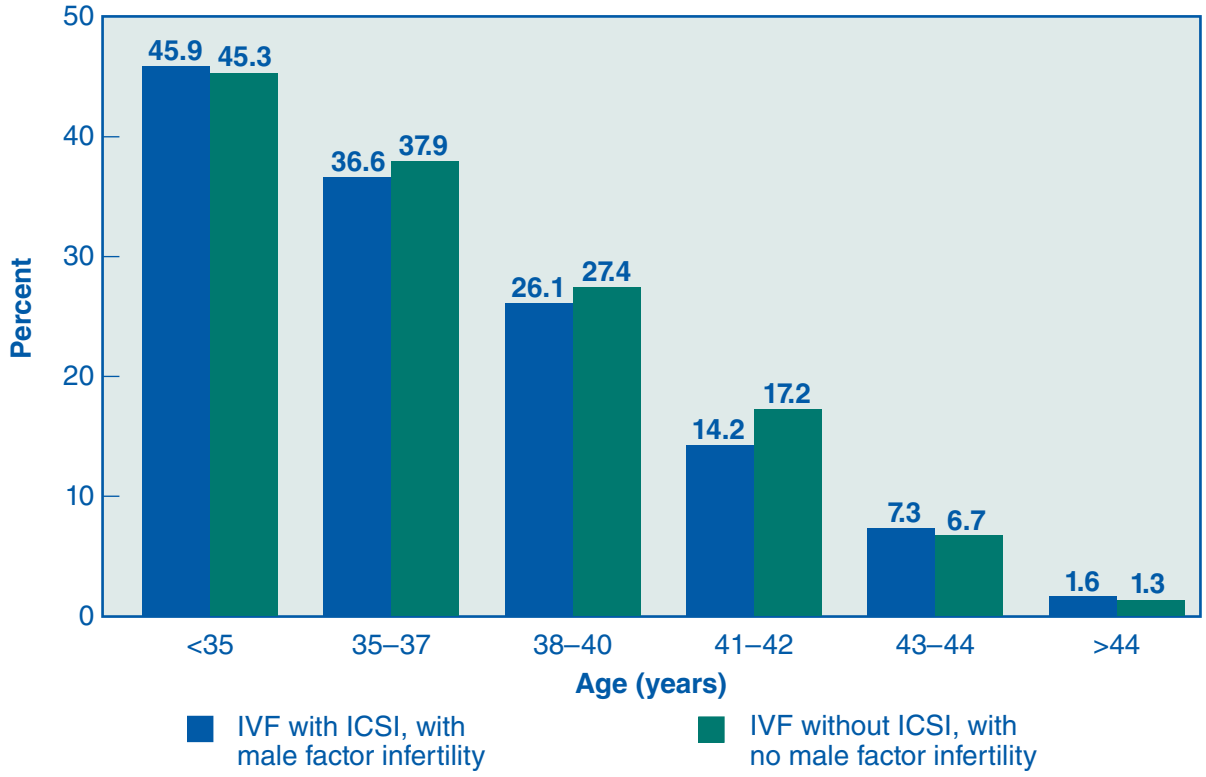

*Total does not equal 100% due to rounding.
† Combination of IVF with or without ICSI and either GIFT or ZIFT.

## What is the percentage of retrievals that result in live births when ICSI is used with diagnosis of male factor infertility?

ICSI was developed to overcome problems with fertilization that sometimes occur with a diagnosis of male factor infertility. In 2010, 84% of couples who received a diagnosis of male factor infertility used IVF with ICSI. Because ICSI can only be performed when at least one egg has been retrieved, Figure 28 presents percentages of retrievals that resulted in live births for these ICSI procedures among couples with diagnosed male factor infertility. For comparison, these percentages are presented alongside percentages for ART cycles that used standard IVF without ICSI among patients and partners who received all diagnoses except male factor infertility.

For most age groups, when ICSI was used for patients with male factor infertility, percentages of retrievals that resulted in live births were similar to those using standard IVF without ICSI and no diagnosis of male factor infertility. Please note, however, that the definitions of infertility diagnoses may vary from clinic to clinic and that a review of select clinical records revealed that reporting of infertility causes may be incomplete. (See Findings from Validation Visits for 2010 ART Data in Appendix A on pages 67–69 for additional information.) Therefore, differences in success rates by causes of infertility should be interpreted with caution.

**Figure 28**
Percentages of Retrievals That Resulted in Live Births Among Couples with Diagnosed Male Factor Infertility Who Used IVF with ICSI, Compared with Couples Without Diagnosed Male Factor Infertility Who Used IVF Without ICSI, by Age Group,* 2010

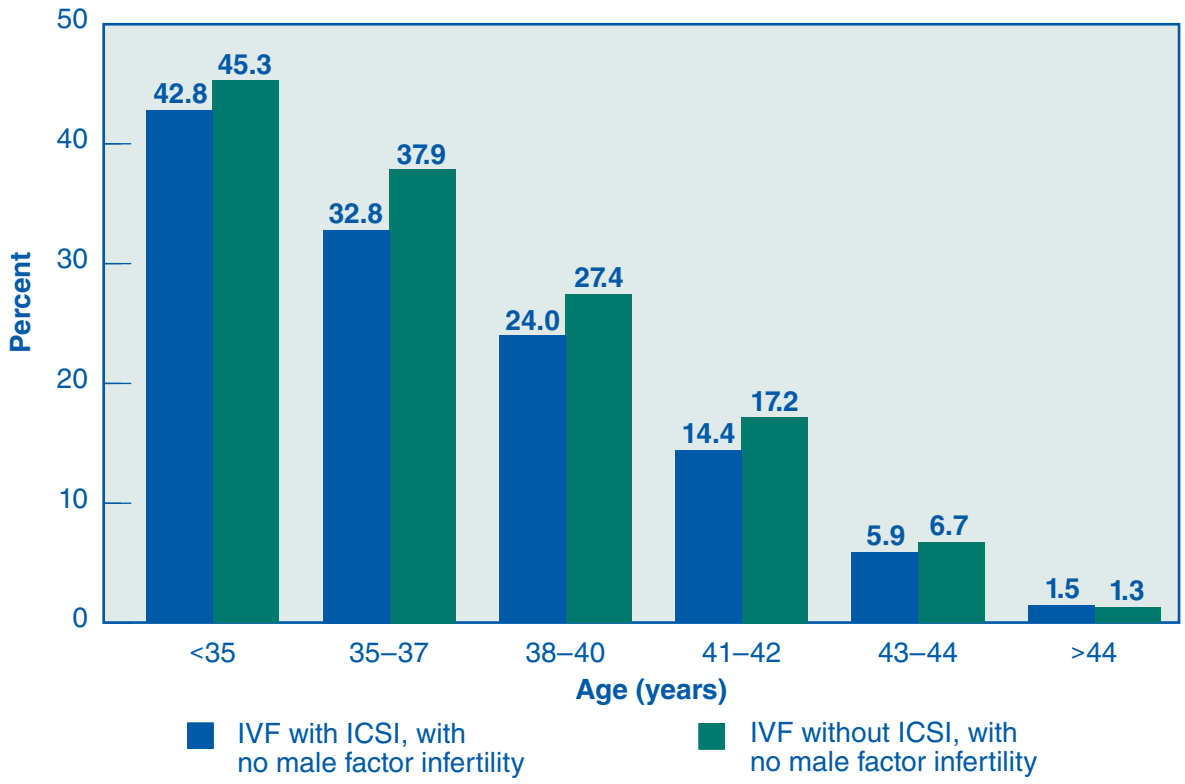



* Cycles using donor sperm and cycles using GIFT or ZIFT are excluded.

## What is the percentage of retrievals that result in live births without a diagnosis of male factor infertility when ICSI is used?

Among 66,830 ICSI cycles performed in 2010, slightly more than half (53%) were performed without a diagnosis of male factor infertility. Figure 29 presents percentages of egg retrievals that resulted in live births for those cycles compared with ART cycles using IVF without ICSI. For women aged 44 and younger, the ICSI procedures were less successful. Please note, however, that the definitions of infertility diagnoses may vary from clinic to clinic and that a review of select clinical records revealed that reporting of infertility causes may be incomplete. (See Findings from Validation Visits for 2010 ART Data in Appendix A on pages 67–69 for additional information.) Additionally, information was not available to determine whether this finding was a direct effect of the ICSI procedure or whether the patients who used ICSI were somehow different from those who used IVF alone. Therefore, differences in success rates by causes of infertility should be interpreted with caution.

**Figure 29**
Percentages of Retrievals That Resulted in Live Births Among Patients Without Diagnosed Male Factor Infertility, by Use of ICSI and Age Group,* 2010

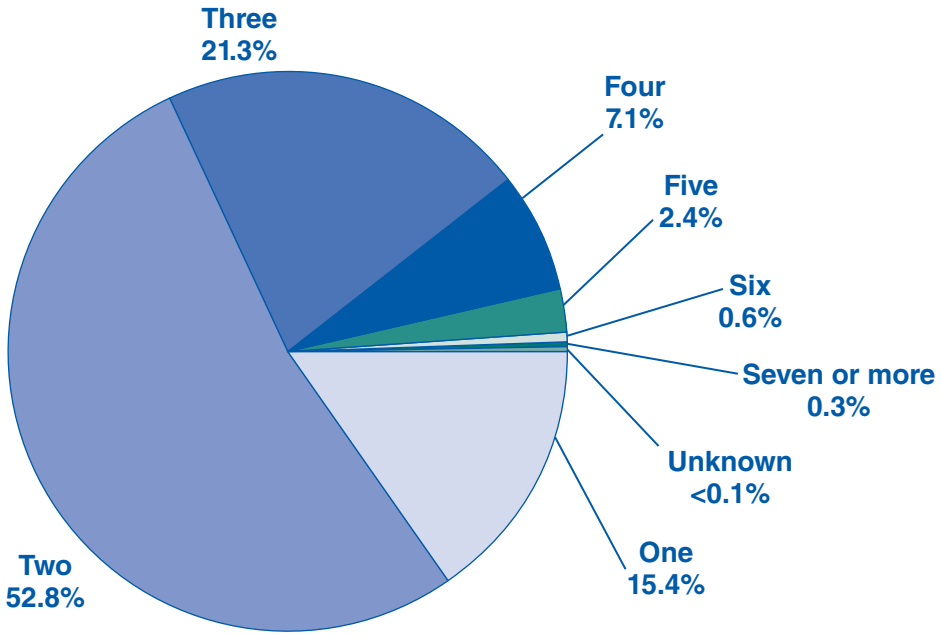



* Cycles using donor sperm and cycles using GIFT or ZIFT are excluded.

## How many embryos are transferred in an ART procedure?

Figure 30 shows that in 2010, the majority (68%) of ART cycles that used fresh nondonor eggs or embryos and progressed to the embryo transfer stage involved the transfer of one or two embryos. Approximately 32% of cycles involved the transfer of three or more, about 10% of cycles involved the transfer of four or more, and approximately 3% of cycles involved the transfer of five or more embryos.

**Figure 30**
Numbers of Embryos Transferred During ART Cycles Using Fresh Nondonor Eggs or Embryos,* 2010

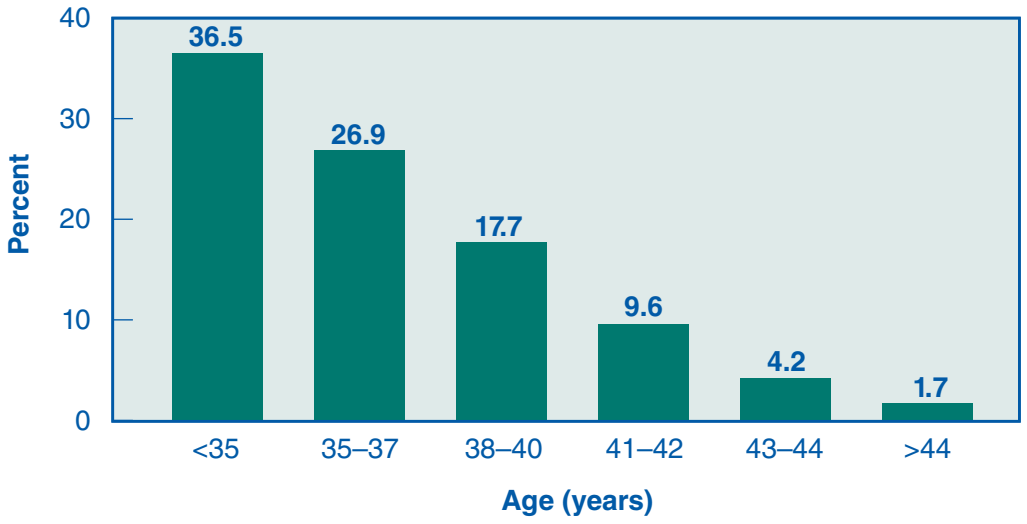



* Total does not equal 100% due to rounding.

## How does the implantation percentage for fresh nondonor embryos differ among women of different ages?

Figure 31 presents the relationship between the implantation percentage (see Implantation rate in Appendix B: the Glossary of Terms on page 74) for fresh nondonor embryos transferred and a woman's age. The percentage of embryos transferred that resulted in implantation was highest (approximately 37%) among women younger than 35. However, the implantation percentage decreased steadily as the age of the woman increased. Specifically, the implantation percentage was lowest (about 2%) among women older than 44 compared with the implantation percentage among women in each of the other age groups.

**Figure 31**
Percentages of Embryos Transferred That Resulted in Implantation Among Women Using Fresh Nondonor Eggs or Embryos, by Age Group, 2010

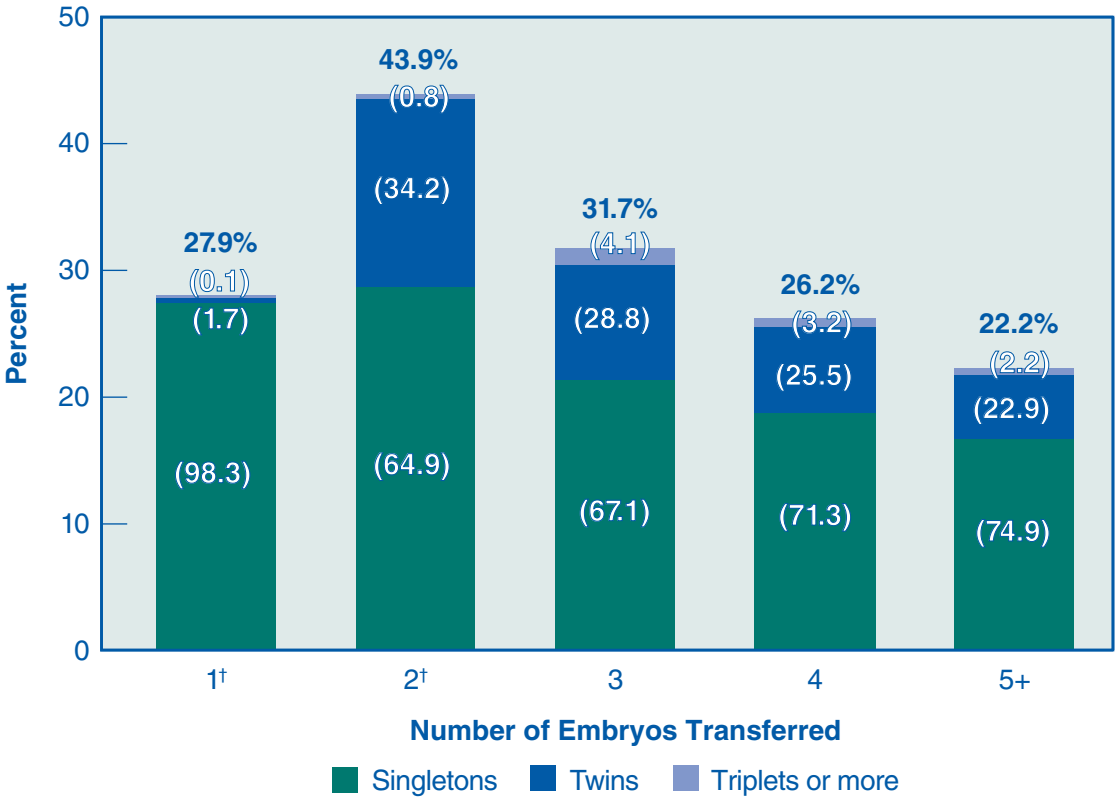


## In general, is an ART cycle more likely to be successful if more embryos are transferred?

Figure 32 shows the relationship between the number of fresh nondonor eggs or embryos transferred and percentages of live births and multiple-infant live births that resulted for these cycles. In 2010, the percentage of transfers that resulted in live births increased when two or three embryos were transferred; however, transferring multiple embryos also poses a risk of having a multiple-infant birth. Multiple-infant births cause concern because of the additional health risks they create for both mothers and infants. Also, pregnancies with multiple fetuses are potentially subject to multifetal reduction. This can happen naturally (e.g., fetal death), or a woman and her doctor may decide to reduce the number of fetuses using a procedure called multifetal pregnancy reduction. CDC does not collect information on multifetal pregnancy reductions.

Interpretation of the relationship between number of embryos transferred, percentages of transfers resulting in live births, and multiple-infant births is complicated by several factors, such as the woman's age and embryo quality. See Figures 33 and 37 (pages 37 and 41) for more details on women using fresh nondonor eggs or embryos who are most at risk of multiple births.

**Figure 32**
Percentages of Transfers That Resulted in Live Births and Percentages of Multiple-Infant Live Births for ART Cycles Using Fresh Nondonor Eggs or Embryos, by Number of Embryos Transferred,* 2010




* Percentages of live births that were singletons, twins, and triplets or more are in parentheses.
Note: In rare cases a single embryo may divide and thus produce twins or triplets. For this reason, small percentages of twins and triplets resulted from a single embryo transfer, and a small percentage of triplets resulted when two embryos were transferred.
† Totals do not equal 100% due to rounding.

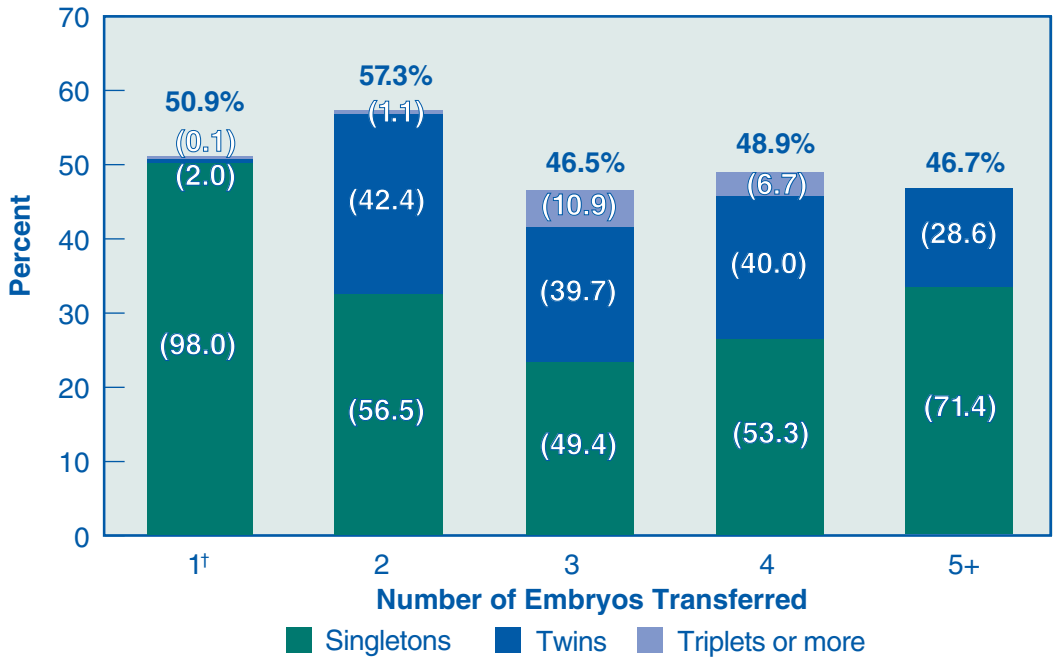
# Are percentages of transfers that result in live births affected by the number of embryos transferred for women who have more embryos available than they choose to transfer?

Figure 33 shows the relationship between the number of fresh nondonor eggs or embryos transferred, percentages of transfers resulting in live births, and multiple-infant births for ART procedures in which the woman was younger than 35 and chose to set aside extra embryos for future cycles rather than transfer all available embryos at one time.

In 2010, the percentage of transfers that resulted in live births was the highest (57%) when two embryos were transferred; however, the highest percentage of singleton live births was observed with the transfer of one embryo.

The proportion of live births that were multiple-infant births (about 40% twins, 11% triplets or more) was highest (51%) when three embryos were transferred.

**Figure 33**
Percentages of Transfers That Resulted in Live Births and Percentages of Multiple-Infant Live Births for ART Cycles Among Women Who Were Younger Than 35, Used Fresh Nondonor Eggs or Embryos, and Set Aside Extra Embryos for Future Use, by Number of Embryos Transferred,* 2010

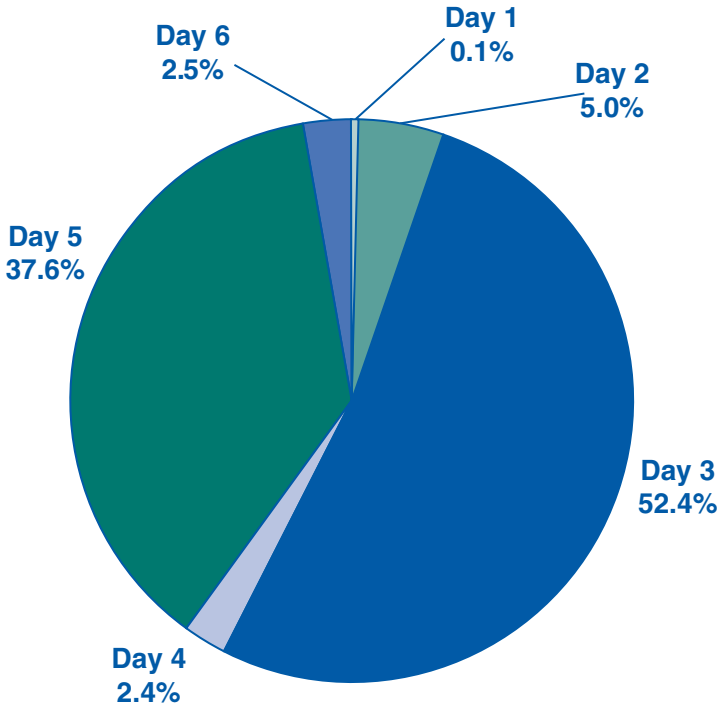



* Percentages of live births that were singletons, twins, and triplets or more are in parentheses.
Note: In rare cases a single embryo may divide and thus produce twins or triplets. For this reason, small percentages of twins and triplets resulted from a single embryo transfer, and a small percentage of triplets resulted when two embryos were transferred.
† Total does not equal 100% due to rounding.

## How long after egg retrieval does embryo transfer occur?

Once an ART cycle has progressed from egg retrieval to fertilization, the embryo(s) can be transferred into the woman's uterus in the subsequent 1 to 6 days. Figure 34 shows that in 2010 approximately 52% of embryo transfers occurred on day 3. Day 5 embryo transfers were the next most common, accounting for about 38% of ART procedures that progressed to the embryo transfer stage.

**Figure 34**
Day of Embryo Transfer* Among ART Cycles Using Fresh Nondonor Eggs or Embryos,† 2010

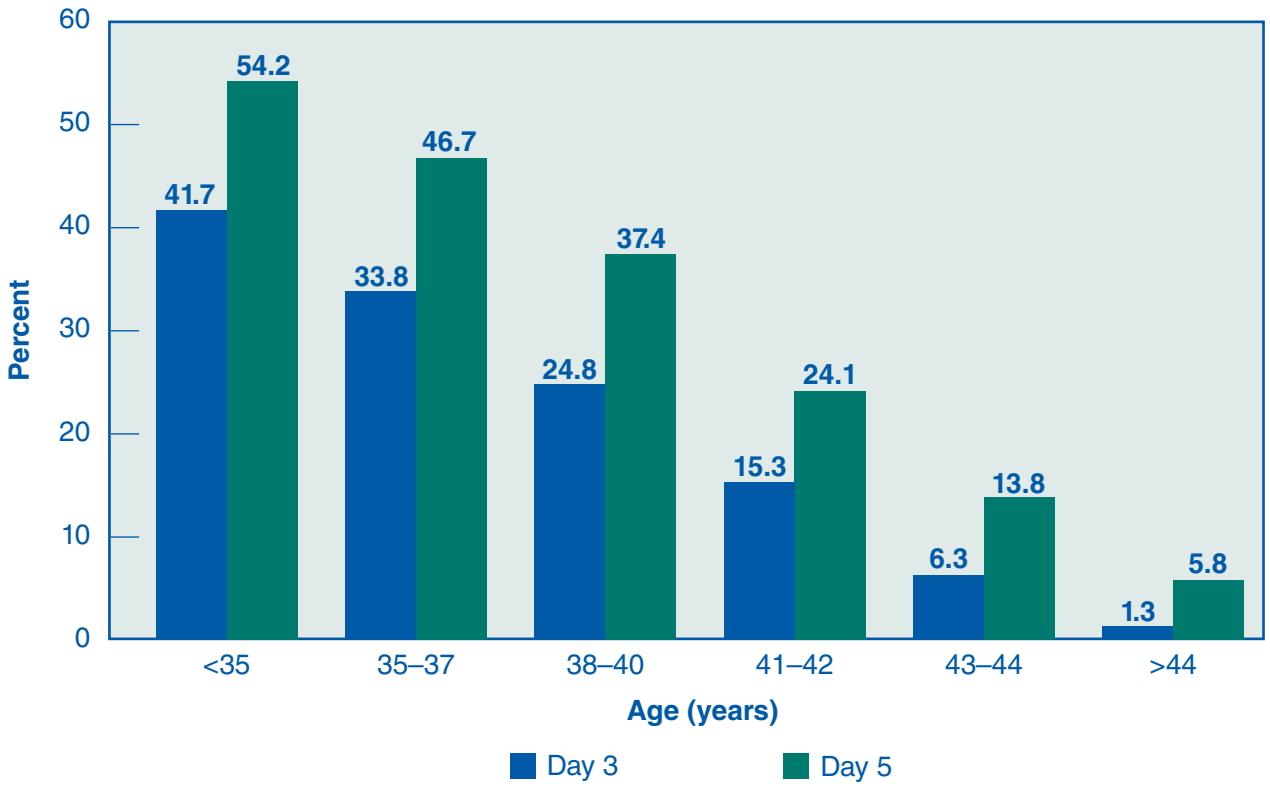



* Number of days following egg retrieval.
† Cycles using GIFT or ZIFT are excluded. Missing or implausible values for day of embryo transfer (i.e., 0 or >6) are not included.

## In general, is an ART cycle more likely to be successful if embryos are transferred on day 5?

As shown in Figure 34 (page 38), in the vast majority of ART procedures using fresh nondonor embryos, embryos were transferred on day 3 (52%) or day 5 (38%). Figure 35 compares percentages of day 3 embryo transfers that resulted in live births with those for day 5 embryo transfers. In all age groups, percentages were higher for day 5 embryo transfers than for day 3 transfers. However, some cycles do not progress to the embryo transfer stage because of embryo arrest (interruption in embryo development) between day 3 and day 5. These cycles are not accounted for in percentages of day 5 transfers that resulted in live births. Therefore, differences in percentages of day 3 and day 5 transfers that result in live births should be interpreted with caution.

**Figure 35**
Percentages of Day 3 and Day 5 Embryo Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, by Age Group,* 2010

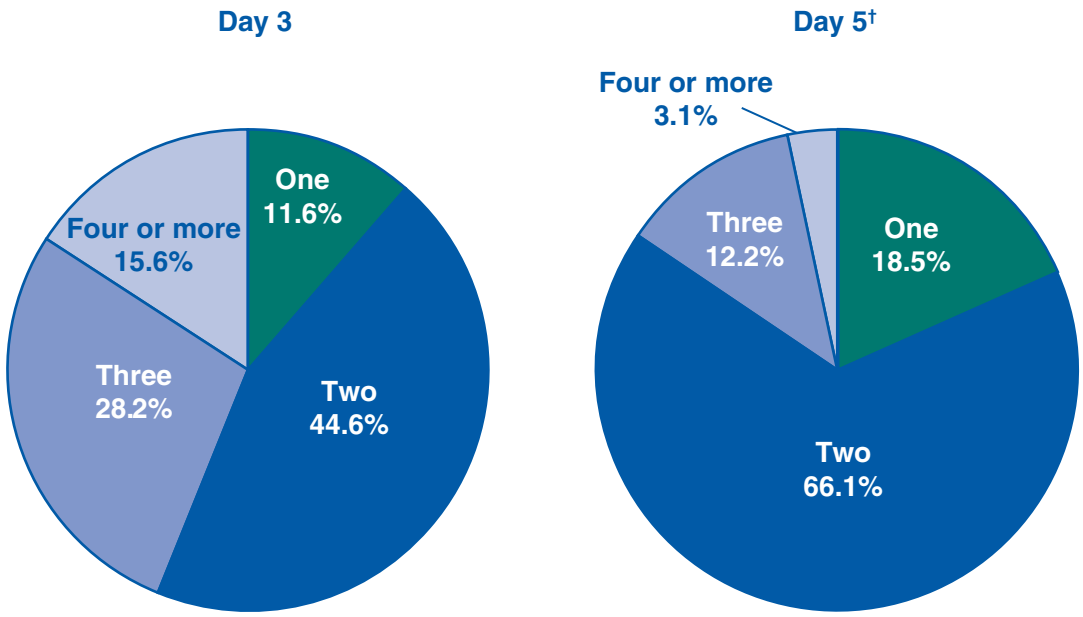



* Cycles using GIFT or ZIFT are excluded. Embryo transfers performed on days 1, 2, 4, and 6 are not included because each of these accounted for a small proportion of procedures.

## Does the number of embryos transferred differ for day 3 and day 5 embryo transfers?

Figure 36 shows the number of fresh nondonor embryos transferred on day 3 and day 5. Overall, fewer embryos were transferred on day 5 than on day 3. Approximately 44% of day 3 embryo transfers and 15% of day 5 embryo transfers involved the transfer of three or more embryos. The decrease in the number of embryos transferred on day 5, however, did not translate into a lower risk of multiple-infant births. See Figure 37 (page 41) for more details on the relationship between multiple-infant birth risk and day of embryo transfer.

**Figure 36**
Numbers of Embryos Transferred Among ART Cycles Using Fresh Nondonor Eggs or Embryos for Day 3 and Day 5 Embryo Transfers,* 2010




* Cycles using GIFT or ZIFT are excluded. Embryo transfers performed on days 1, 2, 4, and 6 are not included because each of these accounted for a small proportion of procedures.
† Total does not equal 100% due to rounding.

## In general, how does the multiple-infant birth risk vary by the day of embryo transfer among fresh nondonor cycles?

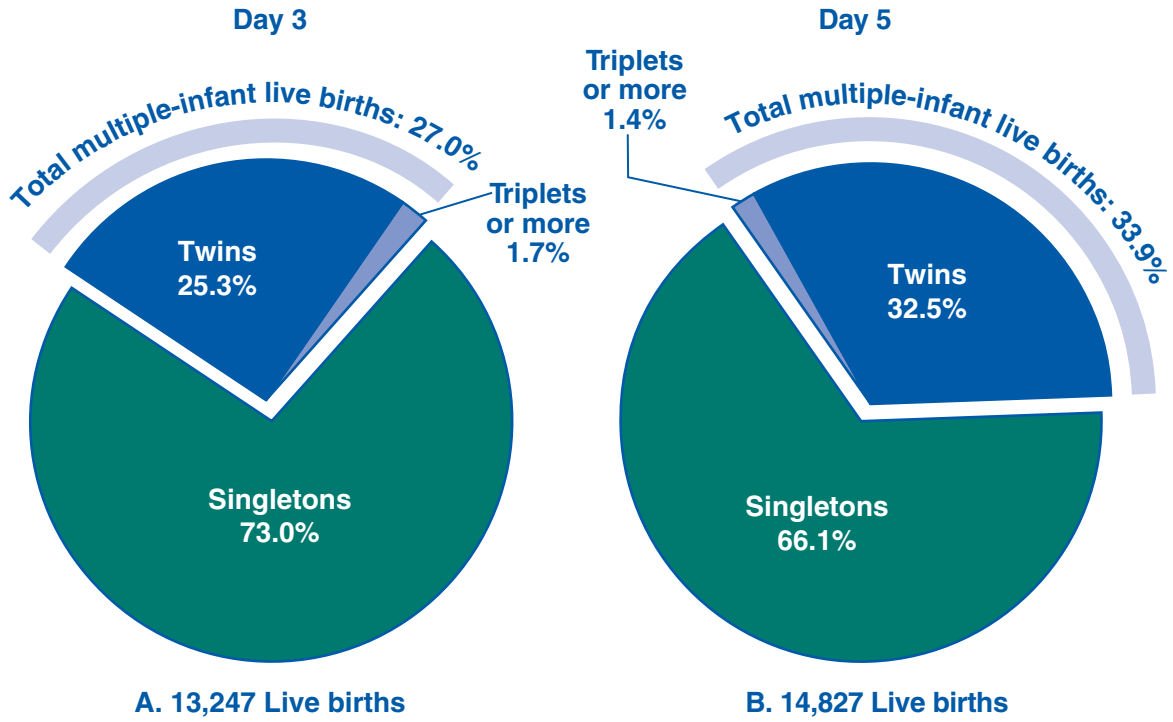
Multiple-infant births are associated with greater problems for both mothers and infants, including higher rates of caesarean section, prematurity, low birth weight, and infant disability or death.

Part A of Figure 37 shows that among the 13,247 live births that occurred following the transfer of day 3 embryos, about 73% were singletons, 25% were twins, and 2% were triplets or more. Thus, approximately 27% of these live births produced more than one infant.

In 2010, 14,827 live births occurred following the transfer of day 5 embryos. Part B of Figure 37 shows that approximately 34% of these live births produced more than one infant.

As shown in Figure 36 (page 40), fewer embryos were transferred on day 5 than on day 3. However, the proportion of live births resulting in twins is higher among transfer procedures performed on day 5 than on day 3. Thus, the risk of having a multiple-infant birth was higher for day 5 embryo transfers. The likelihood of multiple-infant births for both day 3 and day 5 embryo transfers is much higher overall than for multiple-infant births in the general U.S. population (about 3%).

**Figure 37**
Distribution of Multiple-Infant Live Births Among ART Cycles Using Fresh Nondonor Eggs or Embryos for Day 3 and Day 5 Embryo Transfers,* 2010




* Cycles using GIFT or ZIFT are excluded. Embryo transfers performed on days 1, 2, 4, and 6 are not included because each of these accounted for a small proportion of procedures.

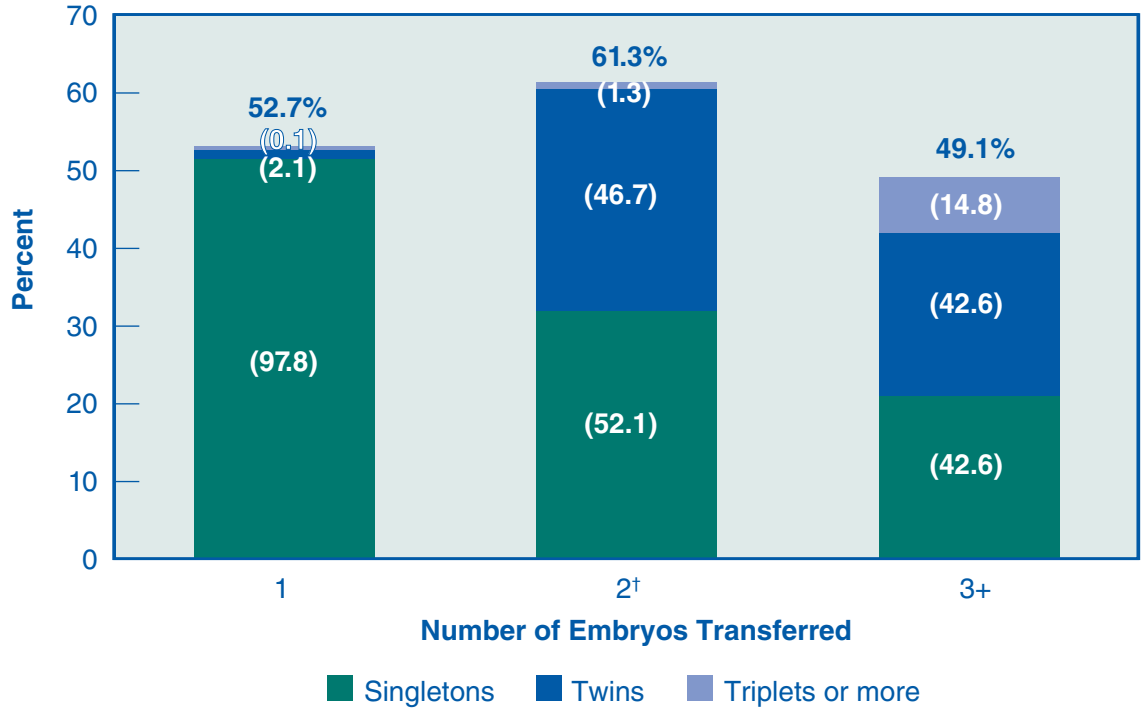
## For day 5 embryo transfers, are percentages of transfers that result in live births affected by the number of embryos transferred for women who have more embryos available than they choose to transfer?

As shown in Figure 37 (page 41), the transfer of fresh nondonor embryos on day 5 resulted in a higher percentage of multiple-infant births compared with embryos transferred on day 3. Figure 38 shows the relationship between the number of embryos transferred, the percentage of transfers resulting in live births, and the percentage of multiple-infant births for day 5 transfers among women who were younger than 35 and set aside extra embryos for future cycles rather than transfer all available embryos at one time.

The percentage of transfers resulting in live births was the highest (about 61%) when two embryos were transferred; however, the proportion of live births that were multiples (twins or more)—which present a higher risk of poor health outcomes—was 48%. The percentage of live births that were higher-order multiples (triplets or more) was much higher when three or more embryos were transferred on day 5 (approximately 15%) than when two embryos were transferred on day 5 (approximately 1%).

If one measures success as the percentage of transfers resulting in singleton live births, the highest percentage (53%) resulted from the transfer of a single embryo on day 5.

**Figure 38**
Percentages of Transfers That Resulted in Live Births and Percentages of Multiple-Infant Live Births for Day 5 Embryo Transfers Among Women Who Were Younger Than 35, Used Fresh Nondonor Eggs or Embryos, and Set Aside Extra Embryos for Future Use, by Number of Embryos Transferred,* 2010



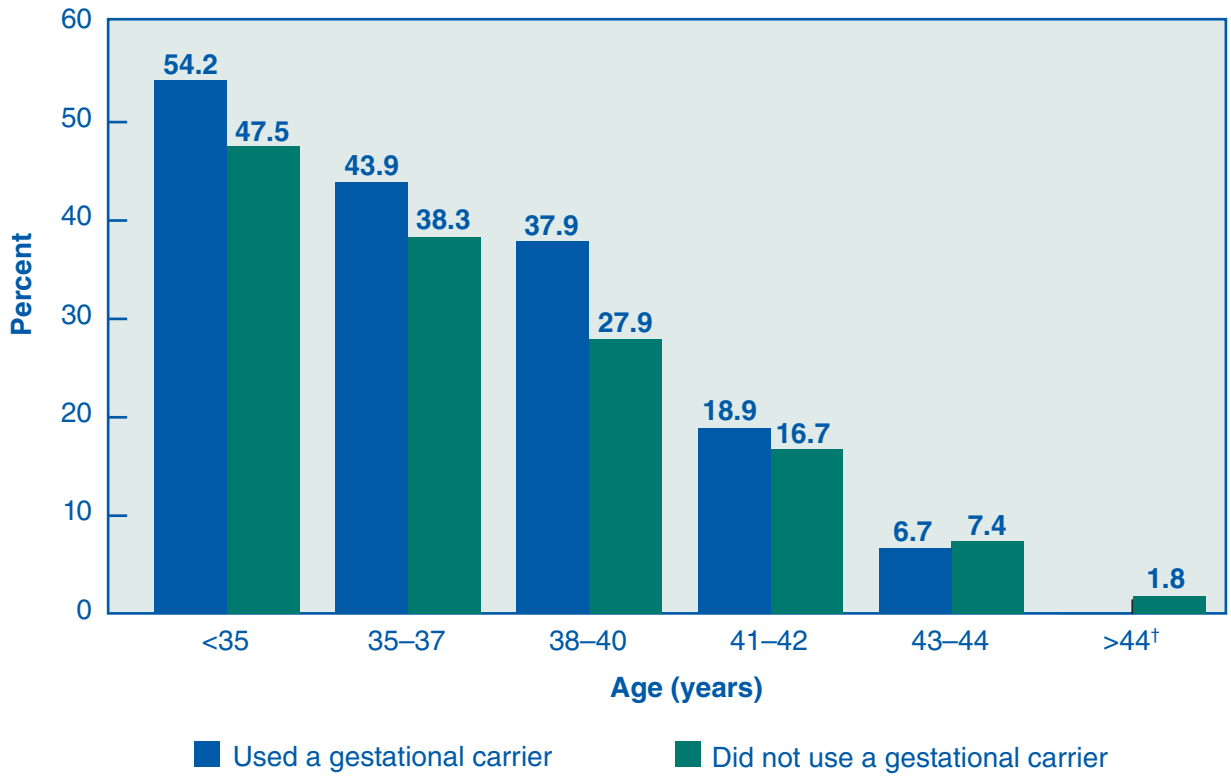

*Percentages of live births that were singletons, twins, and triplets or more are in parentheses. Cycles using GIFT or ZIFT are excluded. Note: In rare cases a single embryo may divide and thus produce twins or triplets. For this reason, small percentages of twins and triplets resulted from a single embryo transfer, and a small percentage of triplets resulted when two embryos were transferred.

† Total does not equal 100% due to rounding.

## How do percentages of transfers that result in live births for ART cycles using gestational carriers compare with those that do not use gestational carriers?

A gestational carrier is a woman who agrees to carry the developing embryo for others. Gestational carriers were used in about 1% of ART cycles using fresh nondonor embryos in 2010 (926 cycles). Figure 39 compares percentages of transfers that resulted in live births for ART cycles that used a gestational carrier in 2010 with cycles that did not. In most age groups, percentages of transfers that resulted in live births for ART cycles that used gestational carriers were higher than for those cycles that did not.

**Figure 39**
Comparison of Percentages of Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births Between ART Cycles That Used Gestational Carriers and Those That Did Not, by Age Group,* 2010




* Age categories reflect the age of the ART patient, not the age of the gestational carrier.
† There were no transfers resulting in live births among ART patients older than 44 who used gestational carriers.

# SECTION 3: ART CYCLES USING FROZEN NONDONOR EMBRYOS

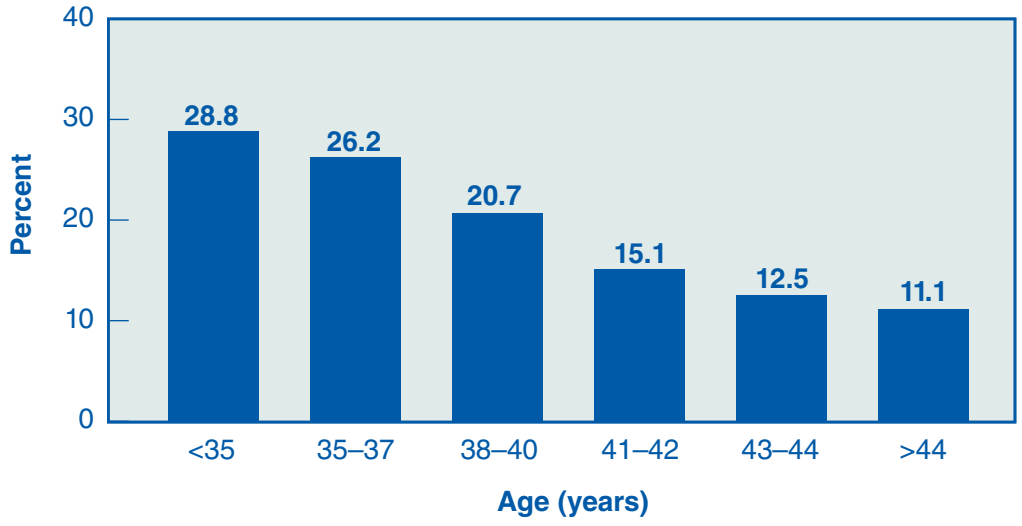
## How does the implantation percentage for frozen nondonor embryos differ among women of different ages?

As shown in Figure 31 (page 35) among women using fresh nondonor eggs or embryos, the percentage of embryos transferred that resulted in implantation decreased as the age of the woman increased. Figure 40 shows the same relationship between implantation percentage and the age of the woman when frozen nondonor embryos were transferred; the percentage of frozen nondonor embryos transferred that resulted in implantation decreased as the age of the woman increased (from about 29% among women younger than age 35 to 11% among women older than age 44).

The percentage of embryos transferred that resulted in implantation among women using frozen nondonor embryos was higher compared with the implantation percentage among women using fresh nondonor embryos (see Figure 31, page 35) in the following age groups:

- 21% (frozen) vs. 18% (fresh) among women aged 38–40 years
- 15% vs. 10% among women aged 41–42 years
- 13% vs. 4% among women aged 43–44 years
- 11% vs. 2% among women older than age 44

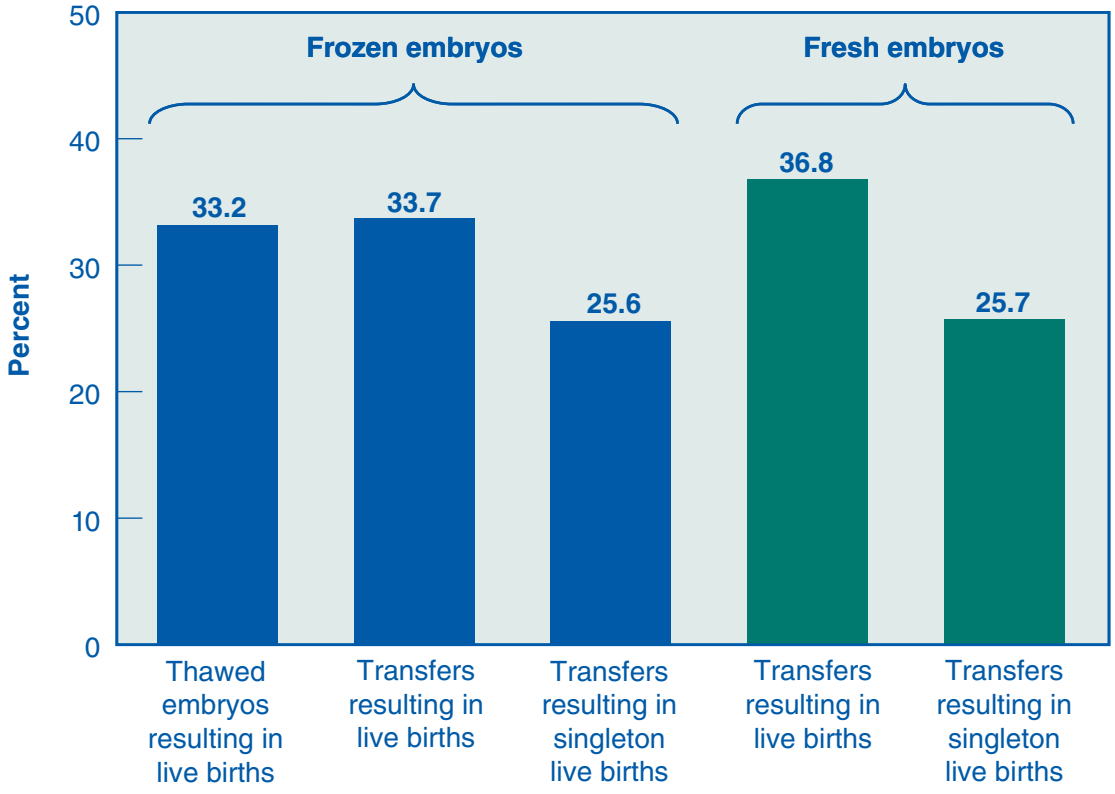
**Figure 40**
Percentages of Embryos Transferred That Resulted in Implantation Among Women Using Frozen Nondonor Embryos, by Age Group, 2010



## What is the percentage of transfers that result in live births and singleton live births for ART cycles using frozen nondonor embryos?

Frozen nondonor embryos were used in approximately 19% of all ART cycles performed in 2010 (28,425 cycles). Figure 41 compares percentages of transfers that resulted in live births and singleton live births for frozen nondonor embryos with those for ART cycles using fresh nondonor embryos. Because some embryos do not survive the thawing process, the percentage of thawed embryos that result in live births is usually lower than the percentage of transfers that result in live births. In 2010, percentages for frozen nondonor embryos were slightly lower than for fresh nondonor embryos, and the average number of embryos transferred was lower for cycles using frozen nondonor embryos than for those using fresh nondonor embryos depending on the woman's age. (See the National Summary table on page 4 for information on the average number of embryos transferred by age group and cycle type.) It is important to note that cycles using frozen nondonor embryos are both less expensive and less invasive than those using fresh nondonor embryos because the woman does not have to go through the fertility drug stimulation and egg retrieval steps again.

**Figure 41**
Percentages of Transfers That Resulted in Live Births and Singleton Live Births for ART Cycles Using Frozen Nondonor Embryos and ART Cycles Using Fresh Nondonor Embryos, 2010



## What is the risk of having a multiple-fetus pregnancy or multiple-infant live birth from an ART cycle using frozen nondonor embryos?

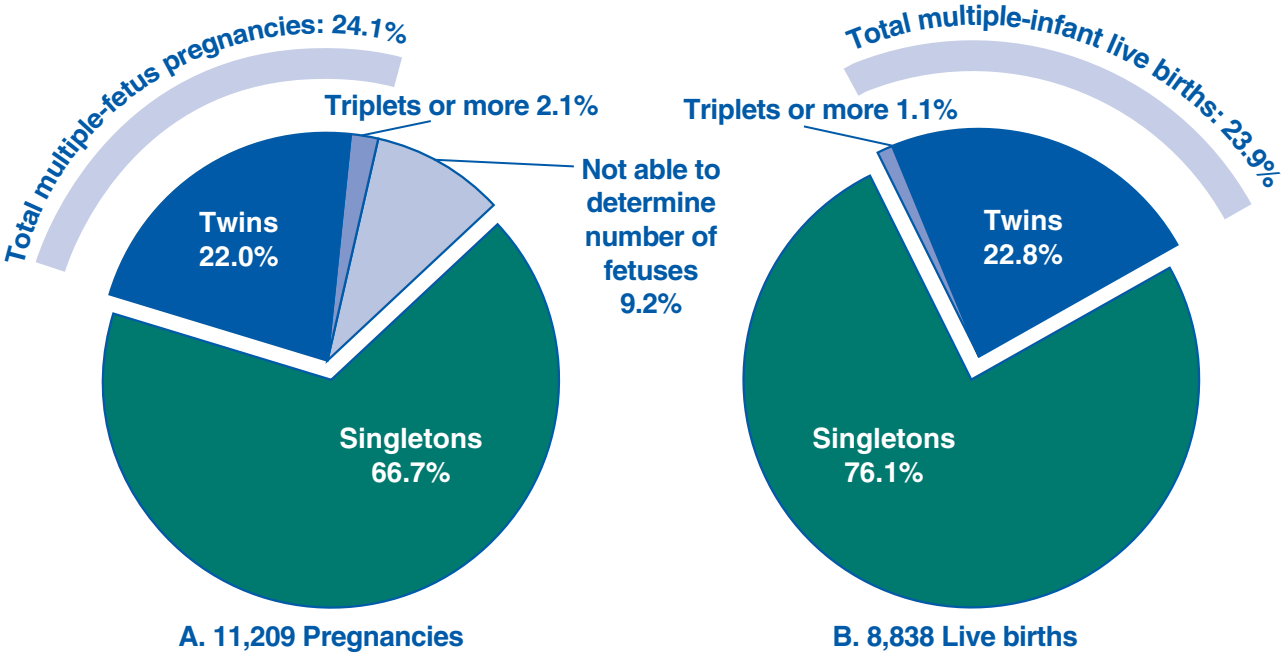
Multiple-infant births are associated with greater problems for both mothers and infants, including higher rates of caesarean section, prematurity, low birth weight, and infant disability or death.

Part A of Figure 42 shows that among the 11,209 pregnancies that resulted from ART cycles using frozen nondonor embryos, approximately 67% were singleton pregnancies, 22% were twins, and 2% were triplets or more. Approximately 9% of pregnancies ended before the number of fetuses could be accurately determined. Therefore, the percentage of pregnancies with more than one fetus might have been higher than what was reported (approximately 24%).

In 2010, 8,838 pregnancies from ART cycles that used frozen nondonor embryos resulted in live births. Part B of Figure 42 shows that approximately 24% of these live births produced more than one infant. This compares with a multiple-infant birth rate of slightly more than 3% in the general U.S. population.

Although the total rates for multiples were similar for pregnancies and live births, there were more triplet or higher order pregnancies than births. Triplet or higher order pregnancies may be reduced to twins or singletons by the time of birth. This can happen naturally (e.g., fetal death), or a woman and her doctor may decide to reduce the number of fetuses using a procedure called multifetal pregnancy reduction. CDC does not collect information on multifetal pregnancy reductions.

**Figure 42**
Distribution of Multiple-Fetus Pregnancies and Multiple-Infant Live Births from ART Cycles Using Frozen Nondonor Embryos, 2010

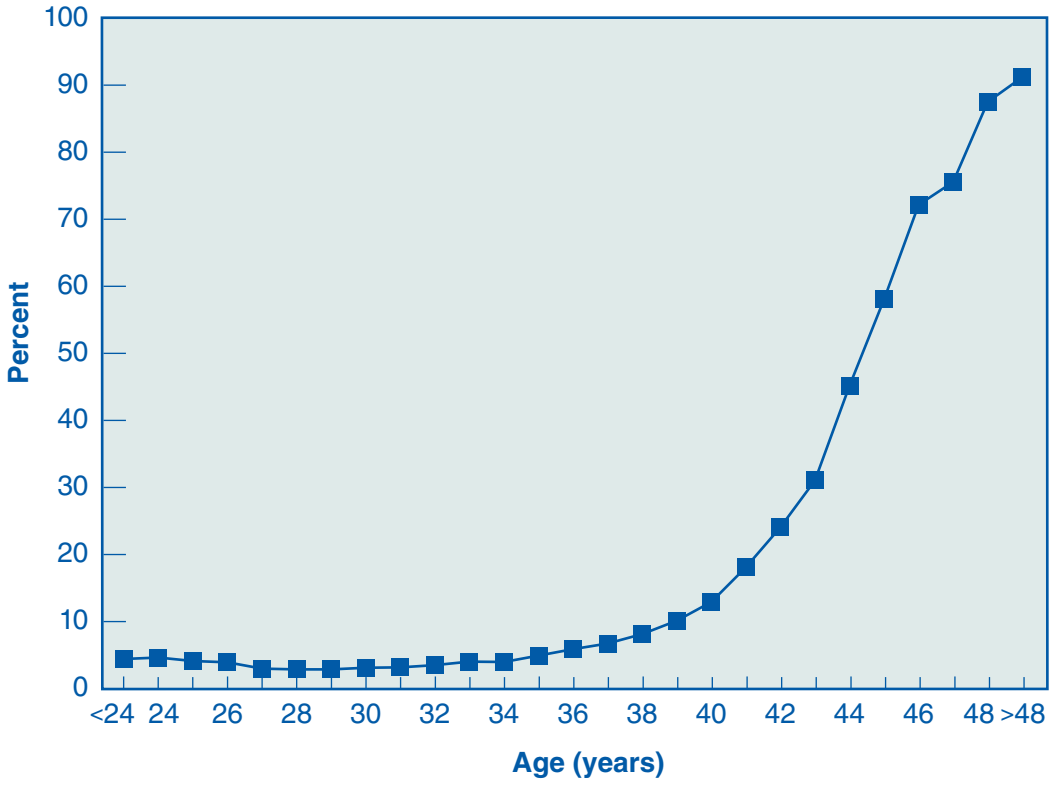


# SECTION 4: ART CYCLES USING DONOR EGGS

## Are older women undergoing ART more likely to use donor eggs or embryos?

As shown in Figure 31 (page 35), eggs produced by women in older age groups form embryos that are less likely to implant and more likely to result in miscarriage if they do implant. As a result, ART using donor eggs is much more common among older women than among younger women. Donor eggs or embryos were used in approximately 12% of all ART cycles performed in 2010 (18,011 cycles). Figure 43 shows the percentage of ART cycles using donor eggs in 2010 according to the woman's age. Few women younger than age 40 used donor eggs; however, the percentage of cycles performed with donor eggs increased sharply after age 40. Among women older than age 48, for example, 91% of all ART cycles used donor eggs.

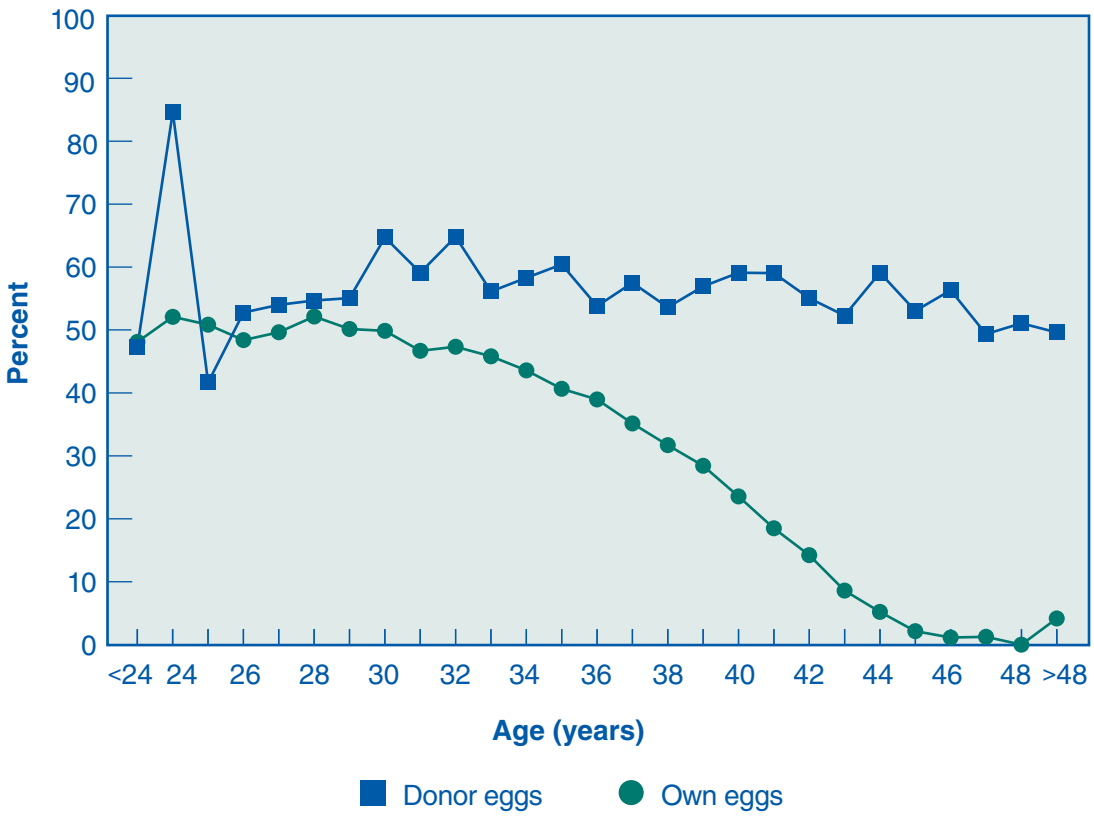
**Figure 43**
Percentages of ART Cycles Using Donor Eggs, by Age of Woman, 2010



## Do percentages of transfers that result in live births differ by age for women who use ART with donor eggs compared with women who use ART with their own eggs?

Figure 44 compares percentages of transfers that resulted in live births for ART cycles using fresh embryos from donor eggs with those for ART cycles using a woman's own eggs, among women of different ages. The likelihood of a fertilized egg implanting is related to the age of the woman who produced the egg. Thus, the percentage of transfers resulting in live births for cycles using embryos from women's own eggs declines as women get older. In contrast, since egg donors are typically in their 20s or early 30s, the percentage of transfers that resulted in live births for cycles using embryos from donor eggs remained consistently high at above 50% among most women of different ages.

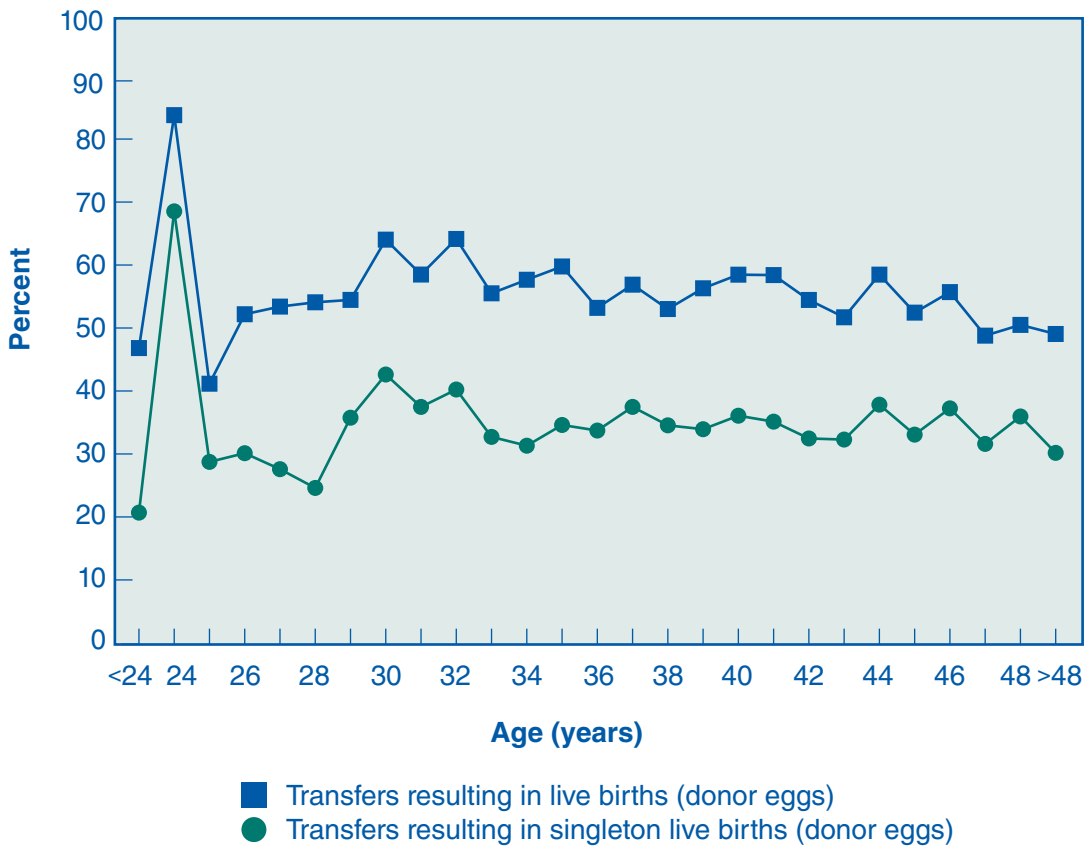
**Figure 44**
Percentages of Transfers That Resulted in Live Births for ART Cycles Using Fresh Embryos from Own Eggs and ART Cycles Using Fresh Embryos from Donor Eggs, by Age of Woman, 2010



## How successful is ART when donor eggs are used?

Figure 45 shows percentages of transfers that resulted in live births and singleton live births for ART cycles using fresh embryos from donor eggs among women of different ages. For all ages, the percentage of transfers that resulted in singleton live births (average 35%) was lower than the percentage of transfers that resulted in live births (average 56%). Singleton live births are an important measure of success because they have a much lower risk than multiple-infant births for adverse infant health outcomes, including prematurity, low birth weight, disability, and death.

**Figure 45**
Percentages of Transfers That Resulted in Live Births and Singleton Live Births for ART Cycles Using Fresh Embryos from Donor Eggs, by Age of Woman, 2010



## What is the risk of having a multiple-fetus pregnancy or multiple-infant live birth from an ART cycle using donor eggs?

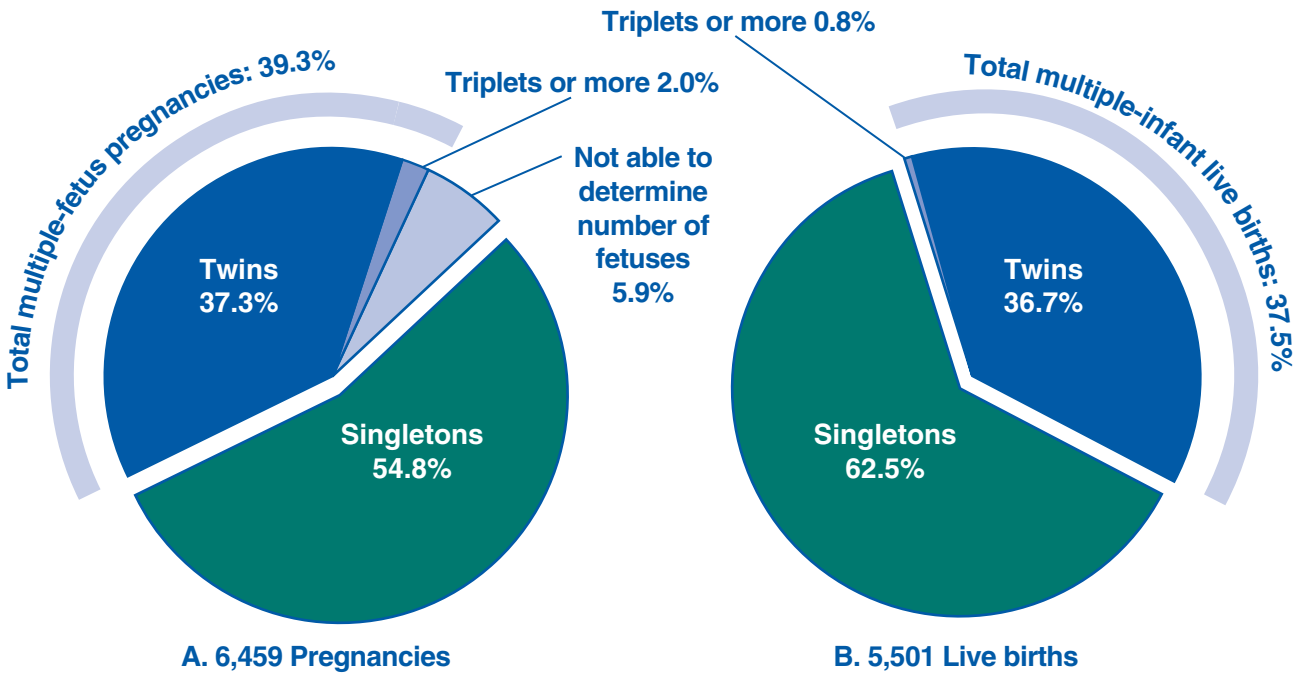
Multiple-infant births are associated with greater problems for both mothers and infants, including higher rates of caesarean section, prematurity, low birth weight, and infant disability or death.

Part A of Figure 46 shows that among the 6,459 pregnancies that resulted from ART cycles using fresh embryos from donor eggs, approximately 55% were singleton pregnancies, 37% were twins, and 2% were triplets or more. About 6% of pregnancies ended before the number of fetuses could be accurately determined. Therefore, the percentage of pregnancies with more than one fetus might have been higher than what was reported (approximately 39%).

In 2010, 5,501 pregnancies from ART cycles that used fresh embryos from donor eggs resulted in live births. Part B of Figure 46 shows that approximately 38% of these live births produced more than one infant. This compares with a multiple-infant birth rate of slightly more than 3% in the general U.S. population.

Although total percentages for multiples were similar for pregnancies and live births, there were more triplet or higher order pregnancies than births. Triplet or higher order pregnancies may be reduced to twins or singletons by the time of birth. This can happen naturally (e.g., fetal death), or a woman and her doctor may decide to reduce the number of fetuses using a procedure called multifetal pregnancy reduction. CDC does not collect information on multifetal pregnancy reductions.

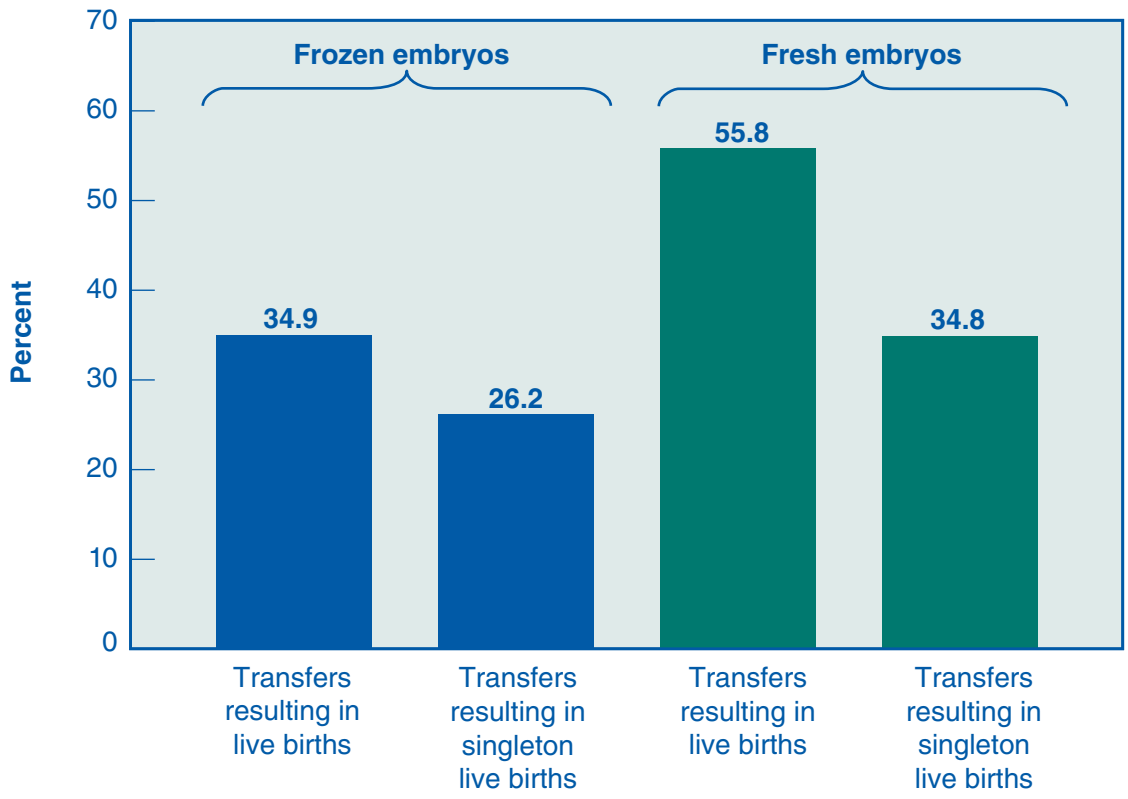
**Figure 46**
Distribution of Multiple-Fetus Pregnancies and Multiple-Infant Live Births from ART Cycles Using Fresh Embryos from Donor Eggs, 2010



## How do percentages of transfers that result in live births differ between ART cycles using frozen donor embryos and those using fresh donor embryos?

Figure 47 shows that percentages of transfers that resulted in live births and singleton live births for ART cycles using frozen donor embryos were substantially lower than for ART cycles using fresh donor embryos. The average number of embryos transferred was the same (2.0) for cycles using frozen donor embryos and those using fresh donor embryos.

**Figure 47**
Percentages of Transfers That Resulted in Live Births and Singleton Live Births for ART Cycles Using Frozen Donor Embryos and ART Cycles Using Fresh Donor Embryos, 2010



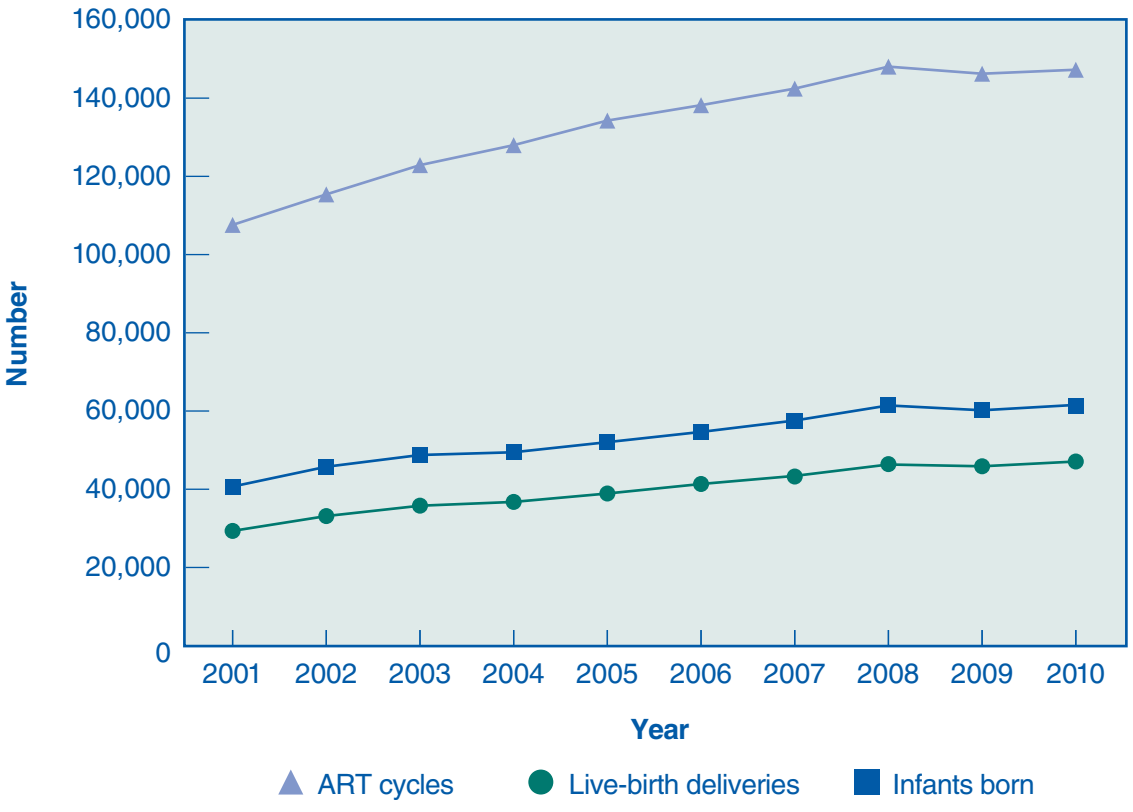
# SECTION 5: ART TRENDS, 2001–2010

*This report marks the sixteenth consecutive year that CDC has published an annual report detailing the success rates for ART clinics in the United States. Having several years of data provides us with the opportunity to examine trends in ART use and success rates over time. This report features an examination of trends for the most recent 10 years, 2001–2010. Statistics for earlier years are available in previous annual publications of the* Assisted Reproductive Technology Success Rates: National Summary and Fertility Clinic Reports.

## Is the use of ART increasing?

Figure 48 shows the number of ART cycles performed, live-birth deliveries, and infants born using ART from 2001 through 2010. The number of ART cycles performed in the United States has increased, from 107,587 cycles in 2001 to 147,260 in 2010. The number of live-birth deliveries in 2010 (47,090) was more than one and a half times higher than in 2001 (29,344). The number of infants born who were conceived using ART also increased between 2001 and 2010. In 2010, 61,564 infants were born, which was more than one and a half times higher than the 40,687 born in 2001. Because in some cases more than one infant is born during a live-birth delivery (e.g., twins), the total number of infants born is greater than the number of live-birth deliveries.

**Figure 48**
Numbers of ART Cycles Performed, Live-Birth Deliveries, and Infants Born Using ART, 2001–2010



## Is the use of ICSI increasing?

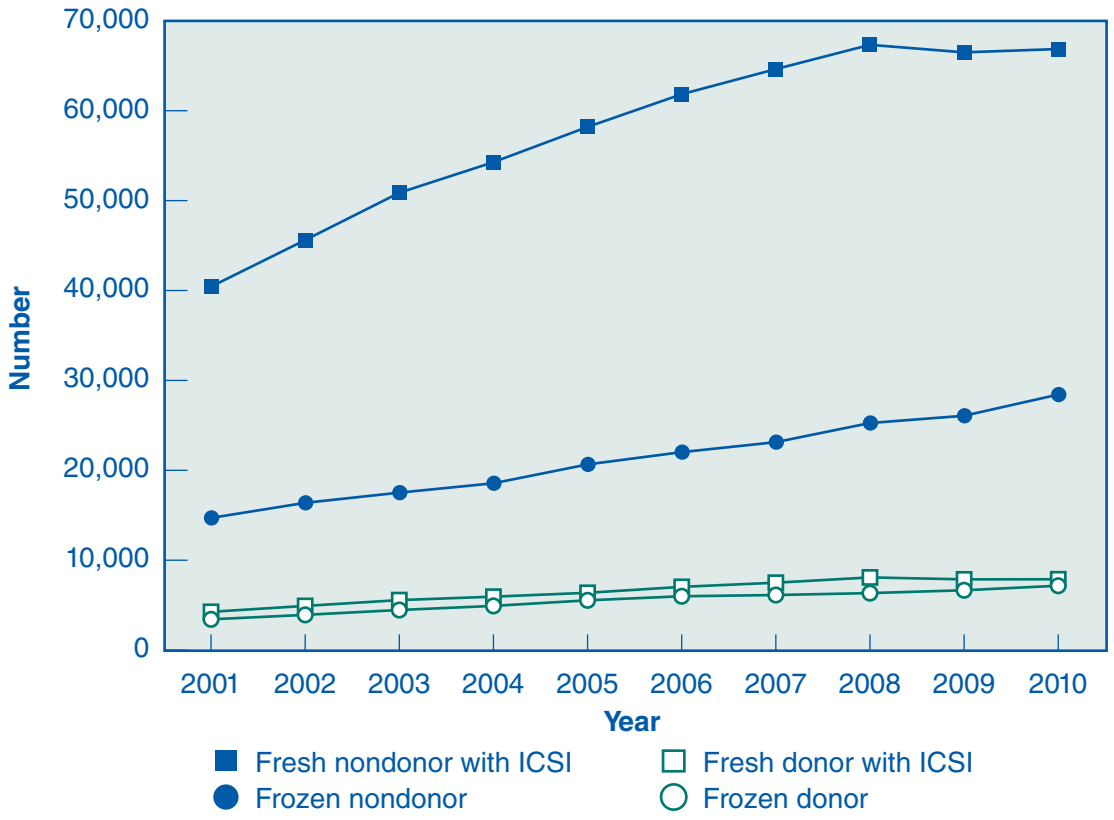
Intracytoplasmic sperm injection (ICSI) was originally developed to use in ART cycles to improve fertilization rates when severe male factor infertility was the indication for using ART. Today, this procedure is widely used even without a diagnosis of male factor infertility.

Figure 49 shows the number of ART cycles performed using ICSI from 2001 through 2010. Overall, the number of ART cycles with ICSI procedures continued to increase for all fresh cycles. During the past 10 years, the number of fresh nondonor cycles performed with ICSI increased more than 65%, from 40,432 in 2001 to 66,859 in 2010. The number of fresh donor cycles with ICSI nearly doubled, from 4,259 to 7,882 over the same period.

The number of frozen cycles (with or without ICSI) nearly doubled, from 14,705 in 2001 to 28,425 in 2010 for frozen nondonor cycles and more than doubled from 3,426 to 7,162 for frozen donor cycles over the same period.

Note that the information on use of ICSI is not consistently collected across clinics for ART cycles using frozen embryos; therefore, these cycles are presented together as one group.

**Figure 49**
Numbers of ICSI Procedures Performed, by Type of ART Cycle, 2001–2010



# Has the percentage of transfers that resulted in live births for ART cycles with or without ICSI changed?

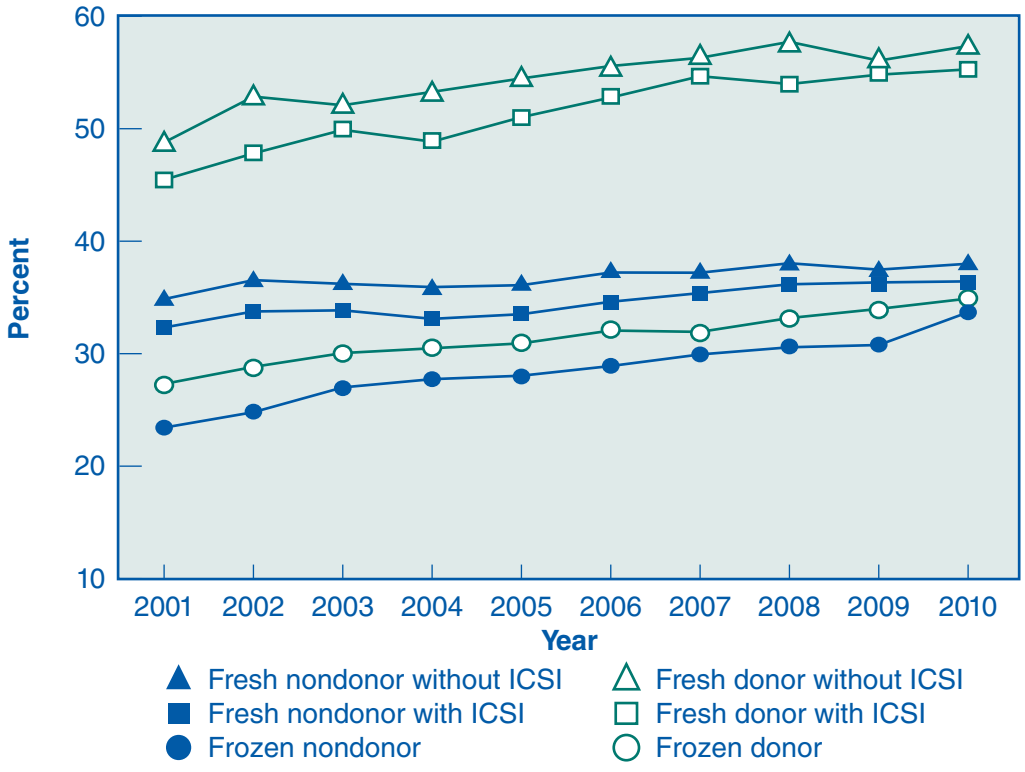
Figure 50 presents percentages of transfers that resulted in live births for ART cycles with or without ICSI. Percentages of transfers that resulted in live births are presented rather than percentages of cycles that resulted in live births because this is the only way to directly compare cycles using fresh embryos with those using frozen embryos.

In general, with or without ICSI, fresh donor cycles had the highest success rates when compared with fresh nondonor cycles or frozen cycles. However, when comparing success rates within each type of ART cycle, the percentage of transfers that resulted in live births among cycles without ICSI remained slightly higher than cycles with ICSI during 2001–2010.

The percentage of transfers that resulted in live births for cycles using fresh donor embryos without ICSI increased from 49% in 2001 to 57% in 2010, while cycles using fresh donor embryos with ICSI increased from 45% to 55% over the same period. Similar to trends with cycles using fresh donor embryos, the percentage of transfers that resulted in live births for fresh nondonor cycles with ICSI increased from 32% in 2001 to 36% in 2010, which was generally lower than for the fresh nondonor cycles without ICSI (35% in 2001 to 38% in 2010).

Note that the information on use of ICSI is not consistently collected across clinics for ART cycles using frozen embryos; therefore, these cycles are presented together as one group.

**Figure 50**
Percentages of Transfers That Resulted in Live Births, by Type of ART Cycle and ICSI, 2001–2010



## Has the percentage of transfers that resulted in singleton live births for ART cycles with or without ICSI changed?

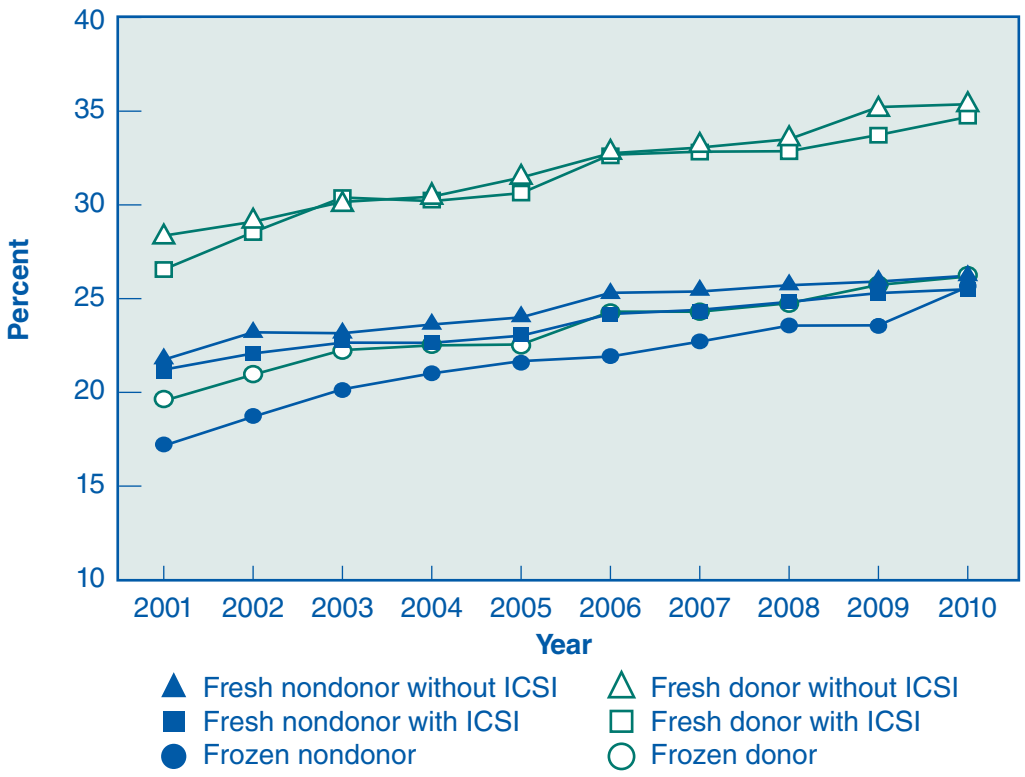
Singleton live births are an important measure of success because they have a much lower risk than multiple-infant births for adverse infant health outcomes, including prematurity, low birth weight, disability, and death. Figure 51 shows that the percentage of transfers that resulted in singleton live births increased over time for all ART cycles with or without ICSI.

Although the total number of nondonor cycles using ICSI increased over the past 10 years (see Figure 49, page 53), percentages of transfers that resulted in singleton live births from these cycles were not any higher than those without ICSI.

Overall, percentages of transfers that resulted in singleton live births were consistently higher for fresh donor cycles than for fresh nondonor cycles and frozen cycles. Fresh donor cycles without ICSI increased from 28% in 2001 to 35% in 2010; a similar increase was observed for fresh donor cycles with ICSI. Over the same period, the percentage of transfers that resulted in singleton live births increased from 22% to 26% for fresh nondonor cycles without ICSI and from 21% to 25% with ICSI.

Note that the information on use of ICSI is not consistently collected across clinics for ART cycles using frozen embryos; therefore, these cycles are presented together as one group.

**Figure 51**
Percentages of Transfers That Resulted in Singleton Live Births, by Type of ART Cycle and ICSI, 2001–2010

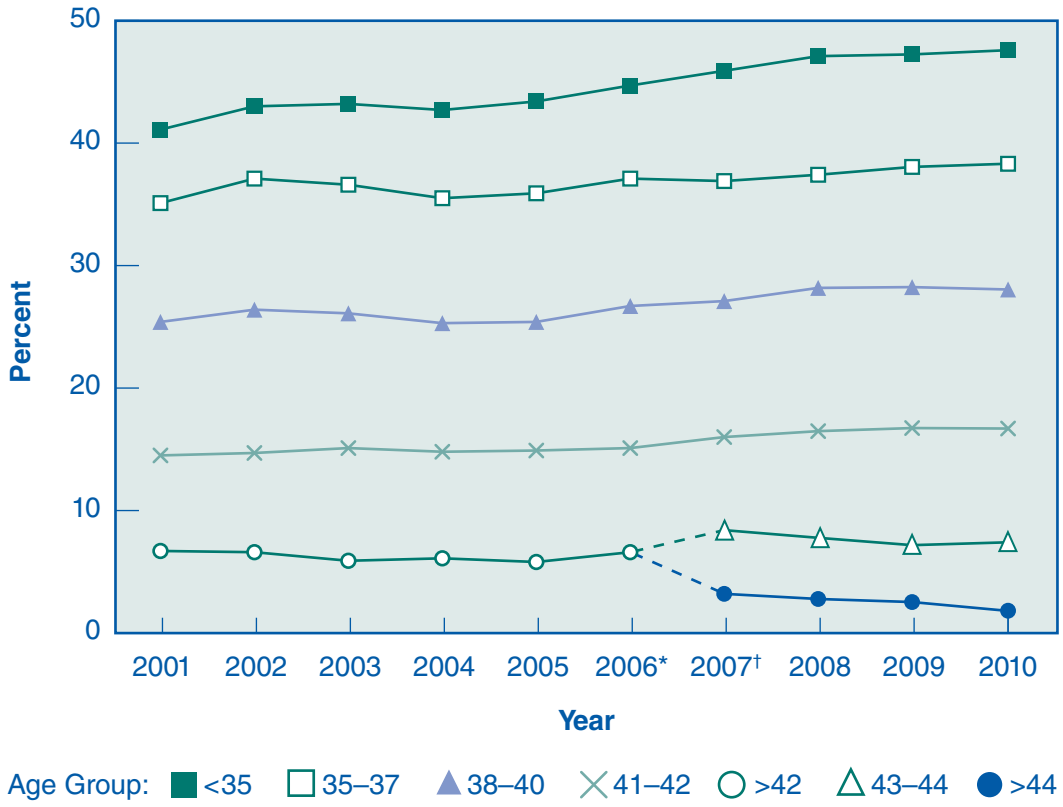


# Has the percentage of transfers that resulted in live births for all ART patients changed or only for those in particular age groups?

Figure 52 presents percentages of transfers that resulted in live births, by the age of the woman, for ART cycles using fresh nondonor eggs or embryos.

From 2001 through 2010, the percentage of transfers that resulted in live births for women younger than age 35 increased 16%, from 41% in 2001 to 48% in 2010. Over the same period, the percentage of transfers that resulted in live births increased 9% (from 35% to 38%) for women aged 35–37 years, 10% (from 25% to 28%) for women aged 38–40, and 15% (from 15% to 17%) for women aged 41–42. Please note that percentages of transfers that resulted in live births were rounded to the nearest whole number, while percent changes were calculated with raw data.

**Figure 52**
Percentages of Transfers That Resulted in Live Births for ART Cycles Using Fresh Nondonor Eggs or Embryos, by Age Group, 2001–2010



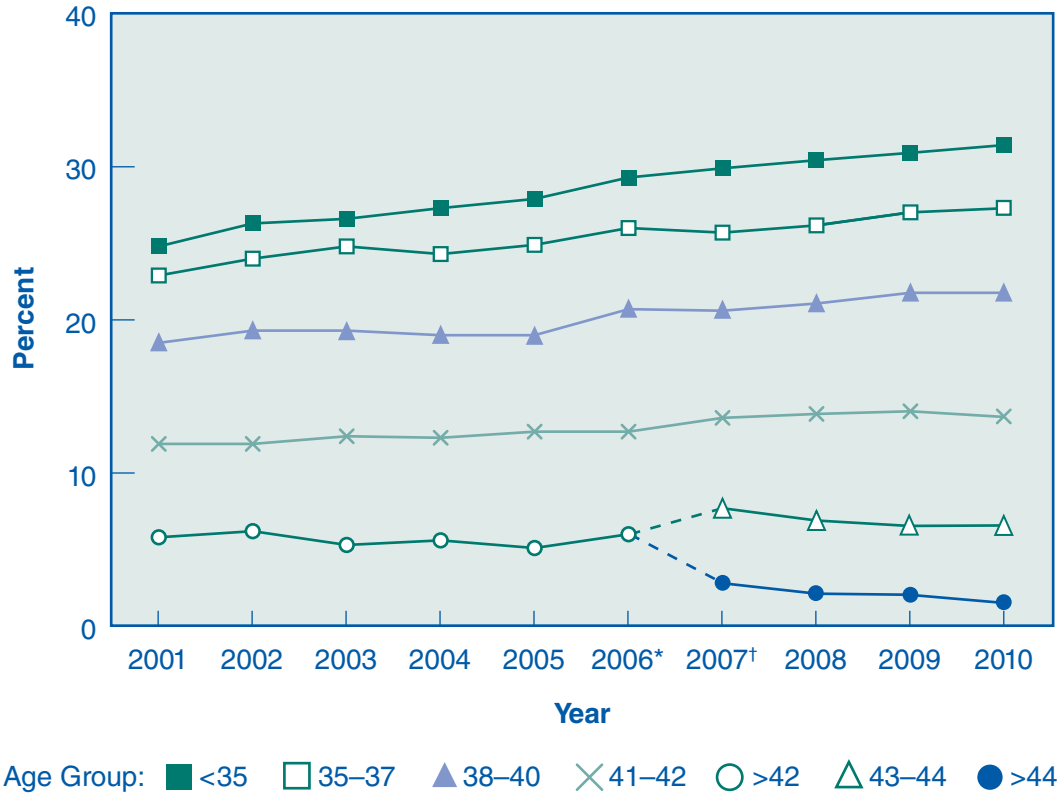

*2006 was the last year in which data were reported together for women older than 42.
†2007 was the first year in which data for women older than 42 were subdivided into ages 43–44 and >44.

## Have there been changes in percentages of transfers that resulted in singleton live births for all ART patients or only for those in particular age groups?

Singleton live births are an important measure of success because they have a much lower risk than multiple-infant births for adverse infant health outcomes, including prematurity, low birth weight, disability, and death. Figure 53 presents percentages of transfers that resulted in singleton live births, by the age of the woman, for ART cycles using fresh nondonor eggs or embryos.

From 2001 through 2010, the percentage of transfers that resulted in singleton live births for women younger than 35 increased 27%, from 25% in 2001 to 31% in 2010. Over the same period, the percentage of transfers that resulted in singleton live births increased 19% (from 23% to 27%) for women aged 35–37, 16% (from 19% to 22%) for women aged 38–40, and 15% (from 12% to 14%) for women aged 41–42. Please note that percentages of transfers that resulted in singleton live births were rounded to the nearest whole number, while percent changes were calculated with raw data.

**Figure 53**
Percentages of Transfers That Resulted in Singleton Live Births for ART Cycles Using Fresh Nondonor Eggs or Embryos, by Age Group, 2001–2010

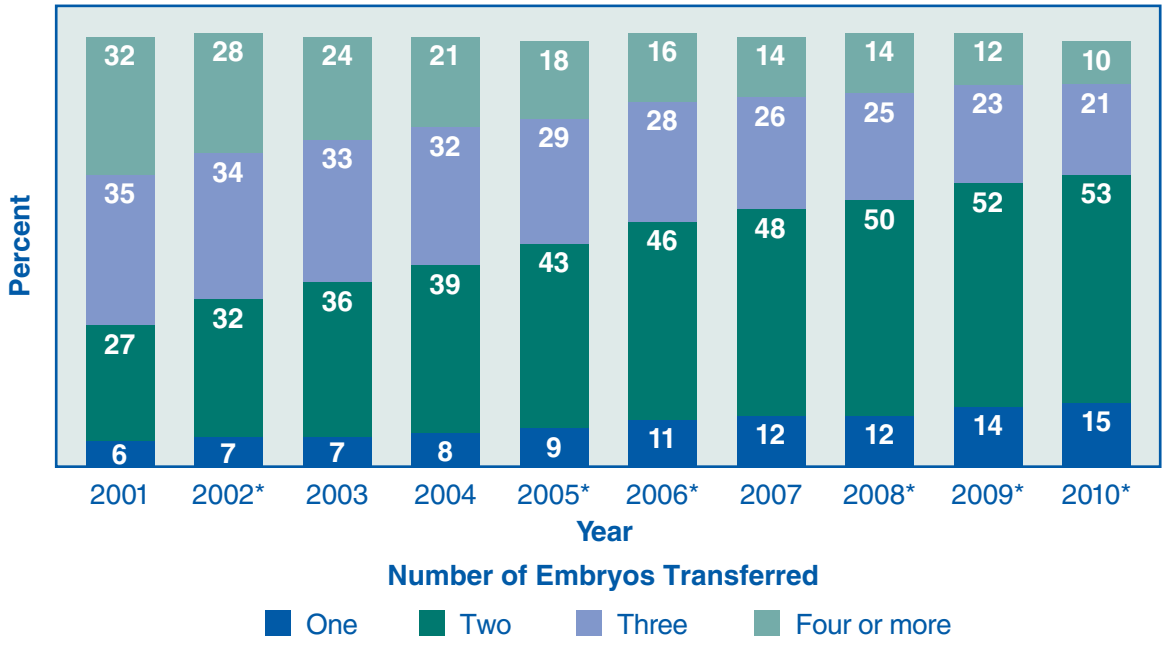



*2006 was the last year in which data were reported together for women older than 42.
†2007 was the first year in which data for women older than 42 were subdivided into ages 43–44 and >44.

## Has the number of embryos transferred changed in fresh nondonor cycles?

Figure 54 presents the trends for the number of embryos transferred in fresh nondonor cycles that progressed to the embryo transfer stage. From 2001 through 2010, cycles that involved the transfer of one embryo more than doubled, from 6% to 15%; cycles that involved the transfer of two embryos nearly doubled, from 27% in 2001 to 53% in 2010. Cycles that involved the transfer of three embryos decreased from 35% in 2001 to 21% in 2010, and cycles that involved the transfer of four or more embryos decreased dramatically from 32% in 2001 to 10% in 2010.

**Figure 54**
Percentages of Fresh Nondonor Cycles That Involved the Transfer of One, Two, Three, or Four or More Embryos, 2001–2010



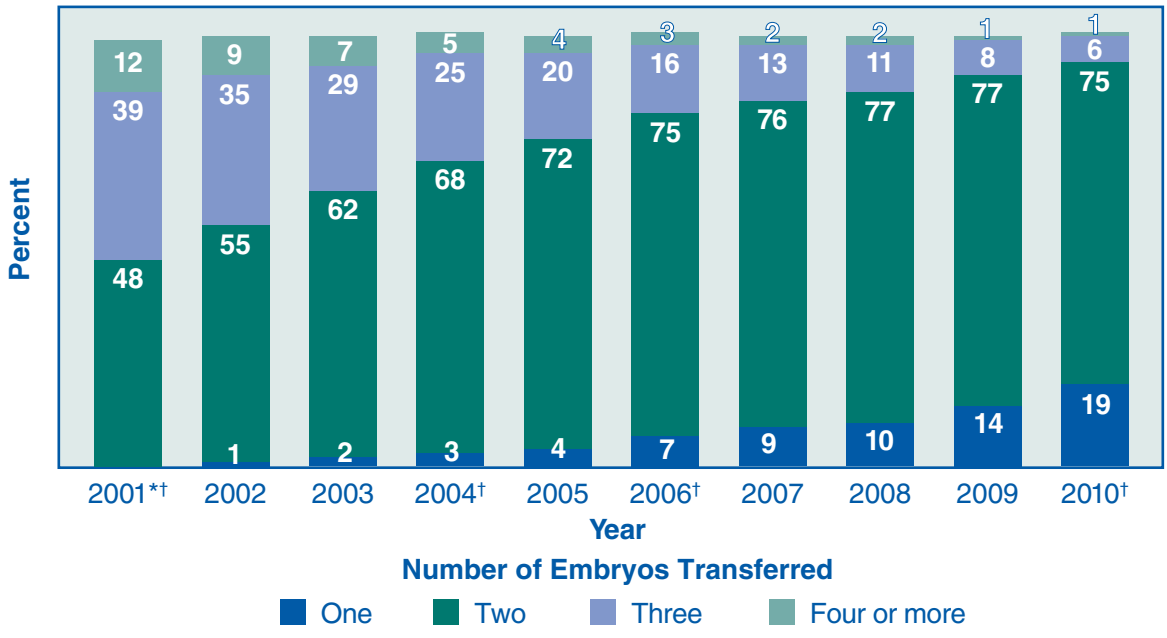

*Totals do not equal 100% due to rounding.

## Has the number of embryos transferred changed in fresh nondonor cycles for women younger than 35 who have more embryos available than they choose to transfer?

As shown in Figure 54 (page 58), the number of embryos transferred in fresh nondonor cycles has decreased during the past 10 years. Figure 55 shows the change over time in the number of embryos transferred for ART cycles in which the woman was younger than 35 and chose to set aside some embryos for future cycles rather than transfer all available embryos at one time. Previous research suggests that the number of embryos available for an ART cycle is important in predicting success. Younger women also tend to have higher percentages of ART cycles that result in pregnancies and live births (see Figure 14, page 18).

Overall, the number of embryos transferred decreased among patients who chose to transfer fewer embryos than were available. In 2001, approximately 12% of ART cycles involved the transfer of four or more embryos; 39%, three embryos; and 48%, two embryos. By 2010, four or more embryos were transferred in about 1% of cycles, three in 6% of cycles, two in 75% of cycles, and one in 19% of cycles.

**Figure 55**
Percentages of Fresh Nondonor Cycles That Involved the Transfer of One, Two, Three, or Four or More Embryos Among Women Who Were Younger Than 35 and Set Aside Extra Embryos for Future Use, 2001–2010



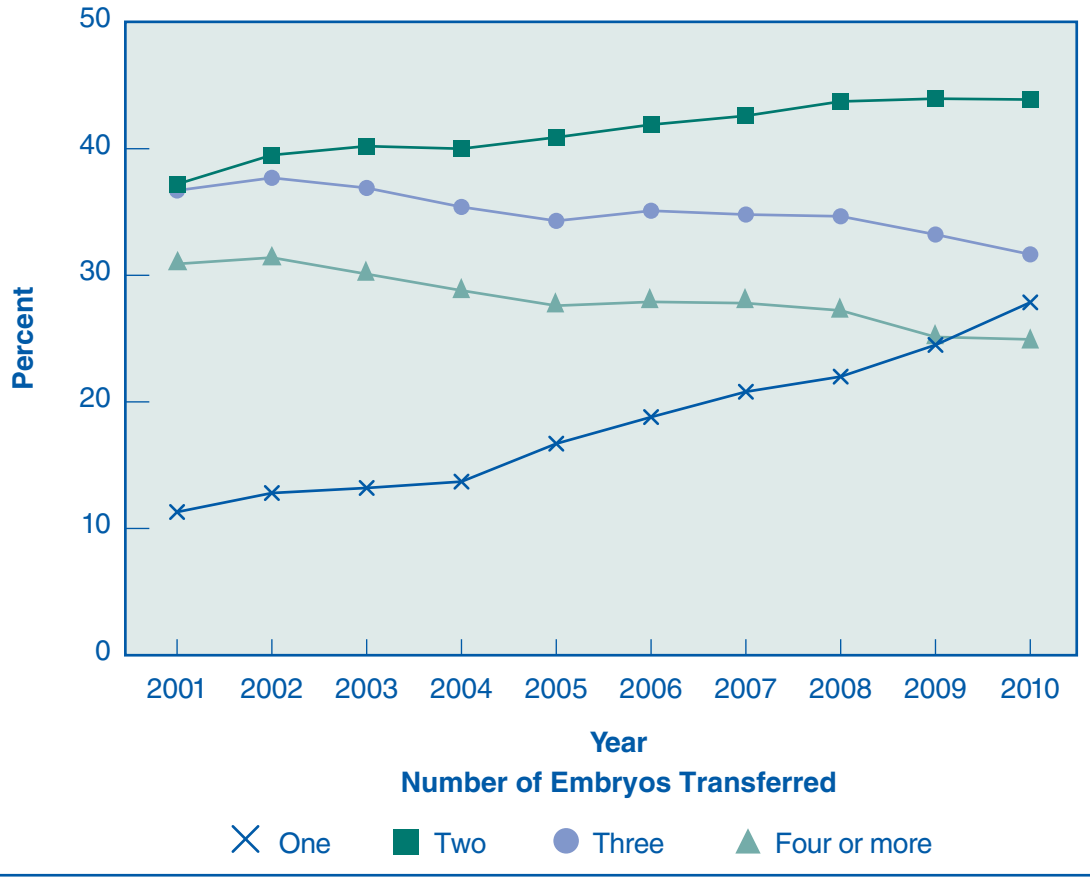

*Cycles involving the transfer of one embryo are not included because of the small number of cycles where one embryo was transferred and extra embryos were set aside for future use.
†Totals do not equal 100% due to rounding.

## Have there been changes in percentages of transfers that resulted in live births, by number of embryos transferred?

Figure 56 presents percentages of transfers that resulted in live births, by the number of embryos transferred for ART cycles using fresh nondonor eggs or embryos from 2001 through 2010. The percentage of transfers that resulted in live births increased for ART cycles that involved the transfer of one or two embryos (11% to 28% and 37% to 44%, respectively). However, over the same period, there was a decrease for ART cycles that involved the transfer of three or four or more embryos (37% to 32% and 31% to 25%, respectively).

Interpretation of the relationship between the number of embryos transferred and success rates is complicated by several factors, such as the woman's age and embryo quality. Trends over time may reflect changes in these factors.

**Figure 56**
Percentages of Transfers That Resulted in Live Births Using Fresh Nondonor Eggs or Embryos, by Number of Embryos Transferred, 2001–2010



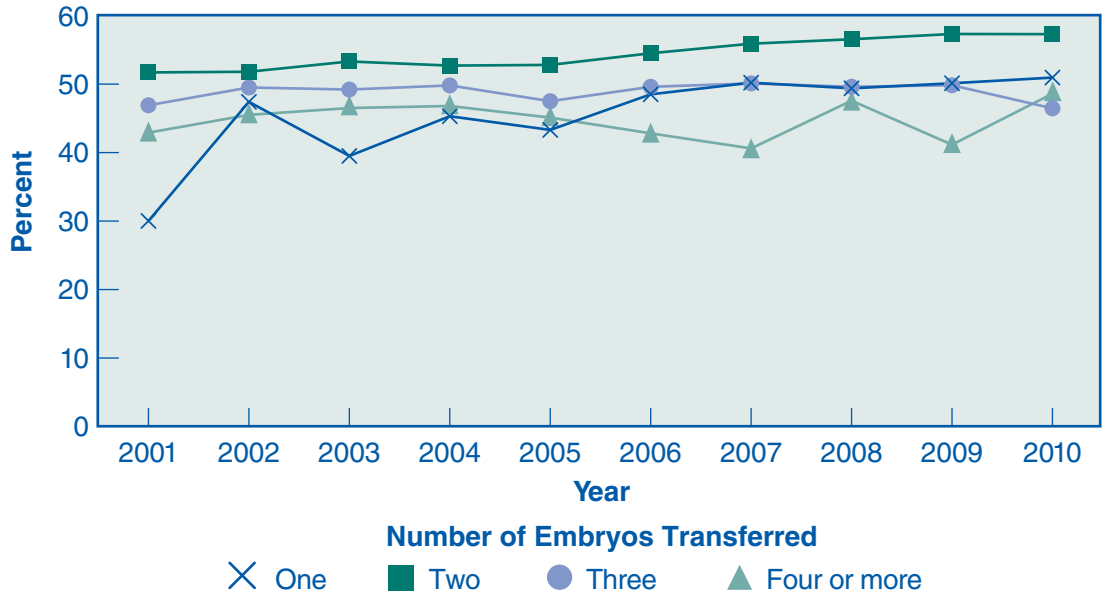
## Have there been changes in percentages of transfers that resulted in live births for women younger than 35 who have more embryos available than they choose to transfer?

Figure 57 shows changes over time in the number of embryos transferred and the percentage of transfers that resulted in live births for ART cycles using fresh nondonor eggs or embryos in which the woman was younger than 35 and chose to set aside some embryos for future cycles rather than transfer all available embryos at one time. Previous research suggests that the number of embryos available for an ART cycle is an important predictor of success. Younger women also tend to have higher percentages of ART cycles that result in pregnancies and live births (see Figure 14, page 18).

For this group of women, the percentage of transfers that resulted in live births generally increased over time, regardless of the number of embryos transferred. The biggest increase was for cycles in which one embryo was transferred, from 30% in 2001 to 51% in 2010.

Percentages of transfers that resulted in live births for cycles involving the transfer of one embryo were comparable to those that involved three or four or more embryos. Elective single-embryo transfer minimizes the risk of multiple-fetus pregnancy and related adverse outcomes. In 2009, the Society for Assisted Reproductive Technology (SART) revised its embryo transfer guidelines to encourage single-embryo transfer among patients with good prognoses. (For more information, contact SART by telephone at 205-978-5000 or online at www.sart.org.)

**Figure 57**
Percentages of Transfers That Resulted in Live Births Using Fresh Nondonor Eggs or Embryos Among Women Who Were Younger Than 35 and Set Aside Extra Embryos for Future Use, by Number of Embryos Transferred, 2001–2010

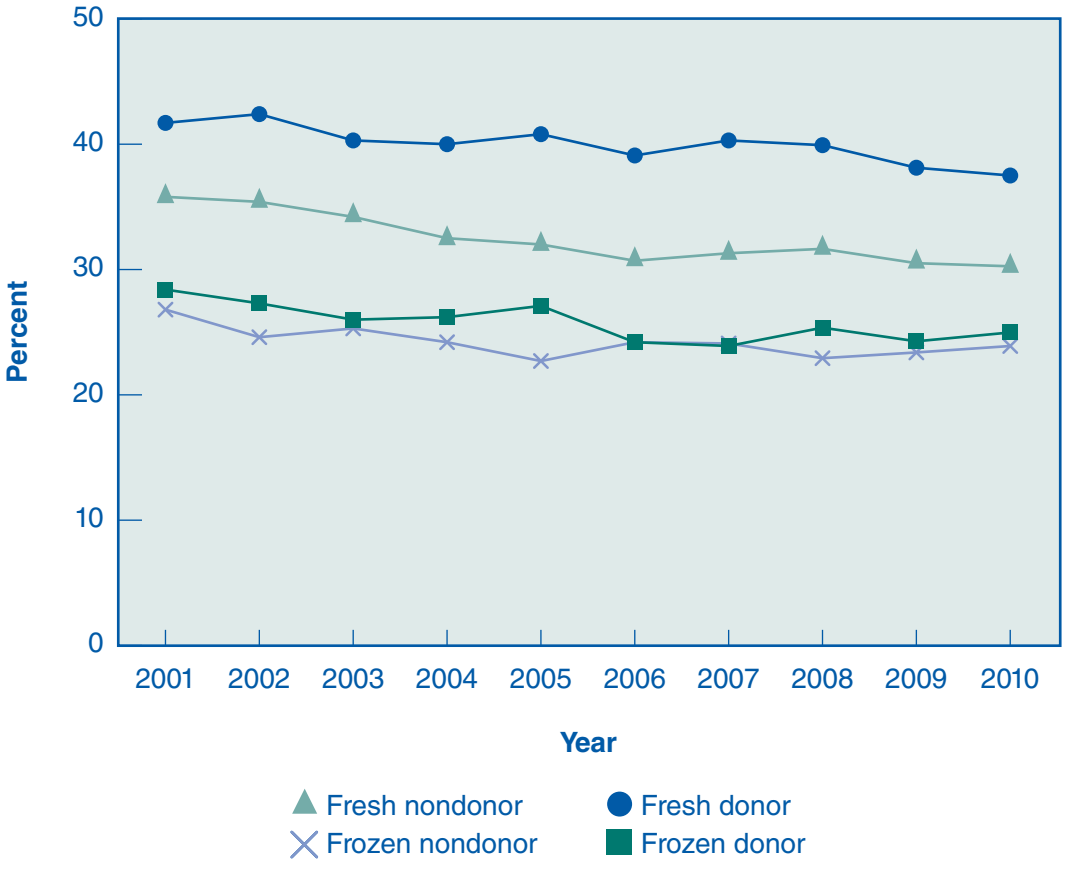


## Have percentages of multiple-infant live births changed?

Multiple-infant births are associated with greater problems for both mothers and infants, including higher rates of caesarean section, prematurity, low birth weight, and infant disability or death. Figure 58 shows percentages of multiple-infant live births for each type of ART cycle performed.

For fresh nondonor cycles, the percentage of multiple-infant live births decreased 15% since 2001, from 36% of all live births in 2001 to 30% in 2010. Over the same period, the percentage of multiple-infant live births decreased 11% for frozen nondonor cycles, 12% for frozen donor cycles, and 10% for fresh donor cycles. Please note that percentages of cycles that resulted in multiple-infant live births were rounded to the nearest whole number, while percent changes were calculated with raw data.

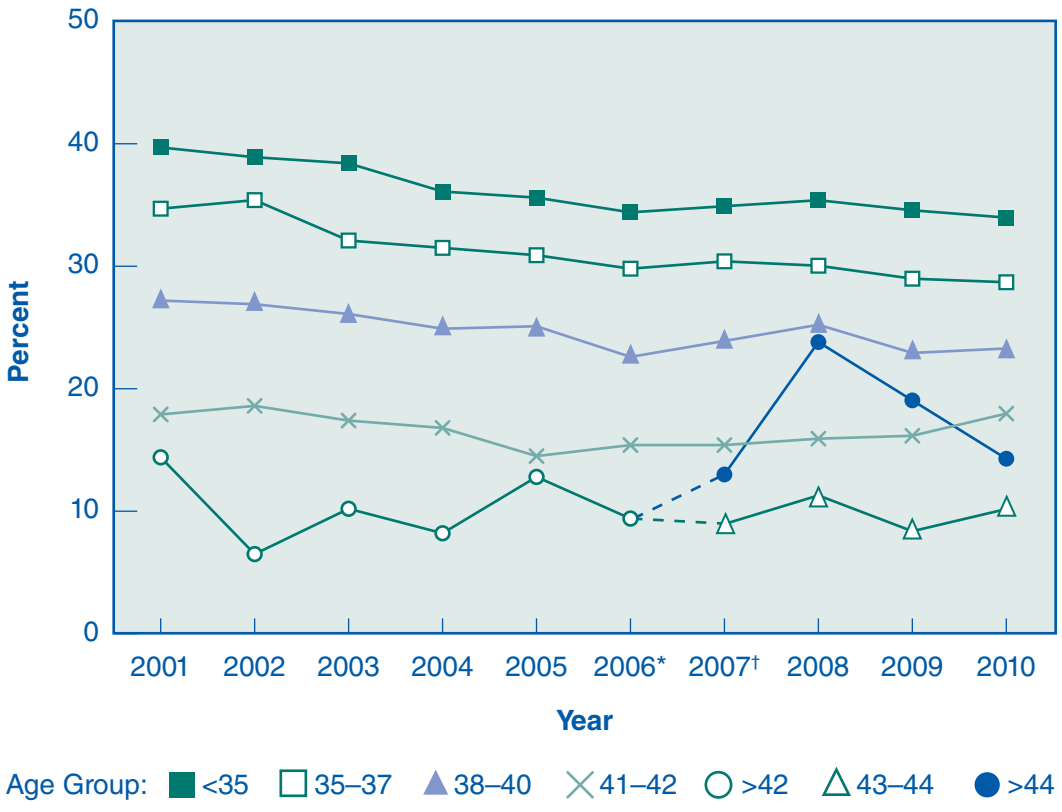
**Figure 58**
Percentages of ART Cycles That Resulted in Multiple-Infant Live Births, by Type of ART Cycle, 2001–2010



## Have percentages of multiple-infant live births for ART cycles using fresh nondonor eggs or embryos changed in particular age groups?

Figure 59 presents percentages of multiple-infant live births by the age of the woman, for ART cycles using fresh nondonor eggs or embryos. From 2001 through 2010, the percentage of multiple-infant live births decreased 14% (from 40% to 34%) for women younger than 35, 17% (from 35% to 29%) for women aged 35–37, and 14% (from 27% to 23%) for women aged 38–40. The percentage of multiple-infant live births remained nearly the same from 2001 through 2010 for women aged 41–42. However, the percentage of multiple-infant live births among women older than 44 increased from 13% to 24% between 2007 and 2008 and decreased to 14% by 2010. Please note that percentages of multiple-infant live births were rounded to the nearest whole number, while percent changes were calculated with raw data.

**Figure 59**
Percentages of ART Cycles That Resulted in Multiple-Infant Live Births Using Fresh Nondonor Eggs or Embryos, by Age Group, 2001–2010



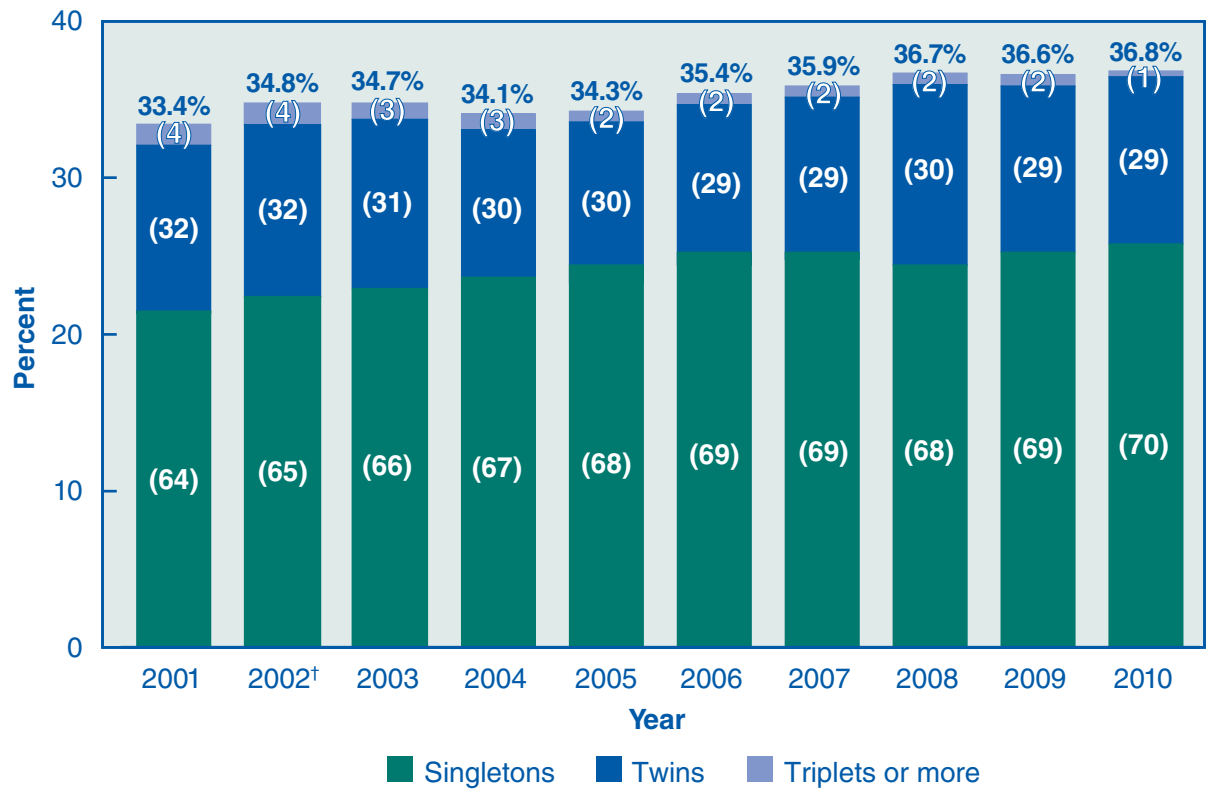

*2006 was the last year in which data were reported together for women older than 42.
†2007 was the first year in which data for women older than 42 were subdivided into ages 43–44 and >44.

## Have percentages of singletons, twins, and triplets or more changed for ART cycles using fresh nondonor eggs or embryos?

Figure 60 presents the trends in percentages of transfers that resulted in live births and percentages of multiple-infant live births for ART cycles using fresh nondonor eggs or embryos. Overall, the percentage of transfers that resulted in live births increased from 33% in 2001 to approximately 37% in 2010. From 2001 through 2010, the percentage of singleton live births increased from 64% to 70%; the percentage of twin births declined from 32% to 29%; and the percentage of triplet or higher order births decreased considerably from 4% in 2001 to 1% in 2010.

It is important to note that twins, albeit to a lesser extent than triplets or more, are still at substantially greater risk of illness and death than singletons. These risks include low birth weight, preterm birth, and neurological impairments such as cerebral palsy.

**Figure 60**
Percentages of Transfers That Resulted in Live Births and Percentages of Multiple-Infant Live Births for ART Cycles Using Fresh Nondonor Eggs or Embryos,* 2001–2010

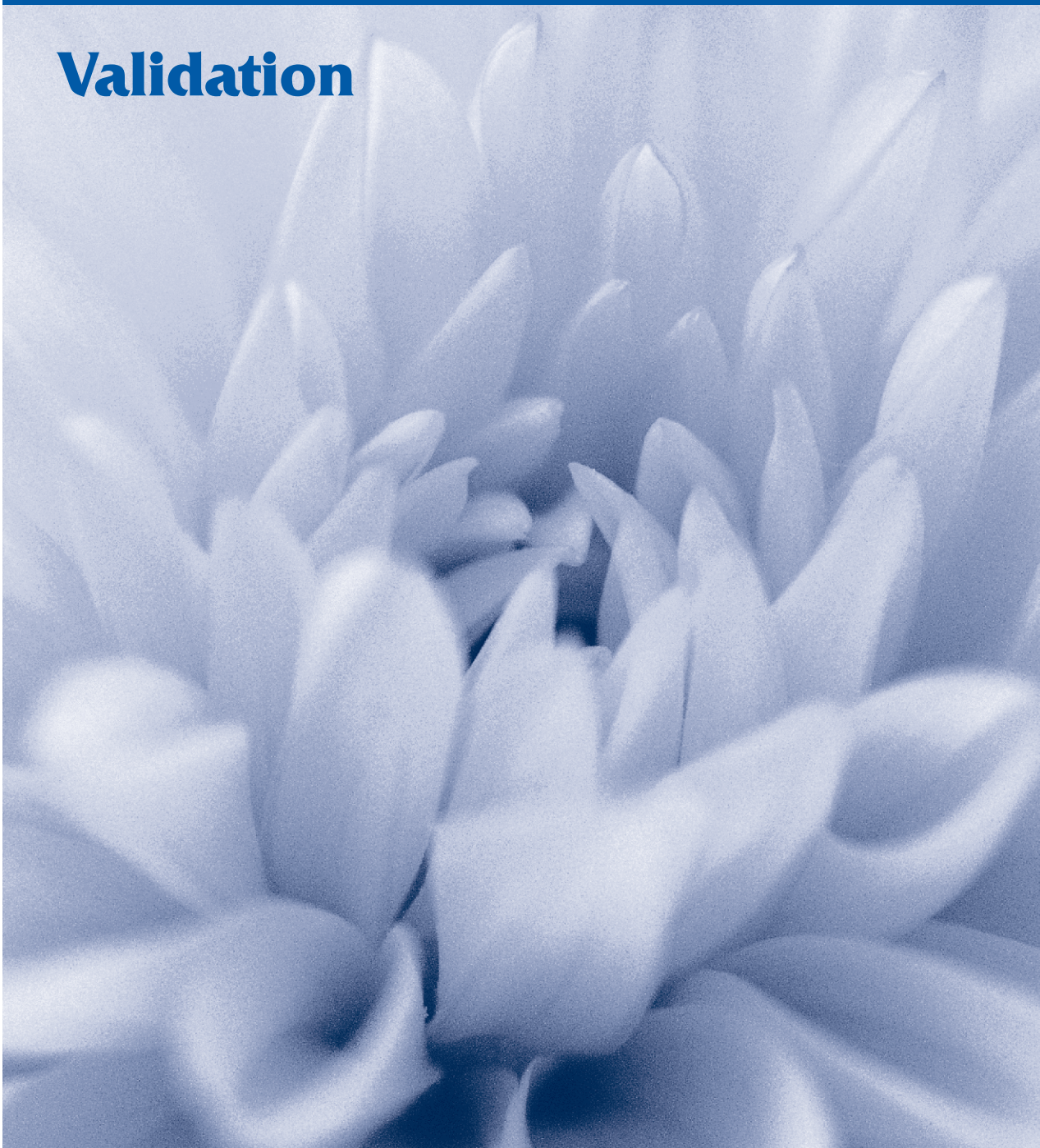



*Percentages of live births that were singletons, twins, and triplets or more are in parentheses.
†Total does not equal 100% due to rounding.

2010

# Appendix A

## Validation



# APPENDIX A: VALIDATION

## Findings from Validation Visits for 2010 ART Data

Site visits to assisted reproductive technology (ART) clinics for validation of 2010 ART data were conducted during April through June 2012. For validation of 2010 data, 35 of the 443 reporting clinics were randomly selected after taking into consideration the number of ART procedures performed, the number of canceled cycles, some cycle and clinic characteristics, and whether the clinic had been selected before. During each validation visit, ART data reported by the clinic to the Centers for Disease Control and Prevention were compared with information documented in medical records.

For each clinic, the fully validated sample included up to 40 ART cycles resulting in pregnancy and up to 20 ART cycles not resulting in pregnancy. In total, 2,070 ART cycles performed in 2010 across the 35 clinics were randomly selected for full validation, along with 135 embryo banking cycles. The full validation included review of 1,352 cycles for which a pregnancy was reported, of which 446 were multiple-fetus pregnancies. In addition, among patients whose cycles were validated, we verified the number of ART cycles performed during 2010. For each of these patients, we compared the total number of ART cycles reported with the total number of ART cycles included in the medical record. If unreported cycles were identified in selected medical records, up to 10 of these cycles were also selected for partial validation.

Discrepancy rates are listed on the next page for validated items of interest. Overall, validation of 2010 ART cycle data indicated that discrepancy rates were low (<5.0%) except for "Diagnosis of infertility." This field corresponds to "Patient Diagnosis" data in the National Summary table in this report (see page 4) and the 2010 individual clinic tables in the *2010 Assisted Reproductive Technology Fertility Clinic Success Rates Report*.

## Discrepancy Rates by Data Fields Selected for Validation

| Data Field Name | Discrepancy Rate* (Confidence Interval†) | Comments |
|---|---|---|
| Patient date of birth | 2.0% (1.0–3.0) | In about 55% of the discrepancies, the difference did not result in changing age category (Age of Woman). |
| Diagnosis of infertility | 17.9% (13.3–22.5) | For approximately 20% of the discrepancies, a single wrong diagnosis was reported, mainly "Other" or "Unexplained," instead of a specific cause. For another 50% of the discrepancies, multiple causes of infertility were found in the medical record, but only a single cause was reported. |
| Cycle intention | <1% | |
| Cycle cancellation | <1% | |
| Number of embryos/ oocytes transferred | <1% | |
| Outcome of ART treatment (i.e., pregnant vs. not pregnant) | <1% | |
| Number of fetal hearts on ultrasound | 2.2% (1.2–3.2) | Of the discrepancies, 15% were misreported as single-fetus pregnancies instead of multiple-fetus pregnancies, whereas 20% of the discrepancies were misreported as having one or more fetal hearts when the medical records actually showed zero (0) fetal hearts. |
| Pregnancy outcome (i.e., miscarriage, stillbirth, and live birth) | 1.4% (0.7–2.2) | For about 70% of the discrepancies, there was no information on pregnancy outcome in the medical records. |
| Date of pregnancy outcome | 4.1% (2.8–5.3) | For about 35% of the discrepancies, there was no information on pregnancy outcome date in the medical records. For another one–third of the discrepancies, the date in the medical records was within 7 days of the reported date. |
| Number of infants born | <1% | |
| Additional cycles in same reporting year | 2.6% (1.1–4.1) | For approximately 75% of the discrepancies, fewer additional cycles were reported by clinics than were found in the medical records. The majority of the discrepancies were due to reporting one less cycle. A further analysis of the non-reported cycles revealed that 40% were canceled cycles and an overwhelming majority (> 95%) did not result in a live birth (success). |

Note: ART = assisted reproductive technology.

*Discrepancy rates estimate the proportion of all treatment cycles with differences for a particular data item. The discrepancy-rate calculations weight the data from validated cycles to reflect the overall number of cycles performed at each clinic. Thus, findings from larger clinical practices were weighted more heavily than those from smaller practices.

†This table shows a range, called the 95% confidence interval, that conveys the reliability of the discrepancy rate. For a more general explanation of confidence intervals, see page 69.

# How to Interpret a Confidence Interval for Findings from Validation Visits

## What is a confidence interval?

Simply speaking, confidence intervals are a useful way to consider margin of error, a statistic often used in voter polls to indicate the range within which a value is likely to be correct (e.g., 30% of the voters favor a particular candidate with a margin of error of plus or minus 3.5%). Similarly, in this report, confidence intervals are presented to provide a discrepancy rate range that we can be confident is an estimate of the proportion of all ART cycles, performed in a given reporting year, with differences for a particular data item.

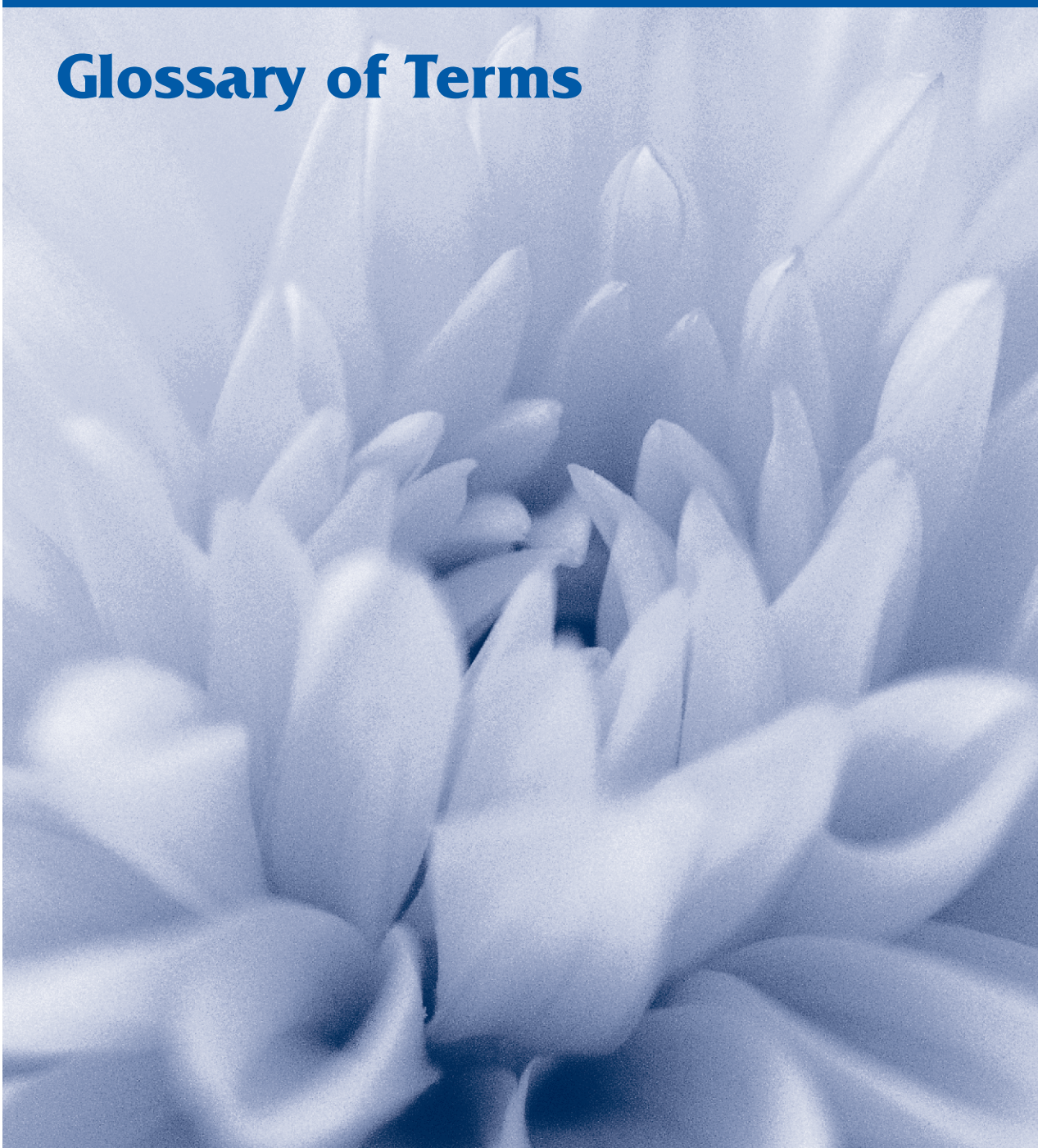
## Why do we need to consider confidence intervals if we already know the exact discrepancy rates for each clinic in 2010?

No discrepancy rate or statistic is absolute. Suppose that during validation, 100 cycles were reviewed, and a discrepancy rate of 15% was determined for a particular data item with a confidence interval of 10%–20%. The 15% discrepancy rate tells us that the average chance that a discrepancy occurred for the selected data field among all reported cycles was 15%. But because only a certain percentage of ART cycles were reviewed during the validation visits at a select number of clinics, how likely is it that this would be the discrepancy rate if we repeated validation? For example, if another 100 cycles were reviewed using similar validation parameters, would the discrepancy rate again be 15%? The confidence interval tells us that the discrepancy rate would likely fall between 10% and 20%.

2010

# Appendix B

## Glossary of Terms



# APPENDIX B: GLOSSARY OF TERMS

**Adverse outcome.** A pregnancy that does not result in a live birth. The adverse outcomes reported for ART procedures are miscarriages, induced abortions, and stillbirths.

**American Society for Reproductive Medicine (ASRM).** Professional society whose affiliate organization, the Society for Assisted Reproductive Technology (SART), is composed of clinics and programs that provide ART.

**ART (assisted reproductive technology).** All treatments or procedures that involve surgically removing eggs from a woman's ovaries and combining the eggs with sperm to help a woman become pregnant. The types of ART are in vitro fertilization (IVF), gamete intrafallopian transfer (GIFT), and zygote intrafallopian transfer (ZIFT).

**ART cycle.** A process in which (1) an ART procedure is performed, (2) a woman has undergone ovarian stimulation or monitoring with the intent of having an ART procedure, or (3) frozen embryos have been thawed with the intent of transferring them to a woman. A cycle begins when a woman begins taking fertility drugs or having her ovaries monitored for follicle production.

**Canceled cycle.** An ART cycle in which ovarian stimulation was performed but was stopped before eggs were retrieved or, in the case of frozen embryo cycles, before embryos were transferred. Cycles are canceled for many reasons: eggs may not develop, the patient may become ill, or the patient may choose to stop treatment.

**Combination cycle.** A cycle that uses more than one ART procedure. Combination cycles usually involve IVF plus either GIFT or ZIFT.

**Cryopreservation.** The practice of freezing extra embryos from a patient's ART cycle for potential future use.

**Diminished ovarian reserve.** This diagnosis means that the ability of the ovary to produce eggs is reduced. Reasons include congenital, medical, or surgical causes or advanced age.

**Donor egg cycle.** An embryo is formed from the egg of one woman (the donor) and then transferred to another woman (the recipient). The donor relinquishes all parental rights to any resulting offspring.

**Donor embryo.** An embryo that is donated by a patient who previously underwent ART treatment and had extra embryos available.

**Ectopic pregnancy.** A pregnancy in which the fertilized egg implants in a location outside of the uterus—usually in the fallopian tube, the ovary, or the abdominal cavity. Ectopic pregnancy is a dangerous condition that must receive prompt medical treatment.

**Egg.** A female reproductive cell, also called an oocyte or ovum.

**Egg retrieval (also called oocyte retrieval).** A procedure to collect the eggs contained in the ovarian follicles.

**Egg transfer (also called oocyte transfer).** The transfer of retrieved eggs into a woman's fallopian tubes through laparoscopy. This procedure is used only in GIFT.

**Embryo.** An egg that has been fertilized by a sperm and has undergone one or more divisions.

**Embryo transfer.** Placement of embryos into a woman's uterus through the cervix after IVF: in ZIFT, the embryos are placed in a woman's fallopian tube.

**Endometriosis.** A medical condition that involves the presence of tissue similar to the uterine lining in abnormal locations. This condition can affect both fertilization of the egg and embryo implantation.

**eSET (elective single-embryo transfer).** Elective single-embryo transfer is a procedure in which one embryo, selected from a larger number of available embryos, is placed in the uterus or fallopian tube. The embryo selected for eSET might be from a previous IVF cycle (i.e., cryopreserved embryos [frozen]) or from the current fresh IVF cycle that yielded more than one embryo. The remaining embryos may be set aside for future use or cryopreservation.

**Fertility Clinic Success Rate and Certification Act of 1992 (FCSRCA).** Law passed by the United States Congress in 1992 requiring all clinics performing ART in the United States to annually report their success rate data to the Centers for Disease Control and Prevention.

**Fertilization.** The penetration of the egg by the sperm and the resulting combining of genetic material that develops into an embryo.

**Fetus.** The unborn offspring from the eighth week after conception to the moment of birth.

**Follicle.** A structure in the ovaries that contains a developing egg.

**Fresh eggs, sperm, or embryos.** Eggs, sperm, or embryos that have not been frozen. Fresh embryos, however, may have been conceived using either fresh or frozen sperm.

**Frozen embryo cycle.** An ART cycle in which frozen (cryopreserved) embryos are thawed and transferred to the woman.

**Gamete.** A reproductive cell, either a sperm or an egg.

**Gestation.** The period of time from conception to birth.

**Gestational carrier (also called a gestational surrogate).** A woman who gestates, or carries, an embryo that was formed from the egg of another woman. The gestational carrier usually has a contractual obligation to return the infant to its intended parents.

**Gestational sac.** A fluid-filled structure that develops within the uterus early in pregnancy. In a normal pregnancy, a gestational sac contains a developing fetus.

**GIFT (gamete intrafallopian transfer).** An ART procedure that involves removing eggs from the woman's ovary, combining them with sperm, and using a laparoscope to place the unfertilized eggs and sperm into the woman's fallopian tube through small incisions in her abdomen.

**ICSI (intracytoplasmic sperm injection).** A procedure in which a single sperm is injected directly into an egg; this procedure is commonly used to overcome male infertility problems.

**Implantation rate.** A measurement of ART success when the ART cycle results in an intrauterine clinical pregnancy, defined as the larger of either the number of maximum fetal hearts by ultrasound or maximum infants born, including live births and stillbirths, out of the total number of embryos transferred.

**Induced or therapeutic abortion.** A surgical or other medical procedure used to end a pregnancy.

**IUI (intrauterine insemination).** A medical procedure that involves placing sperm into a woman's uterus to facilitate fertilization. IUI is not considered an ART procedure because it does not involve the manipulation of eggs.

**IVF (in vitro fertilization).** An ART procedure that involves removing eggs from a woman's ovaries and fertilizing them outside her body. The resulting embryos are then transferred into a woman's uterus through the cervix.

**Laparoscopy.** A surgical procedure in which a fiber-optic instrument (a laparoscope) is inserted through a small incision in the abdomen to view the inside of the pelvis.

**Live birth.** The delivery of one or more infants with any signs of life.

**Male factor.** Any cause of infertility due to low sperm count or problems with sperm function that makes it difficult for a sperm to fertilize an egg under normal conditions.

**Miscarriage (also called spontaneous abortion).** A pregnancy ending in the spontaneous loss of the embryo or fetus before 20 weeks of gestation, or before 18 weeks from the date of transfer if the pregnancy was achieved using ART.

**Multifetal pregnancy reduction.** A procedure used to decrease the number of fetuses a woman carries and improve the chances that the remaining fetuses will develop into healthy infants. Multifetal reductions that occur naturally are referred to as spontaneous reductions.

**Multiple factors, female and male.** A diagnostic category used when one or more female cause and male factor infertility are diagnosed.

**Multiple factors, female only.** A diagnostic category used when more than one female cause of infertility is diagnosed.

**Multiple-fetus pregnancy.** A pregnancy with two or more fetuses, determined by the number of fetal hearts observed on an ultrasound performed early in pregnancy (usually in the first trimester).

**Multiple-infant birth.** A pregnancy that results in the birth of more than one infant.

**NASS (National ART Surveillance System).** Web-based data collection system used by all ART clinics to report data for each ART procedure to CDC.

**Oocyte.** The female reproductive cell, also called an egg.

**Other causes of infertility.** These include immunological problems, chromosomal abnormalities, cancer chemotherapy, and serious illnesses.

**Ovarian monitoring.** The use of ultrasound and/or blood or urine tests to monitor follicle development and hormone production.

**Ovarian stimulation.** The use of drugs (oral or injected) to stimulate the ovaries to develop follicles and eggs.

**Ovulatory dysfunction.** A diagnostic category used when a woman's ovaries are not producing eggs normally. It includes polycystic ovary syndrome and multiple ovarian cysts.

**PGD (preimplantation genetic diagnosis).** A technique combining advances in molecular genetics and ART. PGD allows physicians to identify various genetic diseases in the embryo (fertilized egg with several divisions) prior to implantation, that is, before the pregnancy is established. It is of special value for those who are at risk of having children with serious genetic problems.

**Pregnancy (clinical).** A pregnancy documented by ultrasound that shows a gestational sac in the uterus. For ART data collection purposes, pregnancy is defined as a clinical pregnancy rather than a chemical pregnancy (i.e., a positive pregnancy test).

**Singleton.** A single live-born infant.

**Society for Assisted Reproductive Technology (SART).** An affiliate of ASRM composed of clinics and programs that provide ART.

**Sperm.** The male reproductive cell.

**Spontaneous abortion.** See Miscarriage.

**Stillbirth.** The birth of an infant that shows no sign of life after 20 or more weeks of gestation, or 18 or more weeks from the date of transfer if the pregnancy was achieved using ART.

**Stimulated cycle.** An ART cycle in which a woman receives oral or injected fertility drugs to stimulate her ovaries to produce more follicles.

**Thawed embryo cycle.** Same as frozen embryo cycle.

**Tubal factor.** A diagnostic category used when the woman's fallopian tubes are blocked or damaged, making it difficult for the egg to be fertilized or for an embryo to travel to the uterus.

**Ultrasound.** A technique used in ART for visualizing the follicles in the ovaries, the gestational sac, or the fetus.

**Unexplained cause of infertility.** A diagnostic category used when no cause of infertility is found in either the woman or the man.

**Unstimulated cycle.** An ART cycle in which the woman does not receive drugs to stimulate her ovaries to produce more follicles. Instead, follicles develop naturally.

**Uterine factor.** A structural or functional disorder of the uterus that results in reduced fertility.

**ZIFT (zygote intrafallopian transfer).** An ART procedure in which eggs are collected from a woman's ovary and fertilized outside her body. A laparoscope is then used to place the resulting zygote (fertilized egg) into the woman's fallopian tube through a small incision in her abdomen.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention

CS232095