

## Special Article

## INSURANCE COVERAGE AND OUTCOMES OF IN VITRO FERTILIZATION

TARUN JAIN, M.D., BERNARD L. HARLOW, PH.D., AND MARK D. HORNSTEIN, M.D.

**ABSTRACT**

**Background** Although most insurance companies in the United States do not cover in vitro fertilization, a few states mandate such coverage.

**Methods** We used 1998 data reported to the Centers for Disease Control and Prevention by 360 fertility clinics in the United States and 2000 U.S. Census data to determine utilization and outcomes of in vitro fertilization services according to the status of insurance coverage.

**Results** Of the states in which in vitro fertilization services were available, 3 states (31 clinics) required complete insurance coverage, 5 states (27 clinics) required partial coverage, and 37 states plus Puerto Rico and the District of Columbia (302 clinics) required no coverage. Clinics in states that required complete coverage performed more in vitro fertilization cycles than clinics in states that required partial or no coverage (3.35 vs. 1.46 and 1.21 transfers per 1000 women of reproductive age, respectively;  $P < 0.001$ ) and more transfers of frozen embryos (0.43 vs. 0.30 and 0.20 per 1000 women of reproductive age, respectively;  $P < 0.001$ ). The percentage of cycles that resulted in live births was higher in states that did not require any coverage than in states that required partial or complete coverage (25.7 percent vs. 22.2 percent and 22.7 percent, respectively;  $P < 0.001$ ), but the percentage of pregnancies with three or more fetuses was also higher (11.2 percent vs. 8.9 percent and 9.7 percent, respectively;  $P = 0.007$ ). The number of fresh embryos transferred per cycle was lower in states that required complete coverage than in states that required partial or no coverage ( $P = 0.001$  and  $P < 0.001$ , respectively).

**Conclusions** State-mandated insurance coverage for in vitro fertilization services is associated with increased utilization of these services but with decreases in the number of embryos transferred per cycle, the percentage of cycles resulting in pregnancy, and the percentage of pregnancies with three or more fetuses. (N Engl J Med 2002;347:661-6.)

Copyright © 2002 Massachusetts Medical Society.

**M**ORE than 4 million women in the United States are unable to have children.<sup>1</sup> A substantial number of these women cannot conceive with conventional methods of treatment, such as induction of ovulation, surgery, and insemination with donor sperm, and subsequently become candidates for in vitro fertilization. Since in vitro fertilization was introduced in 1978,<sup>2</sup> there has been a growing debate about whether the substantial medical costs associated with this procedure should be covered by health insurance. Estimates for the direct cost of a single in vitro fertilization cycle range from \$7,000 to \$11,000.<sup>3,4</sup>

In the United States, in vitro fertilization is primarily a privately funded treatment.<sup>5</sup> However, a handful of states have passed laws requiring that insurance companies provide either partial or complete coverage of in vitro fertilization. As of November 2001, three states had laws mandating complete coverage (Illinois, Massachusetts, and Rhode Island), and five states had laws requiring partial coverage (Arkansas, Hawaii, Maryland, Ohio, and West Virginia).<sup>6</sup> Five states did not have in vitro fertilization services (Alaska, Idaho, Maine, Montana, and Wyoming). The remaining 37 states, plus the District of Columbia and Puerto Rico, had clinics that provided in vitro fertilization services primarily on a fee-for-service basis. On January 1, 2002, New Jersey became the fourth state to require complete insurance coverage for in vitro fertilization.

We conducted a study to determine whether insurance coverage for in vitro fertilization services is associated with increased use of such services and whether insurance coverage affects the practice patterns of fertility clinics and the outcomes of their services. Using the most recent data on rates of success of assisted reproductive technology (from 1998),<sup>7</sup> we specifically sought to determine whether state-mandated insurance coverage for in vitro fertilization affects utilization, pregnancy rates, and multiple-gestation rates.

From the Department of Obstetrics and Gynecology (T.J., M.D.H.) and the Obstetrics and Gynecology Epidemiology Center (B.L.H.), Brigham and Women's Hospital and Harvard Medical School, Boston. Address reprint requests to Dr. Hornstein at the Department of Obstetrics and Gynecology, Brigham and Women's Hospital, 75 Francis St., Boston, MA 02115, or at mhornstein@partners.org.

## METHODS

## Collection of Data

In accordance with the Fertility Clinic Success Rate and Certification Act of 1992, the Centers for Disease Control and Prevention (CDC) collects annual data on success rates at fertility clinics.<sup>8</sup> The data are compiled by the CDC; the Society for Assisted Reproductive Technology, which is an affiliate of the American Society for Reproductive Medicine; and RESOLVE: the National Infertility Association. The most recent report includes success rates in 1998 at 360 of the 390 fertility clinics in the United States.<sup>7</sup> Despite the federal requirement to report success rates, 30 clinics either failed to submit their data to the CDC or did not provide verification by the clinic medical director that the tabulated success rates were correct. Two of the 30 nonreporting clinics were in states that require complete insurance coverage, and the rest were in states that do not require coverage.

The assisted reproductive techniques consisted of in vitro fertilization (in 96 percent of cycles), gamete intrafallopian transfer (in 2 percent), and zygote intrafallopian transfer (in 2 percent). The overall rates of live births per oocyte retrieval for in vitro fertilization, gamete intrafallopian transfer, and zygote intrafallopian transfer were nearly identical (29.0 percent, 28.0 percent, and 29.2 percent, respectively). Since in vitro fertilization accounted for the vast majority of the cycles, we use the term in this report as a synonym for assisted reproductive technology. Only cycles involving fresh or frozen embryos from nondonor eggs were analyzed (61,650 and 10,058 cycles, respectively).

Pertinent data from the 1998 report were downloaded from the CDC Web site for analysis.<sup>9</sup> Data on fertility clinics were separated by state and then assigned to one of three categories on the basis of the requirement for insurance coverage for in vitro fertilization (complete, partial, or no coverage).

Complete insurance coverage was defined as a requirement that

health maintenance organizations (HMOs) and insurance companies cover the costs of diagnosis and treatment of infertility (including in vitro fertilization). Partial coverage was defined as a requirement of limited coverage of in vitro fertilization (e.g., required coverage only by HMOs, a maximal lifetime benefit of \$15,000, or coverage of only a portion of the cost of in vitro fertilization). No coverage was defined as the absence of any requirement that HMOs or insurance companies cover in vitro fertilization. The coverage guidelines for states with complete and partial coverage are outlined in Table 1.<sup>6</sup>

For each fertility clinic, the 1998 report provides percentages for several variables: cycles resulting in pregnancies, cycles resulting in live births, oocyte retrievals resulting in live births, embryo transfers resulting in live births, cancellations (cycles that were stopped before oocyte retrieval or embryo transfer), pregnancies with twins, pregnancies with three or more fetuses, live births of multiple infants, and transfers of frozen embryos resulting in live births. For purposes of calculation, we converted these percentages to raw numbers, assigned them to one of our three insurance-coverage categories, and then reconverted the data into percentages. Since the initial percentages were reported to one decimal place, there was the potential for small rounding errors during the conversion process. However, any such error would be minor because of the large numbers in the data set and because it would affect all clinics equally.

The CDC data were organized into four age groups (<35, 35 to 37, 38 to 40, and >40 years). The age range of women who underwent in vitro fertilization in 1998 was defined as 25 to 45 years, on the basis of the CDC data (less than 1 percent of women who underwent an assisted reproductive technology cycle were less than 25 or more than 45 years old). We downloaded data on the U.S. population from the Census Bureau Web site.<sup>10</sup> Data for 2000 were used, since they were closest in time to the 1998 CDC data. Population data for women in every state were organized into four age groups (25 to 34, 35 to 37, 38 to 40, and 41 to 45 years)

**TABLE 1. STATE REQUIREMENTS FOR INSURANCE COVERAGE OF IN VITRO FERTILIZATION SERVICES (AS OF NOVEMBER 2001).\***

| COVERAGE REQUIRED | YEAR ENACTED | SUMMARY OF COVERAGE  |
|-------------------|--------------|--|
| <b>Complete</b>   |              |  |
| Illinois          | 1991         | Applies to all insurance carriers that cover more than 25 people; limits first-time attempts to 4 retrievals of oocytes; if a child is born, 2 retrievals of oocytes for a second pregnancy are covered  |
| Massachusetts     | 1987         | Applies to all insurance carriers; coverage limited to 6 retrievals of oocytes   |
| Rhode Island      | 1989         | Applies to all insurance carriers; insurers can impose up to a 20 percent copayment  |
| <b>Partial</b>    |              |  |
| Arkansas          | 1987         | Applies to all insurance carriers except HMOs; insurers can limit lifetime coverage to \$15,000; coverage is subject to the same deductibles and copayments that apply to maternity benefits   |
| Hawaii            | 1987         | Requires insurance carriers to cover the outpatient costs of one in vitro fertilization cycle; patient or spouse must have at least a 5-year history of infertility  |
| Maryland          | 1985         | Requires insurance carriers to cover the outpatient costs of in vitro fertilization, except for businesses with 50 or fewer employees; coverage limited to 3 in vitro fertilization cycles per live birth achieved, with a maximal lifetime benefit of \$100,000 |
| Ohio              | 1991         | Requires only that HMOs cover infertility services (not defined)   |
| West Virginia     | 1997         | Requires only that HMOs cover infertility services (not defined)   |

\*Data are from the American Society for Reproductive Medicine.<sup>6</sup> HMOs denotes health maintenance organizations.

and then stratified according to the three insurance-coverage categories. Age-specific utilization of in vitro fertilization per 1000 women was calculated according to insurance status on the basis of the 2000 Census data and was standardized to the age distribution in all states that offer in vitro fertilization with the use of direct standardization methods.<sup>11</sup>

### Statistical Analysis

Outcome data for all the fertility clinics were normally distributed. We used chi-square tests to compare the age-specific utilization rates and several key in vitro fertilization outcomes according to insurance status. A two-tailed t-test was used to compare the average numbers of fresh and frozen embryos transferred per cycle in the three insurance categories.

## RESULTS

Of the 360 infertility clinics in the United States in 1998 for which data were available, 31 were in states requiring complete insurance coverage for in vitro fertilization, 27 were in states requiring partial coverage, and 302 were in states that did not require any coverage. In 1998, these clinics performed a total of 61,650 in vitro fertilization cycles involving fresh, nondonor eggs and 10,058 cycles involving transfers of frozen embryos (from nondonor eggs). In 2000, on the basis of Census data, approximately 3.2 million women between the ages of 25 and 45 years lived in states requiring complete insurance coverage for in vitro fertilization, 3.5 million lived in states requiring partial coverage, and 37.8 million lived in states that did not require any coverage. Table 2 shows the correlations

between these three categories of insurance coverage and utilization of in vitro fertilization services. Clinics in states that required complete insurance coverage performed more in vitro fertilization cycles and embryo transfers (3.35 fresh-embryo cycles and 0.43 transfer of frozen embryos per 1000 women) than states requiring partial insurance (1.46 fresh-embryo cycles and 0.30 transfer of frozen embryos per 1000 women) and states with no insurance (1.21 fresh-embryo cycles and 0.20 transfer of frozen embryos per 1000 women), after adjustment for age ( $P < 0.001$  for all comparisons).

As shown in Table 3, the percentages of cycles resulting in pregnancy, cycles resulting in live births, oocyte retrievals resulting in live births, and embryo transfers resulting in live births were significantly higher in states with no mandated insurance coverage for in vitro fertilization than in states requiring partial or complete coverage ( $P < 0.001$  for all comparisons). The percentage of live births involving multiple infants was also higher in the states that did not require coverage than in those that required partial or complete coverage ( $P = 0.04$ ), primarily because of a higher rate of pregnancies involving three or more fetuses in the states with no required coverage ( $P = 0.007$ ). The mean number of fresh embryos transferred per cycle was lower in states that required complete insurance coverage (3.25) than in states that required partial coverage (3.54,  $P = 0.001$ ) or no coverage

**TABLE 2.** UTILIZATION RATES FOR IN VITRO FERTILIZATION SERVICES ACCORDING TO THE CATEGORY OF REQUIRED INSURANCE COVERAGE.\*

| AGE GROUP                      | COMPLETE COVERAGE |                 | PARTIAL COVERAGE |                 | NO COVERAGE   |                 |
|--------------------------------|-------------------|-----------------|------------------|-----------------|---------------|-----------------|
|                                | no. of cycles     | rate/1000 women | no. of cycles    | rate/1000 women | no. of cycles | rate/1000 women |
| <b>Fresh-embryo cycles</b>     |                   |                 |                  |                 |               |                 |
| 25–34 yr                       | 4,684             | 3.25±0.05       | 2485             | 1.63±0.03       | 20,689        | 1.23±0.01       |
| 35–37 yr                       | 2,485             | 5.09±0.10       | 1224             | 2.29±0.07       | 10,437        | 1.82±0.02       |
| 38–40 yr                       | 2,224             | 4.45±0.09       | 903              | 1.63±0.06       | 8,910         | 1.52±0.02       |
| 41–45 yr                       | 1,409             | 1.77±0.05       | 473              | 0.52±0.03       | 5,727         | 0.61±0.01       |
| Total†                         | 10,802            | 3.35±0.03       | 5085             | 1.46±0.02       | 45,763        | 1.21±0.01       |
| <b>Frozen-embryo transfers</b> |                   |                 |                  |                 |               |                 |
| 25–34 yr                       | 709               | 0.49±0.02       | 611              | 0.40±0.02       | 3,979         | 0.24±0.004      |
| 35–37 yr                       | 343               | 0.70±0.04       | 229              | 0.43±0.03       | 1,797         | 0.31±0.007      |
| 38–40 yr                       | 211               | 0.42±0.03       | 130              | 0.23±0.02       | 1,175         | 0.20±0.006      |
| 41–45 yr                       | 131               | 0.17±0.01       | 61               | 0.07±0.01       | 682           | 0.07±0.003      |
| Total†                         | 1,394             | 0.43±0.01       | 1031             | 0.30±0.01       | 7,633         | 0.20±0.003      |

\*As of November 2001, Illinois, Massachusetts, and Rhode Island required complete insurance coverage, and Arkansas, Hawaii, Maryland, Ohio, and West Virginia required partial coverage. Five states did not have in vitro fertilization services. The remaining 37 states, plus Puerto Rico and Washington, D.C., provided in vitro fertilization services but did not require insurance coverage for them. For each category of coverage, the utilization rate per 1000 women ( $\pm$ SE) was calculated by dividing the number of fresh-embryo cycles or frozen-embryo transfers in each age group by the total number of women in that age group (on the basis of 2000 Census data) and multiplying by 1000.  $P < 0.001$  for all comparisons of utilization rates according to the insurance-coverage category.

†Data are age-standardized rates.

**TABLE 3. AGE-STANDARDIZED OUTCOMES OF IN VITRO FERTILIZATION ACCORDING TO THE CATEGORY OF REQUIRED INSURANCE COVERAGE.\***

| OUTCOME                                   | COMPLETE COVERAGE | PARTIAL COVERAGE | NO COVERAGE | P VALUE† |
|---|-------------------|------------------|-------------|----------|
| Pregnancies (% of cycles)‡                | 27.8±0.43         | 26.7±0.63        | 31.5±0.22   | <0.001   |
| Live births (% of cycles)                 | 22.7±0.40         | 22.2±0.59        | 25.7±0.20   | <0.001   |
| Cancellations (% of cycles)               | 12.6±0.32         | 14.8±0.49        | 13.9±0.16   | 0.003    |
| Live births (% of oocyte retrievals)      | 26.0±0.45         | 26.1±0.67        | 29.9±0.23   | <0.001   |
| Live births (% of embryo transfers)       | 28.5±0.49         | 27.9±0.71        | 31.8±0.24   | <0.001   |
| Twins (% of pregnancies)‡                 | 27.6±0.82         | 26.8±1.12        | 27.8±0.37   | 0.89     |
| Three or more fetuses (% of pregnancies)‡ | 9.7±0.55          | 8.9±0.77         | 11.2±0.26   | 0.007    |
| Multiple infants (% of live births)       | 36.0±0.97         | 35.4±1.40        | 38.2±0.45   | 0.04     |

\*Data are percentages ±SE.

†The chi-square test was used to make comparisons among the three categories of insurance coverage.

‡Pregnancies were confirmed by ultrasound evidence of one or more gestational sacs in the uterus.

(3.59, P<0.001) (Table 4). A similar pattern was observed with frozen-embryo transfers, but the differences were not statistically significant.

To evaluate further the association between the number of embryos transferred and the rates of triplets or higher-order multiple gestations, we performed analyses of insurance status and multiple-gestation rates that were stratified according to the mean number of embryos transferred across all clinics (3.53). For clinics at which the mean number of embryos transferred was lower than 3.53, the rate of pregnancies in which there were three or more fetuses was 8.7 percent in states requiring complete coverage, 8.3 percent in states requiring partial coverage, and 10.4

percent in those that did not require any coverage (P=0.02). For clinics at which the mean number of embryos transferred was 3.53 or higher, the rates were 10.3 percent, 10.5 percent, and 12.2 percent, respectively (P=0.14).

### DISCUSSION

Our study shows that states that require complete insurance coverage for in vitro fertilization services have the highest rates of utilization of such services, states that do not require any coverage have the lowest rates, and states that require partial coverage have intermediate rates. States that do not require insurance coverage have the highest number of embryos transferred per cycle, the highest rates of pregnancy and live births from in vitro fertilization, and the highest rates of live births of multiple infants (especially three or more).

It is logical to assume that if an expensive, elective medical procedure that is effective, such as in vitro fertilization, were covered by all health insurance companies, the demand for it and the rate of utilization would increase.<sup>5</sup> With an increased demand for in vitro fertilization services, more clinics would open and existing clinics would increase their capacity, ultimately leading to improved access to care. Our analysis showed that complete insurance coverage for in vitro fertilization in the United States was associated with a rate of utilization that was 277 percent of the rate in the absence of coverage (3.35 vs. 1.21 fresh-embryo cycles per 1000 women of reproductive age). Consistent with this observation, in 1993, the numbers of in vitro fertilization cycles attempted per capita in Ontario, Canada, and in France, both of which provide coverage for in vitro fertilization as part of national health insurance programs, were 279 percent and 494

**TABLE 4. MEAN (±SE) NUMBER OF FRESH OR FROZEN EMBRYOS TRANSFERRED, ACCORDING TO THE CATEGORY OF REQUIRED INSURANCE COVERAGE.\***

| REQUIRED COVERAGE | FRESH EMBRYOS          |                                  | FROZEN EMBRYOS         |                                  |
|-------------------|------------------------|----------------------------------|------------------------|----------------------------------|
|                   | TOTAL NO. OF TRANSFERS | NO. OF EMBRYOS/TRANSFER (95% CI) | TOTAL NO. OF TRANSFERS | NO. OF EMBRYOS/TRANSFER (95% CI) |
| Complete          | 8,593                  | 3.25±0.051 (3.15–3.35)†          | 1394                   | 3.11±0.124 (2.87–3.35)           |
| Partial           | 4,075                  | 3.54±0.075 (3.39–3.69)           | 1031                   | 3.15±0.145 (2.87–3.43)           |
| None              | 37,004                 | 3.59±0.025 (3.54–3.64)           | 7633                   | 3.27±0.054 (3.16–3.38)           |

\*CI denotes confidence interval.

†P=0.001 for the comparison with partial coverage, and P<0.001 for the comparison with no coverage.

percent, respectively, of the number in the United States.<sup>4</sup> These findings suggest that in states that do not require insurance coverage, a substantial number of women who might benefit from in vitro fertilization do not undergo it, probably because of financial constraints, in most cases, and possibly because of limited access to care, in some cases.

Although the rates of pregnancy and live births from in vitro fertilization are higher in states that do not require insurance coverage, so are the rates of pregnancies with three or more fetuses, probably because more embryos are transferred per cycle in these states than in states that require complete insurance coverage. It is also possible that because patients must pay out of pocket in states without mandated coverage, physicians are under pressure to obtain a "successful" outcome the first time and therefore transfer more embryos per cycle.<sup>12,13</sup>

A possible alternative explanation for the lower pregnancy rate in states that require insurance coverage is that a larger proportion of older women (who are less likely than younger women to become pregnant) undergo in vitro fertilization in these states, simply because it is covered by insurance. If they had to pay out of pocket, these older women might instead choose in vitro fertilization with eggs from a donor (an approach that has a higher success rate) or adoption. However, the increase in the rate of utilization in states that require coverage as compared with those that do not is only slightly higher for women who are 38 to 45 years old than for those who are 25 to 37 (fresh-embryo cycles, a 293 percent increase vs. a 269 percent increase; transfers of frozen embryos, a 211 percent increase vs. a 201 percent increase). This small difference is not likely to account for the large difference in pregnancy rates between states requiring insurance coverage and those not requiring coverage.

We cannot rule out the possibility that the pregnancy rate is higher in states that do not require insurance coverage because a greater number of women who are likely to become pregnant (for reasons other than age) undergo in vitro fertilization in those states. Insurance companies and HMOs in states with mandated coverage require that women undergo a certain number of cycles of controlled ovarian hyperstimulation and intrauterine insemination before in vitro fertilization. Since this is not a requirement in states that do not require coverage, perhaps women in these states proceed to in vitro fertilization (a procedure with a higher success rate) more quickly to conserve financial resources. Such women may tend to have a higher rate of pregnancy with in vitro fertilization.

One of the limitations of our study is that our data reflect populations of women rather than individual women. In addition, we did not have information available to control for some potentially confounding

factors (e.g., differences between states in the cause of infertility, the quality of care, the quality of embryos, the number of oocytes retrieved per cycle, the results of ovarian-reserve testing, or the number of prior in vitro fertilization cycles attempted). However, there are no data suggesting that such factors differ among states or between states that require insurance coverage for in vitro fertilization and those that do not.

Another limitation is that the three states classified as having complete insurance coverage (Illinois, Massachusetts, and Rhode Island) may in fact limit coverage for some women. In Illinois, businesses with fewer than 25 employees are exempt from the requirement to provide insurance coverage for in vitro fertilization. Furthermore, our classification of insurance coverage does not account for instances in which a woman residing in one state obtains services in another state. For example, residents of states that do not have fertility clinics (Alaska, Idaho, Maine, Montana, and Wyoming) may pay out of pocket for in vitro fertilization services in states that require complete or partial insurance coverage. Similarly, residents of states that do not require coverage may pay for in vitro fertilization services in states that require complete or partial coverage. Conversely, some women in states that do not require insurance coverage may actually have insurance plans that cover in vitro fertilization, even though the coverage is not required. Any misclassification of insurance status would probably be random with respect to outcomes and would probably attenuate the observed associations between insurance status and outcomes.

This study has potential implications for public health. In states that do not require insurance coverage for in vitro fertilization, more embryos were transferred per cycle and there were higher rates of multiple births (especially of three or more infants). The transfer of more embryos has been associated with an increased risk of multiple births.<sup>14-20</sup> In addition, multiple births have been associated with increased short-term and long-term risks for the woman and her children. The maternal risks include premature labor, premature delivery, pregnancy-induced hypertension, gestational diabetes, and uterine hemorrhage.<sup>13,21-24</sup> Multiple births also entail personal as well as financial costs for the parents. The risks to the children include prematurity (associated with the respiratory distress syndrome, intracranial hemorrhage, cerebral palsy, and blindness), death, and physical, mental, and developmental disabilities.<sup>13,22-25</sup>

Furthermore, the economic impact of multiple births on society is tremendous. In 1991, hospital charges for the delivery of twins were 4 times as high and charges for triplets were 11 times as high as charges for a singleton delivery.<sup>26</sup> However, although multiple births as a percentage of total births might be

expected to decrease with mandated insurance coverage for in vitro fertilization services, the expected increase in the utilization of such services would probably result in a higher absolute number of multiple births.

According to a 1995 analysis, a typical health insurance plan for a family in the United States cost \$3,393 per year, and the estimated cost of adding coverage for in vitro fertilization services was \$3.14 per year.<sup>4</sup> In our study, insurance coverage for in vitro fertilization was associated with a 277 percent increase in utilization (for fresh-embryo cycles). Even with this increase and even though the costs are higher today than they were in 1995, the additional cost of covering in vitro fertilization is still likely to be a small fraction of the total cost of a family plan.<sup>4</sup> Of course, this does not include additional costs generated by these procedures.

In conclusion, state-mandated health insurance coverage of in vitro fertilization services is associated with greater utilization of such services but with reductions in the number of embryos transferred per cycle, the proportion of cycles resulting in pregnancy, and the proportion of pregnancies with three or more fetuses.

Dr. Hornstein is a member of the Medical Advisory Board of the Women's Integrated Network, which provides medical management and oversight of specialized insurance protocols.

*We are indebted to Robert L. Barbieri, M.D., Daniel W. Cramer, M.D., Sc.D., and Jaylyn Olivo for reviewing the manuscript and to Allison F. Vitonis for assistance with the statistical analysis.*

## REFERENCES

- Mosher WD, Pratt WF. Fecundity and infertility in the United States: incidence and trends. *Fertil Steril* 1991;56:192-3.
- Stephens PC, Edwards RG. Birth after the reimplantation of a human embryo. *Lancet* 1978;2:336.
- Neumann PJ, Gharib SD, Weinstein MC. The cost of a successful delivery with in vitro fertilization. *N Engl J Med* 1994;331:239-43.
- Collins JA, Bustillo M, Visscher RD, Lawrence LD. An estimate of the cost of in vitro fertilization services in the United States in 1995. *Fertil Steril* 1995;64:538-45.
- Neumann PJ. Should health insurance cover IVF? Issues and options. *J Health Polit Policy Law* 1997;22:1215-39.
- American Society for Reproductive Medicine. State infertility insurance laws. (Accessed August 6, 2002, at <http://www.asrm.org/Patients/insur.html>).
- Centers for Disease Control and Prevention, American Society for Reproductive Medicine, Society for Assisted Reproductive Technology, RESOLVE. 1998 Assisted reproductive technology success rates. Atlanta: Centers for Disease Control and Prevention, 2000.
- Fertility Clinic Success Rate and Certification Act of 1992 (FCSRCA), Pub. L. No. 102-493, October 24, 1992.
- 1998 Assisted reproductive technology success rates. (Accessed August 6, 2002, at <http://www.cdc.gov/nccdphp/drh/art98/index.htm>).
- Census 2000 summary file 2. (Accessed August 6, 2002, at <http://factfinder.census.gov>).
- Rothman KJ. *Modern epidemiology*. Boston: Little, Brown, 1986:41-7.
- Collins JA. Reproductive technology — the price of progress. *N Engl J Med* 1994;331:270-1.
- Multiple pregnancy associated with infertility therapy. Birmingham, Ala.: American Society for Reproductive Medicine, 2000.
- Staessen C, Janssenswillen C, Van den Abbeel E, Devroey P, Van Steirteghem AC. Avoidance of triplet pregnancies by elective transfer of two good quality embryos. *Hum Reprod* 1993;8:1650-3.
- Balen AH, MacDougall J, Tan SL. The influence of the number of embryos transferred in 1060 in-vitro fertilization pregnancies on miscarriage rates and pregnancy outcome. *Hum Reprod* 1993;8:1324-8.
- Tasdemir M, Tasdemir I, Kodama H, Fukuda J, Tanaka T. Two instead of three embryo transfer in in-vitro fertilization. *Hum Reprod* 1995;10:2155-8.
- Faber K. IVF in the US: multiple gestation, economic competition, and the necessity of excess. *Hum Reprod* 1997;12:1614-6.
- Roest J, van Heusden AM, Verhoeff A, Mous HV, Zeilmaker GH. A triplet pregnancy after in vitro fertilization is a procedure-related complication that should be prevented by replacement of two embryos only. *Fertil Steril* 1997;67:290-5.
- Templeton A, Morris JK. Reducing the risk of multiple births by transfer of two embryos after in vitro fertilization. *N Engl J Med* 1998;339:573-7.
- Schieve LA, Peterson HB, Meikle S, et al. Live-birth rates and multiple-birth risk using in vitro fertilization. *JAMA* 1999;282:1832-8.
- Seoud MA, Toner JP, Kruthoff C, Muasher SJ. Outcome of twin, triplet, and quadruplet in vitro fertilization pregnancies: the Norfolk experience. *Fertil Steril* 1992;57:825-34.
- Albrecht JL, Tomich PG. The maternal and neonatal outcome of triplet gestations. *Am J Obstet Gynecol* 1996;174:1551-6.
- Elster N. Less is more: the risks of multiple births. *Fertil Steril* 2000;74:617-23.
- Tallo CP, Vohr B, Oh W, Rubin LP, Seifer DB, Haning RV Jr. Maternal and neonatal morbidity associated with in vitro fertilization. *J Pediatr* 1995;127:794-800.
- Gabbe SG, Niebyl JR, Simpson JL, eds. *Obstetrics: normal and problem pregnancies*. 3rd ed. New York: Churchill Livingstone, 1996:821-62.
- Callahan TL, Hall JE, Etnner SL, Christiansen CL, Greene MF, Crowley WF Jr. The economic impact of multiple-gestation pregnancies and the contribution of assisted-reproduction techniques to their incidence. *N Engl J Med* 1994;331:244-9.

Copyright © 2002 Massachusetts Medical Society.