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# Embryo transfer practices and perinatal outcomes by insurance mandate status

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## Abstract

**Objective—**To use linked assisted reproductive technology (ART) surveillance and birth certificate data to compare ET practices and perinatal outcomes for a state with a comprehensive mandate requiring coverage of IVF services versus states without a mandate.

**Design—**Retrospective cohort study.

**Setting—**Not applicable.

**Patient(s)—**Live-birth deliveries ascertained from linked 2007–2009 National ART Surveillance System and birth certificate data for a state with an insurance mandate (Massachusetts) and two states without a mandate (Florida and Michigan).

**Intervention(s)—**None.

**Main Outcome Measure(s)—**Number of embryos transferred, multiple births, low birth weight, preterm delivery.

**Result(s)—**Of the 230,038 deliveries in the mandate state and 1,026,804 deliveries in the nonmandate states, 6,651 (2.9%) and 8,417 (0.8%), respectively, were conceived by ART. Transfer of three or more embryos was more common in nonmandate states, although the effect was attenuated for women 35 years or older (33.6% vs. 39.7%; adjusted relative risk [RR], 1.46; 95% confidence interval [CI], 1.17–1.81) versus women younger than 35 (7.0% vs. 26.9%;

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adjusted RR, 4.18; 95% CI, 2.74–6.36). Lack of an insurance mandate was positively associated with triplet/higher order deliveries (1.0% vs. 2.3%; adjusted RR, 2.44; 95% CI, 1.81–3.28), preterm delivery (22.6% vs. 30.7%; adjusted RR, 1.31; 95% CI, 1.20–1.42), and low birth weight (22.3% vs. 29.5%; adjusted RR, 1.28; 95% CI, 1.17–1.40).

**Conclusion(s)—**Compared with nonmandate states, the mandate state had higher overall rates of ART use. Among ART births, lack of an infertility insurance mandate was associated with increased risk for adverse perinatal outcomes.

### Keywords

Assisted reproductive technology; embryo transfer; insurance coverage; multiple birth

In the United States, insurance coverage for infertility treatments is limited, with many patients incurring substantial out-of-pocket costs for medications and medical procedures (1). To increase access to services and reduce financial burden, 15 states have adopted insurance mandates requiring that private insurers provide coverage for infertility treatments (2–5). However, the scope of the mandates is variable with respect to the type of services covered, patient requirements, and exceptions (3–6). As such, infertility insurance mandates are often broadly categorized into three groups according to number and types of services covered and type of plans affected by the policy (2, 7). “Comprehensive” mandates require that insurers cover the costs associated with the diagnosis and treatment of infertility inclusive of assisted reproductive technology (ART) services for at least four oocyte retrievals. “Limited” mandates specify that only certain types of insurers, such as health maintenance organizations, must cover ART or impose limits on the amount of ART coverage to be provided. Finally, “offer” mandates require insurers to make available policies that include coverage for infertility treatments and do not require coverage of ART (2). Currently, eight states have mandates that cover at least one ART cycle (3).

In addition to expanding access to infertility services, mandated coverage of ART may lessen the financial pressure to conceive in one cycle, thereby leading to a reduction in the number of embryos transferred per cycle and a consequent decline in multiple births (1, 2, 8). Studies of insurance coverage and fertility outcomes using clinic data showed increased use of infertility services in states with comprehensive or limited mandates compared with states with no coverage (2, 9). Analyses of population-level fertility effects also demonstrated increases in the use of fertility services (7, 10) and birth rates (4) in states with comprehensive mandates compared with states without mandates; however, the effects were largely concentrated among a subgroup of older, more educated women.

It has been noted that states with comprehensive mandates transfer fewer embryos per cycle than those without mandates (2, 3, 7, 9, 11), although variations by age have been observed (12). The association between mandate status and multiple births (twins, triplets, and higher order births) is inconsistent, with some studies showing lower rates of multiple birth in states with comprehensive mandates compared with nonmandate states (2, 3) and others indicating an effect for triplet or higher order gestations only (7, 9, 11). Furthermore, the reductions in multiple birth rates appear to be heterogeneous across age groups (12) and other factors such as race and education (13).

The effect of infertility insurance mandates on perinatal outcomes such as low birth weight and preterm birth has not been well documented. Moreover, most studies of mandate effects were limited by lack of patient-level data and were unable to control for demographic and clinical factors related to potential differences in patient selection between ART users in a mandate state and those in a state without a mandate. The aim of the current study was to use ART surveillance data that have been linked to birth certificate information for a state with a mandate (Massachusetts) and two states without mandates (Michigan and Florida) to compare ET practices and peri-natal outcomes by mandate status.

## MATERIALS AND METHODS

The data used for this analysis were derived from linked ART surveillance and birth certificate data for three states: Massachusetts, Michigan, and Florida. The linkage methodology has been described elsewhere (14, 15). Briefly, data from the Centers for Disease Control and Prevention's National ART Surveillance System (NASS) were linked with vital records information provided by members of the States Monitoring ART Collaborative. To date, data have been linked only for the three aforementioned states. Data from additional states may be added in the future but were not available for the current analysis. The linkage was constructed using LinkPlus software and used a probabilistic method with maternal and infant date of birth, plurality, maternal residence zip code, and gravidity as primary linkage variables. Duplicate links were resolved using zip code, gravidity, and ancillary information such as maternal race, infant gender, and infant birth weight. Additional selection priorities were used to reconcile near exact matches on the primary linkage variables. Specifically, priority was given when both records matched on gravidity; when there was a single-digit difference in day or month or when day and month were swapped; or when both records matched on maternal race, infant gender, and birth weight or for first deliveries for mothers 35 years of age or older and multiple births. For all three states, this methodology resulted in an overall linkage rate of 90.2% for 2007–2009.

We included all resident live births in Massachusetts, Michigan, and Florida during 2007–2009 that successfully linked with NASS data or those live births identified to have occurred as the result of ART as determined by the linkage process. The unit of analysis was a delivery; infant records for multiple births were aggregated to a single delivery record. Deliveries with missing information on plurality or maternal age were excluded (<0.01% for each state).

Massachusetts adopted an infertility insurance mandate in 1987 requiring that private insurers provide coverage for medically necessary treatments related to the diagnosis and treatment of infertility, which is defined as an inability to conceive during 1 year for women younger than 35 years of age or during 6 months for women 35 years or older (16). Infertility-related services are covered to the same extent as pregnancy-related services, and there is no limit on the number of treatment cycles and no lifetime cap on coverage. Employers that self-insure are not required to provide state-mandated benefits because the federal Employee Retirement Income Security Act preempts the state law (17). Currently, Michigan and Florida have no mandate.

For ART and non-ART live-birth deliveries, we compared sociodemographic factors (maternal age, parity, education, race/ethnicity, and insurance at delivery) for women living in the mandate state with those of women living in the non-mandate states. Among ART deliveries, we examined infertility type (tubal factor, ovulatory dysfunction, diminished ovarian reserve, endometriosis, uterine factor, male factor, other factor, or unexplained infertility), type of ART (fresh nondonor, fresh donor, frozen-thawed nondonor, or frozen-thawed donor embryos), use of intracytoplasmic sperm injection (ICSI), use of assisted hatching, number of supernumerary embryos cryopreserved, embryo stage at transfer (days 2–3, days 5–6, or other), and number of previous ART cycles according to residency in the mandate or nonmandate states. Next, we compared the use of elective single ET (eSET), mean number of embryos transferred, transfer of three or more embryos, and perinatal outcomes (twin or triplet/higher order birth, preterm birth, low birth weight [in any infant for multiple births], and delivery of a term, normal birth weight singleton, i.e., singleton infant with birth weight ≥2,500 g and gestational age ≥37 weeks) for ART deliveries in a mandate state with those in nonmandate states. All sociodemographic characteristics and infant outcomes were derived from birth certificate information. ART treatment characteristics were obtained from NASS data. ESET was defined as cycles in which a single embryo was transferred and at least one supernumerary embryo was cryopreserved.

We used two-tailed $\chi^2$-tests to assess differences in the distribution of maternal and treatment characteristics for women in the mandate state, compared with women in the nonmandate states. Likewise, we used a two-tailed *t* test to compare the mean number of embryos transferred (log transformed) by mandate status. $P<.01$ was considered statistically significant. Using modified Poisson regression models (18) and accounting for clustering by clinic via generalized estimating equations with an independent correlation structure, we calculated adjusted risk ratios for the association between mandate status and ET practices and perinatal outcomes. The mandate state was the referent for all comparisons. All models were adjusted for maternal age, race/ethnicity, education, parity, number of prior ART cycles, infertility diagnosis, use of assisted hatching, number of embryos cryopreserved, type of ART, and year of birth. The models for eSET and transfer of three or more embryos included the interaction of mandate status and age. Use of ICSI and embryo stage at transfer were not included in the final models because information on these characteristics is not consistently collected across clinics for frozen embryo cycles. To evaluate the potential effect of these variables, we restricted the study population to live births resulting from fresh cycles and included ICSI and embryo stage as covariates in adjusted models. SAS version 9.3 was used for all analyses. The study was approved by the institutional review boards at the Centers for Disease Control and Prevention, Massachu-setts Department of Health, Florida Department of Health, and Michigan Department of Community Health.

## RESULTS

During 2007–2009, there were 230,038 deliveries in the mandate state and 1,026,804 deliveries in the nonmandate states. Of those, 6,651 (2.9%) and 8,417 (0.8%), respectively, were conceived by ART. There were eight clinics in the mandate state and 43 clinics in the nonmandate states during the study period. For both ART and non-ART deliveries, a significantly greater proportion of women in the mandate state were 30 years of age and older and college graduates compared with women in the nonmandate states (Table 1). Compared with the mandate state, states without an insurance mandate had higher frequencies of deliveries to Hispanic and non-Hispanic black mothers and to women with two or more previous live births.

With the exception of other and unexplained infertility, the prevalence of every infertility diagnosis was significantly lower for ART deliveries in the mandate state compared with the nonmandate states (Table 2). Deliveries resulting from fresh, nondonor ART cycles were more common in the mandate state than in the nonmandate states (78.5% vs. 68.9%, respectively). Use of ICSI was less common in the mandate state than in the nonmandate states (39.2% vs. 64.1%, respectively), while use of assisted hatching was more common (29.6% vs. 25.5%, respectively). In the mandate state, 32.5% of women who delivered an ART-conceived infant had two or more previous ART cycles, compared with 24.5% of women in the nonmandate states.

For all ART deliveries, the percent using eSET was higher in the mandate state than in the nonmandate states (8.6% vs. 2.5%), with corresponding differences in the transfer of three or more embryos (23.1% vs. 33.6%; Table 3). The percentage of twins and triplets/higher order births was lower in the mandate state compared with in the nonmandate states (25.7% and 1.0% vs. 31.1% and 2.3%, respectively). Approximately 22.6% of ART deliveries in the mandate state were preterm, compared with 30.7% in the nonmandate states. The proportion of term, normal birth weight singleton deliveries was higher in the mandate state than in the nonmandate states (64.6% vs. 56.3%, respectively). When stratified by maternal age at delivery, significant differences in ET practices and perinatal outcomes by mandate status remained, although variations in use of eSET and number of embryos transferred were attenuated for women 35 and older. Notably, for women younger than 35 years of age, 7.0% of births in the mandate state resulted from the transfer of three or more embryos compared with 26.9% in the nonmandate states. When examined according to plurality, the results for singletons and twins were similar to those for all births, with the exception of low birth weight, which did not differ significantly for twins by mandate status. All comparisons were nonsignificant for triplets and higher order multiples.

The association between ET practices and mandate status was modified by maternal age (Table 4). Use of eSET was less frequent in the nonmandate states than in the mandate state, although the effect was attenuated for women 35 years or older (6.0% vs. 2.4%, respectively; adjusted relative risk [RR], 0.31; 95% confidence interval [CI], 0.18–0.51) versus women younger than 35 years of age (12.4% vs. 2.7%, respectively; adjusted RR, 0.18; 95% CI, 0.11–0.29). Notably, women younger than 35 who lived in a state without a mandate were 4 times more likely to transfer three or more embryos compared with women younger than 35 who lived in states with a mandate (7.0% vs. 26.9%, respectively; adjusted RR, 4.18; 95% CI, 2.74–6.36). The association was attenuated but still statistically significant for women 35 or older (33.6% vs. 39.7%, respectively; adjusted RR, 1.46; 95% CI, 1.17–1.81). Compared with deliveries in the mandate state, those in the nonmandate states were 1.2 times more likely to be twins and 2.4 times more likely to be triplets or higher order multiples. Lack of an insurance mandate was also associated with increased risk for preterm delivery (22.6% vs. 30.7%, respectively; adjusted RR, 1.31; 95% CI, 1.20–

1.42) and low birth weight (22.3% vs. 29.5%, respectively; adjusted RR, 1.28, 1.17–1.40) and negatively associated with the delivery of a term, normal birth weight singleton (64.6% vs. 56.3%, respectively; adjusted RR, 0.89; 95% CI, 0.86–0.92).

When the analysis was restricted to live-birth deliveries resulting from fresh ETs, findings were similar to those for all transfers; however, the association between mandate status and ET practice was stronger (Supplemental Table 1). Specifically, the adjusted RRs for use of eSET were 0.12 (95% CI, 0.07–0.20) for women younger than 35 years of age and 0.22 (95% CI, 0.14–0.34) for women 35 or older.

## DISCUSSION

Our analysis of a population-based data set of ART-conceived live-birth deliveries occurring in a state with a comprehensive infertility insurance mandate compared with two states without a mandate revealed important differences in ET practices and perinatal outcomes. We found that fewer embryos were transferred in the mandate states than in the nonmandate state, leading to lower rates of multiple births, preterm delivery, and low birth weight. While other studies using clinic- or cycle-level data have shown similar reductions in the number of embryos transferred and multiple birth rates for states with comprehensive mandates versus those with limited or no mandates (2, 3, 9, 11), our study used patient-level data with detailed information on cycle and patient characteristics that allowed us to control for underlying differences in the types of patients seeking ART treatment in mandate and nonmandate states. As hypothesized by other investigators (2), we found that mothers of ART births in the mandate state tended to have characteristics associated with poor prognosis—they were older, had higher numbers of previous ART cycles, and had cryopreserved fewer embryos than their counterparts in the nonmandate states. However, even after controlling for differences in patient selection, the association between mandate status and ET practices remained, suggesting that state infertility insurance mandates may influence individual-level treatment decisions.

We also found a three-fold difference in the proportion of ART-conceived births in the mandate state compared with in the nonmandate states, a finding that parallels previous reports of higher ART use in states with a comprehensive mandate versus states with a limited, offer, or no mandate (2, 7, 9, 10). Indeed, in 2010, Massachusetts ranked fifth in the nation for number of ART cycles initiated and had the highest percentage of ART-conceived births, nearly 5% (19). While infertility insurance mandates have generally been successful in increasing access to ART services, an unintended consequence of high use is elevated rates of multiple births. In Massachusetts, for example, the multiple birth rate in 2010 was 4.6%, and, of those multiple births, approximately 40% were due to ART (19). Therefore, although insurance mandates may decrease the overall number of embryos transferred during an ART cycle, improvements in multiple birth rates in the state may be partially negated by the increased use of ART. As such, expanded coverage of ART treatments is unlikely to further reduce rates of multiple births unless such benefits are coupled with restrictions on the number of embryos transferred during a single cycle.

Our findings are subject to several limitations. First, state insurance mandates do not apply to employers who self-insure; therefore, our results may overstate the impact of mandates for individuals enrolled in self-insured plans or for those who were uninsured. During 2009, approximately 30.5% of all private-sector establishments in Massachusetts self-insured at least one plan, and the percentage increased according to firm size, ranging from 16.1% for those with less than 100 employees to 71.3% for those with 500 or more employees (20). It is also possible that some self-insured plans in a state with a comprehensive mandate opted to include coverage of infertility services to make their benefit plan attractive to employees. Next our study evaluated clinical practice and perinatal outcomes using mandate status as the predictor of interest; however, the observed differences between the mandate and nonmandate states may be attributed to state-level factors other than insurance coverage, for which we were unable to control. Specifically, we noted considerable differences in the distribution of maternal age, race/ethnicity, and education between the mandate and nonmandate states. Furthermore, the rate of preterm birth was lower for both ART and non-ART births in the mandate state compared with in the nonmandate states, which indicates important underlying differences in the populations of the states included in our analysis. Although we controlled for a number of sociodemographic characteristics in our models, it is possible that residual confounding related to these factors may explain the observed outcomes. We were also unable to account for the use of non-ART treatments, which can increase risks for multiple births. We also lacked information on body mass index, which may differ between the mandate and nonmandate states. Finally, because our analysis was restricted to live births, we could not evaluate differences in use of ART, nor could we assess outcomes for ETs that did not result in a pregnancy or live birth.

## Conclusion

While we found that a comprehensive infertility insurance mandate was associated with the transfer of fewer embryos and improved perinatal outcomes, higher rates of use coupled with the transfer of two or more embryos will in part offset any net reductions in multiple birth rates. Indeed, we found that rate of eSET in the mandate state was only 12.4% for women under 35 years of age, the population of women most likely to be good candidates for the procedure. Although infertility insurance mandates can reduce the financial pressure to transfer multiple embryos during an ART cycle, a mandate alone is not sufficient to reduce multiple births in a state. As other countries have demonstrated, the adoption of a comprehensive mandate in combination with limitations on the number of embryos transferred has the greatest potential to reduce the rates of multiple births after ART without concomitant reductions in live-birth rates (21, 22).

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## TABLE 1

Characteristics of ART and non-ART deliveries in states with or without insurance mandates, 2007–2009.

| | ART deliveries | | | | Non-ART deliveries | | | |
|---|---|---|---|---|---|---|---|---|
| | Insurance mandate | | No insurance mandate[a] | | Insurance mandate | | No insurance mandate[a] | |
| **Characteristic** | **n** | **(%)** | **n** | **(%)** | **n** | **(%)** | **n** | **(%)** |
| Total | 6,651 | | 8,417 | | 223,387 | | 1,018,387 | |
| Maternal age (y) | | | | | | | | |
| <30 | 539 | 8.1 | 1,169 | 13.9 | 108,063 | 48.4 | 655,682 | 64.4 |
| 30–34 | 2,095 | 31.5 | 2,824 | 33.6 | 67,590 | 30.3 | 224,258 | 22.0 |
| 35–37 | 1,648 | 24.8 | 1,859 | 22.1 | 28,247 | 12.6 | 81,654 | 8.0 |
| 38–40 | 1,357 | 20.4 | 1,278 | 15.2 | 14,320 | 6.4 | 40,974 | 4.0 |
| 41+ | 1,012 | 15.2 | 1,287 | 15.3 | 5,167 | 2.3 | 15,819 | 1.6 |
| Parity | | | | | | | | |
| 0 | 4,162 | 63.0 | 5,684 | 67.9 | 102,025 | 46.0 | 423,627 | 41.8 |
| 1 | 1,909 | 28.9 | 1,859 | 22.2 | 75,928 | 34.2 | 322,047 | 31.8 |
| 2+ | 535 | 8.1 | 827 | 9.9 | 44,058 | 19.8 | 268,551 | 26.5 |
| Maternal education | | | | | | | | |
| <High school | 55 | 0.8 | 99 | 1.2 | 25,456 | 11.4 | 190,856 | 18.9 |
| High school | 547 | 8.2 | 962 | 11.5 | 57,437 | 25.7 | 307,455 | 30.4 |
| Some college | 1,098 | 16.5 | 2,020 | 24.2 | 48,494 | 21.7 | 279,183 | 27.6 |
| College graduate | 4,942 | 74.4 | 5,267 | 63.1 | 91,825 | 41.1 | 234,094 | 23.1 |
| Race/ethnicity | | | | | | | | |
| Non-Hispanic white | 5,634 | 84.9 | 6,191 | 74.6 | 149,231 | 66.9 | 539,578 | 53.5 |
| Non-Hispanic black | 211 | 3.2 | 419 | 5.1 | 19,606 | 8.8 | 209,803 | 20.8 |
| Hispanic | 221 | 3.3 | 1,269 | 15.3 | 32,311 | 14.5 | 218,778 | 21.7 |
| Asian/Pacific Islander | 488 | 7.4 | 314 | 3.8 | 17,129 | 7.7 | 25,739 | 2.6 |
| Other | 79 | 1.2 | 104 | 1.3 | 4,699 | 2.1 | 14,897 | 1.5 |
| Insurance at delivery | | | | | | | | |
| Private | 6,304 | 94.8 | 7,514 | 89.3 | 137,367 | 61.5 | 465,358 | 45.7 |
| Public | 102 | 1.5 | 664 | 7.9 | 61,505 | 27.5 | 455,714 | 44.8 |
| Self-pay | 7 | 0.1 | 165 | 2.0 | 1,358 | 0.6 | 73,647 | 7.2 |

| | ART deliveries | | | | Non-ART deliveries | | | |
|---|---|---|---|---|---|---|---|---|
| | Insurance mandate | | No insurance mandate[a] | | Insurance mandate | | No insurance mandate[a] | |
| Characteristic | n | (%) | n | (%) | n | (%) | n | (%) |
| Other | 217 | 3.3 | 54 | 0.6 | 22,318 | 10.0 | 19,681 | 1.9 |
| Unknown | 21 | 0.3 | 20 | 0.2 | 839 | 0.4 | 3,987 | 0.4 |

[a] $P<.01$ for all $\chi^2$-tests of distribution of variables in mandate state versus the nonmandate states.

## TABLE 2

Treatment and clinic characteristics of women who had an ART delivery, by insurance mandate status.

| | Insurance mandate | | No insurance mandate[a] | |
|---|---|---|---|---|
| **Characteristic** | **n** | **(%)** | **n** | **(%)** |
| Infertility diagnosis[b] | | | | |
| Tubal factor | 854 | 12.8 | 1,563 | 18.6 |
| Ovulatory dysfunction | 917 | 13.8 | 1,445 | 17.2 |
| Diminished ovarian reserve | 881 | 13.3 | 1,876 | 22.3 |
| Endometriosis | 465 | 7.0 | 1,310 | 15.6 |
| Uterine | 207 | 3.1 | 353 | 4.2 |
| Male factor | 2,239 | 33.7 | 3,840 | 45.6 |
| Other factor | 957 | 14.4 | 910 | 10.8 |
| Unexplained | 1,466 | 22.0 | 559 | 6.6 |
| ART type | | | | |
| Fresh nondonor | 5,222 | 78.5 | 5,800 | 68.9 |
| Fresh donor | 556 | 8.4 | 1,093 | 13.0 |
| Frozen nondonor | 701 | 10.5 | 1,235 | 14.7 |
| Frozen donor | 172 | 2.6 | 286 | 3.4 |
| Use of ICSI | | | | |
| Yes | 2,610 | 39.2 | 5,396 | 64.1 |
| No | 3,167 | 47.6 | 1,540 | 18.3 |
| Missing[c] | 874 | 13.1 | 1,481 | 17.6 |
| Use of assisted hatching | | | | |
| Yes | 1,968 | 29.6 | 2,150 | 25.5 |
| No | 4,683 | 70.4 | 6,267 | 74.5 |
| No. of embryos cryopreserved | | | | |
| 0 | 4,109 | 61.8 | 4,867 | 58.0 |
| 1–2 | 1,188 | 17.9 | 1,099 | 13.1 |
| ≥3 | 1,354 | 20.4 | 2,431 | 29.0 |
| Embryo stage | | | | |
| Days 2–3 | 4,622 | 69.5 | 3,188 | 37.9 |
| Days 5–6 | 1,136 | 17.1 | 3,571 | 42.4 |
| Other | 20 | 0.3 | 134 | 1.6 |
| Missing[c] | 873 | 13.1 | 1,524 | 18.1 |
| Previous ART cycles | | | | |
| 0 | 3,155 | 47.4 | 4,422 | 52.6 |
| 1 | 1,334 | 20.1 | 1,925 | 22.9 |
| ≥2 | 2,162 | 32.5 | 2,064 | 24.5 |

[a] $P$<.01 for all $\chi^2$-tests of distribution of variables in mandate state versus the nonmandate states.

[b] Categories are not mutually exclusive.

[c] High percentage of missing values due to frozen cycles.

**TABLE 3**

Distribution of ET practices and perinatal outcomes of ART deliveries, by insurance mandate status.

| | All deliveries | | Singleton | | Twins | | Triplets+ | |
|---|---|---|---|---|---|---|---|---|
| **Variable** | **Insurance mandate** | **No insurance mandate** | **Insurance mandate** | **No insurance mandate** | **Insurance mandate** | **No insurance mandate** | **Insurance mandate** | **No insurance mandate** |
| All maternal ages | | | | | | | | |
| eSET (%) | 8.6 | 2.5[a] | 11.6 | 3.8[a] | – | – | – | – |
| Mean no. of embryos transferred (SD) | 2.2 (0.9) | 2.4 (0.8)[a] | 2.1 (1.0) | 2.3 (0.8)[a] | 2.3 (0.8) | 2.4 (0.7) | 3.0 (1.0) | 2.9 (0.7) |
| ≥3 embryos transferred (%) | 23.1 | 33.6[a] | 22.1 | 32.7[a] | 24.3 | 32.6[a] | 65.6 | 74.4 |
| Twin birth (%) | 25.7 | 31.1[a] | NA | NA | NA | NA | NA | NA |
| Triplet or higher order birth (%) | 1.0 | 2.3[a] | NA | NA | NA | NA | NA | NA |
| Preterm (%) | 22.6 | 30.7[a] | 10.1 | 13.2[a] | 55.5 | 63.1[a] | 96.9 | 98.5 |
| Very preterm (%) | 3.4 | 6.2[a] | 1.4 | 2.5[a] | 7.9 | 11.4[a] | 37.5 | 41.5 |
| Low birth weight[b] (%) | 22.3 | 29.5[a] | 7.1 | 9.8[a] | 62.9 | 66.5 | 98.4 | 99.0 |
| Very low birth weight[b] (%) | 3.8 | 6.2[a] | 1.3 | 2.1[c] | 9.3 | 11.7[c] | 45.3 | 48.7 |
| Term, normal birth weight singleton[d] (%) | 64.6 | 56.3[a] | 88.1 | 84.5[a] | NA | NA | NA | NA |
| <35 y | | | | | | | | |
| eSET | 12.4 | 2.7[a] | 17.5 | 4.2[a] | – | – | – | – |
| No. of embryos transferred, mean (SD) | 1.9 (0.5) | 2.3 (0.6)[a] | 1.8 (0.6) | 2.2 (0.7)[a] | 2.1 (0.3) | 2.3 (0.6)[a] | 2.8 (0.8) | 2.8 (0.7) |
| ≥3 embryos transferred (%) | 7.0 | 26.9[a] | 6.3 | 25.1[a] | 7.1 | 26.9[a] | 57.7 | 71.2 |
| Twin birth (%) | 28.5 | 33.7[a] | NA | NA | NA | NA | NA | NA |
| Triplet or higher order birth (%) | 1.0 | 2.6[a] | NA | NA | NA | NA | NA | NA |
| Preterm (%) | 24.9 | 32.2[a] | 10.3 | 12.6 | 58.4 | 64.0 | 100 | 99.0 |
| Very preterm[b] (%) | 3.9 | 7.2[a] | 1.6 | 2.8[c] | 8.6 | 12.6[c] | 38.5 | 48.1 |
| Low birth weight[b] (%) | 24.8 | 31.2[a] | 7.3 | 9.1 | 65.6 | 67.7 | 96.2 | 100.0 |
| Very low birth weight (%) | 4.5 | 6.8[a] | 1.5 | 2.2 | 10.0 | 12.2 | 53.9 | 52.0 |
| Term, normal birth weight singleton[d] (%) | 62.1 | 54.1[a] | 88.0 | 85.0[c] | NA | NA | NA | NA |
| ≥35 y | | | | | | | | |

| Variable | All deliveries | | Singleton | | Twins | | Triplets+ | |
|---|---|---|---|---|---|---|---|---|
| | Insurance mandate | No insurance mandate | Insurance mandate | No insurance mandate | Insurance mandate | No insurance mandate | Insurance mandate | No insurance mandate |
| eSET | 6.0 | 2.4[a] | 8.0 | 3.4[a] | – | – | – | – |
| No. of embryos transferred, mean (SD) | 2.4 (1.1) | 2.5 (0.8)[a] | 2.3 (1.1) | 2.5 (0.9)[a] | 2.6 (1.0) | 2.5 (0.7) | 3.1 (1.1) | 3.0 (0.7) |
| ≥3 embryos transferred (%) | 33.6 | 39.7[a] | 31.8 | 39.0[a] | 37.8 | 38.7 | 71.1 | 78.0 |
| Twin birth (%) | 23.9 | 28.8[a] | NA | NA | NA | NA | NA | NA |
| Triplet or higher order birth (%) | 1.0 | 2.1[a] | NA | NA | NA | NA | NA | NA |
| Preterm (%) | 21.2 | 29.3[a] | 10.0 | 13.7[a] | 53.2 | 62.0[a] | 94.7 | 97.8 |
| Very preterm (%) | 3.1 | 5.3[a] | 1.3 | 2.4[c] | 7.4 | 10.2 | 36.8 | 34.1 |
| Low birth weight[b] (%) | 20.7 | 27.9[a] | 7.0 | 10.3[a] | 60.8 | 65.3 | 100.0 | 97.8 |
| Very low birth weight[b] (%) | 3.4 | 5.6[a] | 1.2 | 2.0[c] | 8.8 | 11.5 | 39.5 | 45.1 |
| Term, normal birth weight singleton[d] (%) | 66.2 | 58.2[a] | 88.1 | 84.1[a] | NA | NA | NA | NA |

*Note:* A dash means the cell was suppressed owing to small numbers (n < 5). NA = not applicable.

[a] *P*<.001 for comparison of mandate versus nonmandate states.

[b] In any infant (for multiple births).

[c] *P*<.01 for comparison of mandate versus nonmandate states.

[d] Refers to delivery of singleton, term (≥37 weeks) infant with birth weight ≥2,500 g.

## TABLE 4

Unadjusted and adjusted risk ratios for the association between insurance mandate status and ET practices and perinatal outcomes among ART deliveries.

| | All maternal ages | | | |
|---|---|---|---|---|
| **Variable** | **Unadjusted risk ratio** | **95% CI** | **Adjusted risk ratio[a]** | **95% CI** |
| eSET | | | | |
| <35 y | 0.22 | (0.14–0.33) | 0.18 | (0.11–0.29) |
| ≥35 y | 0.39 | (0.23–0.66) | 0.31 | (0.18–0.51) |
| ≥3 embryos transferred | | | | |
| <35 y | 3.83 | (2.51–5.84) | 4.18 | (2.74–6.36) |
| ≥35 y | 1.18 | (0.85–1.63) | 1.46 | (1.17–1.81) |
| Twin birth | 1.21 | (1.12–1.31) | 1.20 | (1.12–1.29) |
| Triplet or higher order birth | 2.41 | (1.82–3.19) | 2.44 | (1.81–3.28) |
| Preterm delivery | 1.36 | (1.24–1.49) | 1.31 | (1.20–1.42) |
| Very preterm delivery | 1.80 | (1.46–2.23) | 1.59 | (1.30–1.95) |
| Low birth weight | 1.32 | (1.21–1.44) | 1.28 | (1.17–1.40) |
| Very low birth weight | 1.64 | (1.32–2.03) | 1.48 | (1.21–1.80) |
| Term, normal birth weight singleton | 0.87 | (0.84–0.91) | 0.89 | (0.86–0.92) |

*Note:* The mandate state was the referent for all comparisons.

[a] All models adjusted for age, race, education, parity, prior ART cycles, infertility diagnosis, use of assisted hatching, number of embryos cryopreserved, ART type (donor, nondonor, fresh, frozen), and year of birth. The models for eSET and ≥3 embryos transferred also included the interaction of mandate status and age.