

Is 34 Weeks an Acceptable Goal For a Complicated Singleton Pregnancy?

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ABSTRACT

Purpose: To examine neonatal risk and associated nursery costs for infants with delivery following untreated preterm labor at 34, 35, or 36 weeks' gestation, by assessing the incidence of neonatal intensive care unit (NICU) admission, respiratory distress syndrome (RDS), and need for ventilatory assistance.

Design: Infants with preterm birth at 34, 35, or 36 weeks were identified from a database of prospectively collected clinical information and pregnancy outcomes of women receiving outpatient preterm-labor management services, in addition to routine prenatal care. Cases of singleton gestations with delivery related to spontaneous preterm labor were analyzed. Data were divided into three groups by gestational week at delivery.

Methodology: Descriptive and statistical methods were used to compare maternal demographics, pregnancy outcome, and nursery costs. A cost model was utilized.

Principal findings: 2849 infants were studied. Risk of NICU admission decreased by 47.4 percent from weeks 34 to 35 and 41.8 percent from weeks 35 to 36. Risk of RDS decreased by 25.4 percent from weeks 34 to 35, and 40.7 percent from weeks 35 to 36. Mean nursery costs per infant delivered at 34, 35, and 36 weeks were \$11,439 ± \$19,774, \$5,796 ± \$11,858, and \$3,824 ± \$9,135, respectively ($p < .001$).

Conclusion: Rates of NICU admission, RDS, ventilator use, and nursery-related costs decreased significantly with each week gained. The data indicate that benefit is derived in prolonging pregnancy beyond 34 weeks.

Key words: preterm delivery; preterm labor; prematurity; neonatal morbidity; respiratory-distress syndrome; cost effectiveness; outcomes

INTRODUCTION

The therapeutic decision to use parenteral tocolysis to halt contractions in the treatment of women presenting with acute preterm labor should be based on an evaluation of the specific maternal and fetal risks compared to the neonatal benefits. The primary benefit of using tocolytic medications is prolongation of gestation to allow for fetal maturation. This is achieved by stopping or reducing uterine contractions, thus halting further cervical dilatation and progression of labor to the second

stage. Tocolytic medications will halt contractions and delay delivery in approximately 75 percent to 80 percent of women presenting with preterm labor, for a minimum of 48 to 72 hours.¹ Delaying delivery allows time for the physician to determine if preterm labor is related to a specific medical condition or if it is idiopathic. Additional benefits of delaying delivery may be derived from administration of corticosteroids that may enhance fetal lung maturity and/or transfer to a tertiary center that is better equipped to care for a preterm infant. Delaying delivery also allows time for initiation of, and benefit from, other necessary treatments such as antibiotics and tests such as amniocentesis.

When a woman presents with preterm labor at less than 34 weeks, the risk/benefit ratio of tocolysis is clear relative to the increased rate of short- and long-term morbidity and mortality associated with preterm delivery in these neonates.²⁻⁵ The decision to use tocolytics in women with preterm labor between 34 and 36 weeks is more challenging. Some believe that the risks of tocolysis outweigh the smaller risk of long-term complications in infants delivered at 34 to 36 weeks,⁶ while others believe the risks of respiratory distress syndrome (RDS) and neonatal intensive care unit (NICU) admission, with the accompanying financial and psychological stresses, outweigh the risk of tocolysis, especially at 34 weeks.^{7,8}

An estimated \$10.2 billion is spent annually for newborn medical care in the United States.⁹ Though preterm infants account for only 9 percent of live births per year, their

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care consumes approximately 57 percent, or \$6 billion, of total dollars spent on initial neonatal care.⁹ Approximately 63 percent of total payments for maternal and newborn care are through private, third-party payers with 17 percent through the Medicaid system.¹⁰

An infant born at 38 weeks incurs expenses that are one tenth that of an infant born at 35 weeks (\$441 vs. \$4,733).⁹ First-year health care charges for infants with even moderately low birth weight (1500–2499 g) are 46 percent higher than infants born with normal birth weight.¹¹ Ongoing challenges remain, as infants with low birth weight are more likely than their normal birth weight counterparts to experience long-term health and developmental problems.¹¹ As such, there is both societal and financial incentive for prolonging gestation in women experiencing preterm labor.

The purpose of this study was to identify neonatal risk and the associated nursery costs in infants delivering due to preterm labor between 34 and 36 weeks' gestation, by assessing the incidence of NICU admission, RDS, and need for ventilatory assistance.

METHODS

The patient population for this analysis was extracted from a computerized database (Matria Healthcare, Marietta, Ga.). Patients whose information is in this database received perinatal outpatient services, as prescribed by their health care provider, in addition to routine prenatal care. These outpatient programs and nursing services provide for daily and PRN collection of objective and subjective data used to determine a patient's clinical condition. Decisions related to treatment, such as the use of tocolysis and timing of delivery, are made solely by the patients' individual health care provider.

All data from patients who had received care from perinatal centers

throughout the United States are archived at a central location. Information is collected prospectively during the course of patient care from the patient and/or her physician and consists of medical and obstetrical history, diagnoses and treatment, daily clinical data related to the patients' diagnoses, treatments received, required hospital referrals, admissions and length of stay, and maternal and neonatal outcomes. At initiation of outpatient care, the patients sign an informed-consent document allowing the use of blinded clinical data for research.

Singleton infants with a gestational age at delivery between 34.0 and 36.9 weeks whose mothers were enrolled in the outpatient preterm-labor management program between May 1995 and March 2000 were eligible for inclusion. From this group, we excluded infants with reasons for delivery other than spontaneous preterm labor, such as maternal gestational hypertension, preeclampsia or diabetes, and those with preterm premature ruptured membranes. Also excluded were infants whose mothers received intravenous or subcutaneous tocolytic medications on hospitalization for preterm labor in an attempt to stop preterm uterine contractions and prolong gestation. The final study group consisted of infants delivered at 34.0 to 36.9 weeks after an episode of spontaneous preterm labor that was allowed to progress to delivery without intervention.

Data were divided into three gestational age at delivery (GAD) groups: 34 weeks, 35 weeks, and 36 weeks. Infants were considered to have delivered at 34 weeks' gestation if delivery occurred from 34.0 to 34.9 weeks, at 35 weeks' gestation if delivery occurred from 35.0 to 35.9 weeks, and 36 weeks' gestation if delivery occurred from 36.0 to 36.9 weeks.

Due to the wide variability of costs related to regional variations and payer types, a cost model was applied for the purpose of standardizing

nursery charges. Model values are as follows: \$590/day, regular nursery with a fewer-than-5-day length of stay, infant discharged home with mother; \$1,151/day, no NICU admission, extended nursery stay required (>4 days), infant not discharged with mother; \$1,787/day, NICU, without RDS; \$2,383/day, NICU, with RDS diagnosis. These figures were derived from statistics from the Healthcare Utilization Project (HCUP) Nationwide Inpatient Sample, 1997, Agency for Healthcare Research and Quality (AHRQ).¹²

Rates of infant NICU admission, RDS, ventilator use, and nursery costs were compared using analysis of variance (ANOVA), Kruskal-Wallis H test, Fisher's Exact, and Pearson's χ^2 statistics. Each GAD group was compared only to the previous GAD group. Odds ratios were calculated between weeks to approximate relative risk. The diagnosis of RDS and need for mechanical ventilation were determined by the individual neonatologist caring for each infant. The specific criteria used to make the RDS diagnosis were not documented in the outpatient record.

RESULTS

The overall study group consisted of 2,849 infants — 370 delivered at 34 weeks' gestation, 783 at 35 weeks' gestation, and 1,696 at 36 weeks' gestation. Maternal characteristics of each infant group are presented in Table 1. All mothers received outpatient preterm-labor management services, in addition to routine prenatal care. Of the women who were discontinued from outpatient services and maintenance tocolytics by their physician prior to the onset of preterm labor, 34.6 percent delivered at 34 weeks, 46.5 percent at 35 weeks, and 70.2 percent at 36 weeks. Presence of a mature amniocentesis was documented in only 46 patients (1.6 percent).

In the overall population of infants from singleton gestations that deliv-

ered between 34.0 and 36.9 weeks, 24.9 percent were admitted to NICU, 7.3 percent were diagnosed with RDS, and 4.6 percent required assisted ventilation.

Infant outcome data are presented in Table 2. The number of infants requiring NICU admission and assisted ventilation decreased significantly with each week of advancing gestation. An infant admitted to the NICU experienced a length of stay that was 3 times longer than an infant without NICU admission when delivered at 34 weeks, 4 times longer when deliv-

ered at 35 weeks, and 3.5 times longer when delivered at 36 weeks. In this population, the incidence of RDS was similar for infants delivering at 34 and 35 weeks' gestation ($p=.116$), but it was significantly decreased for infants delivering at 36 weeks versus 34 or 35 weeks, ($p<.001$). The odds of NICU admission decreased by 47.4 percent from weeks 34 to 35 and by 41.9 percent from weeks 35 to 36. The odds of RDS decreased by 25.4 percent from weeks 34 to 35 and by 40.7 percent from weeks 35 to 36. Odds of assisted ventilation decreased by 39.1

percent from weeks 34 to 35 and 44.6 percent from weeks 35 to 36.

An estimated total of \$15,256,858 was spent for nursery care in the overall population of 2,849 infants delivered at 34 to 36 weeks. Respective mean nursery costs per infant delivering at 34, 35, and 36 weeks' gestation were \$11,439 ± \$19,774, \$5,796 ± \$11,858, and \$3,824 ± \$9,135 ($p<.001$) (Figure 1), with median costs of \$5,755, \$1,180 and \$1,180, respectively.

Mean costs per infant by nursery and RDS diagnosis are summarized in Table 3. An infant born at 34 weeks, requiring NICU admission, experienced mean costs more than 7 times that of the infant with similar gestational age who did not require NICU admission (\$18,832 vs. \$2,550). Infants born at 35 or 36 weeks and admitted to NICU had costs more than 10 times their non-NICU counterparts (\$16,416 vs. \$1,514 at 35 weeks, and \$15,745 vs. \$1,437 at 36 weeks). Two hundred eight (7.3 percent) infants were diagnosed with RDS. The diagnosis of RDS approximately doubles NICU costs for each gestational age group. Infants with RDS had nursery expenses of \$5,388,061, for a disproportionate 35.3 percent of the total dollars spent. Mean nursery costs for infants with NICU admission with or without RDS were similar across groups.

DISCUSSION

An American College of Obstetricians and Gynecologists (ACOG) Technical Bulletin¹³ has recommended that the treatment of preterm labor after 34.0 weeks' gestation be "on an individualized basis." We feel that our investigation provides valuable information that the practicing obstetrician can use to determine the need for preterm labor intervention, by identifying the short-term economic consequences of preterm delivery at 34 to 36.9 weeks.

Other authors have also investigated the incidence of RDS at similar

TABLE 1 Maternal characteristics

	34 weeks n=370	35 weeks n=783	36 weeks n=1696	p-value
Maternal age	27.4±6.1	27.4±5.9	28.4±5.6 [†]	<.001
Married	71.1%	77.0% [†]	83.1% [†]	<.001
Smoker	7.3%	6.8%	5.9%	.502
History of PTD*	36.3%	41.1%	33.9% [†]	.003
Cerclage	7.3%	9.1%	8.2%	.572
GA at start**	28.7 ± 4.0	28.7 ± 4.3	29.3±4.2 [†]	.005

Data presented as mean ± SD, or percentage as indicated

*Preterm delivery

**Gestational age at start of outpatient services

[†] $p<.05$ vs. previous GA week

TABLE 2 Pregnancy outcome

	34 weeks n=370	35 weeks n=783	36 weeks n=1696	p-value
Birth weight (g)	2,484±405	2,702±390 [‡]	2,891±397 [‡]	<.001
Low birth weight (<2500 g)	58.4%	32.3% [‡]	16.6% [‡]	<.001
SGA*	0.8%	1.0%	3.5% [‡]	<.001
Total nursery days	6.6±8.9	4.0±5.6 [‡]	3.1±4.0 [‡]	<.001
Median	4	2	2	
≥7 Nursery days	37.0%	14.9% [‡]	8.4% [‡]	<.001
NICU admission	54.6%	28.7% [‡]	16.7% [‡]	<.001
NICU days**	9.5±10.9	8.1±9.1	7.7±8.1 [‡]	.004
Median	7	6	5	
RDS [†]	12.2%	9.1%	5.4% [‡]	<.001
Ventilator use	9.2%	5.6% [‡]	3.1% [‡]	<.001
Caesarean delivery	27.0%	20.4% [‡]	18.9%	.002

Data presented as mean plus or minus standard deviation, or percentage as indicated.

*Small for gestational age

** For infants admitted to NICU

[†]Respiratory distress syndrome

[‡] $p<.05$ vs. previous GA week

gestational ages. In a population of infants from women with singleton, twin, and triplet gestations receiving care through a tertiary military medical center, Jones et al⁷ reported a rate of RDS of 17.4 percent at 34 weeks, 6.3 percent at 35 weeks, and 4.2 percent at 36 weeks. Konte et al³ reported a significant reduction in five measures of short-term morbidity, including a reduction of RDS from 22.5 percent to 2.7 percent and a reduction in NICU admission rate from 72.5 percent to 22.2 percent, by an extension of pregnancy from 34 to 35 weeks, in newborns at a single institution. No pregnancies were ex-

tended. Some were longer.

In a study from five tertiary care centers in the United States from 1983 through 1986, Robertson et al¹⁴ concluded that the incidence of both RDS and patent ductus arteriosus decreased with advancing gestational age and higher birth weight. In their report, the incidence of RDS was 13.3 percent at 34 weeks, 6.4 percent at 35 weeks, and 3.3 percent at 36 weeks.

More recently, Lewis et al⁸ reported an RDS incidence of 16.3 percent, 0.9 percent, and 0 percent at 34, 35, and 36 weeks, respectively, in women with delivery related to preterm labor without premature rupture of mem-

branes prior to labor onset. The investigators concluded that fetal lung maturity studies should be considered and that delivery should possibly be delayed through week 34 of gestation.

The variations in rates of RDS reported may be related to sample size, characteristics of the populations studied, and/or the diagnostic criteria used to determine the presence of RDS. It should be noted, though, that in all these cited studies, including our own, the incidence of RDS at 34 weeks has exceeded 10 percent.

The financial ramifications of prematurity are well documented.^{9,11,15} Gestational age at delivery, the presence of RDS, and pneumonia have been found to be the strongest predictors of hospital charges.¹⁶ Of the five most expensive hospital diagnoses in the United States, RDS and low birth weight are numbered two and three, respectively. Overall, regardless of gestational age at delivery, the average hospital charge for an infant diagnosed with RDS is \$56,660 and \$50,300 for an infant of low birth weight.¹²

In a study of the cost effectiveness of fetal lung maturity testing in women with preterm labor, Myers et al¹⁷ concluded that the cost effectiveness of preterm labor treatment varied with the probability of RDS. In the institution Myers and colleagues studied, the testing for fetal lung maturity, with the decision for tocolytic treatment being based on test results,

FIGURE 1 Mean nursery cost per infant

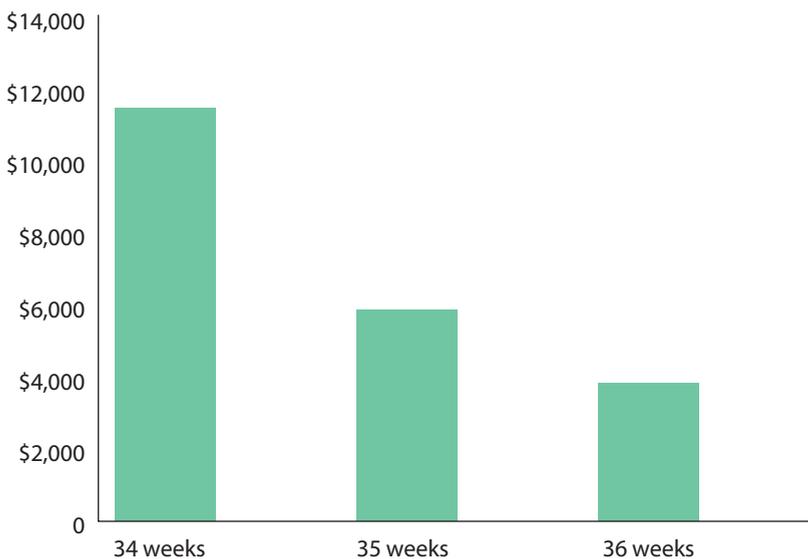


TABLE 3 Costs per infant by nursery utilized

	34 weeks n=370	35 weeks n=783	36 weeks n=1696	p-value
Regular nursery	n=168 \$2,550±\$3,653	n=558 \$1,514±\$1,400*	n=1413 \$1,437±\$1,301	<.001
NICU (no RDS)	n=157 \$15,138±\$13,724	n=154 \$12,672±\$17,343	n=191 \$11,714±\$11,470	.075
NICU (with RDS)	n=45 \$31,712±\$42,303	n=71 \$24,536±\$17,076	n=92 \$24,114±\$24,860	.279

Data presented mean plus or minus standard deviation per infant

* p<.05 vs. previous GA week

proved to be a cost-effective strategy for women presenting with preterm labor at 34 to 36 weeks.

Another conclusion from Myers' study was that non-RDS-related costs in preterm infants should also be considered when determining a strategy for optimal management. When the cost of care for a non-RDS infant compared with an infant born 1 week later differed by at least \$1,300, treatment with tocolysis would be the preferred strategy from an economic point of view.

In the present study, the difference in costs for non-RDS infants delivered at 34 versus 35 weeks was \$4,704, while the difference in costs between 35 and 36 weeks was \$1,267. Using Myers' threshold of \$1,300 in helping to determine a treatment strategy, it appears that using tocolysis to prolong pregnancy through 34 weeks' gestation may be beneficial from a cost perspective even without consideration for infants that develop RDS.

In the current study of women with spontaneous preterm labor and without complicating maternal or fetal factors, the rates of infant NICU admission, RDS, need for ventilatory assistance and nursery costs decreased with each advancing week of gestation from week 34 through 36. In the absence of clinical contraindications to prolonging pregnancy, we believe that attempts should be made to prolong pregnancy in women presenting with preterm labor at 34.0 to 34.9 weeks.

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