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NICU admissions after a policy to discourage elective deliveries prior to 39 weeks

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NICU ADMISSIONS AFTER A POLICY TO DISCOURAGE ELECTIVE DELIVERIES PRIOR TO 39 WEEKS

by

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DEDICATION

I would like to dedicate this work to my mother, Linda Kennedy, for her love, support, and patience throughout the entirety of my academic career.

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ABSTRACT

Background: Early-term infants (37-38 weeks) are at increased risk of short- and long-term morbidities compared with full term infants (39-40 weeks). In 2009, the American College of Obstetricians and Gynecologists (ACOG) issued guidelines to discourage early elective deliveries prior to 39 weeks of gestation, and Beth Israel Deaconess Medical Center (BIDMC) in Boston, MA, adopted a policy to implement these guidelines. The impact of this policy on Neonatal Intensive Care Unit (NICU) utilization at BIDMC is unknown.

Objectives: The objectives of this study were to (1) examine the gestational age distribution of infants at BIDMC from 2004 to 2015 and confirm a reduction in proportion of early-term births (37-38 weeks) after policy implementation in 2009, (2) compare the incidence of NICU admissions among infants ≥37 weeks of gestation before and after policy implementation, and (3) compare the length of NICU stays among infants ≥37 weeks of gestation before and after policy implementation.

Methods: We conducted a medical record review of infants ≥37 weeks of gestation born from January 1, 2004, through November 10, 2015. We used chi-square tests to compare the incidence of early-term deliveries and NICU admissions in two time periods: 2004-2008 (pre-period) and 2010-2015 (post-period). We excluded infants born in 2009 from the analysis. We used logistic regression to calculate the odds ratio of both short (>4 to <24 hours) and long (≥24 hours) NICU admissions in the two time periods. NICU stays ≤4 hours were excluded as they most often occur among asymptomatic infants for evaluation of sepsis in the setting of maternal fever during labor. We also excluded infants transferred to other hospitals. We considered potential confounding variables such as multiple births, maternal age, race and ethnicity, parity, insurance, and marital status. We compared median lengths of stay using a Wilcoxon test.

Results: A total of 50,373 infants were born ≥37 weeks of gestation during the study period, 46,254 of whom were included in the analysis excluding 4,119 infants born in 2009, the washout period. The incidence of early-term delivery was lower in the post-period (27.1%) versus the pre-period (34.2%) (P <0.0001). We detected a slight but statistically insignificant decrease in the incidence of overall NICU admissions from 9.1% in the pre-period to 8.9% in the post-period (P = 0.3). The incidence of short NICU admissions also decreased from 5.3% in the pre-period to 4.6% in the post-period (P < 0.0001). Interestingly, there was an increase in the incidence of long NICU stays from 3.8% in the pre-period to 4.3% in the post-period (P = 0.006). Term infants born after 2009 had lower odds of short NICU stays in adjusted models (adj. OR 0.84; 95% CI 0.77, 0.91). Among NICU admissions >4 hours, the median length of stay (LOS) increased from 21 hours (pre-period) to 39 hours (post-period) (P <0.0001).

Conclusion: A local policy aligned with ACOG national guidelines to reduce early elective deliveries was associated with a reduction in early-term births. We observed a concurrent reduction of short but not long NICU stays. Our findings suggest that a

reduction in early elective deliveries before 39 weeks of gestation may lead to more opportunities for infants to stay with their families in the first 24 hours but may not affect the incidence of significant morbidities requiring longer NICU stays.

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LIST OF ABBREVIATIONS

ACOG .... American College of Obstetricians and Gynecologists

BIDMC .... Beth Israel Deaconess Medical Center

CHIP ....Children's Health Insurance Program

CI...Confidence interval

CMS .... Centers for Medicare and Medicaid Services

HIPAA .... Health Insurance Portability and Accountability Act

ICD...International Classification of Diseases

IRB... Institutional Review Board

LOS .... Length of stay

NICU...Neonatal Intensive Care Unit

OECD.......................................Organization for Economic Cooperation and Development

OR ....Odds ratio

RDS.. Respiratory distress syndrome

TTN... Transient tachypnea of the newborn

INTRODUCTION

Early-Term Versus Term Infants

The traditional definition of a pregnancy carried to full term is ≥37 completed weeks of gestation (Clark et al., 2010; “Ob-Gyns Redefine Meaning of ‘Term Pregnancy’ - ACOG,” n.d.). Not all infants within this traditional definition, however, have the same health outcomes (“Ob-Gyns Redefine Meaning of ‘Term Pregnancy’ - ACOG,” n.d.). For example, early-term infants (37-38 weeks of gestation) compared with term infants (39-40 weeks of gestation) are at a higher risk for morbidity and mortality (Clark et al., 2010; “Nonmedically Indicated Early-Term Deliveries - ACOG,” n.d.; Zhang & Kramer, 2009). Along with increased health risks, the Neonatal Intensive Care Unit (NICU) admission rate is also higher among these early-term infants (“Nonmedically Indicated Early-Term Deliveries - ACOG,” n.d.; Oshiro et al., 2009). As a result of these differences, the American College of Obstetricians and Gynecologists (ACOG) subdivided the traditional definition of term (≥37 weeks) into four new groups. They consider infants as “early-term” (37-38 weeks), “term” (39-40 weeks), “late-term” (41 completed weeks), and “post-term” (≥42 weeks) (“Ob-Gyns Redefine Meaning of ‘Term Pregnancy’ - ACOG,” n.d.) (**Figure 1)**. Infants with the lowest risk of adverse outcomes are “term” infants born at 39-40 completed weeks of gestation (“Ob-Gyns Redefine Meaning of ‘Term Pregnancy’ - ACOG,” n.d.).

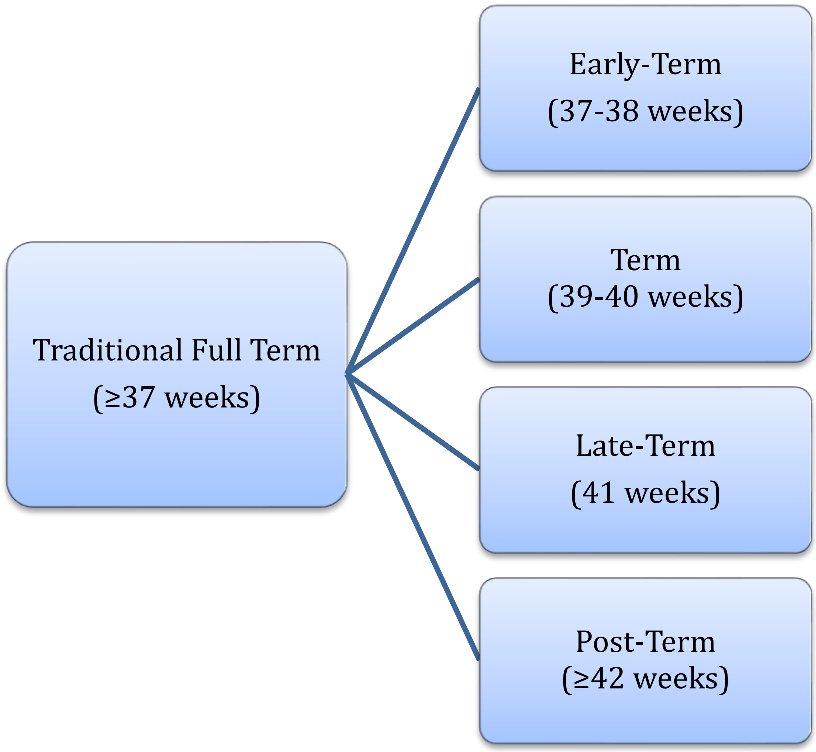

Figure 1. The traditional definition of "full term" subdivided into four new groups. ACOG subdivided the traditional definition of "full term" into "early-term" (37-38 weeks), "term" (39-40 weeks), "late-term" (41 completed weeks), and "post-term" (≥42 weeks) to signify that not all infants ≥37 weeks experience the same health outcomes. (Figure created with information from "Ob-Gyns Redefine Meaning of 'Term Pregnancy' - ACOG," n.d.)

Mortality Rate Among Early-Term Versus Term Infants

In 2013, 88.6% of all births were full term infants, ≥37 weeks of gestation by the traditional definition, and 24.8% of all births were early-term infants, 37-38 weeks of gestation. Thus, 28% of infants ≥37 weeks fit the definition of early-term in 2013 (“National Vital Statistics Reports, Volume 64, Number 1, January 15, 2015 - nvsr64_01.pdf,” n.d.). The percentage of infants ≥37 weeks that are early-term is concerning when mortality and morbidity risks are considered. The mortality rate among infants born at 37 weeks of gestation is double that of infants born at 40 weeks of gestation (Zhang & Kramer, 2009). The mortality rate can be broken down by neonatal mortality versus postneonatal mortality as well as by weeks of gestation (37, 38, 39, and 40 weeks). At 37 weeks of gestation, the neonatal mortality rate is 6.6 per 10,000 births (0.066%), and the postneonatal mortality rate is 16.8 per 10,000 births (0.168%). The neonatal mortality rate among 40-week infants is 3.4 per 10,000 births (0.034%), and the postneonatal mortality rate is 10.3 per 10,000 births (0.103%) (Zhang & Kramer, 2009). Given that these infant mortality rates are higher than in 25 of 29 countries in the Organization for Economic Cooperation and Development (OECD), groups such as ACOG and the March of Dimes have initiated several efforts to reduce infant mortality in the United States (“The World Factbook,” n.d.). One of these efforts is to focus on reducing early-term births. In addition to reducing mortality, because the vast majority of early-term infants survive in the United States, reducing early-term deliveries may reduce the incidence of morbidities that lead to significant health care utilization.

Incidence of Morbidity Among Early-Term Versus Term Infants

Morbidities such as respiratory distress syndrome (RDS), transient tachypnea of the newborn (TTN), and hypoglycemia are more common among early-term (versus full term) infants and decrease in incidence with increasing gestational age (Ehrenthal, Hoffman, Jiang, & Ostrum, 2011; “Nonmedically Indicated Early-Term Deliveries - ACOG,” n.d.; Oshiro et al., 2009; Tita et al., 2009; Wilmink et al., 2010). Compared with full term infants, 37- and 38-week infants are also more likely to be admitted to the NICU, potentially as a result of an aforementioned diagnosis (“Nonmedically Indicated Early-Term Deliveries - ACOG,” n.d.). Furthermore, infants born prior to 39 weeks of gestation are at an increased risk for these morbidities and for admission to the NICU, regardless of whether the delivery was spontaneous or provider-initiated (Clark et al., 2010; Oshiro et al., 2009) (**Figure 2**).

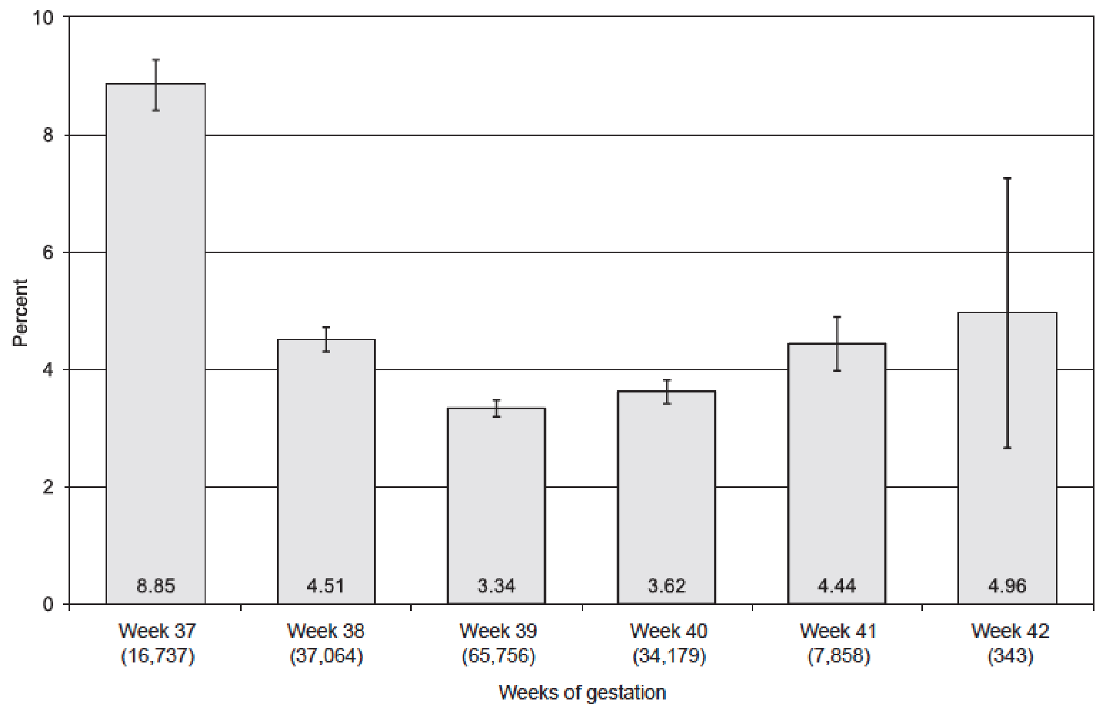

Figure 2. NICU admission rates among uncomplicated pregnancies by gestational age, including two standard deviations. This graph of NICU admission rates includes infants traditionally considered "full term" and illustrates the higher percentage of infants born at 37 or 38 weeks of gestation against the lower percentage of infants typically considered the "healthiest" (39 and 40 weeks of gestation). The values included in this graph are the total number of births at each gestational age as well as the percentages of infants born at each gestational age that are admitted to the NICU. The NICU admission rate is the proportion of the total number of infants born at each gestational age that are admitted to the NICU. This data represents hospitals throughout Utah and Southeast Idaho. (Figure adapted from Oshiro et al., 2009)

Spontaneous, Medically Indicated, and Elective Deliveries

When a woman delivers early, her delivery is categorized as spontaneous or provider-initiated. Spontaneous deliveries result from an unpredictable event such as labor, premature rupture of the membranes, or cervical incompetence (Manuck et al., 2015). Provider-initiated deliveries may be one of two sub-categories: medically indicated or elective (non-medically indicated) (Clark et al., 2010; "Nonmedically Indicated Early-Term Deliveries - ACOG," n.d.). A medically indicated delivery occurs when a provider believes the mother or fetus is at more risk if the pregnancy is continued than if the infant is delivered early (Spong et al., 2011). A medical indication may be a maternal complication such as preeclampsia, a fetal complication such as intrauterine growth restriction, or a placental or uterine pathology such as placenta previa (Brown, Speechley, Macnab, Natale, & Campbell, 2015; "Nonmedically Indicated Early-Term Deliveries - ACOG," n.d.; Spong et al., 2011). An early elective delivery is a non-spontaneous delivery prior to 39 weeks of gestation without a medical indication. ("Nonmedically Indicated Early-Term Deliveries - ACOG," n.d.). Early elective deliveries may be initiated as a result of maternal discomfort or convenience (Brown, Speechley, Macnab, Natale, & Campbell, 2015; Glavind, Henriksen, Kindberg, & Uldbjerg, 2013; Oshiro et al., 2009). A provider may recommend early delivery because of scheduling preference or other factors (Glavind, Henriksen, Kindberg, & Uldbjerg, 2013; Tita et al., 2009).

The method of an early elective delivery is either induction of labor or a cesarean delivery (Clark et al., 2010; Ehrenthal, Hoffman, Jiang, & Ostrum, 2011). Historically, many early elective deliveries occurred in the setting of planned repeat cesarean deliveries after a woman had had a prior cesarean delivery in a previous pregnancy. Repeat cesarean deliveries have become more common in recent years as vaginal births after cesarean deliveries have declined in the last 20 years (Tita et al., 2009). Although studies have shown that compared with scheduled cesarean deliveries, early inductions of labor are less likely to result in adverse outcomes for the infant (Salemi, Pathak, & Salihu, 2016), the risk of an emergency cesarean section is increased if an early induction of labor is attempted and fails ("Born Too Early: Improving Maternal and Child Health by Reducing Early Elective Deliveries," n.d., "Why at least 39 weeks is best for your baby | March of Dimes," n.d.). A cesarean delivery, especially preceding labor, results in increased risk for infant morbidities, such as respiratory distress, that in turn increase the likelihood of NICU admission ("Born Too Early: Improving Maternal and Child Health by Reducing Early Elective Deliveries," n.d.; Oshiro et al., 2009; Tita et al., 2009; Wilmink et al., 2010). Furthermore, maternal and neonatal care costs are higher among cesarean deliveries than vaginal deliveries ("Born Too Early: Improving Maternal and Child Health by Reducing Early Elective Deliveries," n.d.). The health care costs for both mother and baby (including average NICU costs) add up to about $45,496 after cesarean delivery compared with $30,875 after vaginal delivery ("Born Too Early: Improving Maternal and Child Health by Reducing Early Elective Deliveries," n.d.). Some of these costs are due to possibly preventable NICU stays among infants born electively early.

A Policy to Discourage Early Elective Deliveries

In order to achieve the goal of reducing the incidence of early-term births, early elective deliveries have become the target of intervention ("Born Too Early: Improving Maternal and Child Health by Reducing Early Elective Deliveries," n.d.). With increased awareness that an infant is at risk for adverse health outcomes when born prior to 39 weeks, there have been many national recommendations as well as local hospital policies issued. These policies support efforts to educate both patients and physicians, reduce the incidence of early-term deliveries, and improve neonatal health outcomes (Clark et al., 2010; "Nonmedically Indicated Early-Term Deliveries - ACOG," n.d.).

A 2007 retrospective cohort study by Clark et al. (2010) looked at three different efforts to reduce the incidence of early elective deliveries. The study involved 27 hospitals throughout 14 states. The first effort involved a policy that included a hard-stop of early elective deliveries, requiring health professionals to refuse early elective inductions and primary and repeat cesarean deliveries prior to 39 weeks. In the case of an indication for early delivery, a "chain of command" was consulted in order to schedule an induction or cesarean delivery. The second effort was a soft-stop policy, adopted by some of the participating hospitals. The soft-stop was similar to the aforementioned hard-stop policy. However, instead of needing to consult a "chain of command," an attending physician was responsible for deciding whether an early induction or cesarean section was in the best interest of mother and baby. The third effort was an education-only approach without a "formal policy" in which health professionals were given literature regarding recommendations discouraging early elective deliveries. The findings of the Clark et al. (2010) study showed a considerable decrease in early elective deliveries among the hospitals that adopted the hard-stop policy or the soft-stop policy. A more significant decrease was seen in hospitals with the hard-stop policy. Elective deliveries at 37 and 38 weeks decreased from 8.2% in 2007 to 1.7% in 2009 ($P = 0.007$) among the group of 7 hospitals that adopted the hard-stop policy. The hard-stop group experienced a more significant reduction compared with the 8.4% to 3.3% reduction ($P < 0.025$) among the group of 9 hospitals that adopted the soft-stop policy. A decrease was evident but not significant among the group of 11 hospitals that chose to educate staff without adopting a formal policy (10.9% to 6.0%, $P = 0.135$). The results of this study suggest that a hard-stop was most effective at reducing early-elective deliveries (Clark et al., 2010).

In parallel to clinical policies, health plans are also adopting policies to reduce the incidence of early-term births. Similar to the clinical hard-stop, health plans are ceasing to pay for early elective deliveries that are not authorized ("Born Too Early: Improving Maternal and Child Health by Reducing Early Elective Deliveries," n.d.). The Centers for Medicare and Medicaid Services (CMS) have two initiatives to raise awareness and reduce the incidence of early elective deliveries ("Children's Health Insurance Program (CHIP)," n.d.). Strong Start for Mothers and Newborns is an initiative to explore different types of prenatal care and obstetric practice to educate mothers about the importance of carrying a pregnancy to 39 weeks, reduce the incidence of early elective deliveries, and improve maternal and fetal health outcomes ("Strong Start for Mothers and Newborns Initiative," n.d.). The other initiative called Improving Maternal and

Infant Health Outcomes has set out to achieve the goals of reducing preterm births, adverse health outcomes, and cost of care for both mother and infant by improving postpartum visit rates and increasing contraception use ("Maternal and Infant Health Care Quality," n.d.). The Centers for Medicare and Medicaid Services have teamed up with national organizations such as ACOG and March of Dimes to support these initiatives ("Children's Health Insurance Program (CHIP)," n.d.).

In 2009, in an effort to improve perinatal outcomes, Beth Israel Deaconess Medical Center (BIDMC) in Boston, MA, adopted the ACOG guidelines to discourage elective deliveries without medical indication prior to 39 weeks of gestation. According to policy, when a cesarean delivery or an induction of labor is scheduled prior to 39 weeks of gestation, a list is consulted of valid medical indications published by the Joint Commission. Common medical indications found within this list include placenta previa, preeclampsia, and intrauterine growth restriction. The entire list published by the Joint Commission, including the International Classification of Diseases, Ninth Revision (ICD-9) codes and short descriptions, can be found online: https://manual.jointcommission.org/releases/TJC2013A/AppendixATJC.html#Table_Number_11_07_Conditions_Po ("AppendixATJC - Manual - Performance Measurement Network," n.d.). The medical indications including ICD-9 codes and long descriptions can be found in **Table 1**. If an indication for early delivery does not fall within the list, it must be approved by the Medical Director of Labor and Delivery or an appropriate designee. The requirement of a medical indication for an early delivery is expected to prolong the average length of gestation and improve perinatal outcomes.

Table 1. Medical indications for early elective delivery, including ICD-9 codes and long descriptions. Table was adapted from the Association of State and Territorial Health Officials ("ICD9 - http://www.astho.org/JCAHO-Joint-Commission-List-of-Diagnoses/," n.d.).

Code	**Description**
42	Human immunodeficiency virus (HIV) disease
641.01	Placenta previa without hemorrhage, delivered, with or without mention of antepartum condition
641.11	Hemorrhage from placenta previa, delivered, with or without mention of antepartum condition
641.21	Premature separation of placenta, delivered, with or without mention of antepartum condition
641.31	Antepartum hemorrhage associated with coagulation defects, delivered, with or without mention of antepartum condition
641.81	Other antepartum hemorrhage, delivered, with or without mention of antepartum condition
641.91	Unspecified antepartum hemorrhage, delivered, with or without mention of antepartum condition
642.01	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, delivered, with or without mention of antepartum condition

642.02	Benign essential hypertension, complicating pregnancy, childbirth, and the puerperium, delivered, with mention of postpartum complication
642.11	Hypertension secondary to renal disease, complicating pregnancy, childbirth, and the puerperium, delivered, with or without mention of antepartum condition
642.12	Hypertension secondary to renal disease, complicating pregnancy, childbirth, and the puerperium, delivered, with mention of postpartum complication
642.21	Other pre-existing hypertension, complicating pregnancy, childbirth, and the puerperium, delivered, with or without mention of antepartum condition
642.22	Other pre-existing hypertension, complicating pregnancy, childbirth, and the puerperium, delivered, with mention of postpartum complication
642.31	Transient hypertension of pregnancy, delivered , with or without mention of antepartum condition
642.32	Transient hypertension of pregnancy, delivered, with mention of postpartum complication
642.41	Mild or unspecified preeclampsia, delivered, with or without mention of antepartum condition
642.42	Mild or unspecified preeclampsia, delivered, with mention of postpartum complication
642.51	Severe preeclampsia, delivered, with or without mention of antepartum condition

642.52	Severe preeclampsia, delivered, with mention of postpartum complication
642.61	Eclampsia, delivered, with or without mention of antepartum condition
642.62	Eclampsia, delivered, with mention of postpartum complication
642.71	Preeclampsia or eclampsia superimposed on pre-existing hypertension, delivered, with or without mention of antepartum condition
642.72	Preeclampsia or eclampsia superimposed on pre-existing hypertension, delivered, with mention of postpartum complication
642.91	Unspecified hypertension, complicating pregnancy, childbirth, or the puerperium, delivered, with or without mention of antepartum condition
642.92	Unspecified hypertension, complicating pregnancy, childbirth, or the puerperium, delivered, with mention of postpartum complication
645.11	Post term pregnancy, delivered, with or without mention of antepartum condition
646.21	Unspecified renal disease in pregnancy, without mention of hypertension, delivered, with or without mention of antepartum condition
646.22	Unspecified renal disease in pregnancy, without mention of hypertension, delivered, with mention of postpartum complication
646.71	Liver and biliary tract disorders in pregnancy, delivered, with or without mention of antepartum condition
648.01	Diabetes mellitus of mother, complicating pregnancy, childbirth, or the puerperium, delivered, with or without mention of antepartum condition

648.51	Congenital cardiovascular disorders of mother, delivered, with or without mention of antepartum condition
648.52	Congenital cardiovascular disorders of mother, delivered, with mention of postpartum complication
648.61	Other cardiovascular diseases of mother, delivered, with or without mention of antepartum condition
648.62	Other cardiovascular diseases of mother, delivered, with mention of postpartum complication
648.81	Abnormal glucose tolerance of mother, delivered, with or without mention of antepartum condition
648.82	Abnormal glucose tolerance of mother, delivered, with mention of postpartum complication
649.31	Coagulation defects complicating pregnancy, childbirth, or the puerperium, delivered, with or without mention of antepartum condition
649.32	Coagulation defects complicating pregnancy, childbirth, or the puerperium, delivered, with mention of postpartum complication
651.01	Twin pregnancy, delivered, with or without mention of antepartum condition
651.11	Triplet pregnancy, delivered, with or without mention of antepartum condition
651.21	Quadruplet pregnancy, delivered, with or without mention of antepartum condition

651.31	Twin pregnancy with fetal loss and retention of one fetus, delivered, with or without mention of antepartum condition
651.41	Triplet pregnancy with fetal loss and retention of one or more fetus(es), delivered, with or without mention of antepartum condition
651.51	Quadruplet pregnancy with fetal loss and retention of one or more fetus(es), delivered, with or without mention of antepartum condition
651.61	Other multiple pregnancy with fetal loss and retention of one or more fetus(es), delivered, with or without mention of antepartum condition
651.71	Multiple gestation following (elective) fetal reduction, delivered, with or without mention of antepartum condition
651.81	Other specified multiple gestation, delivered, with or without mention of antepartum condition
651.91	Unspecified multiple gestation, delivered, with or without mention of antepartum condition
652.01	Unstable lie, delivered, with or without mention of antepartum condition
652.61	Multiple gestation with malpresentation of one fetus or more, delivered, with or without mention of antepartum condition
655.01	Central nervous system malformation in fetus, delivered, with or without mention of antepartum condition
655.11	Chromosomal abnormality in fetus, affecting management of mother, delivered, with or without mention of antepartum condition

655.31	Suspected damage to fetus from viral disease in the mother, affecting management of mother, delivered, with or without mention of antepartum condition
655.41	Suspected damage to fetus from other disease in the mother, affecting management of mother, delivered, with or without mention of antepartum condition
655.51	Suspected damage to fetus from drugs, affecting management of mother, delivered, with or without mention of antepartum condition
655.61	Suspected damage to fetus from radiation, affecting management of mother, delivered, with or without mention of antepartum condition
655.81	Other known or suspected fetal abnormality, not elsewhere classified, affecting management of mother, delivered, with or without mention of antepartum condition
656.01	Fetal-maternal hemorrhage, delivered, with or without mention of antepartum condition
656.11	Rhesus isoimmunization, delivered, with or without mention of antepartum condition
656.21	Isoimmunization from other and unspecified blood-group incompatibility, delivered, with or without mention of antepartum condition
656.31	Fetal distress, affecting management of mother, delivered, with or without mention of antepartum condition

656.41	Intrauterine death, affecting management of mother, delivered, with or without mention of antepartum condition
656.51	Poor fetal growth, affecting management of mother, delivered, with or without mention of antepartum condition
657.01	Polyhydramnios, delivered, with or without mention of antepartum condition
658.01	Oligohydramnios, delivered, with or without mention of antepartum condition
658.11	Premature rupture of membranes, delivered, with or without mention of antepartum condition
658.21	Delayed delivery after spontaneous or unspecified rupture of membranes, delivered, with or without mention of antepartum condition
658.41	Infection of amniotic cavity, delivered, with or without mention of antepartum condition
659.71	Abnormality in fetal heart rate or rhythm, delivered, with or without mention of antepartum condition
663.51	Vasa previa complicating labor and delivery, delivered, with or without mention of antepartum condition
V08	Asymptomatic human immunodeficiency virus (HIV) infection status
V23.5	Supervision of high-risk pregnancy with other poor reproductive history
V27.1	Outcome of delivery, single stillborn

Objectives

It is unknown whether the 2009 policy to reduce early elective deliveries, adopted by Beth Israel Deaconess Medical Center (BIDMC), has had an impact on NICU utilization. We hypothesized that the change in obstetric practice resulted in a lower proportion of early-term deliveries (37-38 weeks), a lower incidence of NICU admissions among infants ≥37 weeks of gestation, and shorter lengths of NICU stays among infants ≥37 weeks of gestation.

In line with our hypothesis, the objectives of this study were to:

1. Examine the gestational age distribution of infants at BIDMC from 2004 to 2015 and confirm a reduction in proportion of early-term births (37-38 weeks) after policy implementation in 2009.
2. Compare the incidence of NICU admissions among infants ≥37 weeks of gestation before and after policy implementation in 2009.
3. Compare the length of NICU stays among infants ≥37 weeks of gestation before and after policy implementation in 2009.

METHODS

Study Design

We performed a retrospective cohort study of infants ≥37 completed weeks of gestation born at BIDMC from January 1, 2004, through November 10, 2015. We excluded any infants transferred to another hospital and not discharged home from the BIDMC NICU. Our study period was split into two time periods, and we used the year of the policy change, 2009, as a washout period to allow for update of the new obstetric practice. We then compared the post-period, 2010-2015, to the pre-period, 2004-2008, thereby designating the time period as the independent variable. Our outcome (dependent) variables included early-term delivery and NICU admission in the post-period versus the pre-period. NICU admissions included infants who were born 37 weeks or greater and admitted for more than four hours. At BIDMC, infants admitted to the NICU for four hours or less were typically asymptomatic and undergoing evaluation for sepsis due to maternal fever during labor. These infants were not included among NICU admissions for this study. We categorized NICU admissions as either a short stay (between 4 and <24 hours) or a long stay (≥24 hours). We also compared median NICU length of stay among infants ≥37 weeks of gestation.

Institutional Review Board

The Institutional Review Board (IRB) requires every new research protocol to be filed as a New Submission Application. We submitted our application for our protocol titled "NICU admissions after the hard stop of elective deliveries before 39 weeks" on September 22, 2015. The application included a Part A form which provided basic information on the study, such as the title and the type of study. This study was considered an epidemiologic study in the form of a retrospective medical record review. We included a Part B form, which explained our study design and the relevance of our study. Four additional forms, Part M: Expedited Review, Part O: Medical Records, Part P: Data Safety Monitoring Plan, and a Health Insurance Portability and Accountability Act (HIPAA) Waiver of Authorization, were included in the submission of the protocol for an expedited review rather than a full IRB review. The HIPAA Waiver of Authorization was submitted to grant us the ability to study the medical records without obtaining consent from the patients. We also submitted a Research Staffing form along with our application, listing everyone who would be involved in the production of this study, as well as a Scientific Review form signed by the Neonatology Department Scientific Reviewer. The application was approved and activated by the Institutional Review Board on November 4, 2015.

Data Collection

Upon approval from the IRB, we initiated a retrospective medical record review. The medical record review included basic health and demographic information of both mother and baby. With respect to our study aims, we obtained the gestational age and disposition of each infant. We also collected covariate data such as maternal race and ethnicity, insurance, marital status, maternal age, gravidity, parity, mode of delivery, obstetric provider, and multiple versus singleton births.

Statistical Analyses

Once we had a complete data set, we began our analysis by categorizing infants by their gestational age. Within the gestational age distribution, our focus was on the traditionally-defined, full term infants of ≥37 weeks of gestation. We divided infants by post- and pre-period to determine whether there had been a shift in the gestational age distribution corresponding to the implementation of the ACOG hard-stop to early elective deliveries prior to 39 weeks of gestation in 2009.

Within the post- and pre-periods, we compared the proportion of births ≥37 weeks of gestation that were early-term (37-38 weeks of gestation) as well as the incidence of NICU admissions among infants ≥37 weeks of gestation using chi-square tests. NICU admissions were divided into short stays (>4 hours to <24 hours) and long stays (≥24 hours). Logistic regression was used to calculate the adjusted odds ratio (adj. OR) comparing the two periods (post-period versus pre-period) for the likelihood of both short and long NICU admission stays. We adjusted for potential confounding variables: maternal age, multiple births, race and ethnicity, insurance, and parity. We used a Wilcoxon test to compare each period for the median length of stay among infants 37 weeks or greater that were admitted to the NICU. All analyses were completed using SAS version 9.3 and R software.

RESULTS

Maternal Demographics

There were 50,373 infants born ≥37 weeks of gestation in the study period, 46,254 of whom were included in the analysis excluding 4,119 infants born in 2009, the washout period. We observed changes in maternal demographics over time (**Table 2**). In the post-period versus the pre-period, we saw a lower proportion of mothers younger than 25 years old, a lower proportion of white mothers, and a higher proportion of mothers insured by Medicaid. Other covariates were similar in the two time periods.

Gestational Age

We found that the gestational age distribution shifted to the right in the post-period (2010-2015), showing longer gestations after the 2009 policy implementation to reduce early elective deliveries (**Figure 3**). The percentage of all infants born ≥37 weeks of gestation increased from 85.3% in the pre-period to 87.0% in the post-period ($P < 0.0001$). The proportion of infants ≥37 weeks of gestation that were early-term infants (37-38 weeks) decreased from 7,279 (34.2%) in the pre-period to 6,768 (27.1%) in the post-period ($P < 0.0001$) (**Figure 4**). The reduction in the odds of early-term delivery in the post- versus pre-period persisted after adjustment for maternal age, race and ethnicity, insurance status, multiple gestations, and parity (adjusted odds ratio [adj. OR] 0.71; 95% confidence interval [CI] 0.68, 0.74). Further adjustment for marital status did not change this estimate; thus it was included in the final model.

Table 2. Maternal Demographics	**2004-2008**	**2010-2015**	
	n = 21,280	n = 24,974	
	%	**%**	***Chi Square P***
Maternal age (years)			<0.0001
<25	8.3	6.7	
25 - <35	55.1	58.1	
≥35	36.6	35.2	
Race/ethnicity			<0.0001
White	60.4	47.4	
Black	10.3	10.3	
Hispanic	5.3	5.2	
Asian	13.2	15.3	
Other/unknown	10.8	21.9	
Insurance			<0.0001
Private	82.1	81.1	
Medicaid	13.3	15.9	
Other	4.7	3.1	
Multiparous	52.7	51.1	0.0009
Singleton gestation	97.3	97.6	0.08
Married	83.4	77.9	<0.0001
Missing data: Insurance n = 31; Married n = 1646.			

Table 2. Maternal demographics. Maternal demographics are displayed by percentage of mothers in the pre-period (2004-2008) versus the post-period (2010-2015).

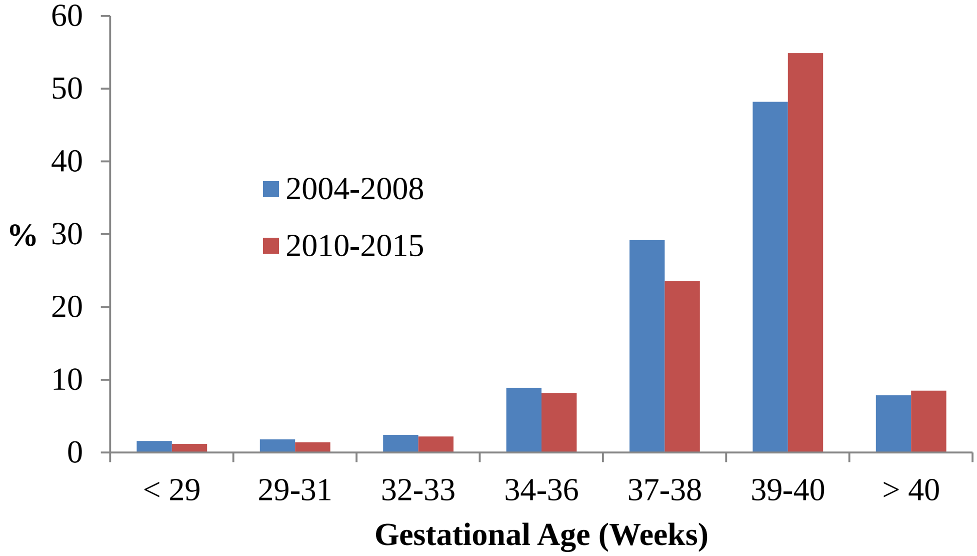

Figure 3. Gestational age distribution in the pre- and post-periods. The gestational age distribution shifted to the right in the post-period (2010-2015) showing longer gestations after the 2009 policy change to reduce early elective deliveries.

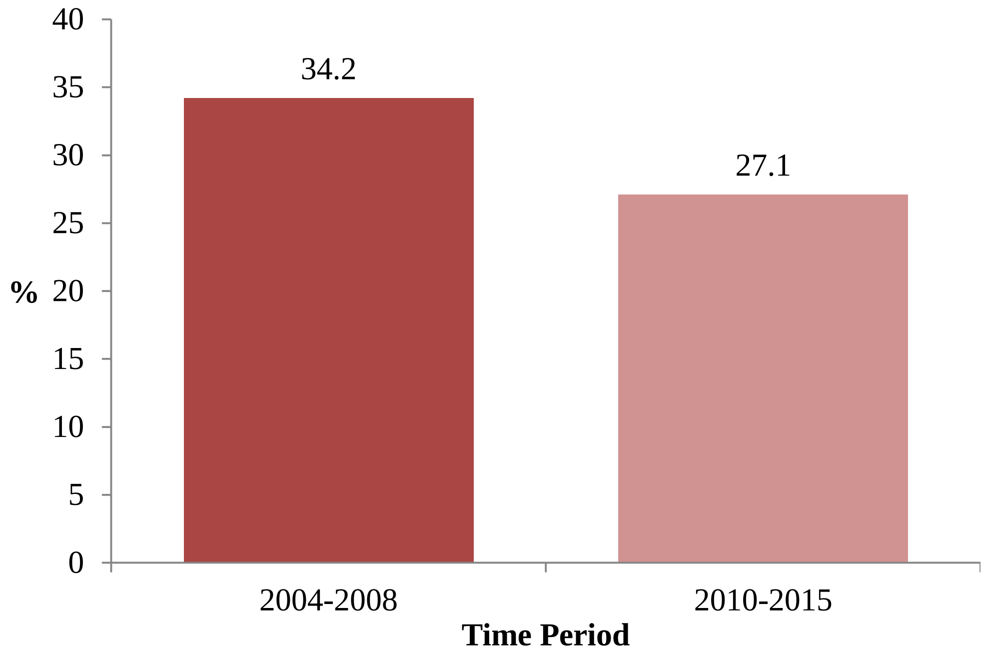

Figure 4. The proportion of infants ≥37 weeks of gestation that were early-term (37-38 weeks) in the pre- and post-periods. The proportion of infants ≥37 weeks of gestation that were early-term infants (37-38 weeks of gestation) decreased substantially in the post-period (2010-2015) to a value of 27.1% compared with the pre-period (2004-2008) value of 34.2%.

NICU Admissions

The percentage of infants ≥37 weeks admitted to the NICU decreased slightly, though not with statistical significance, from 9.1% in the pre-period to 8.9 % in the post-period ($P = 0.3$) (**Figure 5**). The incidence of short-stay NICU admissions, >4 to <24 hours, decreased substantially from 5.3% in the pre-period to 4.6% in the post-period ($P < 0.0001$). Conversely, the incidence of long-stay NICU admissions, ≥24 hours, increased from 3.8% in the pre-period to 4.3% in the post-period ($P = 0.006$) (**Figure 5**). After adjustment for potential confounding variables of maternal age, race and ethnicity, insurance status, multiple gestations, and parity, the reduction in the odds of short NICU stays in the post-period versus the pre-period persisted (adj. OR 0.84; 95% CI 0.77, 0.91), as did the increase in the odds of NICU stays that were at least 24 hours in length (adj. OR 1.16; 95% CI 1.05, 1.27). Consistent with the increase in the incidence of long NICU admissions, we observed a substantial increase in the median length of stay (LOS) among infants ≥37 weeks of gestation admitted to the NICU for >4 hours, from 21 hours in the pre-period to 39 hours in the post-period ($P < 0.0001$) (**Figure 6**).

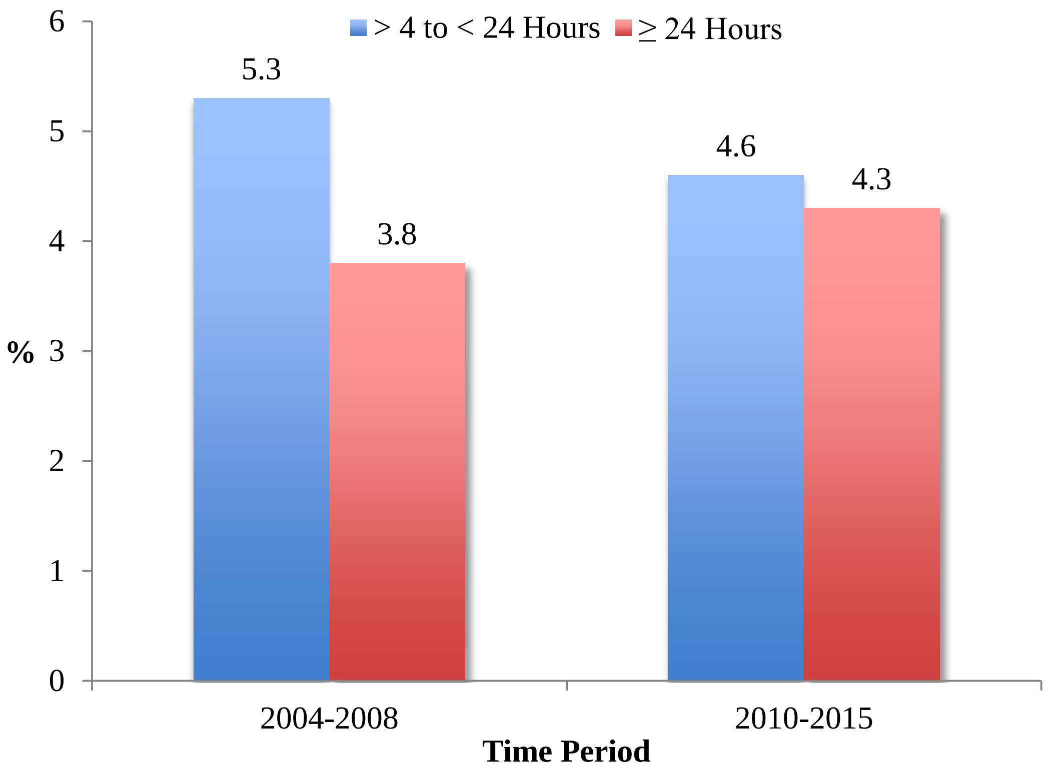

Figure 5. Short and long NICU admissions among infants ≥37 weeks in the pre- and post-periods. With respect to NICU admissions, we observed a slight, insignificant decrease in overall NICU admissions among infants greater than or equal to 37 weeks, from 9.1% in the pre-period (2004-2008) to 8.9% in the post-period (2010-2015) (P = 0.3). For short NICU admissions (>4 to <24 hours), there was a substantial decrease from 5.3% in the pre-period to 4.6% in the post-period (P < 0.0001). For long NICU admissions (≥24hours), there was a more subtle increase from 3.8% in the pre-period to 4.3% in the post-period (P = 0.006).

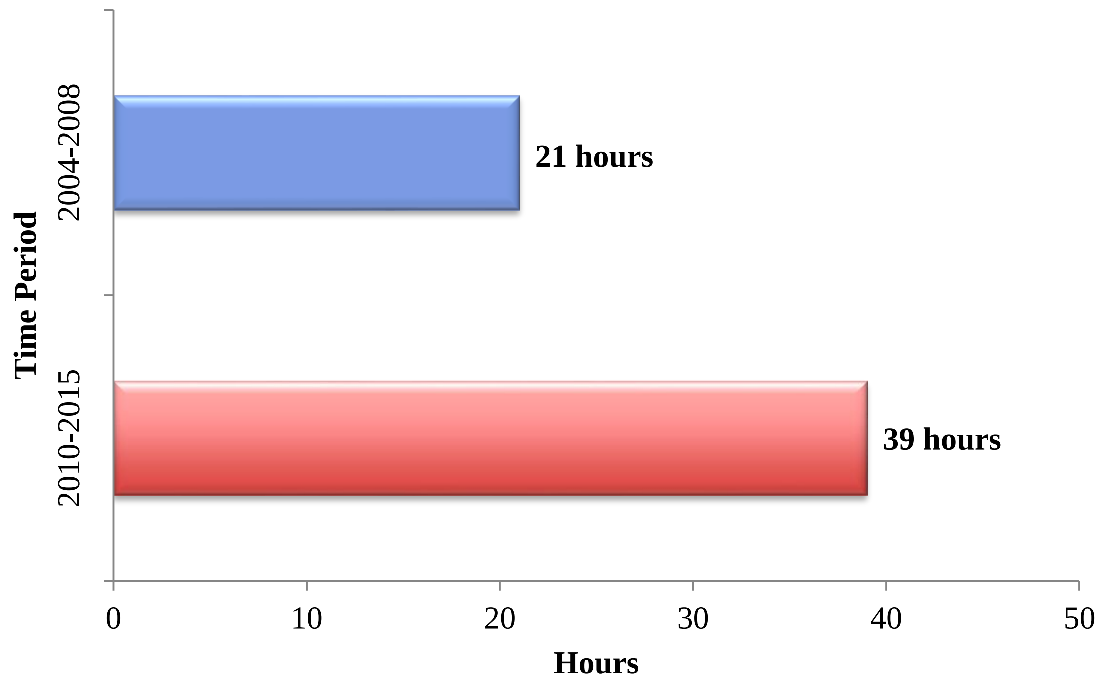

Figure 6. Median length of stay among infants ≥37 weeks. A substantial increase from 21 hours in the pre-period (2004-2008) to 39 hours in the post-period (2010-2015) ($P < 0.0001$) was evident in the median length of stay (LOS) among infants ≥37 weeks of gestation admitted to the NICU for >4 hours.

Restricting to Singleton Gestations

After analyzing the outcomes of NICU admissions, we performed additional statistical analyses to ensure that our results were applicable to singleton births. Removing multiple births from the data is useful in a study centered on gestational age, especially since multiple births are more likely to result in earlier spontaneous deliveries and thus shorter gestations than singleton births ("National Vital Statistics Reports, Volume 64, Number 1, January 15, 2015 - nvsr64_01.pdf," n.d.**)**. Furthermore, the local policy to reduce early elective deliveries was focused on singleton births. Our findings did not differ when we restricted the analysis to singleton births alone. Similar to the results that included all births (singleton and multiple births) (**Figure 5**), there was a substantial decrease in the incidence of short NICU admissions (>4 to <24 hours) from 5.6% in the pre-period (2004-2008) to 4.8% in the post-period (2010-2015) ($P < 0.0001$) (**Figure 7**). As with all births, we also saw a more subtle increase in the incidence of long NICU admissions (≥24 hours) for singleton births from 3.8% in the pre-period to 4.3% in the post-period ($P = 0.006$).

When we performed separate adjusted logistic regression models to estimate the odds ratios of short NICU admissions for all births and for singleton only births, we saw similar odds of short NICU admission by each covariate. Of most interest, we found that there was a similar reduction in the odds of short NICU admissions among infants born prior to 39 weeks for all births in the post- versus pre-period (adj. OR 0.84; 95% CI 0.77, 0.91), and for singletons only in the post- versus pre-period (adj. OR 0.83; 95% CI 0.76, 0.91) (**Tables 3 and 4**).

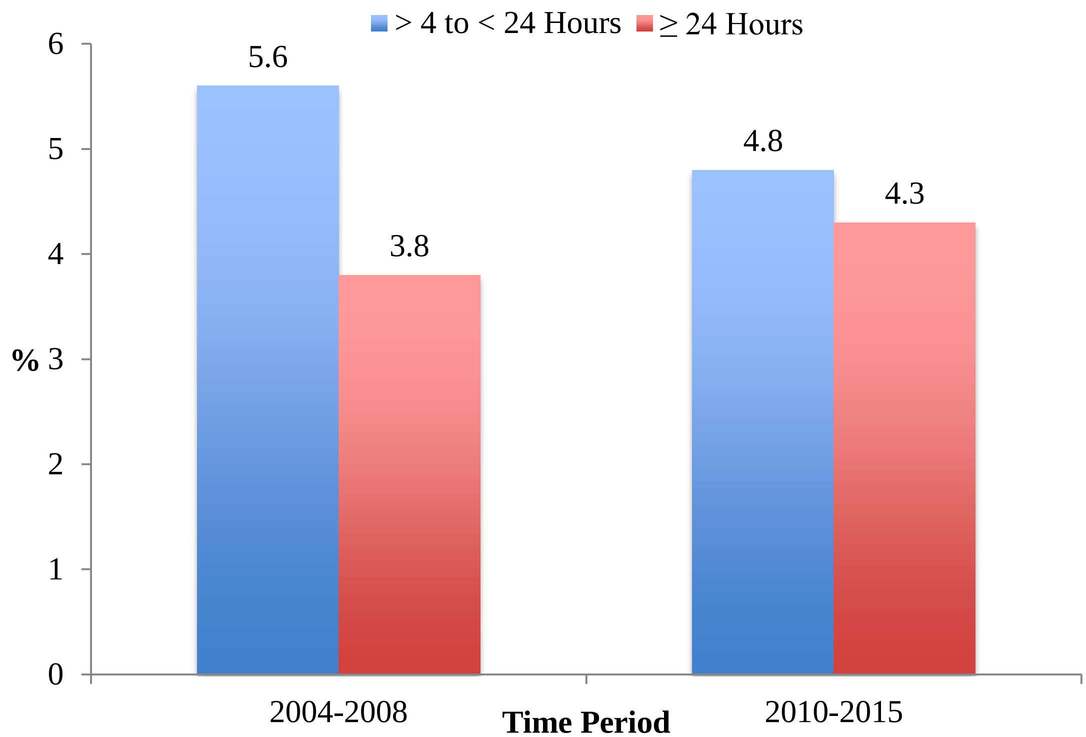

Figure 7. Short and long NICU admissions among singleton infants ≥37 weeks in the pre- and post-periods. When we compared short and long NICU admissions in the pre- and post-periods among singleton infants only, our findings did not differ significantly from the NICU admissions including both singleton and multiple births. We saw a substantial decrease in the incidence of short NICU admissions (>4 to <24 hours) from 5.6% in the pre-period (2004-2008) to 4.8% in the post-period (2010-2015) (P < 0.0001). We saw a more subtle increase in the incidence of long NICU admissions (≥24 hours) from 3.8% in the pre-period to 4.3% in the post-period (P = 0.006).

All Births (Singletons and Multiples)	
Effect	**Odds Ratio (95% CI)**
Early	0.84 (0.77, 0.91)
Age	
≥35 years	0.94 (0.86, 1.04)
<25 years	1.06 (0.89, 1.25)
Multiparous	1.92 (1.75, 2.10)
Race/Ethnicity	
Black	0.88 (0.75, 1.02)
Hispanic	0.90 (0.74, 1.10)
Asian	0.82 (0.72, 0.93)
Other Race	1.02 (0.90, 1.15)
Insurance	
Medicaid	0.95 (0.83, 1.08)
Other Insurance	1.03 (0.82, 1.29)
Singleton	0.63 (0.45, 0.87)

Table 3. Adjusted odds of short NICU admissions (>4 to <24 hours) versus <4 hours (or no admission) among all infants ≥37 weeks at BIDMC in the post-period (2010-2015) versus the pre-period (2004-2008). The adjusted odds ratio of short admissions versus no admission among infants ≥37 weeks of gestation in the post-period (2010-2015) versus the pre-period (2004-2008) of two models, multiple and singleton births and singleton births only, showed no significant difference in incidence of short NICU admissions.

Singleton Births Only	
Effect	**Odds Ratio (95% CI)**
Early	0.83 (0.76, 0.91)
Age	
≥35 years	0.94 (0.86, 1.04)
<25 years	1.06 (0.89, 1.26)
Multiparous	1.92 (1.75, 2.11)
Race/Ethnicity	
Black	0.87 (0.75, 1.01)
Hispanic	0.89 (0.73, 1.09)
Asian	0.81 (0.71, 0.92)
Other Race	1.02 (0.90, 1.15)
Insurance	
Medicaid	0.95 (0.83, 1.08)
Other Insurance	1.03 (0.82, 1.29)

Table 4. Adjusted odds of short NICU admissions (>4 to <24 hours) versus <4 hours (or no admission) among singleton infants ≥37 weeks at BIDMC in the post-period (2010-2015) versus the pre-period (2004-2008). The adjusted odds ratio of short admissions versus no admission among infants ≥37 weeks of gestation in the post-period (2010-2015) versus the pre-period (2004-2008) of two models, multiple and singleton births and singleton births only, showed no significant difference in incidence of short NICU admissions.

DISCUSSION

Strengths and Limitations

The strengths of our study include the large sample size of 46,254 infants meeting the study criteria, our study period consisting of a wide range of years pre- and post-policy implementation, and our ability to examine the implications that this new policy has had on NICU utilization. We also had access to several potential confounding variables allowing us to adjust for potential secular trends that could be responsible for our findings. There have been multiple studies since ACOG published their recommendations that analyzed the change the policy has had on obstetric practice and neonatal outcomes, but the impact on NICU utilization has been largely unstudied. Our ability to look at the consequences that the new obstetric guidelines have had on NICU utilization is what makes our study novel. The data we are currently working to obtain on NICU diagnoses among admitted infants will further strengthen our future work on this study.

Our study was limited by the single-center, retrospective, post- versus pre-policy study design. Single-center studies may have limited generalizability to other settings, and findings from observational retrospective studies may have other explanations than the tested hypothesis. For example, secular trends in maternal morbidities or referral patterns may have affected infant NICU utilization rates among full term infants. Although we adjusted for several covariates, residual confounding may still be present within our multivariable logistic regression models.

Summary, Interpretation, and Future Work

The results of this study suggest that the BIDMC policy, adopted in 2009 to limit early elective deliveries, was associated with changes with respect to gestational age and NICU admissions. After the policy implementation, there was a reduction in the proportion of early-term births, a lower incidence (not statistically significant) of NICU admissions for infants 37 weeks or greater, and a lower incidence of short stays in the NICU among infants 37 weeks or greater. Given these findings, the policy change was associated with a lower likelihood of brief postpartum separations from the mother.

In addition, after the 2009 policy change, a higher proportion of infants $\geq$37 weeks required NICU stays of at least 24 hours. These findings suggest that a reduction in early elective deliveries may not affect the incidence of significant morbidities. The increases in long NICU admissions and length of stay are in contrast to our hypothesis that the policy implementation would result in a decrease in length of NICU stay. Our future work will involve investigating the inconsistency between our hypothesis and our findings.

Our ongoing and future analysis comprises an examination of individual NICU diagnoses and infant morbidities. We are in the process of obtaining clinical information that could identify NICU diagnoses among infants who were admitted >4 hours. Diagnoses of interest include respiratory distress, hyperbilirubinemia, feeding immaturity, thermoregulatory immaturity, hypoglycemia, and transient tachypnea of the newborn. We use two methods to obtain data on these diagnoses of interest. The first method involves ICD-9 codes for respiratory distress syndrome (RDS), transient tachypnea of the newborn (TTN), and hypoglycemia. The second method uses documentation of mechanical devices to obtain data on hyperbilirubinemia (use of phototherapy), thermoregulatory immaturity (use of an isolette in the absence of phototherapy), and feeding immaturity (use of a nasogastric tube for feeding).

Future research includes determining whether testing for the aforementioned diagnoses in the NICU may have become more prevalent during the post-period. If true, this finding may provide an explanation for the higher proportion of admitted infants ≥37 weeks requiring longer lengths of stay. One diagnosis that we are particularly interested in is hypoglycemia. The incidence of gestational diabetes has increased over the last several years at our institution from 4.0% to 5.4% among mothers of infants ≥37 weeks of gestation. Infants born to mothers with gestational diabetes are at higher risk for post-natal hypoglycemia. Furthermore, testing for hypoglycemia at BIDMC has become more common among full term infants born to mothers with gestational diabetes, or infants who are large-for-gestational age or small-for-gestational age. When hypoglycemia is diagnosed, infants are often placed on intravenous fluids and require longer NICU admissions. Next steps for this work involve delving further into which other diagnoses may have contributed to a higher incidence of long NICU stays and a higher median length of stay among full term infants.

REFERENCES

AppendixATJC - Manual - Performance Measurement Network. (n.d.). Retrieved March 18, 2016, from https://manual.jointcommission.org/releases/TJC2013A/AppendixATJC.html#Table_Number_11_07_Conditions_Po

Born Too Early: Improving Maternal and Child Health by Reducing Early Elective Deliveries. (n.d.). Retrieved March 13, 2016, from http://www.nihcm.org/born-too-early-improving-maternal-and-child-health-by-reducing-early-elective-deliveries-issue-brief

Brown, H. K., Speechley, K. N., Macnab, J., Natale, R., & Campbell, M. K. (2015). Maternal, fetal, and placental conditions associated with medically indicated late preterm and early term delivery: a retrospective study. *BJOG: An International Journal of Obstetrics and Gynaecology*. http://doi.org/10.1111/1471-0528.13428

Children's Health Insurance Program (CHIP). (n.d.). Retrieved March 13, 2016, from https://www.medicaid.gov/chip/chip-program-information.html

Clark, S. L., Frye, D. R., Meyers, J. A., Belfort, M. A., Dildy, G. A., Kofford, S., Englebright, J., & Perlin, J. A. (2010). Reduction in elective delivery at <39 weeks of gestation: comparative effectiveness of 3 approaches to change and the impact on neonatal intensive care admission and stillbirth. *American Journal of Obstetrics and Gynecology*, *203*(5), 449.e1–6. http://doi.org/10.1016/j.ajog.2010.05.036

Ehrenthal, D. B., Hoffman, M. K., Jiang, X., & Ostrum, G. (2011). Neonatal outcomes after implementation of guidelines limiting elective delivery before 39 weeks of gestation. *Obstetrics and Gynecology*, *118*(5), 1047–1055. http://doi.org/10.1097/AOG.0b013e3182319c58

Glavind, J., Henriksen, T. B., Kindberg, S. F., & Uldbjerg, N. (2013). Randomised trial of planned caesarean section prior to versus after 39 weeks: unscheduled deliveries and facility logistics--a secondary analysis. *PloS One*, *8*(12), e84744. http://doi.org/10.1371/journal.pone.0084744

ICD9 - http://www.astho.org/JCAHO-Joint-Commission-List-of-Diagnoses/. (n.d.). Retrieved from http://www.astho.org/JCAHO-Joint-Commission-List-of-Diagnoses/

Manuck, T. A., Esplin, M. S., Biggio, J., Bukowski, R., Parry, S., Zhang, H., Huang, H., Varner, M. W., Andrews, W., Saade, G., Sadovsky, Y., Reddy, U. M., Ilekis, J., & Eunice Kennedy Shriver National Institute of Child Health and Human Development Genomics and Proteomics Network for Preterm Birth Research. (2015). The phenotype of spontaneous preterm birth: application of a clinical phenotyping tool. *American Journal of Obstetrics and Gynecology*, *212*(4), 487.e1–487.e11. http://doi.org/10.1016/j.ajog.2015.02.010

Maternal and Infant Health Care Quality. (n.d.). Retrieved March 13, 2016, from https://www.medicaid.gov/medicaid-chip-program-information/by-topics/quality-of-care/maternal-and-infant-health-care-quality.html

National Vital Statistics Reports, Volume 64, Number 1, January 15, 2015 - nvsr64_01.pdf. (n.d.). Retrieved from http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_01.pdf

Nonmedically Indicated Early-Term Deliveries - ACOG. (n.d.). Retrieved March 13, 2016, from http://www.acog.org/Resources-And-Publications/Committee-Opinions/Committee-on-Obstetric-Practice/Nonmedically-Indicated-Early-Term-Deliveries

Ob-Gyns Redefine Meaning of “Term Pregnancy” - ACOG. (n.d.). Retrieved March 13, 2016, from http://www.acog.org/About-ACOG/News-Room/News-Releases/2013/Ob-Gyns-Redefine-Meaning-of-Term-Pregnancy

Oshiro, B. T., Henry, E., Wilson, J., Branch, D. W., Varner, M. W., & Women and Newborn Clinical Integration Program. (2009). Decreasing elective deliveries before 39 weeks of gestation in an integrated health care system. *Obstetrics and Gynecology*, *113*(4), 804–811. http://doi.org/10.1097/AOG.0b013e31819b5c8c

Salemi, J. L., Pathak, E. B., & Salihu, H. M. (2016). Infant Outcomes After Elective Early-Term Delivery Compared With Expectant Management. *Obstetrics and Gynecology*. http://doi.org/10.1097/AOG.0000000000001331

Spong, C. Y., Mercer, B. M., D'alton, M., Kilpatrick, S., Blackwell, S., & Saade, G. (2011). Timing of indicated late-preterm and early-term birth. *Obstetrics and Gynecology*, *118*(2 Pt 1), 323–333. http://doi.org/10.1097/AOG.0b013e3182255999

Strong Start for Mothers and Newborns Initiative: Effort to Reduce Early Elective Deliveries | Center for Medicare & Medicaid Innovation. (n.d.). Retrieved March 13, 2016, from https://innovation.cms.gov/initiatives/Strong-Start-Strategy-1/

The World Factbook. (n.d.). [Government]. Retrieved March 17, 2016, from https://www.cia.gov/library/publications/the-world-factbook/rankorder/2091rank.html

Tita, A. T. N., Landon, M. B., Spong, C. Y., Lai, Y., Leveno, K. J., Varner, M. W., Moawad, A. H., Caritis, S. N., Meis, P. J., Wapner, R. J., Sorokin, Y., Miodovnik, M., Carpenter, M., Peaceman, A. M., O'Sullivan, M. J., Sibai, B. M., Langer, O., Thorp, J. M., Ramin, S. M., Mercer, B. M., & Eunice Kennedy Shriver NICHD Maternal-Fetal Medicine Units Network. (2009). Timing of elective repeat cesarean delivery at term and neonatal outcomes. *The New England Journal of Medicine*, *360*(2), 111–120. http://doi.org/10.1056/NEJMoa0803267

Why at least 39 weeks is best for your baby | March of Dimes. (n.d.). Retrieved March 13, 2016, from http://www.marchofdimes.org/pregnancy/why-at-least-39-weeks-is-best-for-your-baby.aspx#

Wilmink, F. A., Hukkelhoven, C. W. P. M., Lunshof, S., Mol, B. W. J., van der Post, J. A. M., & Papatsonis, D. N. M. (2010). Neonatal outcome following elective cesarean section beyond 37 weeks of gestation: a 7-year retrospective analysis of a national registry. *American Journal of Obstetrics and Gynecology*, *202*(3), 250.e1–8. http://doi.org/10.1016/j.ajog.2010.01.052

Zhang, X., & Kramer, M. S. (2009). Variations in mortality and morbidity by gestational age among infants born at term. *The Journal of Pediatrics*, *154*(3), 358–362, 362.e1. http://doi.org/10.1016/j.jpeds.2008.09.013

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EDUCATION

Bachelor of Science, May 2014
The University of Alabama, Tuscaloosa, Alabama
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Master of Medical Science, September 2014 – present
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WORK EXPERIENCE

Clinical Research Student August 2015 – present
Department of Neonatology, Beth Israel Deaconess Medical Center

- Enrollment of subjects into research study
- Collection, storage, and organization of specimen samples
- Maintain research database and related documents
- Amend and submit documents to IRB
- Medical record review
- Abstract, thesis, and manuscript writing

Department of Obstetrics and Gynecology, Beth Israel Deaconess Medical Center & Boston IVF

- Medical record review

Unit Secretary May 2012 – August 2014
Emergency Department -- University of Massachusetts Memorial Medical Center -- Worcester, Massachusetts

- Use medical programs Soarian and Ibex to enter orders for patients (ex. diagnostic tests and screenings), enter bed slips for admitted patients, update patient information regarding discharges and transitions within the hospital, and look up information necessary for treatment by medical staff
- Answer incoming and outgoing calls and pages on multiple phone lines and determine the appropriate action for each.
- Organize and file paperwork and patient medical charts
- Use fax machine and photocopier to make and send copies of various paperwork

Intern August 2012 – May 2014
Health Hut, Student Health Center -- The University of Alabama
Tuscaloosa, Alabama

- Promote health and wellness among peers by use of verbal interaction, educative games and activities, informative handouts, and social media
- Create informative handouts and materials to educate peers on health topics
- Create talking points to facilitate conversations between students and Health Hut interns
- Participate in tabling events focused towards health awareness
- Attend peer health education and interpersonal communication skill building classes including workshop for motivational interviewing

Student Observer October 2012 – May 2014
Oncology – Lewis and Faye Manderson Cancer Center
OB/GYN and Pediatrics – University Medical Center
Tuscaloosa, Alabama

- o Observe physician - patient interaction, diagnosis, and treatment
- o Observe medical school lectures and student rotation presentations
- o Participate in discussion of medical student presentation topics

LEADERSHIP **President** February 2013 – May 2014
Be The Match on Campus, The University of Alabama
Tuscaloosa, Alabama

- o Established a presence as a new student-lead organization
- o Coordinated meetings, drives, and fundraisers to inform students of the need for bone marrow donors
- o Fundraising to support national organization
- o Added over 1,200 donors to the bone marrow registry

SKILLS Microsoft Word, Microsoft PowerPoint, Microsoft Excel
REDCap Database (Research Electronic Data Capture)

ACTIVITIES/HONORS

- New England Perinatal Society (NEPS) Conference – 2016 – Oral abstract presentation

- Program Presentation -- Alcohol and Other Drugs Workshop, The University of Alabama
- Participated in Susan and Gaylon McCollough Medical Scholars Forum
- Member of Project Health (4 semesters)
- Member of Alpha Lambda Delta Honor Society (7 semesters)
- Member of Sigma Alpha Lambda Honor Society (7 semesters)
- Dean's List: Spring 2011, Fall 2013
- President's List: Spring 2014

ABSTRACT PRESENTATION

Kennedy EB, Hacker MR, Ada M, Golen T, Miedema D, Pursley DM, Burris HH. NICU admissions after a policy to reduce elective deliveries before 39 weeks. 2016. Presented as an oral presentation at the annual meeting of the New England Perinatal Society, Newport, RI.