V11.4 NPIC/QAS Special Quarterly Report:

Changes in Labor Induction and Cesarean Delivery Between 2006 and 2010 in NPIC/QAS Member Hospitals

I. Introduction

Given awareness of increasing rates of labor induction and cesarean delivery, and guidelines to reduce non-medically indicated preterm and early term births, this National Perinatal Information Center/Quality Analytic Services (NPIC/QAS) Special Report examines recent trends in delivery methods in the United States. There have been substantial changes in the use of obstetric interventions for delivery from the early 1990s until the mid 2000s [1]. Forceps or vacuum operative delivery became less common, while rates of cesarean delivery and labor induction increased [2-9]. Other trends identified in the literature included increases in repeat cesarean delivery, risk for cesarean delivery after labor induction, and preterm birth [5, 7, 10-12].

A shift of gestational age at birth to lower ages has been attributed to increased rates of delivery interventions before spontaneous onset of labor [13-16]. Research revealing adverse consequences of late preterm and early term birth resulted in recommendations to limit non-medically indicated deliveries prior to 39 weeks completed gestation [16, 17]. Some hospitals have reported successfully reducing deliveries prior to 39 weeks after implementing comprehensive programs [18-21]. However, widespread effects of such guidelines across unaffiliated hospitals, such as NPIC/QAS member hospitals, and in obstetric teaching ("academic") versus obstetric non-teaching ("nonacademic") hospitals have yet to be determined.

NPIC/QAS has provided comparative reports to member hospitals since 1985. NPIC/QAS member hospitals are grouped according to academic/nonacademic status (presence of OB/GYN residents). Currently, there are 82 member hospitals; 53 of whom (65%) have been members for 5 years or more. Any hospital that has provided data for the most recent five years is included in our trend database, allowing NPIC/QAS to provide trend analyses for many indicators of interest to our membership. This Special Report is an analysis of hospital discharge data from delivery hospitalizations for forty-seven hospitals that reported data for 2006 and 2010. We identified interventional and medically indicated deliveries from administrative hospital discharge data from 47 obstetrical academic and obstetrical nonacademic member hospitals; including 231,691 deliveries in 2006 and 213,710 deliveries in 2010. We use the Joint Commission list of "conditions possibly justifying elective delivery prior to 39 weeks gestation"[22], and add the ICD-9 code for early spontaneous onset of delivery prior to 37 weeks completed gestation (644.21) to define medically indicated deliveries. Deliveries lacking a diagnosis code for any of these conditions are classified as non-medically indicated. It is not possible to discern whether deliveries in this category, particularly term deliveries, were elective or initiated by spontaneous labor or rupture of membranes.

We also examined delivery methods by gestational age in a subset of 17 hospitals that had at least 75% of newborn records linked to the corresponding maternal record and reported completed weeks of gestation for at least 80% of mother-newborn linked records in both 2006 and 2010. The sample was restricted to live born deliveries between 20 and 44 completed weeks

gestation and deliveries resulting in multiple births were included as long as at least one newborn was live born. Outcomes evaluated included total deliveries, labor inductions, cesarean deliveries, and whether a medical indication for delivery less than 39 weeks was present in the discharge diagnoses.

II. Findings

Delivery methods
Hospitals experienced a 7.8% decrease in deliveries from 2006 to 2010; operative vaginal deliveries decreased 24% from 2006 to 2010 to less than 5 per 100 deliveries (Table 1).

Table 1: Changes in methods of delivery among 47 hospitals, 2006 - 2010

	2006	2010	Percent change
Total deliveries	231,691	213,710	-7.8%
Operative vaginal deliveries	12,795	9,001	
Proportion of total deliveries	0.055	0.042	-23.7%
Cesarean deliveries	79,286	77,486	
Proportion of total deliveries	0.342	0.363	6.0%
Primary cesarean	47,380	43,933	
Proportion of total deliveries	0.204	0.206	0.5%
Repeat cesarean	31,906	33,553	
Proportion of total deliveries	0.138	0.157	14.0%
Induction of labor	46,354	47,522	
Proportion of total deliveries	0.200	0.222	11.1%
Inductions resulting in cesarean	10,035	11,258	
Proportion of labor inductions	0.216	0.237	9.4%
Primary cesarean	9,772 (97.4%)	10,970 (97.4%)	
Repeat cesarean	263 (2.6%)	288 (2.6%)	

The proportions of deliveries involving cesarean delivery or labor induction each increased during the study period. In 2010, 36 per 100 deliveries were cesarean and 22 per 100 deliveries involved labor induction. A greater proportion of total deliveries were repeat cesarean in 2010 (16 per 100) compared to 2006 (14 per 100). Nearly 24 of every 100 labor inductions resulted in a cesarean delivery in 2010, a 9% increase over 2006.

Changes over time for operative vaginal deliveries and cesarean deliveries were similar in both academic and nonacademic hospitals (Table 2, below). Between 2006 and 2010, labor induction rates increased in academic hospitals but decreased slightly in nonacademic hospitals. The proportion of labor inductions resulting in cesarean delivery increased by 1.5 in 100 for academic hospitals but by more than 4 in 100 for nonacademic hospitals. In both 2006 and 2010, nonacademic hospitals had a significantly higher proportion of deliveries that were cesarean compared to academic hospitals. Labor induction was more common in nonacademic hospitals in 2006, but more common in academic hospitals in 2010. At both time points, labor inductions were more likely to result in cesarean delivery in nonacademic hospitals than in academic

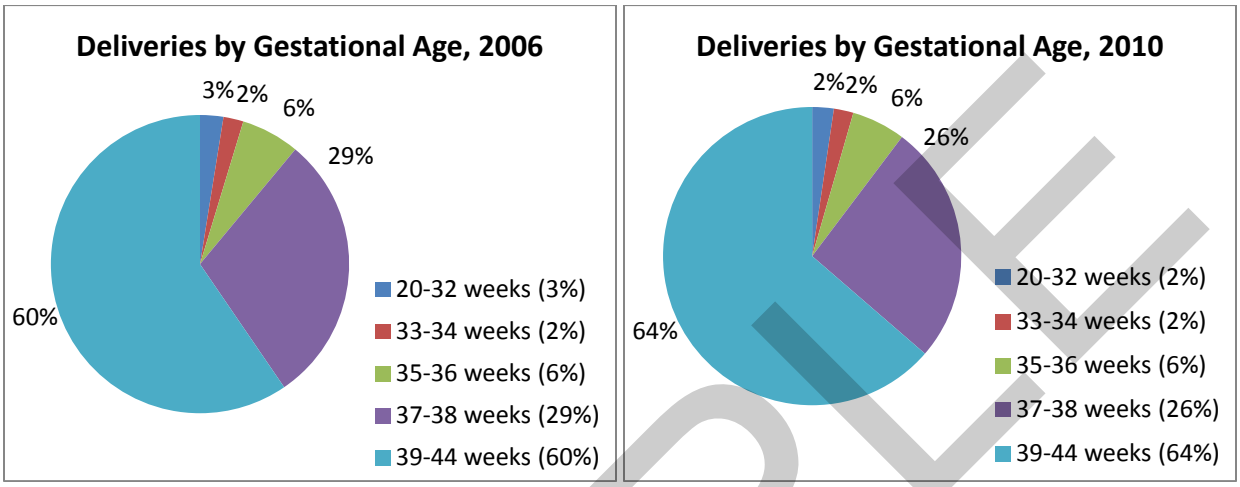
hospitals. Chi-square analyses indicate that delivery methods differed significantly ($p<.05$) between academic and nonacademic hospitals, except operative vaginal delivery in 2010.

Table 2: Changes in method of delivery in academic versus nonacademic hospitals, 2006 - 2010

	2006	2010	percent change
Total deliveries			
Academic	168,874	157,379	-6.80%
Nonacademic	62,817	56,331	-10.30%
Operative vaginal deliveries			
Academic	9,444	6,656	-24.40%
Proportion of total deliveries	0.056	0.042	
Nonacademic	3,351	2,345	-22.00%
Proportion of total deliveries	0.053	0.042	
Cesarean deliveries			
Academic	55,933	54,764	5.10%
Proportion of total deliveries	0.331	0.348	
Nonacademic	23,353	22,722	8.50%
Proportion of total deliveries	0.372	0.403	
Primary cesarean			
Academic	33,365	31,083	0.00%
Proportion of total deliveries	0.198	0.198	
Nonacademic	14,015	12,850	2.20%
Proportion of total deliveries	0.223	0.228	
Repeat cesarean			
Academic	22,568	23,681	12.60%
Proportion of total deliveries	0.134	0.15	
Nonacademic	9,338	9,872	17.90%
Proportion of total deliveries	0.149	0.175	
Induction of labor			
Academic	32,683	35,672	17.10%
Proportion of total deliveries	0.194	0.227	
Nonacademic	13,671	11,850	-3.30%
Proportion of total deliveries	0.218	0.21	
Resulting in cesarean			
Academic	6,892	8,047	7.00%
Proportion of labor inductions	0.211	0.226	
Nonacademic	3,143	3,211	17.90%
Proportion of labor inductions	0.23	0.271	
Primary cesarean			
Academic	6,743	7,807	
Proportion of cesareans	97.8%	97.0%	
Nonacademic	3,029	3,163	
Proportion of cesareans	96.4%	98.5%	
Repeat cesarean			
Academic	149	240	
Proportion of cesareans	2.2%	3.0%	
Nonacademic	114	48	
Proportion of cesareans	3.6%	1.5%	

Outcomes by gestational age
For the described subset of 17 hospitals, the largest changes between 2006 and 2010 were observed at later gestational ages (Figure 1). In 2006, 40% of total deliveries occurred in week 38 or earlier, while in 2010 only 36% of total deliveries occurred in week 38 or earlier.

Figure 1: Composition of total deliveries by gestational age among 17 hospitals in 2006 and 2010



There was a trend toward fewer late term births, as pregnancies reaching the 40th and 41st weeks were more likely to be induced in those respective weeks in 2010 compared to 2006. The largest changes in gestational age specific delivery method incidence between 2006 and 2010 were in weeks 38 and 39. Incidences decreased for labor induction in week 38 (4.2 per 100 total deliveries in 2006 to 3.1 per 100 total deliveries in 2010), primary cesarean delivery in week 38 (2.9 per 100 to 2.2 per 100), and repeat cesarean delivery in week 38 (4.4 per 100 to 3.0 per 100). Incidences increased for labor induction in week 39 (7.5 per 100 deliveries in 2006 to 8.8 per 100 deliveries in 2010), and repeat cesarean delivery in week 39 (5.2 per 100 to 8.2 per 100).

Indications for early term delivery
As illustrated above in Figure 1, early term births (37-38 weeks) comprised 29% of all deliveries in 2006, but declined to 26% of deliveries in 2010. Similarly, 32% of cesarean deliveries occurred early term in 2006, while only 26% occurred early term in 2010. Finally, 24% of labor inductions occurred early term in 2006, while 20% occurred early term in 2010. There were also slight reductions in the proportion of late preterm deliveries at 35-36 weeks. When focusing on early term deliveries, we found that early term non-indicated iatrogenic deliveries were more common at nonacademic hospitals and had a smaller decline over time compared to academic hospitals (Table 3).

Note: in Table 3 below, iatrogenic deliveries include labor inductions and cesarean deliveries. Percentages shown are calculated among pregnancies that reached 37 weeks.

Table 3: Early term deliveries at 17 hospitals by indication and hospital academic status, 2006 and 2010

	2006		2010	
	#	%	#	%
Pregnancies that reached 37 weeks				
Academic	44,686		43,070	
Nonacademic	14,170		12,999	
Spontaneous delivery 37-38 weeks				
Academic	6,703	15.0%	6,223	14.4%
Nonacademic	2,067	14.6%	1,808	13.9%
Indicated iatrogenic delivery 37-38 weeks				
Academic	4,848	10.8%	4,448	10.3%
Nonacademic	1,149	8.1%	1,093	8.4%
Non-indicated iatrogenic delivery 37-38 weeks				
Academic	3,404	7.6%	1,811	4.2%
Nonacademic	1,289	9.1%	905	7.0%
Continued to week 39				
Academic	29,731	66.5%	30,588	71.0%
Nonacademic	9,665	68.2%	9,193	70.7%

III. Summary

This analysis of longitudinal data from NPIC/QAS member hospitals identified continuing trends for decreasing rates of operative vaginal deliveries and increasing rates of cesarean delivery and labor induction. The incidence of primary cesarean delivery remained relatively constant between 2006 and 2010, but increases in repeat cesarean delivery drove the overall increase in cesarean incidence. Labor inductions increased by more than 11% in four years. Labor inductions have been shown previously to increase the risk for cesarean delivery compared to spontaneous labor [12]. More concerning, we show a significant increase in the proportion of labor inductions that ended in cesarean delivery in 2010 compared to 2006. Delivery methods differed slightly between academic and nonacademic hospitals, with nonacademic hospitals experiencing more cesarean deliveries and a smaller decline in non-medically indicated early term births.

Spontaneous deliveries remained relatively constant over time at weeks 38 and 39, while labor inductions and repeat cesarean deliveries declined in week 38 and increased in week 39. Reductions in early term births were largely limited to week 38, as there were few changes in delivery incidence and methods over time at week 37. The reductions in early term births between 2006 and 2010 are likely to reflect successful efforts to limit unnecessary births prior to 39 completed weeks gestation.

Note: this special report is based on a manuscript that has been submitted for publication.

IV. References

1. MacDorman, M.F., E. Declercq, and J. Zhang, *Obstetrical intervention and the singleton preterm birth rate in the United States from 1991-2006.* Am J Public Health, 2010. 100(11): p. 2241-7.
2. Menacker, F. and B.E. Hamilton, *Recent trends in cesarean delivery in the United States.* NCHS Data Brief, 2010(35): p. 1-8.
3. Denk, C.E., L.K. Kruse, and N.J. Jain, *Surveillance of cesarean section deliveries, New Jersey, 1999-2004.* Birth, 2006. 33(3): p. 203-9.
4. MacDorman, M.F., F. Menacker, and E. Declercq, *Cesarean birth in the United States: epidemiology, trends, and outcomes.* Clin Perinatol, 2008. 35(2): p. 293-307, v.
5. Martin, J.A., et al., *Annual summary of vital statistics: 2006.* Pediatrics, 2008. 121(4): p. 788-801.
6. Ananth, C.V. and A.M. Vintzileos, *Trends in cesarean delivery at preterm gestation and association with perinatal mortality.* Am J Obstet Gynecol, 2011. 204(6): p. 505 e1-8.
7. Bettegowda, V.R., et al., *The relationship between cesarean delivery and gestational age among US singleton births.* Clin Perinatol, 2008. 35(2): p. 309-23, v-vi.
8. MacDorman, M.F., et al., *Trends and characteristics of induced labour in the United States, 1989-98.* Paediatr Perinat Epidemiol, 2002. 16(3): p. 263-73.
9. Wier, L.M., et al., *HCUP Facts and Figures: Statistics on Hospital-based Care in the United States, 2009.* Agency for Healthcare Research and Quality, 2011: p. 1-101.
10. Martin, J.A., M.J. Osterman, and P.D. Sutton, *Are preterm births on the decline in the United States? Recent data from the National Vital Statistics System.* NCHS Data Brief, 2010(39): p. 1-8.
11. MacDorman, M., E. Declercq, and F. Menacker, *Recent trends and patterns in cesarean and vaginal birth after cesarean (VBAC) deliveries in the United States.* Clin Perinatol, 2011. 38(2): p. 179-92.
12. Ehrenthal, D.B., X. Jiang, and D.M. Strobino, *Labor induction and the risk of a cesarean delivery among nulliparous women at term.* Obstet Gynecol, 2010. 116(1): p. 35-42.
13. Murthy, K., et al., *Trends in induction of labor at early-term gestation.* Am J Obstet Gynecol, 2011. 204(5): p. 435 e1-6.
14. Lisonkova, S., J.A. Hutcheon, and K.S. Joseph, *Temporal trends in neonatal outcomes following iatrogenic preterm delivery.* BMC Pregnancy Childbirth, 2011. 11: p. 39.
15. Joseph, K.S., K. Demissie, and M.S. Kramer, *Obstetric intervention, stillbirth, and preterm birth.* Semin Perinatol, 2002. 26(4): p. 250-9.
16. Davidoff, M.J., et al., *Changes in the gestational age distribution among U.S. singleton births: impact on rates of late preterm birth, 1992 to 2002.* Semin Perinatol, 2006. 30(1): p. 8-15.
17. Tita, A.T., et al., *Timing of elective repeat cesarean delivery at term and neonatal outcomes.* N Engl J Med, 2009. 360(2): p. 111-20.
18. Oshiro, B.T., et al., *Decreasing elective deliveries before 39 weeks of gestation in an integrated health care system.* Obstet Gynecol, 2009. 113(4): p. 804-11.
19. Fisch, J.M., et al., *Labor induction process improvement: a patient quality-of-care initiative.* Obstet Gynecol, 2009. 113(4): p. 797-803.
20. Clark, S.L., et al., *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.* Am J Obstet Gynecol, 2010. 203(5): p. 449 e1-6.
21. Ehrenthal, D.B., et al., *Neonatal outcomes after implementation of guidelines limiting elective delivery before 39 weeks of gestation.* Obstet Gynecol, 2011. 118(5): p. 1047-55.
22. Commission, T.J., *Specifications Manual for Joint Commission National Quality Core Measures - Version 2011A.* 2010.