

Labor Induction Process Improvement

A Patient Quality-of-Care Initiative

John M. Fisch, MD, MMM, Dennis English, MD, MMM, Susan Pedaline, MSN, Kerri Brooks, MSN, and Hyagriv N. Simhan, MD, MSCR

OBJECTIVE: To examine the effects that medical staff education and a new process for scheduling inductions had on decreasing inappropriate inductions.

METHODS: At our institution in 2004, guidelines were developed and shared with the medical staff and reinforced in 2005. The guidelines for elective induction required patients to have completed 39 weeks of gestation and to have a Bishop score of at least 8 for nulliparas and 6 for multiparas. In 2006, the induction scheduling process was changed and the guidelines were strictly enforced. All scheduled inductions during the same 3-month time period (June through August) in 2004 (n=533) and 2005 (n=454) and during a 13-month period from November 2006 to December 2007 (n=1,806) were compared. Outcomes included elective inductions less than 39 weeks, cesarean birth rate for elective inductions among nulliparas, and the overall induction rate.

RESULTS: From 2004–2007, the overall induction rate dropped from 24.9% to 16.6%, a 33% reduction ($P<.001$); the elective induction rate dropped from 9.1% to 6.4%, a 30% reduction ($P<.001$); the percentage of elective inductions before 39 weeks of gestation dropped from 11.8% to 4.3%, a decrease of 64% ($P<.001$); and the frequency of cesarean delivery among nulliparas undergoing elective induction dropped from 34.5% to 13.8%, a decrease of 60%. ($P=.01$).

CONCLUSION: Medical staff education and the development and enforcement of induction guidelines contributed to a decrease in inappropriate inductions, a

lower cesarean birth rate for electively induced nulliparas, and a lower elective and overall induction rate.

(*Obstet Gynecol* 2009;113:797–803)

LEVEL OF EVIDENCE: III

Traditionally, induction of labor has been undertaken when the potential risks of continuing the pregnancy outweigh the benefits of expectant management. The frequency of labor induction nationally has increased dramatically over the past 20 years, from an incidence of 9% in 1989 to 21% in 2004, according to the National Center for Health Statistics.¹ The increase in inductions is thought to be due to several factors, including an increase in elective inductions either due to patient preference, physician practice style, or the practice of defensive medicine.^{2–4}

Magee-Womens Hospital is the largest maternity hospital in Western Pennsylvania, performing more than 9,300 deliveries in 2007. Magee has also seen a rise in the use of induction, reaching a high of 28% in 2003. In 2004 The Quality Assurance Committee of the Department of Obstetrics and Gynecology at Magee began evaluating inductions performed from a quality perspective, specifically targeting inappropriate inductions. Inappropriate inductions were defined as elective inductions performed before 39 completed weeks or before the cervix was ripe. In 2004, guidelines were developed based on the American College of Obstetricians and Gynecologists (ACOG) standards.⁵ The guidelines permitted elective induction only after 39 weeks, required accurate gestational age dating, and advised a Bishop score greater than or equal to 8 for nulliparous patients and greater than or equal to 6 for multiparous patients before scheduling an elective induction. Cervical ripening agents were not to be used when performing an elective induction. Elective inductions that do not meet criteria recommended by ACOG (at least 39 weeks of gestation and Bishop's score more than 8) can result in increased

From the Magee-Womens Hospital of University of Pittsburgh Medical Center; and Department of Obstetrics, Gynecology and Reproductive Sciences, Division of Maternal-Fetal Medicine, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania.

Corresponding author: John M. Fisch, MD, MMM, One Monroeville Center, Monroeville, PA 15146; e-mail: jfisch@mail.magee.edu.

Financial Disclosure

The authors did not report any potential conflicts of interest.

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ISSN: 0029-7844/09



risk for infection, premature delivery, neonatal intensive care unit admissions, longer labor, and the need for cesarean delivery, especially in nulliparas with an unripe cervix.^{2,6-12} In 2006, a process improvement initiative changed the induction scheduling process and strictly enforced the guidelines. The goal was to reduce the frequency of these inappropriate inductions, and in doing so, lower the overall induction rate. The purpose of this article is to report the effect of physician education and a change in the induction scheduling process on the frequency of inappropriate inductions.

MATERIALS AND METHODS

This retrospective study had three study groups: all scheduled inductions at Magee-Womens Hospital of the University of Pittsburgh Medical Center during the 3-month periods of June through August in 2004 and 2005, and the 13-month period of November 2006 to December 2007. The time frame for the first audit was chosen arbitrarily shortly after induction guidelines were implemented. The second audit was intentionally done exactly 1 year later to look for any change. The third study period started when the induction scheduling process was changed. The data on the first two study periods were collected by review of the induction scheduling book, chart review, and a computerized database of delivery outcomes. A computerized scheduling process replaced the manual induction scheduling book in 2006 and this was used to collect data for the third study period. In 2006, as part of our initiative, a computerized scheduling process (MIDAS—Medical Information Data Analysis System, Affiliated Computer Systems, Tucson, AZ) replaced the manual process of writing into an induction scheduling book. Subsequently, all inductions were scheduled using the MIDAS health management software. A hierarchical database was formed with links to our patient registration software. In this way, patient demographics and delivery outcomes were linked for analysis and real-time access. In addition, an audit form was developed that went on the front of the chart of every patient who presented to the labor and delivery unit for induction. This information was also entered into MIDAS after delivery. Managing inductions has become a continuous quality improvement project, and these data are now reviewed monthly. Patients who were scheduled for induction but who went into spontaneous labor were excluded from the study groups. Data collected included gestational age, the stated reason for induction, the inducing physician, gravidity, parity, Bishop score, and the delivery outcomes. Elective inductions

were defined as all inductions without a medical or obstetric indication and included logistic inductions with indications such as a prior history of rapid labor or advanced cervical dilation. Any scheduled post-term induction less than 41 0/7 weeks was reclassified as an elective induction. It is possible that some inductions classified as elective may have had valid indications, but were not apparent from a chart review. Every effort was made to be as consistent as possible in applying the definition of elective induction. Inductions were performed using standardized institutional oxytocin protocols, and cervical ripening for medical and postterm inductions, when used, was accomplished with prostaglandin, E₂ gel, Foley bulb, or misoprostol 25 micrograms vaginally. Per the induction guidelines, cervical ripening agents were not to be used with elective inductions.

The first audit in 2004 was done shortly after the induction guidelines were implemented. A physician champion was chosen to share the results with the medical staff at meetings, through articles in medical staff newsletters, and in one-on-one conversation. A slide presentation of the results was given by the physician champion at numerous committee meetings (Obstetrical Services, Quality Assurance, and the general Medical Staff meeting, among others). With the support of the Vice President for Medical Affairs, the Medical Director of the Birth Center, the Chairman of the Department of Obstetrics, Gynecology and Reproductive Sciences, and the Chief Executive Officer of Magee Hospital, the message was delivered repetitively and consistently. These informational opportunities were accompanied by recommendations to medical staff about the induction guidelines and a process to conduct peer review of all elective inductions less than 39 weeks. A computerized induction scheduling process was also recommended for data collection/research/audit purposes, along with a requirement to provide a Bishop score when scheduling inductions.

In 2005 another 3-month audit was done of the same 3 months as the prior year, looking at the same indicators. Once again, the data were shared with the medical staff, comparing 2004 to 2005, and similar recommendations were made.

In 2006, a task force was developed to address a multitude of patient volume and staffing management issues within the Birth Center. The task force membership was chosen strategically to maximize physician and nurse enthusiasm and participation. Included on the task force were private attendings, faculty attendings, physician administrators, the Medical Director of the Birth Center, and the nurse manager of the



Birth Center. Meetings were held monthly for an hour at a time from 7 AM to 8 AM to ensure maximal attendance before the start of the normal work day. Most of the work was done “behind the scenes” by the authors and brought to the committee for discussion and approval. After reviewing patient volume patterns, the task force determined that there was a strikingly uneven distribution of scheduled labor inductions. In late 2006, the task force changed the induction scheduling process. The criteria for elective induction were kept the same, but now they were strictly enforced. Also, the number of induction slots was decreased from 13 to eight, and an induction could not be scheduled more than 1 week before the planned delivery. The number of induction slots was compared to actual inductions accomplished per day. With 13 slots per day, there frequently was poor capacity management and less than optimal bed and staff utilization. The time frames for the eight induction slots were chosen based on historical and anticipated patient flow, bed availability, leveling of workload, and physician practice preferences.

The eight induction slots were independent of the cesarean delivery schedule. The eight scheduled induction times were flexible, 3-hour time windows to allow staff to “pull” patients into the department as beds were available, rather than specific appointment times. Our previous experience with specific appointment times was one of potentially (and frequently) disappointing a patient and/or physician with delays.

To enforce the induction guidelines, inductions that did not meet criteria were reviewed on a monthly basis by the Process Improvement Team. The attending physician responsible for the induction was contacted and educated about the guidelines. Peer review was performed and letters from the Vice President of Medical Affairs sent to physicians who scheduled

inductions that did not follow the guidelines. This became part of their permanent recredentialing file. As the guidelines have become known throughout our institution, a more proactive approach has developed with the secretary who schedules inductions. The scheduler is empowered to seek the advice of the nurse manager of the Birth Center regarding any inductions that do not meet criteria. In cases that do not meet criteria for induction before 39 weeks but where it is believed that the risk of continuing the pregnancy outweighs the risk of early delivery, approval for early delivery is obtained from the Medical Director of the Birth center.

For this analysis, there are two important subsets of inductions: elective inductions at less than 39 weeks of gestation and nulliparas that were electively induced. Most significant outcomes of interest were the overall induction rates, the gestational age at the time of elective induction, and delivery outcomes.

A serially sampled, cross-sectional design was used for this study. Data in 2004 was collected by retrospective review of three consecutive months of data and aggregated into one group. The same three months were selected for analysis in 2005. Data collected from the start of the process improvement initiative in November 2006 were collected and analyzed consistently on a continuous monthly basis for 13 months, and form the third group of data. Outcomes from time periods were compared using χ^2 test. $\alpha=0.05$ was the a priori threshold for significance. All analyses were performed using Stata 10 (Stata Corp, College Station, TX).

RESULTS

Table 1 describes the basic characteristics of deliveries that occurred in each of our three time periods of interest. From the three study periods, a total of

Table 1. Induction Audits at Magee-Womens Hospital

| | June Through August 2004 | June Through August 2005 | P* | November 2006 to December 2007 | P† |
|--|--------------------------|--------------------------|------|--------------------------------|-------|
| Total deliveries | 2,139 | 2,260 | | 10,895 | |
| Total inductions | 533 | 454 | | 1,806 | |
| Elective inductions | 195 | 211 | | 700 | |
| Elective inductions/total deliveries—elective induction rate (%) | 9.10 | 9.30 | .42 | 6.40 | <.001 |
| Elective nullipara inductions | 29 | 33 | | 87 | |
| Elective nullipara cesarean births | 10 | 5 | | 12 | |
| Elective nullipara cesarean birth rate (%) | 35.70 | 15.20 | .08 | 13.80 | .01 |
| Elective inductions less than 39 wk gestation | 23 | 21 | | 30 | |
| Less than 39-wk elective/total elective inductions (%) | 11.80 | 10.00 | .56 | 4.30 | <.001 |
| Total inductions/total deliveries—total induction rate (%) | 24.90 | 20.10 | .001 | 16.60 | <.001 |

* Comparison between June through August 2004 and June through August 2005.

† Comparison between June through August 2004 and November 2006 to December 2007.



15,329 deliveries and 2,793 inductions were reported. The 2004 audit (June through August) included 2,139 deliveries and 533 inductions. The 2005 audit included 2,260 deliveries and 454 inductions, and the November 2006 to December 2007 audit included 10,895 deliveries and 1,806 inductions.

The overall induction rate at our hospital dropped from 24.9% in 2004 to 20.1% in 2005 to 16.6% in 2006–2007. Comparing 2004 to 2005, the odds of induction decreased by 24% (odds ratio [OR] 0.76, 95% confidence interval [CI] 0.66–0.88), $P=.001$. Comparing 2004 to 2006–2007, the odds of induction decreased by 33% (OR 0.6, 95% CI 0.54–0.67, $P<.001$). The cesarean delivery rate for electively induced nulliparas dropped from 34.5% in 2004 to 15.2% in 2005 to 13.8% in 2006. Comparing 2004 to 2005, the odds of a cesarean delivery trended toward a decrease of 70%, but was not statistically significant (OR 0.3, 95% CI 0.08–1.3, $P=.08$). Comparing 2004 to 2006–2007, the odds of cesarean delivery decreased by 66% (OR 0.3, 95% CI 0.1–0.9, $P=.01$).

Even given the drop in the overall induction rate from 2004 to 2005, elective inductions less than 39 weeks were still being performed at an unacceptably high level in 2005 (11.8% of all elective inductions in 2004 to 10.0% of all elective inductions in 2005, not statistically significant, OR 0.83, 95% CI 0.42–1.6, $P=.56$). There was also no change in the elective induction rate from 2004 to 2005 (9.1% in 2004 to 9.3% in 2005, not statistically significant, OR 1.02, 95% CI 0.84–1.26, $P=.42$). After implementation of strict scheduling guidelines in 2006, the rate of elective inductions less than 39 weeks fell to 4.3%, a decrease of 64% in the odds of induction less than 39 weeks from 2004 (OR 0.33, 95% CI 0.18–0.62,

$P<.001$), and the elective induction rate fell to 6.4%, a decrease in the odds of elective induction by 30% over 2004 (OR 0.68, 95% CI 0.58–.81, $P<.001$).

The maternal demographics from the three study periods are presented in Table 2. Because this study was a quality improvement initiative, the demographic information is not collected specifically for women undergoing induction of labor. Table 2 describes clinical and demographic variables from all deliveries at Magee-Womens Hospital during the three time periods. There were no significant differences with regard to maternal age, race, parity, or the presence of preeclampsia or gestational diabetes among the three study periods. There were a greater proportion of private pay patients in the third study period than in the previous two periods.

DISCUSSION

Our approach and findings highlight the effectiveness of a program to reduce inappropriate inductions at a large maternity hospital with a mixture of clinic and private patients. Although induction of labor may have merit when the risks of continuing pregnancy outweigh the benefits, the rapid rise in inductions in this country since 1989 is most attributable to a rise in elective inductions.⁴ Given the high rate of induction in our institution (28% in 2003), there was concern over whether all the inductions were appropriate. For some women who undergo elective induction of labor, the risk of cesarean section can be twice that of women with spontaneous labor.^{6,9,11} Although the data on inductions in multiparas are mixed with regard to the risk of cesarean births,^{12–14} an unfavorable Bishop score is an independent risk factor for failed induction and cesarean birth in nulliparous

Table 2. Characteristics of All Births at Magee-Womens Hospital During Three Study Epochs

| Characteristic | June Through August 2004 | June Through August 2005 | November 2006 to December 2007 |
|----------------------------|--------------------------|--------------------------|--------------------------------|
| Maternal age (y) | 30 (14–47) | 30 (13–43) | 29 (10–41) |
| Maternal race | | | |
| White | 76.2 | 76.5 | 72.8 |
| Nonwhite | 23.8 | 23.5 | 27.2 |
| Number of prior deliveries | | | |
| 0 | 44.3 | 43.2 | 45 |
| 1 | 33.4 | 34.6 | 31.7 |
| 2 | 13.2 | 14 | 14.6 |
| 3 or more | 9.1 | 8.2 | 8.7 |
| Payor status | | | |
| Private | 77.5 | 79.4 | 86.3 |
| Public | 22.5 | 20.6 | 13.7 |
| Smoking during pregnancy | 17.0 | 10.3 | 16.3 |
| Preeclampsia | 6.1 | 6.5 | 6.0 |
| Maternal diabetes | 4.3 | 4.0 | 4.9 |

Data are median (range) or %.



women.⁶ This relationship emphasizes the importance of selecting appropriate patients for labor induction. The Bishop score is a common cervical scoring system used in clinical practice, initially evaluated for prediction of the onset of labor in multiparous women.¹⁵ Since its introduction, however, it has been evaluated and found to be useful in nulliparous patients as well.^{6,11,12} Elective deliveries before 39 weeks also increase neonatal intensive care unit (NICU) admissions. In a study by Morrison and Rennie,¹⁶ there was a small but significant difference in NICU admissions, depending on gestational age. At 37 weeks, 7–8 per 1,000 were admitted to the NICU; at 38 weeks it was 5 per 1,000; and at 39 weeks it was 3 per 1,000. We modeled our guidelines at Magee-Womens Hospital after those of ACOG as well as Intermountain Health Care, who were able to reduce the percentage of elective inductions before 39 weeks from 28% in 1999 to 3.4% in 2006.¹⁷

A major strength of this study is its applicability for use at other institutions faced with an unacceptably high induction rate. Whereas other studies have clearly documented the risks associated with the induction of labor, this article provides a blueprint for the development and implementation of a program to reduce these risks.

It is estimated that nationwide, 10% of all deliveries are elective inductions.⁴ The elective induction rate at Magee dropped from 9.1% in 2004 to 6.4% in 2007. This decrease occurred even as the percentage of private-pay deliveries increased. Because the practice of elective induction is confined largely to the private medical staff at Magee, the drop in elective inductions is even more impressive.

The major potential for bias in this initiative would come from measurement error and information bias. For example, some inductions initially classified as medical were changed to elective if the task force felt that the indication did not meet the ACOG definition for medical induction. The same definitions for medical, elective, and postterm inductions, however, were used in all three cohorts, mitigating this bias.

The characteristics of this study being confined to the patient's hospitalization means there were no issues with bias due to loss of follow-up or nonresponse. In addition, our outcomes of interest were not subjective but were easily captured and verified for accuracy by chart review, minimizing outcomes bias.

As a quality improvement initiative, this project targeted induction rates and delivery outcomes. The evaluation of other maternal outcomes such as infection or length of stay or neonatal outcomes such as

neonatal intensive care unit admissions were outside the scope of this project. Previous research has already validated the utility of decreasing elective inductions that do not meet criteria recommended by ACOG (at least 39 weeks of gestation and Bishop score of more than 8). These inductions can result in increased risk for infection, premature delivery, neonatal intensive care unit admissions, longer labor, and the need for cesarean delivery, especially in nulliparas with an unripe cervix.^{2,6–12} A limitation of our study is our inability to evaluate the influence of our process changes on the aforementioned outcomes.

Magee-Womens Hospital is a large tertiary care center with 36 obstetric and gynecologic residents caring for a large clinic population as well as more than 100 practicing physicians. All physicians or group of physicians has their own practice style with regard to the elective induction of labor. Some groups perform elective induction liberally, and some not at all. Luthy et al² have shown that the physician is an independent risk factor for cesarean delivery after elective induction in nulliparous women. Luthy et al² postulated that physicians with lower cesarean delivery rates may be selecting their patients better using Bishop score or other criteria or managing the labor differently. In our study, by implementing guidelines requiring a Bishop score of at least 8 before an elective induction in a nullipara, the cesarean birth rate fell among women being cared for by the same cohort of providers over the study periods.

An important factor in the success of this program was buy-in from the medical staff. This was accomplished progressively, over a 3-year period. Before implementing the induction guidelines in 2004, an initial audit showed induction rates of more than 30% for some physicians. Initial reaction to the guidelines ranged from skeptical to hostile, as physicians objected to oversight of their medical decision making. Early on it was decided not to present the guidelines as a way to decrease inductions, but rather as a way to decrease inappropriate inductions, specifically elective inductions less than 39 weeks or those inductions with an unfavorable cervix. These were common goals of most members of the medical staff. By presenting the guidelines as a quality initiative, based on ACOG standards, specifically focused on ensuring the optimal outcomes for mother and fetus, resistance lessened. In addition, the members of our task force, which changed the induction scheduling process in 2006, were chosen carefully, due to the sensitive nature of altering physician practice patterns within such a large group of practitioners. The overall de-



crease in the induction rate is a byproduct of the guidelines.

Requiring a ripe cervix before scheduling an elective induction had a number of beneficial effects. The number of electively induced nulliparas requiring cesarean birth declined and the overall induction rate fell, presumably because more patients went into spontaneous labor before their induction. The cesarean birth rate of 13.8% for electively induced nulliparas in the most recent study group is now approaching our overall cesarean rate of 13% among nulliparas. An important point of emphasis is that the processes necessary to effect these changes took 3 years in a step-wise and self-evaluative manner.

The importance of strong physician and nursing leadership cannot be overstated. The change in the induction scheduling process that began to enforce the guidelines strictly in late 2006 was spearheaded by the Ob Process Improvement Committee, whose members included the hospital's Vice President for Medical Affairs, the Medical Director of the Birth Center, and the nursing leadership for the Birth Center. The support of stakeholders from several disciplines was vital. With their support, the guidelines regarding gestational age and Bishop scoring could be strictly enforced, and the percentage of elective inductions less than 39 weeks fell.

Initially, the induction scheduler, as the "messenger" of the guidelines, met resistance from some physicians and their offices. In these instances the scheduler was instructed to involve the nursing unit director who would discuss the rationale for the induction with the attending and if necessary, seek approval for the induction from the Medical Director. This process has evolved over time to the point where an attending will go directly to the Medical Director if they feel that approval will be needed to schedule an induction.

In the last 10 years the number of hospitals performing obstetrics in our region has declined, with smaller obstetric units closing down and transferring their deliveries to regional tertiary care centers. Because of this, the number of deliveries at Magee continues to grow, from 6,761 in 1999 to 9,379 in 2007. Along with the higher cesarean delivery rate and their longer length of stay, a recurring theme has developed: "No room at the Inn." Maslow and Sweeny¹⁸ demonstrated that women undergoing induction of labor spend more time in the hospital and incur greater costs for care than women in spontaneous labor. If the induction percentage from the start of our initiative in 2004 was applied to current 2007 data we would expect 71 more inductions and five more

cesarean births per month. This accounts for 284 more hours in the hospital and a cost of \$29,235 more per month, based on estimates from Maslow's study and Magee-Womens Hospital cost data. This translates into a total cost savings of \$350,820 and 3,408 hours per year.

In the future, individual provider induction rates may be monitored and evaluated, especially if the induction rates and subsequent cesarean birth rates are excessive. As evidence-based obstetric care quality measures are developed, we can evaluate the influence of our induction practice guidelines on this indicator. The cesarean birth rate, length of stay, and cost implications of improving the labor induction process are all reasons that other large institutions struggling with the demands of running an obstetric unit will find this study is of particular interest.

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