A multidisciplinary approach to improving process and outcomes in unscheduled cesarean deliveries

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BACKGROUND: Effective communication between providers of various disciplines is crucial to the quality of care provided on labor and delivery. The lack of standardized language for communicating the clinical urgency of cesarean delivery and the lack of standardized processes for responding were identified as targets for improvement by the Obstetric Patient Safety Committee at the Hospital of the University of Pennsylvania. The committee developed and implemented a protocol aimed at improving the performance of our multidisciplinary team and patient outcomes.

OBJECTIVE: To evaluate whether implementation of a multidisciplinary protocol that standardizes the language and process for performing unscheduled cesarean deliveries had reduced the decision to incision interval and improved maternal and neonatal outcomes.

MATERIALS AND METHODS: This was a retrospective cohort study of patients who underwent unscheduled cesarean delivery pre- and postimplementation of a protocol standardizing language, communication, provider roles, and processes. The primary outcome was cesarean decision to incision interval overall and stratified by fetal and nonfetal indications for delivery. Secondary outcomes included decision to operating room and operating room to incision intervals, operative complications, use of general anesthesia, maternal transfusion, 5-minute Apgar score <6, and umbilical cord arterial pH <7.2. Descriptive statistics were calculated. Continuous variables were tested for normality and compared using the Student *t* test or Mann–Whitney *U* test as appropriate. Categorical variables were characterized by proportions and compared by the χ^2 or Fisher exact test as appropriate.

RESULTS: There were 121 and 119 subjects in the pre-and postimplementation groups respectively, collected from corresponding 3-month periods. There were no significant differences in demographics, comorbidities, or indications for cesarean delivery between groups. Overall median decision to incision interval did not differ between the pre- and postimplementation groups. There was a significant decrease in median decision to incision interval (63 versus 50 minutes, $P = .02$) in cesarean deliveries performed for nonfetal indications. This was driven by a shorter median decision to operating room interval (32.5 versus 23 minutes, $P = .01$). The incidences of operative complications (35% [19/55] versus 11% [6/53], $P < .01$) and cord pH <7.2 (36% [20/55] versus 17% [9/53], $P = .02$) were also decreased in cesarean deliveries performed for nonfetal indications. The incidences of general anesthesia, maternal transfusion, and 5-minute Apgar score <6 did not differ. Outcomes did not differ between the pre- and postimplementation groups in cesarean deliveries performed for fetal indications.

CONCLUSION: Implementation of a multidisciplinary process improvement protocol that standardizes language, roles, and processes for unscheduled cesarean deliveries was associated with a reduced decision to incision interval and improved maternal and neonatal outcomes in cesarean deliveries performed for nonfetal indications. Standardized process implementation on labor and delivery has the potential to improve patient outcomes.

Key words: decision to incision interval, obstetric team training, patient safety, process improvement, quality improvement, 30-minute rule

Effective communication between providers of various disciplines is crucial to the quality of care provided on labor and delivery. A number of classification schemes based on the urgency of cesarean delivery have been proposed to enhance interdisciplinary communication and to improve processes with the goal of optimizing efficiency and safety of care delivery.[1,2] In 2010, the Royal College of Obstetricians and Gynaecologists published a Good Practice document encouraging the use of a nationally accepted classification of urgency of cesarean delivery within the United Kingdom. Their aims were to facilitate data collection, to minimize communication difficulties relating to the urgency of delivery both between and within teams, and to facilitate retrospective audit of outcomes.[3] Parallel guidelines have not been issued by American obstetric societies.

The lack of standardized language for communicating the clinical urgency of cesarean delivery and the lack of standardized processes for responding were identified as top priorities for improvement by the Obstetric Patient Safety Committee, a multidisciplinary group, at the Hospital of the University of Pennsylvania at its inception. A protocol addressing these issues entitled "Guidelines for Prioritization of Cesarean Delivery" was developed by the multidisciplinary committee, was approved by the Department of Obstetrics and Gynecology, and was instituted in April 2013. We sought to evaluate whether implementation of the protocol affected the time interval between the decision to proceed with an unscheduled cesarean delivery and the skin incision and whether implementation was associated with improved maternal and neonatal outcomes. We hypothesized that the decision to incision interval would be shorter, and that maternal and neonatal outcomes would be improved, after implementation of these multidisciplinary guidelines that streamlined communication and processes relating to unscheduled cesarean deliveries.

Materials and Methods

This retrospective cohort study was conducted at the Hospital of the

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AJOG MFM at a Glance

Why was this study conducted?

Shared understanding of the urgency of an unscheduled cesarean delivery, effective communication between providers of various disciplines, and standardized processes are crucial to the quality of care provided on labor and delivery.

Key findings

Implementation of a multidisciplinary process improvement protocol that standardizes language, roles, and processes for unscheduled cesarean deliveries was associated with a reduced decision to incision interval, and with improved maternal and neonatal outcomes in cesarean deliveries performed for nonfetal indications. Outcomes did not differ between time periods in cesarean deliveries performed for fetal indications.

What does this add to what is known?

Standardized process implementation on labor and delivery has the potential to improve patient outcomes. Although cesarean deliveries with nonfetal indications are arguably less urgent, our study suggests that standardized, multidisciplinary processes may expedite delivery and improve outcomes in these cases.

University of Pennsylvania and was approved by the Institutional Review Board (protocol number 820182). The hospital is an urban, university-based, tertiary care, medical center with an Obstetrics and Gynecology residency program. The labor and delivery unit is staffed by 2 attending Obstetricians, junior and senior Obstetrics and Gynecology residents, and Obstetric Anesthesiologists. It contains 3 dedicated operating rooms. The multidisciplinary protocol, "Guidelines for Prioritization of Cesarean Delivery," was drafted by the Obstetric Patient Safety committee with input from general Obstetrics, Maternal Fetal Medicine, Anesthesiology, and labor floor nursing. It received departmental approval, was introduced to members of the labor floor team via printed materials, in-person instructional sessions, and video simulations, and was implemented in April 2013. Copies of the guidelines remained easily accessible throughout the labor and delivery unit for reference by all members of the team. Briefly, these guidelines standardized the language used to communicate the urgency of cesarean delivery, defined provider roles, and established a protocol for preparation and transport of the patient for surgery. Clinical urgency was denoted by a 3-tiered system, with standard definitions, to prioritize patients who required cesarean delivery (Table 1). Level 1 signified an immediate threat to the life of the mother or fetus, such as severe hemorrhage, suspected uterine rupture, or umbilical cord prolapse. Level 2 was assigned to cases of maternal or fetal compromise that were not immediately life threatening or that had responded to resuscitation, such as recurrent decelerations or arrest of descent, as well as to patients with a prior cesarean delivery who were in labor and desired repeat cesarean delivery. Finally, level 3 denoted cases with stable maternal and fetal status in which same-day cesarean delivery was deemed necessary, such as malpresentation with ruptured membranes but not in labor. Each level was associated with its own communication process and provider roles and responsibilities (Table 2).

To evaluate the impact of implementing this standardized protocol, subjects were collected from 2 discrete time periods: December 2011 through February 2012, the "preimplementation" period, and December 2013 through February 2014, the "postimplementation" period. To avoid any differences in training levels of resident physicians and to account for any seasonal trends, the pre- and post-implementation cohorts were derived from corresponding months of the year. A preimplementation washout period of 14 months was allotted to prevent knowledge of ongoing protocol development from affecting cesarean delivery work flow prior to implementation. In addition, an 8-month period between implementation and ascertainment of the postimplementation cohort was allotted to minimize the chance that the observed effects were due to the team's awareness of performance evaluation to determine the true impact of the process implemented. All women who underwent unscheduled cesarean delivery during these time periods with a decision for cesarean delivery made after admission to the labor floor who had decision time and skin incision time available in the medical record were eligible for inclusion. Patients who underwent scheduled cesarean delivery were not included, as the decision for delivery was made prior to admission.

The primary outcome measure was the decision to incision (DTI) interval, defined as the time in minutes between the decision to proceed with cesarean delivery and the skin incision. Secondary process outcomes included the time between decision and entrance to the operating room, and the time between entrance to the operating room and incision. Secondary maternal outcomes were balancing measures and included operative complications (a composite of hysterotomy extension, uterine artery laceration, uterine dehiscence or rupture, bowel or bladder injury, or hematoma requiring intervention), use of general anesthesia, and transfusion of blood products. Secondary neonatal outcome measures included 5-minute Apgar score <6 and arterial cord pH <7.2. Because a main goal of the guidelines was standardization of language and processes of care based on communication of a standardized and clear level of urgency, a planned prespecified analysis stratifying subjects by fetal versus nonfetal indications for unscheduled cesarean delivery was

TABLE 1
Cesarean delivery prioritization system

Delivery priority	Description	Example(s)	Time goal(s)
Level 1	Immediate threat to life of the mother or fetus	Umbilical cord prolapse, hemorrhage, fetal bradycardia, suspected uterine rupture	Proceed to operating room immediately
Level 2[a]	- Maternal or fetal compromise identified but not immediately life threatening - Maternal or fetal compromise has responded to resuscitation - Prior cesarean delivery in labor with no identified compromise	Recurrent decelerations, abruption remote from delivery but overall reassuring status, arrest of dilation or descent	- Team huddle[c] within 5 min - Proceed to the operating room within 30 min
Level 3[b]	Mother and fetus are stable but same-day cesarean delivery is required	Malpresentation or prior cesarean delivery with rupture of membranes not in labor with reassuring fetal status	- Team huddle[c] within 30 minutes - Same-day delivery

[a] Level 2: factors discussed include degree of maternal or fetal compromise, and staffing and acuity of the labor floor; [b] Level 3: factors discussed include operating room availability, and staffing and acuity of labor floor; [c] Huddle procedure: team (obstetric senior resident or attending, anesthesia resident or attending, charge nurse) assembles to discuss timing of cesarean delivery; team then communicates to perioperative staff and primary nursing plan and timing of cesarean delivery.

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performed. Subjects were classified as having a "fetal indication" if nonreassuring fetal status or fetal intolerance of labor was designated as 1 of the indications in the patient chart or operative report. Cesarean deliveries without any fetal indication were classified as having "nonfetal indications" and included failed induction of labor, labor arrest disorders, prior cesarean delivery in labor, and malpresentation. Because the cesarean deliveries in the preimplementation period were performed prior to institution of the 3-tiered system of urgency set forth by our guidelines, it was not possible to compare delivery urgency between the 2 time periods using these levels.

All outcome and demographic data were abstracted from the medical record by 2 investigators (H.Q., R.H.) using a uniform data collection form. Cesarean delivery decision, operating room entry, and incision times were collected from the labor floor paper chart, the electronic fetal monitoring and charting system used by both nurses and physicians, and the electronic anesthesia record, and were confirmed by more than 1 of these sources when possible. Both investigators examined any discrepancy in the data so as to include the most accurate times. Demographic, maternal, and neonatal outcome data were obtained from the outpatient and inpatient electronic medical records.

Descriptive statistics were calculated. Continuous variables were tested for normality and compared using the Student t test or Mann−Whitney U test as appropriate. Categorical variables were characterized by proportions and compared by χ^2 or Fisher exact test as appropriate. Data analysis was performed using STATA (Version 12; StataCorp, College Station, TX).

Prior to study initiation, the baseline median time from decision to incision for unscheduled cesarean deliveries was calculated for a 1-month period (January 2012) and was found to be 52 minutes. A 15-minute decrease in DTI interval was believed by the authors to be clinically relevant. To have 90% power to

TABLE 2
Summary of provider roles and responsibilities by priority of delivery

Provider	Summary of primary responsibilities	
	Level 1	Level 2 and 3
Charge nurse	• Assign nurses to be "patient assist nurse" and "OR assist nurse" • Ensure scrub tech in the OR opening • Act as "extra hand" in the OR	• Work with OB Team and primary nurses to triage cases • Ensure OR available • Ensure scrub tech in the OR opening • Act as "extra hand" in the OR • Confirm that primary nurse, OB, anesthesia, and the OR are ready
Primary nurse	• Take patient to the OR • Obtain fetal heart rate tracing • Assist anesthesia • Initiate time out prior to incision	• Obtain CBC and type and screen • Perform abdominal scrub prior to OR • Take patient to the OR • Obtain fetal heart rate tracing • Assist anesthesia • Initiate time out prior to incision
Patient assist nurse	• Help primary nurse transfer patient • Prepare patient for cesarean delivery (Foley, grounding pad, safety strap) • Prepare patient abdomen	• Role not assigned for levels 2 and 3
OR assist nurse	• Proceed immediately to the OR • Assist scrub tech • Prepare baby bed • Contact NICU	• Role not assigned for levels 2 and 3
Scrub tech	• Proceed to the OR immediately • Open and count with OR assist nurse	• Proceed to the OR to open before the patient is brought back • Count with the scrub nurse • Communicate any delays in OR turnover to charge nurse
Anesthesia resident/ attending	• Proceed to the labor room immediately • Dose up anesthesia if epidural catheter in place • If no epidural catheter, discuss mode of anesthesia (regional/general) with OB • Help transfer patient to OR • Confirm anesthetic choice in OR	• Review pending and scheduled cesarean deliveries with charge nurse and OB team • Participate in team huddles • Inform primary nurse when ready to proceed
OB resident/attending	• Inform anesthesia of LEVEL 1 cesarean • Assign OB residents to the case • Additional residents, if available, assist with patient and OR preparation • Evaluate FHR tracing in OR and state whether proceeding with LEVEL 1 or slow down • Review anesthesia type and adequacy	• Designate the cesarean as LEVEL 2 or 3 • Inform anesthesia of new cases • Assign OB residents to the case • Additional residents, if available, assist with patient and OR preparation • Surgeons responsible for ensuring gloves are pulled

CBC, complete blood count; *FHR,* fetal heart rate; *NICU,* neonatal intensive care unit; *OB,* obstetrics; *OR,* operating room; *tech,* technician.

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detect a 15-minute decrease in the median DTI interval with an α of 0.05, a total of 240 subjects, 120 each in the preimplementation and postimplementation groups, were required.

Results

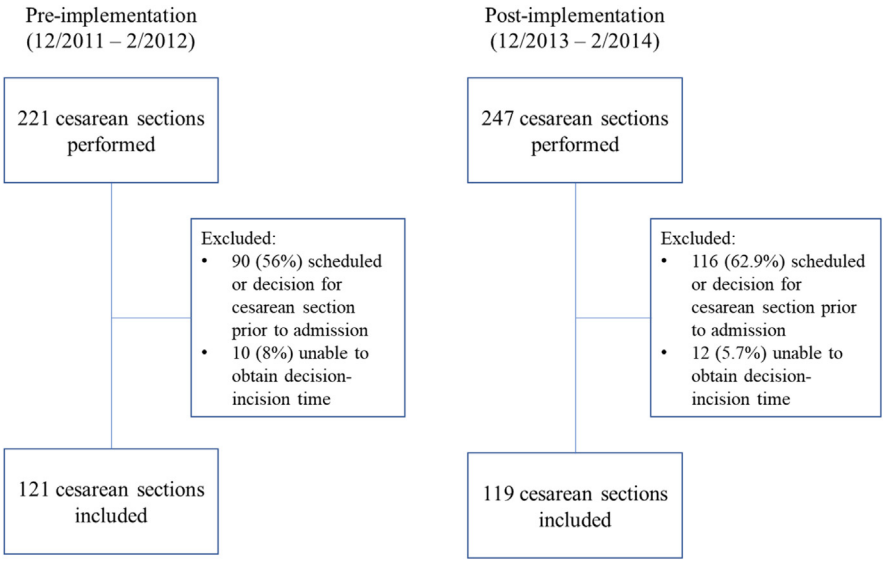
A total of 240 patients undergoing unscheduled cesarean deliveries, 121 in the preimplementation group and 119 in the postimplementation group, were included (Figure 1). There were no significant differences in demographics, comorbidities, or indication for cesarean delivery between the 2 groups (Table 3). The overall median DTI intervals of 48 minutes (interquartile range, 24−69) in the preimplementation group and 42 minutes (interquartile range, 23−58) in the postimplementation group were not significantly different ($P = .18$). Similarly, the decision to operating room and the operating room to incision intervals did not differ significantly between the 2 time periods (Table 4).

Subjects were then stratified by fetal vs nonfetal indication for cesarean delivery. There were 66 cesarean deliveries performed for fetal indications and 55 for nonfetal indications in the preimplementation group. In the postimplementation group, 66 cesarean deliveries were performed for fetal and 53 for nonfetal indications. The median DTI interval was shorter for fetal indications as compared to nonfetal indications during both time periods (preimplementation: 28.5 vs 63 minutes, $P < .01$; postimplementation 35.5 vs 50 minutes, $P < .01$). There were no significant differences in DTI, decision to operating room, or operating room to incision intervals between the 2 time periods within the cesarean deliveries performed for fetal indications. However, the DTI interval was significantly shorter in the postimplementation group (63 vs 50 minutes, $P = .02$) in those cesarean deliveries performed for nonfetal indications. This was driven by a shorter median decision to operating room interval (32.5 vs 23 minutes, $P = .01$), whereas operating room to incision interval did not change (Table 4).

Overall, operative complications were significantly lower in the postimplementation group, although other maternal and neonatal outcomes did not differ between the time periods. Among those cesarean deliveries performed for nonfetal indications, both the incidence of operative complications (35% vs 11%, $P < .01$) and the incidence of umbilical cord pH <7.2 (36% vs 17%, $P = .02$) were lower in the postimplementation group. There were no significant outcome differences between the 2 time periods in those cesarean deliveries performed for fetal indications (Table 5).

Given the observed differences in rates of operative complications and neonatal outcomes, median incision to delivery intervals were also compared. Incision to delivery intervals were shorter in the postimplementation period for cesarean deliveries overall (7 vs 6 minutes, $P = .02$) and for those with fetal indications (6 vs 3.5 minutes, $P < .01$). There was no difference in incision to delivery interval among cesarean deliveries performed for nonfetal indications (8 vs 8 minutes, $P = .92$).

FIGURE 1
Study population



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Comment

Principal findings

Our results indicate that implementation of a multidisciplinary process improvement protocol that standardizes communication, response, and provider roles for unscheduled cesarean deliveries was associated with a reduced DTI interval and improved maternal and neonatal outcomes in cesarean deliveries performed for nonfetal indications. The reduction in DTI interval was driven by a shorter time from decision to operating room entry. Importantly, there was a decrease in operative complications in the cohort as a whole, and both decreased operative complications and improved neonatal outcomes in those cesarean deliveries performed for nonfetal indications after protocol implementation.

Results in the context of other observations

Recent literature has challenged the relevance of the DTI interval, specifically the "30-minute rule," as a benchmark for appropriate care of the laboring patient who requires cesarean delivery. First proposed as a standard for timely performance of emergent cesarean delivery in 1989,[4] more recent publications have argued against its clinical relevance.[5,6] Within a large prospective cohort, Bloom et al found that infants delivered within 30 minutes for an emergency

TABLE 3
Demographics by enrollment period

Characteristic	Preimplementation (n = 121)	Postimplementation (n = 119)	*P*
Maternal age, y	26 (22, 34)	27 (23, 32)	.50
Race			.15
Black	85 (77.3)	85 (73.3)	
White	16 (14.6)	22 (19.0)	
Asian	8 (7.3)	5 (4.3)	
Other	1 (0.9)	4 (3.5)	
Multiparous	45 (37.2)	47 (39.5)	.13
Singleton gestation	116 (95.9)	114 (95.8)	.87
Body mass index, kg/m^2	27.7 (23.8, 32.8)	27.4 (23.0, 35.0)	.71
Gestational age at delivery, wk	39.4 (37.6, 40.4)	39.3 (37.4, 40.3)	.28
Delivery indication			.22
Spontaneous labor or rupture	75 (62.0)	62 (52.1)	
Maternal medical	21 (17.4)	24 (20.2)	
Fetal	17 (14.1)	22 (18.5)	
Bleeding	3 (3.0)	7 (5.9)	
Other	5 (4.1)	4 (3.4)	
Prior cesarean delivery	20 (40)	30 (60)	.19
Tobacco use	7 (5.8)	12 (10.4)	.20

Data are median (quartile 1, quartile 3) (Mann–Whitney *U* test), or n (%) (χ^2 test or Fisher exact test).
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indication were *more* likely to be acidemic and to require intubation, whereas very few delivered beyond 30 minutes manifested adverse outcomes. The authors concluded that obstetricians effectively triage emergency cesarean deliveries.[7] This is consistent with the observed lack of significant impact of our protocol on DTI interval in cesarean deliveries with fetal indications. Although the median DTI interval for those deliveries with fetal indications was higher in the postintervention period (28.5 minutes vs 35.5 minutes), this difference was not statistically significant, and the interquartile ranges (18–50 vs 14–51) demonstrate that the majority of cases fell within a similar interval. Although we do not think that this process affected fetal indication cesarean deliveries in any negative way, it is important to continue to monitor the impact of any new process for intended and unintended outcomes. Importantly, although those with nonfetal indications are arguably less urgent, our study suggests that standardized multidisciplinary processes may expedite delivery and improve outcomes in these cases.

Prior studies have assessed the impact of process improvement protocols on DTI interval almost exclusively in cesarean deliveries performed for fetal indications. Nageotte and Vander Wal sought to increase the proportion of deliveries for fetal intolerance to labor performed within 30 minutes. Although they succeeded, they also found that cesarean deliveries performed for sudden fetal compromise were already uniformly achieved within 30 minutes.[8] Weiner et al reported on a protocol that successfully shortened the decision to delivery interval for emergency cesarean deliveries and also led to improved neonatal outcomes.[9] These studies focused on urgent cesarean deliveries in an effort to shorten time to delivery. Our protocol aimed to enhance communication for all levels of unscheduled cesarean delivery by creating a standardized language and process by level of urgency, with the hypothesized impact being decreased decision to incision time. Our inclusion of cesarean deliveries performed for nonfetal indications, which were excluded from prior studies, reveals the potential to improve pregnancy outcomes in those less urgent cases in which we hypothesize that unnecessary delays may more readily occur and lead to adverse outcomes. Importantly, neither operating room to incision nor incision to delivery interval differed between the 2 time periods among those cesarean deliveries with nonfetal indications. This highlights the importance of communication and team dynamics prior to the surgery itself.

Maternal complications have been associated with extremely short DTI intervals in the most urgent cesarean deliveries.[10] In fact, Grobman et al observed a decrease in bleeding complications in cesarean deliveries performed for "fetal" indications when DTI was greater than 30 minutes. They found no association between DTI interval and maternal outcomes in cesarean deliveries performed for "arrest disorders."[11] We observed a postimplementation decrease in operative complications, predominantly hysterotomy extensions, in cesarean deliveries with nonfetal indications. In addition, the shorter DTI interval in this group was driven by the shorter decision to operating room interval, again suggesting the importance of communication and team dynamics prior to the operating room.

Strengths and limitations

The main strength of this study is that it establishes the effectiveness of our institution's quality improvement process, more specifically the development and implementation of a multidisciplinary initiative driven by perceived process deficiencies within our labor and delivery unit. Moreover, it demonstrates that the standardization of roles, language, and processes for unscheduled

cesarean deliveries has the potential not only to enhance the performance of the labor floor team, but also to improve neonatal outcomes without compromising maternal care. Finally, our study shows that improvement in team communication and processes as they relate to cesarean deliveries with nonfetal indications, which have not been included in prior process improvement studies, can lead to significant clinical benefits.

We acknowledge a number of limitations of our study. First, despite allowing for a significant washout period both before and after implementation, it is possible that the postimplementation improvements are at least partially due to the "Hawthorne effect,"[12] that is, the team's awareness that its performance was being evaluated. Second, although the guidelines and team member roles and responsibilities remained easily accessible to all labor floor team members, our study did not specifically evaluate adherence to these roles and processes. At a minimum, we know that there were no major staffing changes during the study period, nor were there significant changes to other neonatal, labor and delivery, or perioperative protocols. Finally, the retrospective nature of the study rendered us reliant on the accuracy of the medical record. The intervention itself focused on communication of the precise indication for cesarean delivery, and although it is possible that the reliability of clinical documentation differed between the time periods, no direct changes were made to education or processes regarding documentation. Similarly, as the intervention included specific time goals related to the urgency of cesarean delivery, it is possible that the accuracy of recorded times improved in the postimplementation period. Given similar proportions of fetal and nonfetal indications in the 2 time periods and the exclusion of less than 10% of the eligible cases in both time periods due to inability to ascertain an accurate DTI, we believe that clinical documentation was reliable and similar throughout the study.

TABLE 4
Time intervals by indication for cesarean delivery

	Median time interval								
	All cesarean deliveries			Fetal indications			Nonfetal indications		
Interval	Preimplementation (n = 121)	Postimplementation (n = 119)	*P*	Preimplementation (n = 66)	Postimplementation (n = 66)	*P*	Preimplementation (n = 55)	Postimplementation (n = 53)	*P*
Decision to incision (min)	48 (24, 69)	42 (23, 58)	.18	28.5 (18, 50)	35.5 (14, 51)	.99	63 (44, 96)	50 (40, 69)	.02[a]
Decision to OR (min)	22 (9, 41)	21 (10, 33)	.29	12.5 (6, 28)	19.5 (4, 32)	.76	32.5 (21, 67)	23 (16, 38)	.01[a]
OR to incision (min)	21.5 (15.5, 29)	21 (14, 28)	.45	17.5 (12, 22)	17.5 (10, 24)	.97	25 (20.5, 30.5)	26 (22, 35)	.2

Data are median (quartile 1, quartile 3) (Mann–Whitney *U* test).

OR, operating room.

[a] Statistically significant.

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TABLE 5
Maternal and neonatal outcomes by indication for cesarean delivery

Outcomes	All cesarean deliveries			Fetal indications			Nonfetal indications		
	Preimplementation (n = 121)	Postimplementation (n = 119)	*P*	Preimplementation (n = 66)	Postimplementation (n = 66)	*P*	Preimplementation (n = 55)	Postimplementation (n = 53)	*P*
Maternal									
Operative complications[a]	33 (27.3)	14 (11.8)	<.01[b]	14 (21.2)	8 (12.1)	.16	19 (34.5)	6 (11.3)	<.01[b]
General anesthesia	14 (11.6)	12 (10.1)	.71	9 (13.6)	9 (13.6)	1.0	5 (9.1)	3 (5.7)	.5
Transfusion	8 (6.6)	8 (6.7)	.97	5 (7.6)	4 (6.1)	.73	3 (5.5)	4 (7.6)	.66
Neonatal									
5-min Apgar score <6	3 (2.5)	6 (5.1)	.33	1 (1.5)	5 (7.7)	.12	2 (3.6)	1 (1.9)	1.0
Arterial cord pH <7.2	46 (38.0)	34 (28.6)	.12	26 (39.4)	25 (37.9)	.86	20 (36.4)	9 (17.0)	.02[b]

Data are n (%) (χ^2 or Fisher exact test).

[a] Operative complications defined as at least 1 of the following: hysterotomy extension, uterine artery laceration, uterine dehiscence or rupture, bowel or bladder injury, or hematoma requiring intervention; [b] Statistically significant.

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Conclusions and clinical implications

There are many factors that have an impact on cesarean decision to delivery time, including perceived urgency, prioritization with respect to other events on the labor floor, and the team's shared understanding of roles and processes. Team training has been applied to medicine in an attempt to reduce errors and to improve patient safety.[13,14] Structured clinical communication has been shown to improve team efficiency and patient care in the settings of perioperative handoffs and interdisciplinary rounds.[15–17] Quality improvement research on code team structure, roles, and procedures has demonstrated measurable improvements in team function and patient care.[18] Obstetric team training programs that incorporate all disciplines and staff members and include didactics, simulation and evaluation of outcomes have been associated with improved quality and performance metrics.[19,20] Assessment of such process improvement interventions is challenging and requires clinically meaningful outcome measures and quality improvement tools.[21] Our study highlights the importance of communication and team dynamics for the optimization of process and outcomes in what may be perceived as less clinically urgent cesarean deliveries, which, until now, have not been well studied. Although our cesarean delivery guidelines were developed to address the perceived process deficiencies on our unit, the process improvement lessons can be applied broadly. These findings continue to inspire our unit and have created the basis for sustainability of our cesarean delivery prioritization guidelines since their implementation. ■

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