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CLINICAL ARTICLE

The effects of resource improvement on decision-to-delivery times for cesarean deliveries in a Ghanaian regional hospital

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ABSTRACT

Objective: To evaluate the effects of having a dedicated obstetric operating room (OR) on the decision-to-delivery interval (DDI) in a large referral hospital in Ghana. *Methods:* An observational study was undertaken of all patients undergoing cesarean delivery at Ridge Regional Hospital, Accra, before (pre-OR; August–September 2011) and after (post-OR; August–September 2012) introduction of an obstetric OR. The primary outcome was the DDI. *Results:* In total, 581 cesareans were performed in the pre-OR period and 574 in the post-OR period. Overall, the median DDI decreased from 259 min (interquartile range [IQR] 161–432) in the pre-OR period to 195 min (IQR 138–319) in the post-OR period ($P < 0.001$). DDI was lower in the post-OR period than in the pre-OR period for both emergency (175 min [IQR 126–241] vs 220 min [IQR 146–315]; $P < 0.001$) and elective (1828 min [IQR 1432–2985] vs 4291 min [IQR 2992–5862]; $P < 0.001$) cesarean deliveries. Only one emergency cesarean—in the post-OR period—was conducted within the recommended 30-minute timeframe. *Conclusion:* An obstetric OR lowered the DDI for cesarean delivery; however, a realistic timeframe for emergency cesareans in low-income countries remains to be determined.

1. Introduction

Maternal and neonatal mortality remain high in Sub-Saharan Africa despite improved access to medical care and global efforts to address Millennium Development Goals (MDGs) 4 and 5 [1]. From 1990 to 2009, progress was made in Ghana, with an average annual rate of reduction of 2.9% for under-five mortality and of 3.3% for maternal mortality [2]. However, these reductions are below the required 4.3% and 5.5% needed to achieve the MDG 4 and 5 targets, respectively, by 2015 [2].

Delays in recognizing the need for, and receiving, appropriate emergency healthcare continue to contribute to unnecessary deaths [3,4]. In hospitals offering emergency obstetric and neonatal care, the ability to conduct a timely emergency cesarean delivery is important to avoid maternal and/or neonatal complications [4]. The decision-to-delivery interval (DDI)—i.e. the time needed to perform an emergency cesarean after the decision to operate has been made—is a focus of attention and debate. The American College of Obstetricians and Gynecologists [5] and the Royal College of Obstetricians and Gynaecologists [6] recommend a 30-minute DDI for emergency delivery in hospitals providing emergency obstetric and neonatal care. Limited resources in low-income countries hamper the ability to conduct prompt emergency delivery despite the widely accepted 30-minute benchmark upheld in most high-income countries.

In 2007, the non-governmental organization Kybele partnered with the Ghana Health Service at Ridge Regional Hospital, a high-volume, high-risk obstetric referral hospital in Accra, Ghana. The goal of the partnership was to reduce maternal and newborn deaths by addressing clinical and operational gaps through a quality improvement approach [7]. Within 5 years, the rates of maternal mortality and stillbirth decreased by 23% and 52%, respectively, but a concomitant increase in patient volume and high-risk conditions threatened to erode the gain. The annual number of deliveries increased from 4793 in 2006 to 9357 in 2011, without an accompanying staff increase or infrastructural improvement. In 2011, Ridge Regional Hospital had 10 labor and delivery beds, and four general operating rooms (ORs) that were shared among surgical services and located remotely from the labor ward. From 2006 to 2011, the number of cesareans rose from 4.2 to 9.2 per day (rate 32.4%–35.9%), 80% of which were deemed emergency cesareans.

Inadequate staff and space resources were identified as operational barriers to achieving MDG 4 and 5 outcomes [7]. The lack of OR availability prolonged waiting times, congested holding areas, and increased the risk of poor outcomes for patients requiring emergency cesareans. In 2011, a collaboration was initiated between the United States Agency for International Development, the Ghana International Women's Club, Ridge Regional Hospital, and Kybele to renovate an unused space

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into an obstetric OR and recovery room. The present study was conducted to evaluate the effects of having a dedicated obstetric OR on the DDI and newborn outcomes in a low-resource setting.

2. Materials and methods

An observational study was undertaken of all patients undergoing cesarean delivery at Ridge Regional Hospital before (pre-OR; August 1 to September 30, 2011) and after (post-OR; August 1 to September 30, 2012) an obstetric OR was opened on March 1, 2012. The data were collected during months with an intermediate patient volume to reduce the potential influence of seasonal variation on the DDI during low and peak periods. Approval to conduct the present study was granted by the Institutional Review Board of Wake Forest School of Medicine, USA, and the Ghana Health Service. Informed consent was deemed unnecessary because the time assessments and patient information were de-identified.

The data were collected by a trained nurse, who reviewed patient records and log books within 24 hours of surgery. Data were collected for obstetric history, indications for cesarean, surgical urgency (elective or emergency), anesthesia type, and outcome. Indications for emergency cesarean included non-reassuring fetal heart rate, bleeding due to placenta previa, placental abruption, severe pre-eclampsia, umbilical cord prolapse, and uterine rupture. Emergency indications also included diagnoses typically deemed "urgent," such as failure to progress, previous cesarean delivery, malpresentation in labor, premature rupture of membranes, and cephalopelvic disproportion; however, this category did not exist in the population studied.

The primary outcome was the DDI. The following timepoints were recorded: the time when a decision to perform a cesarean delivery was made by a physician (T1), the time of arrival in the OR holding area (T2), the anesthesia start time (T3), the time of delivery (T4), the time of arrival in the recovery room (T5), and the time of discharge from the recovery room (T6). These timepoints were selected to help to determine when delays occurred throughout the system. The DDI was defined as the time difference between T1 and T4. Another interval with the potential to influence the DDI was the time spent in the recovery room (T5 to T6), because surgery could not begin unless a recovery room bed was available. Additionally, the DDI and recovery room time differences during the pre- and post-OR periods were analyzed by urgency (elective vs emergency CD), day of the week (weekday vs weekend), and work shift (day vs night). Secondary outcomes were maternal complications (difficult intubation, high spinal block, hemorrhage requiring transfusion, cardiac arrest, and death) and newborn status (Apgar scores, neonatal care unit [NCU] admission, NCU discharge within 7 days following delivery, and death).

The time intervals were calculated in minutes and reported as median (hh:mm format) and interquartile range (IQR) because the data were non-normally distributed. Continuous variables were analyzed using the *t* test, and categorical data using the χ^2 test. The Mann–Whitney *U* test was used to compare median time intervals during the pre- and post-OR periods. $P < 0.05$ was considered statistically significant. Missing data points were excluded from the analysis. The statistical analysis was performed using SPSS version 19 (IBM, Amonk, NY, USA).

3. Results

A total of 1155 patients underwent cesarean delivery at Ridge Regional Hospital during the study periods; 581 (50.3%) occurred in August–September 2011 (pre-OR) and 574 (49.7%) occurred in August–September 2012 (post-OR). Patient and surgical characteristics are presented in Table 1.

Overall, the median DDI decreased from 259 min (IQR 161–432) in the pre-OR period to 195 min (IQR 138–319) in the post-OR period, a reduction of 22% ($P < 0.001$). For emergency cesareans, it decreased by 20%; for elective cesareans, it decreased by 57% (Table 2). For emergency cesareans, the largest reductions in delay were noted in the recovery room time (T5 to T6) and the holding room time (T2 to T3), which decreased by 46% and 29%, respectively, in the post-OR period ($P < 0.001$). There was an increase in the time spent on anesthesia administration (T3 to T4) and the surgical time (T4 to T5); however, these did not offset the reduction in delay that occurred within the holding room (T2 to T3). Fig. 1 presents a frequency distribution of DDI times for emergency cesarean before and after introduction of the obstetric OR and recovery room.

Table 1
Patient and surgical characteristics.[a]

Characteristic	Pre-OR (n = 581)[b]	Post-OR (n = 574)[c]
Age, y	29.1 ± 5.1 (15–44)	29.5 ± 5.3 (15–46)
15–34	494 (85.0)	465 (81.0)
≥35	87 (15.0)	109 (19.0)
Pregnancy duration, d	271.9 ± 17.1	275.3 ± 14.2
Nulliparity	197 (33.9)	204 (35.5)
Urgency of the cesarean		
Elective	103 (17.7)	105 (18.3)
Emergent	478 (82.3)	469 (81.7)
Anesthesia type		
Spinal	547 (94.1)	558 (97.2)
General	34 (5.9)	16 (2.8)[d]

Abbreviation: OR, operating room.
[a] Values are given as mean ± SD (range), number (percentage), or mean ± SD.
[b] August–September 2011.
[c] August–September 2012.
[d] $P = 0.01$. There were no other significant differences between the pre-OR and post-OR groups.

The leading causes of cesarean were fetal/pelvic disproportion and prior uterine scar, during both the pre-OR period and the post-OR period (Table 3). Patients frequently had two or more indications for cesarean. An average of six cesareans were performed per day shift (8:00 AM–8:00 PM) and four per night shift (8:01 PM–7:59 AM) throughout the entire study. The pre-OR DDI for emergency cesarean was similar during day, night, weekday, and weekend shifts (Table 4). In the post-OR period, the median DDI times for emergency cesarean decreased by 25% and 15% during day and night shifts and by 22% and 14% during weekday and weekend shifts, respectively (Table 4). Similarly, there was a significant reduction in the recovery room stay in the post-OR period for both emergency and elective cesareans throughout all shifts.

Maternal and newborn outcomes are shown in Table 5. Several maternal complications associated with anesthesia administration were not measured in the pre-OR period and cannot be compared. There were no maternal deaths during cesareans in the 2011 study period, but three occurred in 2012. During the entire study, 1199 infants were born by cesarean; 605 (50.5%) were delivered in August–September 2011 and 594 (49.5%) in August–September 2012. The number of twins born by cesarean was 24 in 2011 and 20 in 2012. In 2012, there was a 30% reduction in newborns admitted to the NCU (20.5% vs 14.3%; $P = 0.014$) (Table 5). In 2011, of the 116 NCU admissions, 13 (11.2%) occurred following elective cesarean and 103 (88.8%) after emergency cesarean. This was similar in 2012: of 81 NCU admissions, 7 (8.6%) occurred after elective cesarean and 74 (91.4%) following emergency cesarean. In addition, 29% more newborns were discharged from the NCU within 7 days in the post-OR period (45.7% vs 64.2%; $P = 0.002$).

Despite a significant reduction in delay, only 2 (0.3%) emergency cesareans in 2011 and 9 (1.6%) in 2012 had a DDI of less than 60 minutes; only one emergency cesarean was conducted within a DDI of 30 minutes in 2012. There were no differences in Apgar scores, stillbirths, or neonatal death within 24 hours (Table 5); however, all newborns who died within 24 hours (2011, two deaths; 2012, three deaths) were delivered by emergency cesarean. For patients with pre-eclampsia, there was a positive correlation between a shorter DDI and a lower likelihood of NCU admission, but the results were not significant ($P = 0.08$).