



# Decision-to-delivery interval in emergency cesarean delivery in tertiary care hospital in Thailand

Khemanat Khemworapong, Nalat Sompagdee, Dittakarn Boriboonhirunsarn

Department of Obstetrics and Gynaecology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

## Objective

To determine the decision-to-delivery interval (DDI) in emergency cesarean delivery and associated factors.

## Methods

A total of 431 pregnant women who were indicated for emergency cesarean delivery were included. Clinical information and timing of process after decision until delivery and pregnancy outcomes were evaluated.

## Results

Mean age was 30 years, and 59.4% were nulliparous. Mean gestational age at delivery was 37.9 weeks. The decision was made during normal office hour in 33.2%. Median decision-to-operating room interval, decision-to-incision interval, and DDIs were 45, 70, and 82 minutes, respectively. Only 3.5% of patients had DDI  $\leq$ 30 minutes, while 52.0% had DDI >75 minutes. During after office hours, every time interval was significantly shorter and 4.9% had DDI  $\leq$ 30 minutes compared to 0.7% in normal office hours ( $P=0.001$ ). Compared to other indications, time intervals were significantly shorter in those with non-reassuring fetal heart rate (FHR), and DDI  $\leq$ 30 minutes was achieved in 18.8% vs. 0.8% ( $P<0.001$ ). Shortest DDI was observed among those with non-reassuring FHR during after office hours. Neonatal outcomes were comparable between different DDIs.

## Conclusion

Only 3.5% of emergency cesarean delivery had a DDI  $\leq$ 30 minutes (median 82 minutes). Significant shorter time intervals were observed in those with non-reassuring FHR during after office hours.

**Keywords:** Decision making; Cesarean section; Emergencies

## Introduction

There is a recommendation by the American College of Obstetricians and Gynecologists and the Royal College of Obstetricians and Gynaecologists (RCOG) that decision-to-delivery interval (DDI) in emergency cesarean delivery should be within 30 minutes [1,2]. The 30-minute rule was granted by the consensus of experts without acknowledges supporting study. No evidence has been found to prove that the 30-minute rule helps improve maternal or fetal outcomes [3]. Furthermore, DDI of 30 minutes is difficult to achieve in many settings according to various problems in real clinical practice [4-6].

The latest RCOG National Institute for Health and Care Excellence (NICE) guideline has recommended that category 1 (immediate threat to life of the woman or fetus) and category 2 (maternal or fetal compromise that is not immediately life-

threatening) cesarean sections should be carried out within 30 minutes and 75 minutes after the decision, respectively. They also recommend the use of 30-minute and both 30- and

---

Received: 2017.04.20. Revised: 2017.07.17. Accepted: 2017.07.21.  
Corresponding author: Dittakarn Boriboonhirunsarn  
Department of Obstetrics and Gynaecology, Faculty of Medicine  
Siriraj Hospital, Mahidol University, 2 Wanglang Road,  
Bangkoknoi, Bangkok 10700, Thailand  
E-mail: [dittakarn.bor@mahidol.ac.th](mailto:dittakarn.bor@mahidol.ac.th)  
<http://orcid.org/0000-0002-5901-5923>

Articles published in *Obstet Gynecol Sci* are open-access, distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Copyright © 2018 Korean Society of Obstetrics and Gynecology

75-minute intervals to measure the overall performance of an obstetric unit in category 1 and category 2 cesarean sections, respectively [7].

Many factors have been reported to affect DDI, including team readiness, team communication, availability of operating room and severity of fetal-maternal complications [8]. Previous studies reported that good preparation can reduce DDI, such as locating operating room near delivery room, availability of obstetricians and anesthesiologists, and an effective teamwork. In developed countries, achievement of 30-minute goal as recommended among cases diagnosed with fetal distress was approximately 40%–65% [5,6,9,10]. Meanwhile, in developing countries, the achievement has been reported to be only 0%–20% [11-13].

In Thailand, there is limited information regarding the time interval for emergency cesarean delivery and no specific recommendation has been adopted. A recent report in Thailand showed that only 6.6% of women with non-reassuring fetal heart rate (FHR) pattern achieved the 30-minute goal for cesarean delivery with a median time of 56 minutes [14]. However, such study focused on only women with non-reassuring FHR, but not on women with other indications for emergency cesarean delivery. Exploring and understanding of the time process of emergency cesarean delivery in real clinical practice would provide more insight into the appropriateness of current management protocols and related information on the delay. In addition, it would also help in providing further information related to medico-legal claims in general obstetric practice.

Therefore, the primary objective of this study was to determine the DDI for emergency cesarean delivery. Adverse perinatal outcomes, potential associated factors, and the time intervals of care processes were also evaluated. The results can be regarded as an audit and subjective evaluation of performance of current management provided to this group of women in the institution. The information would also guide the care team to identify the cause of the delay and its barriers with firm evidence in order to improve the quality of care given to these patients. The findings will provide additional information for other settings with similar care problems and processes at both national and international levels. Moreover, policy makers can also use this information to plan future improvements in the patient care process for better care of pregnant women.

## Materials and methods

After approval by the Siriraj Institutional Review Board, this retrospective cohort study was conducted at the Department of Obstetrics and Gynaecology, Faculty of Medicine Siriraj Hospital, which is the largest University-based tertiary referral center in Thailand. After informed consent, a total of 431 term, singleton pregnant women who were indicated for emergency cesarean delivery were included during January to April 2016. Women with detected fetal anomalies and intrauterine fetal death were excluded. During labor, all of the women were managed according to institutional clinical protocol. Decision for emergency cesarean delivery was made by attending staff based on available clinical information on a patient-by-patient basis. The anesthetic methods for cesarean delivery were determined by the attending anesthesiologist.

The data were obtained from medical records, including baseline characteristics, obstetric data, antenatal and intrapartum characteristics, indication for cesarean delivery, and neonatal outcomes. The component process times from decision-to-delivery were recorded and reviewed, including time of decision, time of entering the operating room, time of skin incision, and time of delivery. The decision time was also classified as having been made either during or after normal office hours. According to the NICE recommended guideline and to further facilitate the analysis, DDIs were classified into the following 3 groups:  $\leq 30$ , 31–75, and  $>75$  minutes [7].

Descriptive statistics, including the mean, standard deviation, median, interquartile range, number and percentage were applied as appropriate. Comparisons between and among groups were performed using Student's *t*-test, Mann-Whitney *U* test,  $\chi^2$  test, Kruskal-Wallis test, and analysis of variance as appropriate. Subgroup analysis was also performed using factors that potentially affected time intervals. *P*-values less than 0.05 were regarded as being statistically significant. All statistical analyses were performed using IBM® SPSS® Statistics version 21 (IBM Corp., Armonk, NY, USA).

## Results

During January to April 2016, there were 1,418 deliveries and 559 were cesarean deliveries (39.4%). Indications for cesarean delivery included previous cesarean delivery (13.3%), cephalopelvic disproportion (CPD; 8.9%), non-reassuring FHR

**Table 1.** Baseline clinical characteristics of the study population (n=431)

Characteristics	Value
Mean age (yr)	30.4±6.1
Nulliparous	256 (59.4)
Mean gestational age at delivery (wk)	37.9±2.1
Indication for cesarean delivery	
CPD	118 (27.4)
Non-reassuring FHR pattern	64 (14.8)
Others	
Failed induction	70 (16.2)
Previous cesarean delivery	99 (23.0)
Breech presentation	50 (11.6)
Others	30 (7.0)
Timing of decision	
Normal office hours	143 (33.2)
After office hours	288 (66.8)
Anesthesia	
Regional anesthesia	391 (90.7)
General anesthesia	40 (9.3)
Mean birth weight	3,018.6±561.5
Apgar	
1 min <7	27 (6.3)
5 min <7	4 (0.9)
NICU admission	15 (3.5)

Values are shown as mean±SD or number (%). SD, standard deviation; CPD, cephalopelvic disproportion; FHR, fetal heart rate; NICU, neonatal intensive care unit.

(6%), and others (11.2%). A total of 431 women underwent emergency cesarean delivery were included. Table 1 shows baseline characteristics of the participants. The mean maternal age was 30.4±6.1 years, and the majority of patients were nulliparous (59.4%). The mean gestational age at delivery was 37.9±2.1 weeks. The most common indication for emergency cesarean delivery were CPD (27.4%). Non-reassuring FHR was found in 14.8% and only 6 cases (1.4%) were in category III according to the National Institute of Child Health and Human Development (NICHD) classification. One-third (33.2%) of the operations were performed during office hours. The majority of operations (90.7%) were done under regional anesthesia.

The intervals from decision for cesarean delivery to various endpoints was shown in Table 2. The median time for decision-to-operating room interval (DRI), decision-to-incision

**Table 2.** Intervals from decision for cesarean delivery to various endpoints (n=431)

Time intervals	Time (min)
DRI	
Mean±SD	94.8±115.9
Median (IQR)	45 (20.0–127.5)
DII	
Mean±SD	117.9±117.3
Median (IQR)	70 (40–151)
DDI	
Mean±SD	125.9±118.4
Median (IQR)	82 (49–157)
≤30	15 (3.5)
31–75	192 (44.5)
>75	224 (52.0)

Values are shown as mean±SD, median (IQR), or number (%). DRI, decision-to-operating room interval; DII, decision-to-incision interval; DDI, decision-to-delivery interval; SD, standard deviation; IQR, interquartile range.

interval (DII), and DDI were 45, 70, and 82 minutes, respectively. Only 3.5% of cases had DDI of ≤30 minutes, while as many as 52.0% had DDI of >75 minutes.

Comparisons of various process intervals between different decision time was shown in Table 3. Compared with operation performed during normal office hours, every time interval was significantly shorter during after office hours (DRI: 70.0 vs. 37.5 minutes,  $P<0.001$ ; DII: 96.0 vs. 62.5 minutes,  $P=0.001$ ; and DDI: 103.0 vs. 69.0 minutes,  $P=0.001$ ). DDI of ≤30 minutes were achieved in 4.9% of cases during after office hours compared to only 0.7% during normal office hours ( $P=0.001$ ), and DDI of >75 minutes was also significantly lower (45.8% vs. 64.3%).

When stratified by indications for cesarean delivery, every time interval in the patients with non-reassuring FHR was significantly shorter than those with CPD and other indications, as demonstrated in Table 4. DDI of ≤30 minutes was achieved in 18.8% of those with non-reassuring FHR while it was only 0.8% among those with other indications ( $P<0.001$ ).

Comparisons of intervals from decision to various endpoints among different decision times and indications for cesarean delivery were outlined in Table 5. In terms of DDI, the best performance was observed among non-reassuring FHR pattern during after office hours, and worst performance was observed among those with other indications during normal

# Obstetrics & Gynecology Science

Khemanat Khemworapong, et al. DDI in emergency cesarean delivery

**Table 3.** Comparison between intervals from decision to various endpoints between different decision time

Time intervals (min)	Office hours (n=143)	After office hours (n=288)	P-value <sup>a)</sup>
DRI	70.0 (30–149)	37.5 (15–109)	<0.001
DII	96.0 (51–176)	62.5 (39–139.25)	0.001
DDI	103 (61–181)	69 (47–149.75)	0.001
≤30	1 (0.7)	14 (4.9)	0.001 <sup>b)</sup>
31–75	50 (35.0)	142 (49.3)	
>75	92 (64.3)	132 (45.8)	

Values are shown as median (IQR) or number (%).

DRI, decision-to-operating room interval; DII, decision-to-incision interval; DDI, decision-to-delivery interval; IQR, interquartile range.

<sup>a)</sup>Mann-Whitney *U* test; <sup>b)</sup> $\chi^2$  test.

**Table 4.** Comparison between intervals from decision to various endpoints between different indication for cesarean delivery

Time intervals (min)	CPD (n=118)	Non-reassuring FHR (n=64)	Other indications (n=248)	P-value <sup>a)</sup>
DRI	37.5 (20–119) <sup>b)</sup>	20.0 (10–43.7) <sup>c)</sup>	69.0 (25–149)	<0.001
DII	62.5 (41–144.2) <sup>b)</sup>	40.0 (27.2–67) <sup>c)</sup>	95.0 (47.5–180)	<0.001
DDI	69 (51–152.2) <sup>b)</sup>	47 (33–76.7) <sup>c)</sup>	102 (57–188)	<0.001
≤30	1 (0.8)	12 (18.8)	2 (0.8)	<0.001 <sup>d)</sup>
31–75	63 (53.4)	36 (56.2)	93 (37.3)	
>75	54 (45.8)	16 (25.0)	154 (61.8)	

Values are shown as median (IQR) or number (%).

DRI, decision-to-operating room interval; DII, decision-to-incision interval; DDI, decision-to-delivery interval; CPD, cephalopelvic disproportion; FHR, fetal heart rate; IQR, interquartile range.

<sup>a)</sup>Kruskal-Wallis test; <sup>b)</sup>Significantly different compared to other indications; <sup>c)</sup>Significantly different compared to CPD and others indications;

<sup>d)</sup> $\chi^2$  test.

office hours. A significant shorter DDI was observed during after office hours in those with non-reassuring FHR and other indications, but not CPD. For non-reassuring FHR pattern, 23.4% had DDI ≤30 minutes during after office hours, compared to 5.8% during office hours ( $P=0.032$ ), with the median DDI of 45 and 64 minutes, respectively ( $P=0.042$ ).

Neonatal outcomes were compared between the 3 DDI categories and are shown in Table 6. No significant differences were observed among groups in terms of birth weight, birth asphyxia, or neonatal intensive care unit admission. Other complications including respiratory distress, transient tachypnea of the newborn, meconium aspiration, and sepsis were also comparable between groups.

## Discussion

The results of this study demonstrated that the median DDI among patients with emergency cesarean delivery was 82

minutes, and only 3.5% has DDI ≤30 minutes. This is corresponded to previous studies that DDI was commonly longer than the 30-minute recommendation in real clinical practice, especially among developing countries [4-6,10-13]. However, the results also showed that 48% had DDI ≤75 minutes, which is the suggested time for non-life-threatening cesarean delivery [7].

Since the 30-minute goal has been advocated, no scientific evidence supports this threshold that DDI ≤30 minutes could improve perinatal outcome [3,8]. The latest Guidelines for Perinatal Care refers only to an obstetric unit's capability to respond to an obstetric emergency, with no mention about requirements for delivery within any time frame [15]. It was recommended that DDI should be based on the timing that best incorporates maternal and fetal risks and benefits and should be tailored to local circumstances and logistical capabilities. The NICE guideline has been using 30- and 75-minute rules only for clinical audit of the quality of hospitals and not judging multidisciplinary team performance for any individual

**Table 5.** Comparison between intervals from decision to various endpoints between different decision time and indication for cesarean delivery

Time intervals	Office hours	After office hours	P-value <sup>a)</sup>
CPD	n=35	n=83	
DRI	40 (25.0–129.0)	30 (20.0–111.5)	0.397
DII	63 (43.0–146.0)	62 (41.5–137.5)	0.925
DDI (min)	69 (54.0–152.0)	69 (51.5–147.0)	0.777
≤30	0 (0.0)	1 (1.2)	0.762 <sup>b)</sup>
31–75	18 (51.4)	45 (54.2)	
>75	17 (48.6)	37 (44.6)	
Non-reassuring FHR	n=17	n=47	
DRI	35 (20.0–79.0)	20 (10.0–37.5) <sup>c)</sup>	0.064
DII	57 (38.0–107.0)	39 (25.5–61.0) <sup>c)</sup>	0.051
DDI (min)	64 (4.05–113.0)	45 (32.0–68.5) <sup>c)</sup>	0.042
≤30	1 (5.8)	11 (23.4)	0.032 <sup>b)</sup>
31–75	8 (47.1)	28 (59.6)	
>75	8 (47.1)	8 (17.0)	
Other indications	n=90	n=158	
DRI	86.5 (40–164) <sup>d)</sup>	57.5 (20–139)	0.008
DII	107 (63–189) <sup>d)</sup>	82 (42–164)	0.011
DDI (min)	113 (72–195) <sup>d)</sup>	57.5 (20–139)	0.013
≤30	0 (0.0)	2 (1.3)	0.011 <sup>b)</sup>
31–75	24 (26.4)	69 (43.7)	
>75	67 (73.6)	87 (55.1)	

Values are shown as median (IQR) or number (%).

CPD, cephalopelvic disproportion; DRI, decision-to-operating room interval; DII, decision-to-incision interval; DDI, decision-to-delivery interval; FHR, fetal heart rate; IQR, interquartile range.

<sup>a)</sup>Mann-Whitney *U* test; <sup>b)</sup> $\chi^2$  test; <sup>c)</sup>Significantly different from CPD and other indications during after office hours; <sup>d)</sup>Significantly different from CPD and non-reassuring FHR during office hours.

cesarean delivery [7].

Many factors play an important role in achieving the 30-minute goal, including the obstetric care unit setting, availability of operating room, the clinician's perception of delivery urgency, severity of fetal-maternal complications, and the communication and transfer processes of the setting [8,16]. In this study, component time intervals and factors potentially affecting the DDI were evaluated, including the decision time and indication for cesarean delivery (which partly reflects the level of emergency). The results demonstrated that the median DRI contributed mainly for DDI. In addition, when the decision was made after office hours, every time process was significantly shorter than during office hours. Median DRI was only half of office-hour cases (37.5 vs. 70 minutes), median DDI was reduced to 69 minutes, 4.9% achieved the 30-min-

ute goal, and more than half (54.2%) had DDI ≤75 minutes. Similar better performance during after office hours was observed in every indication of cesarean delivery. This reflected that patient transfer process, as well as availability of operating room are important factors for DDI [5,17].

Similar to other studies, another factor influencing DDI is the severity of maternal and fetal conditions, as specified by indication for cesarean delivery [8,18]. Significant shorter time intervals were observed among those with non-reassuring FHR pattern that median DDI was 47 minutes and 18.8% and 75% had DDI ≤30 and <75 minutes, respectively. Similar significant shorter DDI was also observed even among cases after office hours. This might be due to an increased sense of awareness from the level of emergency among these cases.

However, it should be noted that, among non-reassuring

**Table 6.** Comparison of neonatal outcomes between various decision-to-delivery intervals

Neonatal outcomes	DDI (min)			P-value <sup>a)</sup>
	≤30 (n=15)	31–75 (n=191)	>75 (n=225)	
Mean birth weight (g)	3,043.0±379.6	2,998.0±596.2	3,034.5±542.2	0.793 <sup>b)</sup>
Birth weight category				0.383
SGA	1 (6.7)	16 (8.4)	16 (7.1)	
AGA	13 (86.7)	146 (76.4)	161 (71.6)	
LGA	1 (6.7)	29 (15.2)	48 (21.3)	
Apgar				
1 min <7	2 (13.3)	15 (7.9)	10 (4.4)	0.186
5 min <7	1 (6.7)	2 (1)	2 (0.9)	0.127
Respiratory distress	0 (0)	6 (3.1)	2 (0.9)	0.205
Transient tachypnea of the newborn	1 (6.7)	16 (8.4)	32 (14.2)	0.146
Meconium aspiration	0 (0)	3 (1.6)	3 (1.3)	0.877
Sepsis	0 (0)	2 (1.0)	1 (0.4)	0.722
NICU admission	0 (0)	9 (4.7)	6 (2.7)	0.397

Values are shown as mean±SD or number (%).

SD, standard deviation; SGA, small for gestational age; AGA, appropriate for gestational age; LGA, large for gestational age; NICU, neonatal intensive care unit; DDI, decision-to-delivery interval.

<sup>a)</sup>χ<sup>2</sup> test; <sup>b)</sup>Student's *t*-test.

FHR cases, there was still an average of 20 minutes difference between room-in and incision time. This was probably due to the combination of process of patient preparation, anesthesia, and degree of abnormal FHR. In this study, majority of women with non-reassuring FHR pattern were in NICHD category II that regional anesthesia was provided. On the other hand, the other 6 cases with abnormal FHR in NICHD category III which immediate delivery was required, general anesthesia was provided and the median room-in to incision time was reduced to 10 minutes.

Previous studies reported an improvement in the time to delivery by implementing a multidisciplinary protocol, a team training with more effective communication and an obstetric care process [19,20]. The results of this study also showed some improvement in the care process among women with non-reassuring FHR, compared to a recent report from the same institution [14]. Achievement of 30-minute goal increased from 6.6% to 18.8% and rate of delivery in ≤75 minutes increased from 69.5% to 75%. The median DDI has been improved from 56 to 47 minutes. This was partly due to an improvement in care process, team communication, and guideline amendment that were implemented after the results of previous study.

No significant differences in perinatal outcomes between

various DDI was observed in this study. Similar results were reported in previous studies [8,9,13,18,21,22]. However, a previous study showed that DDI >75 minutes was significantly related with poor perinatal outcomes such as asphyxia and increased in the need for special care [23]. Another study also reported a significant improvement in neonatal outcomes after the DDI in emergency cesarean delivery was shortened, especially in severe irreversible indications such as cord prolapse and placental abruption [20].

Some limitations of this study need to be addressed. The evaluation of the actual cause of delays (e.g., transfer process details, availability of operating room at decision time, anesthetic difficulty) was not possible due to the retrospective nature of this study. In addition, limited sample size in subgroup analyses might result in insufficient power to detect significant differences between groups. Larger prospective studies should be conducted to determine the DDI in various specific subgroups and to evaluate the actual causes of delay in details.

It is recommended that all obstetric unit should improve the time to delivery by realizing the process of emergency cesarean delivery. Communication skills and team readiness should be improved, either by team training and regular audit [19]. Prioritization by the severity of various indications should also

be considered. The operating room should always be available for emergency cesarean deliveries especially for extremely urgent indications.

Although the results are similar to those of other previous reports, these findings provide additional information for both local and national policy makers to plan future improvements in the patient care process. Moreover, the results could be shared with other settings with similar care problems and processes. Nonetheless, further continuous quality improvement processes should be developed and implemented. Processes between decision and delivery should be evaluated systematically and in more details to determine possible barriers and appropriate solutions.

In conclusion, only 3.5% of emergency cesarean delivery had a DDI  $\leq 30$  minutes (median 82 minutes). Significant shorter time intervals were observed in those with non-FHR pattern and when the decision was made after office hours. Causes of the delay should be further investigated and continuous quality improvement in the care process is warranted in order to minimize the unnecessary delay and improve maternal and neonatal outcomes.

## Conflict of Interest

No potential conflict of interest relevant to this article was reported.

## References

1. American Academy of Pediatrics; American College of Obstetricians and Gynecologists. Guidelines for perinatal care. 5th ed. Elk Grove Village (IL): American Academy of Pediatrics; 2002.
2. Royal College of Obstetrics and Gynaecology. Report of a joint working group: organization standards for maternity services. London (GB): Royal College of Obstetricians and Gynecologists Press; 1995.
3. Schauburger CW, Chauhan SP. Emergency cesarean section and the 30-minute rule: definitions. *Am J Perinatol* 2009;26:221-6.
4. Bruce D, Stone S, Harding K. Evaluation of emergency caesarean sections--completion of the audit cycle in a Central London teaching hospital. *J Obstet Gynaecol* 2002;22:273-8.
5. Helmy WH, Jolaoso AS, Ifaturoti OO, Afify SA, Jones MH. The decision-to-delivery interval for emergency caesarean section: is 30 minutes a realistic target? *BJOG* 2002;109:505-8.
6. Livermore LJ, Cochrane RM. Decision to delivery interval: a retrospective study of 1,000 emergency caesarean sections. *J Obstet Gynaecol* 2006;26:307-10.
7. Royal College of Obstetrics and Gynaecology. Caesarean section: NICE clinical guideline 132. London (GB): Royal College of Obstetricians and Gynecologists Press; 2011.
8. Leung TY, Lao TT. Timing of caesarean section according to urgency. *Best Pract Res Clin Obstet Gynaecol* 2013;27:251-67.
9. Bloom SL, Leveno KJ, Spong CY, Gilbert S, Hauth JC, Landon MB, et al. Decision-to-incision times and maternal and infant outcomes. *Obstet Gynecol* 2006;108:6-11.
10. Tuffnell DJ, Wilkinson K, Beresford N. Interval between decision and delivery by caesarean section--are current standards achievable? *Observational case series. BMJ* 2001;322:1330-3.
11. Bello FA, Tsele TA, Oluwasola TO. Decision-to-delivery intervals and perinatal outcomes following emergency cesarean delivery in a Nigerian tertiary hospital. *Int J Gynaecol Obstet* 2015;130:279-83.
12. Chukwudi OE, Okonkwo CA. Decision - delivery interval and perinatal outcome of emergency caesarean sections at a tertiary institution. *Pak J Med Sci* 2014;30:946-50.
13. Onah HE, Ibeziako N, Umezulike AC, Effetie ER, Ogbuokiri CM. Decision - delivery interval and perinatal outcome in emergency caesarean sections. *J Obstet Gynaecol* 2005;25:342-6.
14. Boriboonhirunsarn D, Watananirun K, Sompagdee N. Decision-to-delivery interval in pregnant women with intrapartum non-reassuring fetal heart rate patterns. *J Eval Clin Pract* 2016;22:998-1002.
15. American Academy of Pediatrics; American College of Obstetricians and Gynecologists. Guidelines for perinatal care. 7th ed. Elk Grove Village (IL): American Academy of Pediatrics; 2012.
16. Chauleur C, Collet F, Furtos C, Nourrissat A, Seffert P, Chauvin F. Identification of factors influencing the decision-to-delivery interval in emergency caesarean sections. *Gynecol Obstet Invest* 2009;68:248-54.

17. Sayegh I, Dupuis O, Clement HJ, Rudigoz RC. Evaluating the decision-to-delivery interval in emergency cesarean sections. *Eur J Obstet Gynecol Reprod Biol* 2004;116:28-33.
18. MacKenzie IZ, Cooke I. What is a reasonable time from decision-to-delivery by caesarean section? Evidence from 415 deliveries. *BJOG* 2002;109:498-504.
19. Fuhrmann L, Pedersen TH, Atke A, Møller AM, Østergaard D. Multidisciplinary team training reduces the decision-to-delivery interval for emergency caesarean section. *Acta Anaesthesiol Scand* 2015;59:1287-95.
20. Weiner E, Bar J, Fainstein N, Ben-Haroush A, Sadan O, Golan A, et al. The effect of a program to shorten the decision-to-delivery interval for emergent cesarean section on maternal and neonatal outcome. *Am J Obstet Gynecol* 2014;210:224.e1-6.
21. Hillemanns P, Strauss A, Hasbargen U, Schulze A, Genzel-Boroviczeny O, Weninger E, et al. Crash emergency cesarean section: decision-to-delivery interval under 30 min and its effect on Apgar and umbilical artery pH. *Arch Gynecol Obstet* 2005;273:161-5.
22. Holcroft CJ, Graham EM, Penning DH. Cord gas analysis, decision-to-delivery interval and the 30-minute rule for emergency cesareans. *J Perinatol* 2005;25:616.
23. Thomas J, Paranjothy S, James D. National cross sectional survey to determine whether the decision to delivery interval is critical in emergency caesarean section. *BMJ* 2004;328:665.