Association Between Time of Day of Unscheduled Caesarean Section and Outcomes

Constance Wing-Kei CHAN MBBS(HK), MRCOG
Choi-Wah KONG MBChB, MRCOG, FHKAM (Obstetrics and Gynaecology)
William WK TO MBBS, MPH, MPhil, MD, FRCOG, FHKAM (Obstetrics and Gynaecology)
Department of Obstetrics and Gynaecology, United Christian Hospital, Kwun Tong, Hong Kong

Objective: To evaluate the association between the time of day of unscheduled Caesarean section and maternal and perinatal outcomes.
Methods: This retrospective study was conducted at a regional hospital in Hong Kong. All unscheduled Caesarean sections performed between January 2014 and December 2016 were reviewed. Maternal outcomes included blood loss, postpartum haemorrhage, need for intra-operative blood transfusion, duration of operation, operative complications, postpartum fever, wound complications, and severe maternal morbidities. Perinatal outcomes included birthweight, Apgar scores, admission to the special care baby unit, birth trauma, stillbirths, and neonatal deaths. Data were stratified and compared according to three duty shifts: day shift (08:30-16:30), evening shift (16:31-00:30), and overnight shift (00:31-08:30).
Results: During the study period, 1631 unscheduled Caesarean sections were performed, accounting for 54.7% of all Caesarean sections. The highest proportion (40.4%) of unscheduled Caesarean sections were performed during the day shift. Blood loss was significantly more in the overnight shift than the day or evening shift (444 vs. 366 vs. 386 ml, p=0.005), although the rate of postpartum haemorrhage did not differ significantly. The rate of wound complications requiring re-suturing was higher in the overnight shift than the day or evening shift (3.2% vs. 0.3% vs. 0.16%, p<0.001). For perinatal outcomes, birthweight was lower in the day shift, probably related to the slightly earlier gestation at delivery (p<0.001). There were no significant differences among shifts in terms of Apgar score, special care baby unit admission, birth trauma, or perinatal mortality.
Conclusion: Unscheduled Caesarean sections performed during the overnight shift did not significantly increase maternal or perinatal complications. The current practice is safe for both mothers and neonates.

Hong Kong J Gynaecol Obstet Midwifery 2018; 18(1):24-9

Keywords: Cesarean section; Infant morbidity; Maternal mortality; Shift work schedule

Introduction

Ensuring high-quality care in the delivery suite is essential. Trainees in obstetrics and gynaecology need to be on call for ≥24 hours on a one-in-three to one-in-five rotation as per the College training requirement in Hong Kong[1]. There is controversy about whether performance of doctors is impaired as a result of shift work schedule. Errors in medical judgement tend to increase when physicians are deprived of sleep[2]. After a night on call in a surgical department, surgeons have been reported to show impaired speed and accuracy in simulated laparoscopic performance[3]. In addition, attention failure increases during night work hours[4].

Delivery room work shifts may affect delivery outcomes. The association between the time of day of delivery and maternal and neonatal outcomes has been inconsistent. Two observational studies have reported that infants born at night may be at increased risk of early neonatal death[5,6]. Population-based studies in Sweden and California have reported a significant increase in the risk of neonatal morbidities and mortalities in those born during the night shift[7,8]. Nonetheless, epidemiological studies have failed to demonstrate any significant differences in neonatal outcomes in terms of the time and day of birth[9-11].

This study aimed to examine the association between the time of day of unscheduled Caesarean section and maternal and perinatal outcomes in a regional obstetric unit over a 3-year period from January 2014 to December 2016. We hypothesised that maternal and neonatal complications would increase in unscheduled Caesarean deliveries performed during the overnight shift, compared with the day or evening shift.

Correspondence to: Dr Constance Wing-Kei Chan
Email: cwk391@ha.org.hk

© 2018 Obstetrical & Gynaecological Society of Hong Kong and Hong Kong Midwives Association

Methods

This retrospective study was approved by the Hospital Authority Research Ethics Committee (Kowloon Central Cluster). The need for individual patient consent was waived. This study was conducted at the obstetric unit of the United Christian Hospital, which is a training centre for general specialist trainees and maternal-fetal medicine subspecialist trainees under the Hong Kong College of Obstetricians and Gynaecologists. Over 95% of unscheduled Caesarean sections were performed by first-call or second-call residents. During a call day, residents were on call from 08:30 to around 12:30 the next day, i.e. a continuous shift of 28 hours, before going off duty for a post-call half-day rest. Meanwhile, residents were on cover for labour ward emergencies from 08:30 to 08:30 the next day, and then usually had clinic duties the following day until 12:30. Occasionally, doctors were required to cover the labour ward until they went off duty at 12:30.

Cases were stratified to three groups according to the time of unscheduled Caesarean section: day shift (08:30-16:30), evening shift (16:31-00:30), and overnight shift (00:31-08:30). Most unscheduled Caesarean sections during the day shift were performed by residents who just started duty (duty hours, 0-8). Fewer than 5% of unscheduled Caesarean sections were performed by those during duty hours 24 to 28 after an overnight call. Caesarean sections during the evening shift and overnight shift were performed by those during duty hours 9 to 16 and 17 to 24, respectively.

Records of all pregnant women who underwent an unscheduled Caesarean section at the United Christian Hospital between January 2014 and December 2016 were retrospectively retrieved from the labour ward registry, electronic patient record, and antenatal record system. Demographic data included maternal age, parity, gestation at delivery, pregnancy complications, indication for Caesarean section, type of anaesthesia, type of Caesarean section, and degree of urgency. Surgical outcomes included blood loss, postpartum haemorrhage, need for intra-operative blood transfusion, duration of surgery, complications of surgery, postpartum fever, wound complications, peripartum hysterectomy, and maternal death. Neonatal outcomes included birthweight, Apgar score at 1 and 5 min, special care baby unit admission, birth trauma, stillbirths, and neonatal death.

SPSS (IBM Corp, Armonk [NY], US) was used for statistical analyses. Variables were compared across the day, evening, and overnight shifts using the Chi-square test for categorical variables and the analysis of variance for continuous variables. The post-hoc Bonferroni test was applied to delineate between-group differences. A p value of <0.05 was considered statistically significant.

Results

From January 2014 to December 2016, there were 12 861 deliveries (mean, approximately 4200 per year). Of these, 2982 (23.1%) were Caesarean deliveries, of which 1631 (54.7%) were unscheduled; of the latter, nearly all were lower-segment Caesarean section. Most of the unscheduled Caesarean deliveries occurred during the day shift (n=659, 40.4%), followed by the evening shift (n=500, 30.7%) and overnight shift (n=472, 28.9%) [Table 1].

The proportion of nulliparous women in the overnight shift was significantly higher, probably reflecting a longer labour. The mean gestational age at delivery significantly differed between the three groups, probably owing to a higher proportion of women with induction of labour for post-term pregnancy during the overnight shift. The most common indication for Caesarean section was no progress or labour dystocia. The rates of fetal distress ($p<0.001$) and no progress ($p=0.003$) were higher in the evening shift. The rate of previous Caesarean section ($p=0.037$) was higher in the day shift. The rates of failed instrumental delivery ($p=0.024$) and failed induction of labour ($p=0.004$) were higher in the overnight shift. The rate of general anaesthesia was higher in the evening shift ($p=0.012$). The rate of crash Caesarean sections ($p<0.001$) was higher in the day shift. The rate of second-stage Caesarean sections ($p=0.019$) was higher in the overnight shift.

Blood loss was higher in the overnight shift than the day or evening shift (444 vs. 366 vs. 386 ml, $p=0.005$, Table 2), although the absolute difference of 60-80 ml was not of clinical significance. The rates of primary postpartum haemorrhage, severe postpartum haemorrhage of >1 litre, and need for intra-operative blood transfusion were similar among the three shifts. The rate of wound complications requiring re-suturing was higher in the overnight shift than day or evening shifts (3.2% vs. 0.3% vs. 1.6%, $p<0.001$). Duration of operation and intra-operative complications such as uterine rupture or adjacent organ trauma were similar in the three shifts. There was one case of peripartum hysterectomy in each shift.

The mean birthweight was lower in the day shift than evening or overnight shift (2955 vs. 3096 vs. 3137 g,

Table 1. Baseline maternal characteristics

Variable	Day shift (n=659)*	Evening shift (n=500)*	Overnight shift (n=472)*	p Value
Maternal age (years)	33.5 ± 4.99	33 ± 5.12	33 ± 4.84	0.204
Parity				0.001
Nulliparous	412 (62.5)	354 (70.8)	340 (72.0)	
Multiparous	247 (37.5)	146 (29.2)	132 (28.0)	
Gestation at delivery (weeks)	37.9 ± 2.72	38.5 ± 2.61	38.7 ± 2.41	<0.001†
Multiple pregnancy	35 (5.3)	27 (5.4)	16 (3.4)	0.24
Diabetes mellitus				0.95
Gestational diabetes	116 (17.6)	81 (16.2)	82 (17.4)	
Pre-existing diabetes	6 (0.9)	4 (0.8)	3 (0.6)	
Pre-eclampsia	66 (10.0)	40 (8.0)	30 (6.4)	0.08
Main indications for Caesarean section				
Fetal distress	61 (9.3)	80 (16.0)	40 (8.5)	<0.001
No progress/ labour dystocia	131 (19.9)	142 (28.4)	113 (23.9)	0.003
Placenta praevia	25 (3.8)	11 (2.2)	9 (1.9)	0.11
Abruptio placenta	9 (1.4)	6 (1.2)	5 (1.1)	0.89
Breech	22 (3.3)	21 (4.2)	23 (4.9)	0.42
Previous Caesarean section	113 (17.1)	59 (11.8)	67 (14.2)	0.037
Failed instrumental delivery	8 (1.2)	4 (0.8)	16 (3.4)	0.024
Failed induction of labour	39 (5.9)	28 (5.6)	49 (10.4)	0.004
Type of anaesthesia				0.012
Spinal	507 (76.9)	349 (69.8)	341 (72.2)	
Epidural	42 (6.4)	46 (9.2)	52 (11.0)	
General	110 (16.7)	105 (21.0)	79 (16.7)	
Type of Caesarean section				0.53
Lower segment	656 (99.5)	495 (99.0)	468 (99.2)	
Classical	3 (0.5)	5 (1.0)	4 (0.8)	
Type of emergency				<0.001
Emergency	441 (66.9)	390 (78.0)	404 (85.6)	
Crash	218 (33.1)	110 (22.0)	68 (14.4)	
Second-stage Caesarean section	28 (4.2)	32 (6.4)	39 (8.3)	0.019

* Data are presented as mean ± standard deviation or No. (%) of subjects

† By analysis of variance with post-hoc Bonferroni test: day vs. evening shift (mean difference [MD]= -0.54, 95% confidence interval [CI]= -0.91 to -0.17, p=0.001); day vs. overnight shift (MD= -0.77, 95% CI= -1.15 to -0.39, p<0.001); evening vs. overnight shift (MD= -0.23, 95% CI= -0.63 to 0.17, p=0.527)

p<0.001, Table 3), probably owing to the slightly earlier gestation at delivery. Other neonatal outcomes including Apgar scores and birth trauma were comparable among the three shifts. There were six stillbirths: two for placenta abruptio, one for severe pre-eclampsia, one for fetal distress, and one for maternal request. The sixth involved a peri-mortem Caesarean section in a patient with cardiac arrest following cerebrovascular haemorrhage complicating a severe hypertensive crisis. Of the four neonatal deaths, two were due to congenital abnormalities and two were due to complications of prematurity.

Unscheduled Caesarean sections performed during the overnight shift were associated with only minor increases in maternal morbidities (blood loss and wound complications) and not with any neonatal morbidities.

Table 2. Maternal outcomes of unscheduled Caesarean section

Variable	Day shift (n=659)*	Evening shift (n=500)*	Overnight shift (n=472)*	p Value
Blood loss (ml)	366 ± 339	386 ± 364	444 ± 502	0.005†
Total postpartum haemorrhage	137 (20.8)	108 (21.6)	112 (23.7)	0.49
Severe postpartum haemorrhage	14 (2.1)	15 (3.0)	12 (2.5)	0.64
Peripartum hysterectomy	1 (0.2)	1 (0.2)	1 (0.2)	0.96
Intra-operative blood transfusion	9 (1.4)	7 (1.4)	10 (2.1)	0.58
Duration of operation (min)	44.3 ± 18.2	45.6 ± 18.4	45.6 ± 15.3	0.91
Lower segment tear	4 (0.6)	6 (1.2)	8 (1.7)	0.10
Adjacent organ trauma	1 (0.2)	0 (0.0)	0 (0.0)	0.48
Postpartum fever	34 (5.2)	20 (4.0)	26 (5.5)	0.51
Wound complications requiring re-suturing	2 (0.3)	8 (1.6)	15 (3.2)	<0.001
Maternal death	0 (0.0)	1 (0.2)	0 (0.0)	0.32

* Data are presented as mean ± standard deviation or No. (%) of subjects

† By analysis of variance with post-hoc Bonferroni test: day vs. evening shift (mean difference [MD]= -19.8, 95% confidence interval [CI]= -76.7 to 37.1, p=1.0); day vs. overnight shift (MD= -77.6, 95% CI= -135.5 to -19.7, p=0.004); evening vs. overnight shift (MD= -57.8, 95% CI= -119.4 to 3.8, p=0.074)

Table 3. Neonatal outcomes of unscheduled Caesarean section

Variable	Day shift (n=694)*	Evening shift (n=527)*	Overnight shift (n=488)*	p Value
Birthweight (g)	2955 ± 729	3096 ± 684	3137 ± 615	<0.001†
Apgar score <4 at 1 min	6 (0.9)	7 (1.3)	3 (0.6)	0.48
Apgar score <7 at 5 min	16 (2.3)	15 (2.8)	10 (2.0)	0.70
Special care baby unit admission	466 (67.1)	361 (68.5)	327 (67.0)	0.85
Birth trauma				0.51
Lacerations	2 (0.3)	1 (0.2)	0 (0.0)	
Fractures	0 (0.0)	0 (0.0)	0 (0.0)	
Stillbirth	2 (0.3)	3 (0.6)	1 (0.2)	0.60
Neonatal death	2 (0.3)	1 (0.2)	1 (0.2)	0.93

* Data are presented as mean ± standard deviation or No. (%) of subjects

† By analysis of variance with post-hoc Bonferroni test: day vs. evening shift (mean difference [MD]= -140.2, 95% confidence interval [CI]= -235.0 to -45.5, p<0.001); day vs. overnight shift (MD= -181.1, 95% CI= -278.0 to -84.2, p<0.001); evening vs. overnight shift (MD= -40.9, 95% CI= -143.9 to 62.2, p=1.000)

Discussion

In this study, unscheduled Caesarean sections performed during the overnight shift did not result in a significant increase in maternal or perinatal complications, compared with other shifts. Since the publication of the Doctor Work Reform Recommendation report by the steering committee on doctor work hours of the Hong Kong Hospital Authority[12], an upper limit of 28 continuous working hours has been used as a corporate audit standard for doctor work hours. Our resident call system and work hours have shown no negative effects on doctor performance. The current practice in a typical obstetric service and training unit is safe for both mothers and neonates.

The possible negative effects of fatigue and sleep deprivation on clinical performance have been reported[2]. In a study of the impact of partial sleep deprivation after an overnight call on the mood status and cognitive skills of anaesthesiologists, tension, anger, fatigue, confusion,

irritability, jitteriness, and sleepiness were significantly affected, and there was a decrease in vigour, energy, and confidence[13]. Even when anaesthesiology residents were required to do only shift duty, they spent less time on manual tasks and more on monitoring tasks during the night shift than during the day shift, and they experienced more negative moods at night[14]. Among junior physicians, post-on-call alert scores were significantly reduced compared with their pre-on-call scores if they slept fewer hours during the call compared with normal sleep hours[15]. When emergency medicine registrars were presented with simulated scenarios and tested with clinical questions of fellowship examination standard, their scores were significantly higher during their dayshift than nightshift[16]. When paediatric residents were challenged with a medical decision questionnaire after 24 hours on call, those with most sleep deprivation and nap time of <1 hour during the shift were significantly more likely to choose riskier medical options than those with more sleep[17]. In a meta-analysis of 16 studies on the impact of sleep deprivation and disturbed circadian rhythm on the performance of surgical residents, mixed results were obtained. Nonetheless, when results showed a negative impact, surgical residents with less training/experience appeared to be more affected than more senior residents[18]. When obstetrics and gynaecology residents were asked to complete a series of tasks to test fine-motor coordination before and after 24 hours on call, there was a significant decline in performance after an overnight call, and there were significant differences in performance when stratified by year of training and gender. Female residents appeared to tolerate better the lack of sleep than male residents, and third-year residents showed no changes in post-call compared with more junior colleagues[19].

The negative effects on performance can be due to fatigue, sleep deprivation, or disturbed circadian rhythm. Compelling evidence of the detrimental effects of sleep deprivation derives from comparisons between the effects of acute sleep deprivation and those of alcohol intoxication. Even 17 hours of continued wakefulness can decrease performance to a degree similar to that seen with a blood alcohol concentration of 0.05%[20,21] (The law against drunk driving in Hong Kong sets the maximum blood alcohol level at 55 mg per 100 ml or 0.055%). Although our findings did not show any major negative impact on maternal or neonatal morbidities in unscheduled Caesarean sections carried out during the overnight shift, there were still subtle differences such as slightly more blood loss and more wound complications requiring re-suturing. A large epidemiological study showed that the night shift is an independent risk factor for increases in severe maternal morbidities, such as third- and fourth-degree perineal tears, vaginal haematoma, re-laparotomy, and even hysterectomy[22]. It may be argued that the adrenaline response of the doctor during emergency operations will counteract the reduced alertness due to fatigue. However, 90% of our residents were female and could have tolerated sleep deprivation better than male residents. In addition, many of our residents were in their third year of training or above and their experience may have compensated for their slightly compromised performance[18,19]. Indeed, in sleep-deprived residents on a peg transfer task in two different laparoscopic skills simulators, level of expertise could override sleep hours and fatigue to be the only significant determinant of performance[23].

Neonatal outcomes can be affected by many other obstetric and neonatal management factors. It remains controversial whether the time of delivery is relevant. A large epidemiological study in California showed that the neonatal mortality per 1000 livebirths rose from 1.88 for daytime to 2.37 for early night and 2.31 for late night, and there was excess mortality in neonates with birthweight of <1500 g[8]. Similarly, in a population-based cohort study from Scotland, delivery of a baby outside the normal working week was associated with an increased risk of neonatal death at term ascribed to intrapartum anoxia[24]. Nonetheless, outcomes of vaginal and Caesarean births involve the performance of both the obstetric and neonatal teams and other supporting services. A Japanese retrospective series reported that Caesarean delivery during the night had an increased risk of neonatal but not maternal morbidity[25]. On the contrary, a large North American Caesarean registry failed to demonstrate any increase in maternal or neonatal complications after Caesarean sections performed during the night shift[9]. In addition, a retrospective cohort study from Israel showed that Caesarean section performed in the night shift was associated with a longer operative time and an increased risk of maternal but not neonatal morbidity[10]. The risks of out-of-hour neonatal death in the 1990s had become non-significant by 2000-2004, and had no significant association by 2005-2009[26]. Improvement in staffing patterns of neonatal units to provide consistent and standard care has mitigated the differences in perinatal outcome in relation to the time of delivery.

This study had limitations. Data were collected from a single regional hospital in Hong Kong and not from all tertiary care hospitals; this limited the sample size for assessing neonatal mortality. Although our on-call and duty-hour system and the level of experience of our

residents were largely similar to those of other teaching hospitals in Hong Kong, there could still be discrepancies and results might not be directly applicable.

Conclusion

Unscheduled Caesarean sections that were performed during the overnight shift were associated with only minor increases in maternal morbidities and were not associated with neonatal morbidities. It is reassuring that our current on-call system and practice are safe for both mothers and neonates.

Declaration

As an editor of this journal, William WK To was not involved in the peer review process of this article. All other authors have disclosed no conflicts of interest.

References

1. Structured Training in Obstetrics and Gynaecology (endorsed by the Council on 10th November 2016). Hong Kong College of Obstetricians and Gynaecologists. Available from: http://www.hkcog.org.hk/hkcog/Download/3-Basic_training.pdf.
2. Weinger MB, Ancoli-Israel S. Sleep deprivation and clinical performance. *JAMA* 2002; 287:955-7.
3. Grantcharov TP, Bardram L, Funch-Jensen P, Rosenberg J. Laparoscopic performance after one night on call in a surgical department: prospective study. *BMJ* 2001; 323:1222-3.
4. Lockley SW, Cronin JW, Evans EE, et al. Effect of reducing interns' weekly work hours on sleep and attentional failures. *N Engl J* Med 2004; 351:1829-37.
5. Luo ZC, Karlberg J. Timing of birth and infant and early neonatal mortality in Sweden 1973-95: longitudinal birth registry study. *BMJ* 2001; 323:1327-30.
6. Heller G, Misselwitz B, Schmidt S. Early neonatal mortality, asphyxia related deaths, and timing of low risk births in Hesse, Germany, 1990-8: observational study. *BMJ* 2000; 321:274-5.
7. Stephansson O, Dickman PW, Johansson AL, Kieler H, Cnattingius S. Time of birth and risk of intrapartum and early neonatal death. *Epidemiology* 2003; 14:218-22.
8. Gould JB, Qin C, Chavez G. Time of birth and the risk of neonatal death. *Obstet Gynecol* 2005; 106:352-8.
9. Bailit JL, Landon MB, Thom E, et al. The MFMU Cesarean Registry: impact of time of day on cesarean complications. *Am J Obstet Gynecol* 2006; 195:1132-7.
10. Peled Y, Melamed N, Chen R, Pardo J, Ben-Shitrit G, Yogev Y. The effect of time of day on outcome of unscheduled cesarean deliveries. *J Matern Fetal Neonatal Med* 2011; 24:1051-4.
11. Caughey AB, Urato AC, Lee KA, Thiet MP, Washington AE, Laros RK Jr. Time of delivery and neonatal morbidity and mortality. *Am J Obstet Gynecol* 2008; 199:496.e1-5.
12. Executive summary. Doctor Work Reform Recommendation Report. Hospital Authority 2007. Steering Committee on Doctor Work Hour.
13. Saadat H, Bissonnette B, Tumin D, et al. Time to talk about work-hour impact on anesthesiologists: The effects of sleep deprivation on Profile of Mood States and cognitive tasks. *Paediatr Anaesth* 2016; 26:66-71.
14. Cao CG, Weinger MB, Slagle J, et al. Differences in day and night shift clinical performance in anesthesiology. *Hum Factors* 2008; 50:276-90.
15. Wali SO, Qutah K, Abushanab L, Basamh R, Abushanab J, Krayem A. Effect of on-call-related sleep deprivation on physicians' mood and alertness. *Ann Thorac Med* 2013; 8:22-7.
16. Marcus L, Liew D, Knott J. The effect of nightshift on emergency registrars' clinical skills. *Emerg Med Australas* 2010; 22:211-5.
17. Aran A, Wasserteil N, Gross I, Mendlovic J, Pollak Y. Medical decisions of pediatric residents turn riskier after a 24-hour call with no sleep. *Med Decis Making* 2017; 37:127-33.
18. Sturm L, Dawson D, Vaughan R, et al. Effects of fatigue on surgeon performance and surgical outcomes: a systematic review. *ANZ J Surg* 2011; 81:502-9.
19. Ayalon RD, Friedman F Jr. The effect of sleep deprivation on fine motor coordination in obstetrics and gynecology residents. *Am J Obstet Gynecol* 2008; 199:576.e1-5.
20. Williamson AM, Feyer AM. Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Occup Environ Med* 2000; 57:649-55.
21. Clark SL. Sleep deprivation: implications for obstetric practice in the United States. *Am J Obstet Gynecol* 2009; 201:136.e1-4.
22. Lyndon A, Lee HC, Gay C, Gilbert WM, Gould JB, Lee KA. Effect of time of birth on maternal morbidity during childbirth hospitalization in California. *Am J Obstet Gynecol* 2015; 213:705.e1-11.
23. Olasky J, Chellali A, Sankaranarayanan G, et al. Effects of sleep hours and fatigue on performance in laparoscopic surgery simulators. *Surg Endosc* 2014; 28:2564-8.
24. Pasupathy D, Wood AM, Pell JP, Fleming M, Smith GC. Time of birth and risk of neonatal death at term: retrospective cohort study. *BMJ* 2010; 341:c3498.
25. Suzuki S. The effect of time of day on unscheduled cesarean delivery and perinatal outcome. *Int J Gynaecol Obstet* 2012; 116:117-8.
26. Gardosi J, Tonks A, Francis A. Risk of neonatal death due to intrapartum anoxia in out of hours deliveries in the West Midlands. Available from: http://www.bmj.com/rapid-response/2011/11/02/risk-neonatal-death-due-intrapartum-anoxia-out-hours-deliveries-west-midla