RESEARCH REPORT

Impact of a cultural belief about ghost month on delivery mode in Taiwan

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Background: Many Chinese believe the lunar month of July, ''ghost month'' is inauspicious for major surgical procedures. This study hypothesised that caesaren delivery (CS) rates will be significantly lower during lunar July, and higher than normal during June, representing pre-emptive caesaren delivery to avoid delivering in July.

Methods: Population based data from Taiwan on all singleton deliveries during 1997–2003 (1 750 862 cases) were subjected to multivariate autoregressive integrated moving average (ARIMA) modelling, adjusting for major obstetric complications (previous CS, breech presentation, dystocia, and fetal distress).

Results: ARIMA intervention models showed significantly lower CS rates in lunar July, and among younger age groups ($p<0.001$), but not among 35 plus aged mothers. Incidence of previous CS, is significantly higher among June deliveries, while the incidence of the remaining major complications is similar in July, June, and other months. Patients with clinically less salient obstetric complications show significantly lower CS rates in July.

Conclusions: Adjusted CS rates during the ghost month are significantly lower than other months. Lunar June shows an increase in deliveries of previous CS mothers (almost all by CS), suggesting elective CS to pre-empt CS in July. A major policy implication is that health education must be launched to dissipate the cultural belief about the ghost month. Evidence also implies some proportion of clinically un-indicated CS in other months, showing the need for professional and policy initiatives to reduce unnecessary CS. Policy makers and researchers in other countries should be alert to cultural beliefs associated with delivery to enable informed delivery choices by mothers.

Increasing caesaren section (CS) rates are being reported in developed and developing countries alike (Chile 40% in 1996,[1] Taiwan 32.5% in 2001,[2] UK 22.0% in 2001[3]), far exceeding the World Health Organisation's (WHO) recommendation of a primary CS rate of 15%.[4] Although many question the specified norm, the general consensus is that a substantial proportion of caesarens is clinically unnecessary, some suggesting that a third of all CS operations are unnecessary.[5] Careful meta-analyses covering a wide range of studies show that, compared with vaginal deliveries, inappropriate CS not only increases maternal and neonatal morbidity and mortality,[6] but also increases the costs of health care.[7]

Many authors have explored the issue of high CS rates. Apart from the clinical indications, many non-clinical factors influence CS rates, such as, fear of litigation, reimbursement type, provider and hospital characteristics, and patient's socioeconomic status.[2 8–10] Empirical evidence on non-clinical factors can help in policy development, to avert clinically un-indicated caesarens.

To design targeted interventions, it may be useful to stratify the non-clinical factors into provider driven and patient driven CS. The literature suggests a policy bias targeting provider decision making through clinical and financial interventions.[11] It is possible that patient driven CS may be more amenable to health education efforts, particularly those involving cultural beliefs.

Few studies have examined the issue of cultural beliefs in patients' CS decisions,[12 13] and fewer still have empirically assessed their impacts on caesaren delivery. A qualitative study found that Australian women considered CS easy and convenient for childbirth.[12] Lo reported significantly higher likelihood of a CS operation on auspicious days among Chinese patients.[13] Studies on the cultural factors affecting patient decisions about delivery mode can assist in policy formulation to counter the problem of unnecessary CS.

This empirical study examines a widely prevalent cultural belief that the Chinese lunar month of July, is inauspicious for major life events such as childbirth, especially operative childbirth. The lunar calendar lags three to six weeks behind the solar calendar, depending upon the year. Lunar July is believed to be a ''ghost month'', when the door of hell is opened, freeing ghosts to revisit the human world. Many Chinese avoid being outdoors alone at night as well as travelling during this month, to avoid evil encounters or mishaps mediated by ghosts. Similarly, many avoid hospitalisation for elective surgery including CS, because ghosts are believed to congregate in hospitals and cause death or needless suffering. We examine seven year population based data on deliveries in Taiwan to examine how this belief affects caesaren rates.

Taiwan initiated National Health Insurance (NHI) in March 1995, offering including universal coverage to all citizens, a single payer system (with the government as the sole insurer and payer) and comprehensive health benefits. These features present a unique opportunity to examine the population wide impact of beliefs about the ghost month on CS rates. We hypothesise that CS rates should be significantly lower during the lunar month of July, and significantly higher in lunar June, than during other months.

METHODS

Study sample

We used seven year population based data (1997–2003) from the NHI database to examine the association between the ghost month and CS rates. All records have one principal diagnosis and up to four secondary diagnoses by ICD-9CM

Abbreviations: CS, caesarean section; ARIMA, autoregressive integrated moving average; MAPE, mean absolute percentage error; MAE, mean absolute error

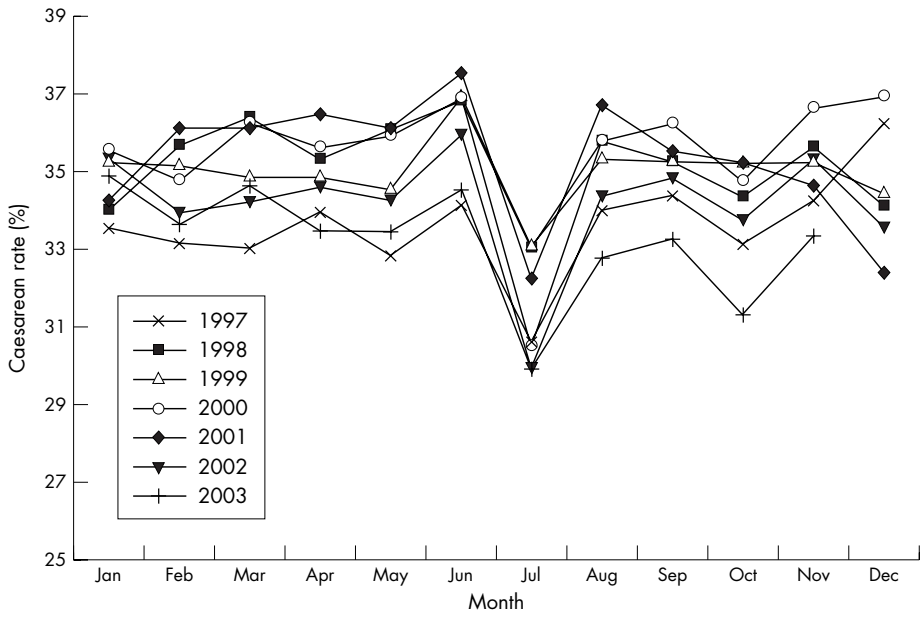

Figure 1 Monthly CS rates in Taiwan, by the Chinese lunar calendar. (Lunar July is believed to be the ghost month).

codes, and the operative procedure (ICD-OP) code. In addition, in Taiwan, caesaren deliveries have two distinct DRG codes, for physician decided CS (presumed to be clinically indicated) compared with maternal request CS (without clinical need as judged by the attending physician). Clinically indicated CS is reimbursed at twice the rate fixed for vaginal delivery, whereas maternal request CS is reimbursed at the same rate as vaginal delivery. Physicians have to bill the patient for the difference.

All patients aged between 15 and 50 years with a singleton delivery (ICD-OP codes 72XX or 73XX) during January 1997 through November 2003 were selected, and classified by delivery mode based on DRG 0371A CS deliveries, and DRGs 740, 741, 742, and 744 for vaginal deliveries, for a total sample of 1 750 862 mothers. The study period spans seven Chinese lunar years, and the sample distribution by year is as follows: 292 657 cases in lunar 1997, 260 022 in 1998, 257 072 in 1999, 274 314 in 2000, 253 050 in 2001, 223 260 in 2002, and 190 87 in 2003 (ending November 2003 of the Christian calendar).

We include all cases, regardless of DRG codes, clinically indicated CS or maternal request CS. This is because the physician decides the classification, and there is a possibility of some maternal request CS cases being coded as clinically indicated CS, to absolve the patient of the 50% cost share liability imposed by NHI on maternal request CS. It is also not possible to determine how far the final delivery decision was influenced by the physician's accommodation to, or concurrence with the maternal belief about the ghost month, or whether the delivery mode decision was initiated by the physician's own belief about the ghost month. The influence of the attending physician's preferences on the mother's choice of delivery mode is well reported.[14] To avoid confounding on these accounts, all deliveries are included in the study.

Data analysis

We used time series analysis in SAS to identify the influence of lunar July on CS rates. Monthly CS rates were calculated for each lunar month of the study period. The lunar month is of four weeks duration, resulting in one additional month every three years. In the Chinese calendar, this is credited to one particular month that occurs twice during that year. During 1997–2003, 1998 had two May months, and 2001 had two April months. CS rates for May 1998 and April 1998, as well as complication rates are the means for the two months with the same name. Thus, our time series comprises seven series of 12 observations each (only 11 observations in 2003).

Monthly CS rates were calculated for the pooled sample combining all age groups each year, and also classified into three age groups of $\leqslant 24$, 25–34, and $\geqslant 35$ years. These four groups are modelled separately, spanning 84 months of the

Table 1 Distribution of study patients (n = 1750862 delivery cases, 1997–2003)

Variable (% of total cases)	Total deliveries n (% CS)	Physician decided CS n (% of total CSs)	Maternal request CS n (% of total CSs)
Age (years)			
$\leqslant 24$ (18.7)	327272 (24.2)	70285 (88.9)	8745 (11.1)
25–34 (65.1)	1139635 (33.9)	349130 (90.4)	37290 (9.6)
$\geqslant 35$ (16.2)	283955 (46.1)	118856 (90.9)	11957 (9.1)
Complication category*			
Previous caesaren section (12.0)	209411 (98.1)	200913 (97.8)	4554 (2.2)
Indisputable indications for CS† (16.1)	281298 (94.6)	261115 (98.1)	5108 (1.9)
Other complications potentially justifying caesaren (8.6)	150911 (38.8)	55309 (94.4)	3259 (5.6)
Pelvic floor/perineal/birth canal injury (8.7)	152213 (0.1)	76 (60.3)	50 (39.7)
Other comorbidities not ordinarily indications for caesaren (5.2)	90260 (64.2)	18797 (32.4)	39150 (67.6)
No complication (49.5)	866769 (0.9)	2061 (26.0)	5871 (74.0)

*Lin and Xirasagar, 2004. †Diagnosis of breech presentation, dystocia or fetal distress, assigned based on Anderson and Lomas (1984) hierarchy of obstetric complications.

Table 2 Distribution of deliveries, 1997–2003 by complication status and month (July compared with June, and other months)

	July (n = 138337)		June (n = 144006)		Other months (n = 1468519)	
Variables	**n (%)**	**CS rate (%)**	**n (%)**	**CS rate (%)**	**n (%)**	**CS rate (%)**
Complication						
Previous caesaren section	15169 (11.0)	98.1	18354 (12.8)	98.2	175888 (12.0)	98.1
Indisputable indications	21284 (15.4)	94.6	23617 (16.4)	95.0	236397 (16.1)	94.6
Other complications potentially justifying caesaren	12199 (8.8)	37.2	12170 (8.5)	40.5	126542 (8.6)	38.8
Pelvic floor/perineal/birth canal injury	12202 (8.8)	0.1	11975 (8.3)	0.1	128036 (8.7)	0.1
Other comorbidities not ordinarily indications for caesaren	6974 (5.0)	63.0	7460 (5.2)	65.7	75826 (5.2)	64.2
No complication	70509 (51.0)	0.9	70430 (48.9)	1.0	725830 (49.4)	1.0

*All differences, July compared with June, June compared with other months, and July compared with other months are significant ($p<0.0001$).

Christian calendar. The unit of analysis is the monthly CS rate in Taiwan.

We used multivariate autoregressive integrated moving average (ARIMA) modelling, including a constant term, several terms for auto-regressions, an intervention variable of lunar July (represented as a dummy variable), and other month effects on CS rates. Within the ARIMA models, our study controlled for the monthly CS prevalence among mothers identified as previous CS, and mothers with a secondary diagnosis of dystocia, fetal distress, and breech presentation. An earlier study has reported these conditions as highly salient factors in CS delivery in Taiwan.[2]

The final model was selected from among the family of multivariate ARIMA models, based upon the lowest mean absolute percentage error (MAPE) or mean absolute error (MAE). A two tailed significance level of 0.05 was used to determine statistical significance.

RESULTS

Figure 1 presents the monthly CS rates for lunar 1997, 1998, 1999, 2000, 2001, 2002, and 2003 (mean (SD) 34.57% (1.67%); range, 29.91% in lunar July 2003 to 37.54% in lunar June 2001). Mean CS rates in June, July, and August are 36.10%, 31.32%, and 34.94%, respectively, all significant ($p<0.001$).

Examined by age group, mothers aged ⩾35 years have the highest CS rates (mean (SD) 49.32% (4.64%)), followed by 25–34 age group (mean 34.80 (2.25%)), and ⩽24 years (mean 24.24% (1.45%)), data/figures not presented. The monthly variation patterns among the pooled sample and among the age groups below 35 years are consistent, with the rate peaking every (lunar) June, followed by a sharp trough in July. Among the age group of 35 plus, a trough is evident in some years and not in others.

Table 1 shows the sample distribution by age group, presence of salient obstetric complications, and corresponding CS rates. Table 2 shows the distribution of deliveries in all seven lunar June months, seven July months, and other months of the study period, by complication status and corresponding CS rates. Analysing the prevalence of complications, it is seen that the prevalence of ''previous CS'' in July deliveries compared with June, and July compared with other months, is significantly lower. Analysing CS rates among the complication groups, the category ''other complications potentially justifying caesaren'' shows significantly different rates by month. In July, this category shows a 37.2% caesaren rate, in June 40.5%, and in ''other months'', 38.8%. While monthly CS rate differences across all categories show statistical significance (because of large sample size), the magnitude of effect among ''other complications potentially justifying caesaren'' has significant policy implications.

Table 3 describes the multivariate ARIMA models. From a family of alternative models, ARIMA $(3,0,0)_{12}$ model was selected for the pooled sample with all age groups, based on a MAPE of 1.35%. For the subsets classified by age, AR2 models were selected, based on their respective MAPE values of

Table 3 ARIMA intervention model showing the impact of lunar July on CS rates in Taiwan: number (all age groups) = 1750862

	All age groups	<24							(n = 327272)	25–34		
(n = 1139635)	>35								(n = 283955)			
Independent variable	β	SE	*t* value	β	SE	*t* value	β	SE	*t* value	β	SE	*t* value
Intercept	11.62	3.29	3.53***	8.75	1.60	5.48***	4.30	2.22	1.93#	12.20	3.38	3.60***
AR1	0.47	0.11	4.28***	0.42	0.12	3.67***	0.53	0.11	4.73***	0.37	0.11	3.49***
AR2	0.32	0.11	2.85**	0.20	0.12	1.68†	0.29	0.11	2.60*	0.49	0.11	4.59***
June	0.35	0.28	1.23	0.57	0.26	2.22*	−0.08	0.21	−0.38	0.31	0.49	0.62
July	−2.42	0.28	−8.59***	−1.26	0.21	−6.00***	−0.75	0.22	−3.41***	−0.03	0.44	−0.07
August	0.12	0.25	0.47	−0.15	0.26	−0.60	0.13	0.19	0.68	0.48	0.44	1.08
Previous CS	1.01	0.15	6.71***	0.73	0.15	4.98***	1.20	0.12	10.13***	0.96	0.12	8.29***
Breech/dystocia/fetal distress	0.69	0.16	4.20***	0.83	0.11	7.78***	0.99	0.11	8.62***	0.91	0.12	7.69***
RMSE (root mean square error)	0.6461	0.6357	0.5125	1.2443								
MAPE (mean absolute per cent error)	1.3452	2.0566	1.1305	1.9706								
MAE (mean absolute error)	0.4596	0.4956	0.3932	0.9765								
R^2	0.827	0.806	0.948	0.927								

AR2 models used for the three age classified subgroups, and AR3 model for the pooled sample. All selections based on MAPE values. †$p<0.1$; *$p<0.05$; **$p<0.01$; ***$p<0.001$.

2.06%, 1.13%, and 1.97%. All four models included dummy variables for lunar June and July. In addition, all age group models also included controls for previous CS, breech presentation, dystocia, and fetal distress. These four complications are widely reported as obstetrically salient for the delivery mode.[2 15] We assigned patients with multiple complications to a specific category based on Anderson and Lomas's hierarchy of clinical complications.[15]

The ARIMA model R^2 for the pooled sample is 0.83, and among the age group subsets, ranges between 0.81 ($\leqslant$24 years), and 0.95 (25–34 years). We saw a significant effect of lunar July in the pooled sample, and among the age subgroups ($p<0.001$) except among the $\geqslant$35 group. The parameter estimates for July represent a significant decrease in CS rates in lunar July, over an average month, among mothers without obstetric complications that most often predict a caesaren. Estimates for ''previous CS'' and ''breech/dystocia/fetal distress'' are consistently high in all models, ranging from 0.73 to 1.20 for the former variable, and between 0.69 and 0.99 for the latter. Parameter estimates for lunar June and August are not significant showing that the higher levels seen in the graphs are on average, comparable to the rates in other months.

DISCUSSION

Although culture is speculated to influence CS rates,[12 13] not many empirical studies are reported. A study by Huang *et al* in Taiwan found that 45.1% of women who had undergone a CS chose to have, or time an elective CS, primarily to ensure astrologically auspicious time of delivery.[16] Our population based study finds that a belief among Chinese about the ghost month is associated with reduced CS rates during the ghost month of lunar July, controlling for salient obstetric complications. The model R^2 for all age groups is high, ranging between 0.81 and 0.93, showing high predictive validity. The obstetric complication variables show high parameter estimates that are comparable in all age groups. Parameter estimates show that women without obstetrically salient complications, experience a significant decline in CS rates during lunar July.

Lunar July appears at different locations of the solar calendar through the seven year period. This shows that the ghost month effect is not due to systematic seasonal variations across the solar calendar year, often noticed in many health related phenomena. For example, lunar July corresponded to the solar month of August in 1997, September in 1998, and August in 1999. In other years, lunar July mostly overlapped with solar August or adjoining weeks of July and August. The consistent trough in lunar July, after a noticeable peak in June, followed by a return to average levels in lunar August support our hypothesis of the ghost month effect.

Our findings also show that CS decisions in cases with salient obstetric complications are not compromised by ghost month related beliefs. Table 2 shows that there is no difference in CS rates by month (July, June, other months) among mothers with the complications of, ''previous CS,'' ''indisputable indications'', and ''other complications potentially justifying caesaren.'' Our assertion that the ghost month effect does not compromise clinically indicated CS is also supported by table 3. The parameter estimates for the clinical complication variables show high CS propensities even after controlling for the month effect, in all age groups. Furthermore, among mothers aged over 35 years, lunar July does not show a significant effect. The mean CS rate among this group is almost 50%. These findings together with high effect sizes for previous CS and breech/dystocia/fetal distress, and a high model R^2 of 0.93, are consistent with a conclusion that despite cultural beliefs about lunar July, CS decisions among high risk groups are not compromised.

Lack of the lunar July effect among older women may seem counterintuitive. This group is more prone to have CS because of clinical considerations, and because of widespread perceptions among physicians and patients alike about fetal and maternal risks of not conducting a CS. Our finding of about 50% CS rates among this age group, and lack of the lunar July effect reinforces our inference that clinical concerns about maternal and fetal safety override the CS dampening effect of the ghost month.

Our data have other indications of the subgroups contributing to the July effect. While complication incidence is similar during lunar July, June, and other months (table 2), July CS rates by complication type show lower CS rates among cases with ''other complications potentially justifying CS''. The complications included in this category are shown in the appendix. Reviewing the list, most clinicians would agree that this subgroup permits considerable clinical discretion in choosing the delivery mode. Plausibly, in many cases, vaginal delivery could be chosen without detriment to infant or maternal health. Our data show that at least part of the reduction in July CS rates comes from a higher threshold for CS decisions in this sub-category of patients. Alternatively, it reflects a lower threshold for a CS decision in other months. Thus, lunar July seems to affect discretionary CS decisions. By implication, a percentage of CS cases in other months are clinically unnecessary.

Another curious finding is a significant increase in ''previous CS'' cases among June deliveries (1.8% higher) compared with July. This suggests that some mothers with previous CS (virtually certain to have a CS delivery in Taiwan, 98% secondary CS rate), may choose to elective CS before full term gestation, to avoid CS surgery in the ghost month.

During the past two decades, considerable research and policy effort has been invested to examine the issue of escalating CS rates, mainly addressing physician and institutional factors, with little attention to patient driven CS. Maternal request CS is postulated as one reason for escalating CS rates.[17 18] Maternal request accounted for 24.9% of all elective CS at one large hospital in the UK,[18] and for 7.6% of all CS operations in Norway.[19] Others have reported that US mothers were more likely to deliver in the last week of December, relative to the first week of January, which they attributed to tax benefits.[20] These studies have examined patient preferences from a lifestyle and economic perspective, rather than cultural issues.

An anthropological-ethical dilemma of culture related studies is highlighted by our study. In eastern cultures, where ''individual'' preference is often indivisible from family or societal thoughts and beliefs, maternal preferences may often represent the family's belief and value system, in this case manifesting in the delivery mode, a female phenomenon. Thus, our comparison of Taiwan's patient driven CS rates with women's preferences in western countries, and attributing the belief driven preference to the woman, could be perceived as derogatory to Chinese women, implying gullibility of women in a non-western culture. It is possible, indeed probable, that their ''preference'' as deduced from the data, contains a significant component of their spouse's and physician's reinforcement or initiative. We hasten to emphasise that our language referring to belief driven maternal preference is designed solely to comply with the prevailing conventions in reporting consumer driven care. Furthermore, we also note that the word ''belief'' itself, may justify derogatory connotations for many persons who are steeped in a western-centric meta-culture. Such perceptions ignore the essentially temporal and contextual validity of all beliefs including the ''scientific temper.''

Policy implications

Our study reports a medically significant cultural belief, showing reduced CS rates in July. Although our evidence shows that clinically needed CS is not compromised by this belief, empirical evidence of the existence of this belief suggests that women needing CS may suffer needless anxiety about the need to have a CS during lunar July. There is a need to educate people about the safety of operative procedures conducted in the ghost month. The government could sponsor research studies to empirically show this, to alleviate fear and psychological consequences among those who hold this belief but need CS for clinical reasons.

Our study also implies that part of Taiwan's high CS rate is attributable to discretionary CS among younger women, with marginal or no clinical indication (in non-July months). Discretionary CS as a significant contributor to high CS rates in Taiwan was reported by Lin and Xirasagar.[2] Our findings reinforce past evidence about discretionary CS that was based on a secular study, without cultural factors. These studies suggest the need for the Taiwan government to initiate a major consultation process among obstetricians to develop delivery management algorithms to reduce unjustifiable obstetric practice variations. In addition to professionally mediated initiatives, the government may consider reimbursement options to correct excessive CS preferences.

Contribution of this study

There is little empirical evidence about the impact of culture on health behaviours and outcomes. Our population based study on the impact of the ghost month highlights the need for health policymakers and researchers to be alert to cultural beliefs among the population or subgroups that may impact health services and outcomes. Culture sensitive strategies are needed to address such impacts. With increasing diversity in almost all countries, culture sensitivity to health behaviours needs attention.

Study limitations

The data lack information on parity, which significantly affects the choice of delivery mode. Another limitation is the lack of data on fetal outcomes such as birth weight, neonatal morbidity, and long term maternal morbidity, which would better clarify the significance and policy implications of our findings.

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APPENDIX

Clinical complications covered in the category ''other complications potentially justifying cesarean''

Diagnosis	(ICD-9-CM code)
Premature rupture of membranes	658.1
Early onset of delivery	644.2
Placenta previa with haemorrhage	641.1
Primary uterine inertia	661.1
Anaemia	648.2
Other and unspecified cord entanglement, without mention of compression	663.3
Other complications of labour and delivery	669.8
Placenta previa without haemorrhage	641.0
Delayed delivery after spontaneous or unspecified rupture of membranes	658.2
Excessive fetal growth	656.6
Other specified indications for care or intervention related to labour and delivery	659.8
Premature separation of placenta	641.2
Severe pre-eclampsia	642.5
Transverse or oblique presentation	652.3
Unspecified malposition or malpresentation	652.9
Caesarean delivery, without mention of indication	669.7
Primary uterine inertia	661.0
Failed medical induction or unspecified induction	659.1
Unspecified abnormality of labour	661.9
Other and unspecified abnormality of organs and soft tissues of pelvis	654.9
Poor fetal growth	656.5
Other specified malposition or malpresentation	652.8
Other and unspecified uterine inertia	661.2
Prolonged pregnancy, unspecified as to episode of care or not applicable	645.0
Tumours of body uterus	654.1
Unstable lie	6520
Unspecified antepartum haemorrhage	641.9
Infection of amniotic cavity	658.4