Appendix. Additional Information

This file includes the ICD-9-CM codes used to identify the exposure and outcome variables, more information regarding the study design, code to run the models in Stata and additional information regarding the code, and a description of the two coding anomalies that were detected in the originally extracted dataset.

ICD-9-CM codes used to identify deliveries to women with a previous cesarean delivery

DX code	Description
65.420, 65.421, and 65.423	Previous cesarean delivery

ICD-9-CM codes used to define severe uterine ruptures

DX or PR code	Description
665.10 and 665.11	Uterine rupture during labor including rupture not elsewhere specified
68.3, 68.31, 68.39, 68.4, 68.41, 68.49, 68.5, 68.51, 68.59, 68.7, 68.71, 68.79, 68.9	Hysterectomy
99.03, 99.04, 99.05, 99.07, 99.08	Blood Transfusion
666.0, 666.1, 666.2, 666.3	Post-partum haemorrhage
38.86, 39.98	Embolization
V27.1, V27.3, V27.4, V27.6, V27.7	Stillbirth

ICD-9-CM Diagnosis and procedure codes used to identify labor

DX Code	Description	PR Code	Description
650	Normal delivery	72.0-72.4	Forceps, breech extraction, vacuum extraction, instrumental delivery
653.4	Fetopelvic disproportion	73.01	ROM
653.5	Fetopelvic disproportion NOS	73.09	Artificial ROM
653.8	Disproportion NEC	73.1	Surgical induction of labor NEC
653.9	Disproportion NOS	73.3-73.6	Failed forceps, medical induction, manual assisted delivery, episiotomy
658.2	Prolonged ROM NOS	73.93-.99	Other assisted delivery procedures
658.3	Delayed delivery after artificial ROM	75.32	FetalEKG
659.0-659.1	Failed induction	75.38	Fetal pulse oximetry
659.2-659.3	Pyrexia (fever) during labor, septicemia (infection) during labor	75.6	Repair of OBGYN laceration to bladder, rectum/anus, NEC, other
660-662	Obstructed labor, dystocia, failed forceps, failed trial of labor, prolonged labor, abnormal labor, etc		
664	Perineal trauma/laceration or related		
665.1	Uterine rupture		

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The authors provided this information as a supplement to their article.

ICD-9-CM diagnoses to identify diabetes

DX Code	Description
250	Diabetes mellitus
648.0	Diabetes mellitus in pregnancy
648.8	Abnormal glucose tolerance in pregnancy (i.e., gestational diabetes)

Introduction to the difference-in-differences design

In the simplest DID scenario, two hospitals are observed over a calendar year, of which only one hospital has a uterine rupture (i.e., becomes exposed) during the year. In this scenario, the following linear probability model could be fit:

$$E(Y = 1|trt, time) = Int + \beta_1 I[trt = 1] + \beta_2 I[time = 2] + \beta_3 I[trt = 1 \,\&\, time = 2],$$

Where *trt*=1 denotes the hospital that becomes exposed and *time*=2 denotes the time period following the uterine rupture, and I[*] represents the indicator function that is equal to unity when the expression within the function is true and 0 otherwise. Thus, the third indicator variable equals unity only for deliveries in the hospital with the rupture following the occurrence of the rupture. In this model, the intercept estimates the average risk of the outcome in the first time period in the hospital that never had a uterine rupture. β_1 is the estimated difference in the risk of the outcome in the hospital with the uterine rupture compared with the hospital without the uterine rupture in the first time period. β_2 is the estimated change in the risk of the outcome between the time periods in the hospital that never have the uterine rupture. Finally, β_3 is the parameter of interest because it denotes the additional change in the mean of the outcome in the hospital that experiences a rupture above and beyond the change anticipated due to secular trends alone. In a linear model, β_3 corresponds to the estimated risk difference, which is the effect measure of interest in our study (see Figure 1 in the article).

To generalize the above framework to a setting in which there are multiple hospitals observed over many time periods, one could include multiple indicator variables to denote the multiple hospitals and multiple time indicators to denote each time period. An alternative method, which we use in our paper, is to use conditional regression (specified in Stata using the -xtreg- command with the fe option), where the analysis is conditioned within the level of the hospital, or alternatively the hospital-year. This is equivalent to including indicator variables for hospital and year in the regression model, but has the added benefit of not requiring the estimation of these coefficients, as they are considered nuisance parameters in our model and do not need to be estimated.

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Stata code for the conditional linear probability models

Model 1:

```
xtreg TOLsuccess i.timeCounter i.timeSinceUR_after, fe i(hospYrID) vce(robust)
```

Description of Model 1:

This is a model of the over-arching VBAC rate as it is a model of the successful trials of labor (`TOLsuccess`, i.e., successful vaginal deliveries) over all the women with a previous CS (i.e., unrestricted by whether there was a labor attempt). It models the VBAC rate as a function of 155 time indicator variables (`i.timeCounter`) and 12 exposure variables (`i.timeSinceUR_after`) conditional on hospital-year (`fe i(hospYrID)`), as specified in the main text.

Model 2:

```
xtreg TOLAC i.timeCounter i.timeSinceUR_after, fe i(hospYrID) vce(robust)
```

Description of Model 2:

This is a model of the trial of labor after cesarean (TOLAC) rate.

Model 3:

```
xtreg TOLsuccess i.timeCounter i.timeSinceUR_after if labor==1, fe i(hospYrID)
vce(robust)
```

Description of Model 3:

This is a model of the trial of labor success rate (`TOLsuccess`). It is constrained to the subset of women who attempted labor (`if labor==1`).

Further information:

In all models, we specified the level of clustering as the hospital-year, and that the likelihood estimation should only use variation within the hospital-year to inform the estimation of the model coefficients. Specified in this way, the hospital-year indicator variables are treated as nuisance parameters and are not explicitly estimated by the model. While it would be most natural to specify the hospital rather than the hospital-year as the unit of clustering, we chose the hospital-year because this allows us to conduct the pre-post estimation using at most 11 months of data on either side of the uterine rupture which we deemed as sufficient to capture any hypothesized lag and effect on the outcomes of interest. Furthermore, clustering on the hospital-year allowed us to use multiple uterine ruptures within the same hospital to inform the analysis rather than discarding these events or making *a priori* assumptions about the effect duration that would impact how the exposure indicator variables were coded over time within the same hospital.

While the outcomes were binary, we used a linear probability model (LPM) rather than logistic regression. The LPM is additive in risk, implying that the model coefficients represented risk differences. This is the effect measure of interest because it can be interpreted directly as the excess number of cases attributed to the intervention (1). We examined the predicted probabilities to ensure that they did not fall outside of the range of valid probabilities, which can sometimes be a concern with LPMs, but which should not be a concern in this setting where the outcomes have frequencies that are far from the boundaries of this range and the sample size is large.

The Huber White sandwich variance estimator was used to correct the model for the violation of the assumption of homoskedastic variance (2) and to correct for any serial correlation of the deliveries occurring within each hospital over time (3).

The NIS sampling weights are not used in our main etiologic analysis. Since our model was conditioned on hospital-year, this implies that we are conditioning on a finer strata than the one used to define the sampling scheme. This is therefore a form of "model-based adjustment for sampling" (4) and gives rise to unbiased estimates of the parameters of interest.

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Coding anomalies

1. Deliveries at one hospital in 2005 were excluded due to an implausibly high number of uterine ruptures. A cross-tabulation indicated that 157 uterine ruptures during labor occurred at this hospital in 2005. For comparison, the next highest number of uterine ruptures was 18 in 2005, suggesting a coding error during this period. As well, there were less that 400 uterine ruptures during labor in 2004 and 2006across all sampled hospitals.The 157 ruptures occurring at one institution were deemed to be due to misclassification. This hospital's data was removed for 2005 but other hospital-years were kept in the data as the problem did not persist to other years.

2. It appeared that during the years 2000 and 2001, several hospitals were mistakenly using the ICD-9-CM code for adrenal incision (ICD-9-CM code 0741) instead of the code for cesarean delivery (ICD-9-CM code 741). We noticed this error because the affected hospitals had unrealistically low cesarean deliveries rates (including rates of 0%), and upon examining the diagnosis codes, the common use of the 0741 adrenal code became apparent. This code is found in the data in the year 2000 for these hospitals and is never found elsewhere in the dataset of the entire obstetrical population. To address this, we re-coded the code as 741 and made note of the change in the dataset. The analysis was conducted using the re-coded information. This re-coding affected 2,872 deliveries (less than 0.03%) of the total obstetrical population.