OBSTETRICS

Measurement and risk adjustment of prelabor cesarean rates in a large sample of California hospitals

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OBJECTIVE: Prelabor cesareans in women without a prior cesarean is an important quality measure, yet one that is seldom tracked. We estimated patient-level risks and calculated how sensitive hospital rankings on this proposed quality metric were to risk adjustment.

STUDY DESIGN: This retrospective cohort study linked Californian patient data from the Agency for Healthcare Research and Quality with hospital-level operational and financial data. Using the outcome of primary prelabor cesarean, we estimated patient-level logistic regressions in progressively more detailed models. We assessed incremental fit and discrimination, and aggregated the predicted patient-level event probabilities to construct hospital-level rankings.

RESULTS: Of 408,355 deliveries by women without prior cesareans at 254 hospitals, 11.0% were prelabor cesareans. Including age, ethnicity, race, insurance, weekend and unscheduled admission, and 12 well-known patient risk factors yielded a model c-statistic of 0.83. Further maternal comorbidities, and hospital and obstetric unit characteristics only marginally improved fit. Risk adjusting hospital rankings led to a median absolute change in rank of 44 places compared to rankings based on observed rates. Of the 48 (49) hospitals identified as in the best (worst) quintile on observed rates, only 23 (18) were so identified by the risk-adjusted model.

CONCLUSION: Models predict primary prelabor cesareans with good discrimination. Systematic hospital-level variation in patient risk factors requires risk adjustment to avoid considerably different classification of hospitals by outcome performance. An opportunity exists to define this metric and report such risk-adjusted outcomes to stakeholders.

Key words: primary prelabor cesarean, quality measurement, risk adjustment

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Cesareans represent the most common major surgical procedure in the United States. The rise in utilization, variation in rates, and concerns about unnecessary procedures are driving national debate among providers, payers, regulators, and patients.[1]

Unnecessary procedures pose potential immediate medical harms[2,3] to both mother[4-6] and child,[7-9] negatively impact maternal attachment[10] and breast-feeding rates,[11] lead to potential harms in future pregnancies,[12,13] and do not prevent pelvic floor dysfunction.[14,15]

Current US rates of cesarean are high[16] and more than double[17] the consensus 10-15% optimal rate defined by the World Health Organization,[18] and still far above the objective of 23.9% for low-risk nulliparous pregnancies set by Healthy People 2020.[19] Especially when performed without a woman having begun to labor,[20] many cesareans may not be medically indicated,[21-23] although they can be ethically performed on an informed patient's request.[24]

Preventing unnecessary first cesarean delivery is a valid national goal for quality improvement in maternity care.[25] Well-known research has long identified indications for primary prelabor cesareans using administrative data[26] yet this quality measure is not widely calculated or reported.

To support this and the related goal of public reporting of meaningful quality metrics, we used risk-adjustment techniques to estimate patient- and hospital-level prelabor cesarean rates among women without prior cesarean in a large sample of California hospitals. We then explored the extent to which systematic variation across hospitals in hospital, maternal, fetal, and placental risk factors affected hospital rankings on this quality measure.

Materials and Methods

We conducted a cross-sectional study using data from all inpatient admissions to Californian state-regulated hospitals in 2010 in the State Inpatient Database

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datasets of the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project. Our patient-level analytic dataset was constructed as follows (Appendix; Supplementary Table 1 and Figure 1). We included patient admissions with any instances of *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes of outcomes of delivery.[27] We excluded patients with nondelivery codes. We excluded patients with a history of cesarean, missing age due to masking, or aged <14 years. Our analytic dataset thus comprised 408,355 records (Figure 1). This study qualified for expedited review under 45 Code of Federal Regulations 46.110 (b)(2) and was approved by the Institutional Review Board of the University of Southern California.

We followed the algorithm of Gregory et al[26] closely. We identified cesareans by *ICD-9-CM* procedural codes (74, 74.0, 74.1, 74.2, 74.4, 74.9, or 74.99) in any 1 of 21 procedure fields and/or a diagnostic-related group code for cesarean (370, 765, 371, or 766). To identify the presence of labor during this admission, we coded for the presence of vaginal delivery, cephalic version from breech (652.1X), disproportion (653.XX), obstructed labor (660.XX), abnormality of forces of labor (661.XX), long labor (662.XX), failed induction of labor (659.0X and 659.1X), fetal distress (656.3), and cord prolapse (663.0). The coded presence of a cesarean in the absence of coded labor was defined as the outcome of interest. In sensitivity analyses, we classified deliveries in which a diagnosis of nonreassuring fetal heart rate (FHR) (*ICD-9-CM* diagnostic code 659.71) had been made as occurring after labor, removing them from the outcome of interest.

We recorded 39 patient characteristics using AHRQ data on demographics, admission, and comorbidities (Table 1). We coded for age, Hispanic ethnicity, race, primary insurance or payer status, the quartile of state income to which the median household income in the patient ZIP code belonged, whether the admission was scheduled, or occurred on a weekend. We coded for 12 well-known maternal, fetal, and placental risk factors previously shown to be associated with prelabor cesareans.[26] We also coded for a further 13 maternal comorbidities associated with higher-risk pregnancies.[27-29]

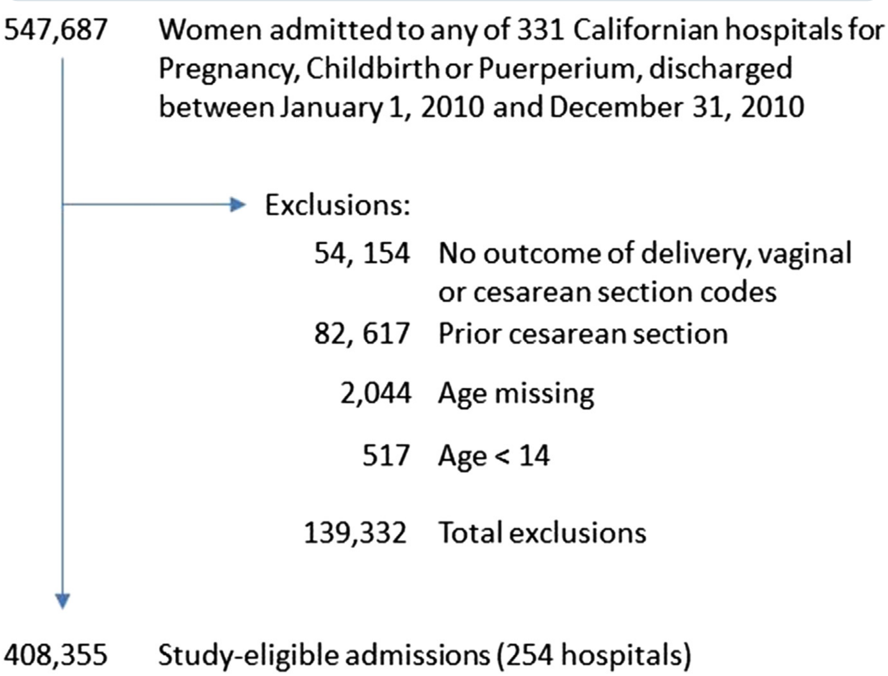
We associated hospitals in the 2010 patient-level data with 2 sources of hospital-level data from the Californian Office of Statewide Health Planning and Development (Table 2). California Automated Licensing Information and Tracking System data were available from the close of the 2010 calendar year. Using Automated Licensing Information and Tracking System data, we recorded hospital ownership type, number of beds and bassinets, teaching hospital status, total number of yearly discharges, and the 24-hour on-premise availability of selected physician types and services.

Additionally, within 4 months of the end of their respective fiscal year end, licensed hospitals in California submit detailed operational and financial data. Due to differences in hospital reporting dates and fiscal years, these data were variously reported on June 30, 2009; Sept. 30, 2009; Dec. 31, 2009; and Jan. 31, 2010. We used these data to record the original license date of the hospital, detailed hospital-level financials and key financial ratios, overall hospital payer mix, professional staffing with attending and trainee anesthesiologists and obstetricians, presence of particular nurse educational programs, and obstetric productivity and operations data.

For patient characteristics we present means, and for hospital characteristics we present patient-weighted means. We used χ^2 tests for differences in categorical variables and Kruskal-Wallis equality of population tests for differences in continuous variables between those women without a prior cesarean who labored, and those who instead received a prelabor cesarean.

We constructed a series of progressively more saturated logistic regression models on the outcome of interest. For each model, we recorded the generalized R^2 and the c-statistic, or discrimination of the model. The c-statistic can be interpreted as the probability that the model correctly identifies the 1 patient

FIGURE 1
Study participation



Study flow diagram depicting inclusions, exclusions, and final sample size

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