Variations in cesarean deliveries associated with payer type

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Precis:

Women with private insurance are 30% more likely to have a cesarean delivery compared to women who are publicly insured.

Abstract

Objective: *The rates of cesarean deliveries (CD) in the United States (U.S.) have been increasing since the 1990s making it the most common operating room procedure in U.S. hospitals. CD may be necessary due to a variety of medical indications; however, it is not clear whether socioeconomic factors affect CD rates. This study examines the association between type of insurance coverage pregnant women have and rates of CD in the U.S.*

Methods: *This is a retrospective analysis of the discharge records of pregnant women admitted to U.S. hospitals between 2012 and 2014 extracted from the National Inpatient Sample dataset. The study population was divided into two groups according to insurance coverage (public vs private). Logistic regression analysis was used to examine the association between type of insurance and CD rates while controlling for an array of demographic, medical, social and behavioral confounding factors.*

Results*: 12,450,349 subjects were included in the analysis, of those, 29.9% had a CD. 82.6% of women are between 18-34 years old and 49.5% are Caucasians. 48.9% of women have private insurance. Women with private insurance received a higher percentage of cesarean deliveries (31.8%) compared to women with public insurance (28.3%), adjusted odds ratio (aOR): 1.30 (CI: 1.29-1.30, p<0.001). This ratio was more significant in AMA women (aOR: 1.37) but not among teenagers. Although, higher in all race/ethnicity groups, African American, Hispanic and Native American women have more significant association to receive CD when covered by private insurance compared to Caucasian women. Giving birth at an urban-teaching hospital was associated with a higher CD rate (31.9% vs. 27.4%), aOR: 1.42. Delivery in the Northeast was associated with increased CD rates (32.8% vs. 27.5%) when covered with private insurance, aOR: 1.43, while in the West, private insurance was associated with less CD,*

aOR: 1.17.

Conclusion: *After controlling for demographic, clinical, behavioral, and system variables, private insurance was associated with a 30% increase in rate of CD compared to public insurance.*

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Introduction

Since the 1990s, cesarean delivery (CD) rates have been increasing in the U.S.[1,2] Currently CD is the most common operating room procedure in U.S. hospitals.[1-3] Data have shown that from 1996 to 2009 the CD rate rose from 20.7% to 32.9%.[2] However, this has not been uniformly associated with improved birth outcomes or maternal benefits.[4,5] Approximately 50% of the increase may be attributed to an increase in primary cesarean deliveries.[5,6] Unfortunately, only about 10% of women deliver vaginally following their primary CD.[7] There are multiple theories that explain the increase in CD over the past two decades. As an example, a few medical indications for CD have increased over time, such as fetal distress, labor arrest disorders, multiple gestation, and pre-eclampsia.[8] Globally, the increase in CD rates have mainly occurred in middle- and high-income countries, which increasingly utilize advanced technology for continuous external fetal monitoring.[9,10]

The National Institutes of Health estimate that elective CD make up about 2.5% of all births in the U.S.[11] The option of an elective CD may be contributing to rising CD rates. Traditionally, CD has been considered a form of emergency or high-level intervention to respond to a critical or emergent maternal or fetal situation. Whether there is a new perception of CD as a safe alternative to vaginal birth, needs further investigation. Theories such as a maternal sense of control and convenience, fear of pain during labor, minimized perineal lacerations or incontinence associated with vaginal delivery may be hypothesized as motives to elect for a CD.[12,13]

Insurance coverage is a major factor in ensuring that pregnant women receive proper perinatal care. Private/public insurance coverage has been shown to a have peculiar distribution among different race/ethnicities and age groups amongst pregnant women.[10,13] In ideal circumstances, the type of insurance coverage a mother has should not impact the care delivered to her. An increase in utilization and cost with no improvement in outcomes represents a decline in value.[2-3] The identification of potentially unwarranted variation in CD rates associated with the type of insurance raises the specter that one group is receiving lower quality, and hence lower value care, which is a health inequity issue. This study assesses the relationship between insurance coverage of pregnant women and the rate of CD utilizing a large publicly available U.S. administrative dataset. The aim is to determine if there is a difference in CD rates between publicly and privately insured pregnant

women.

Methods

Data source

A retrospective cohort analysis was conducted on the discharge records of pregnant women who were admitted to U.S. hospitals in 2012-2014. Data was captured from the National Inpatient Sample (NIS) dataset produced by the Healthcare Cost and Utilization Project (HCUP) that collects data from the hospital admissions records. The NIS is the largest, publicly available de-identified, inpatient health care database in the U.S., yielding national estimates of hospital inpatient stays from 45 states and the district of Columbia.[14] NIS approximates a 20% stratified sample of all discharges from U.S. hospitals and contains information on all patients regardless of primary payer.[14] It contains demographic and clinical data that is relevant to a discharge abstract, including primary and secondary diagnoses and procedures, patients' demographics, hospital characteristics, payment source, and comorbidity measures. The data elements are captured in each hospital for administrative purposes using Current Procedural Terminology (CPT) codes that are supported by recognized diagnoses identified by respective International classification of diseases (ICD).[14]

Study design

At the time of conducting this analysis, HCUP datasets were available only up to 2015. The study cohort was chosen from 2012-2014 to include a uniform set of data coded with the same set of codes (ICD-9 version) before the U.S. healthcare transitioned to ICD-10 coding system in late 2015. The study period was limited to three years to decrease the chances of including the same patient more than once. The study population was divided into two main groups based on their primary payer. Those covered by private insurance (labelled in the dataset as private) were grouped under "private", while those covered by public insurance (labelled in the dataset as Medicare or Medicaid) were grouped under "public".

ICD-9 procedure codes 740-744, 7491, and 7499 were used to identify CD, the dependent variable, see supplemental Table 1. The principal independent variable was 'Expected' primary payer at time of discharge. Confounding variables that might influence the primary association between primary payer and CD included demographic, clinical, behavioral, and health system factors. Demographic variables included race and maternal age. Maternal age was coded into three categories: teenage mothers (less than 18), expected maternal age (18 to 34) and advanced maternal age (35 and above). Race and ethnicity values included Caucasian, African American, Hispanic/Latino, Asian, Native American and other. Clinical variables included previous CD, multiple gestation, uterine malformations, hypertension or preeclampsia, chorioamnionitis, diabetes mellitus, cardiovascular or renal disorder, anemia, thyroid dysfunction, coagulopathies, placenta previa or abruption, failed induction and prematurity. Factors that may reflect behavioral practices included drug use,

smoking, alcohol, obesity and bariatric surgery. Fetus-related variables included fetal distress, poor or excessive fetal growth and central nervous system malformations. Health system factors such as rural vs. urban, academic vs. non-academic settings and hospital region.

Statistical Analysis

Univariate analyses were performed to obtain descriptive statistics of the study population. Pearson's Chi-square tests were used to calculate frequencies of pregnant women in each group and then in each subcategory of variables, including demographics, clinical, behavioral and health system factors. Three percent of hospital records were excluded for missing variables for the primary outcomes; insurance type and mode of delivery. Logistic regression models were used to examine the association between insurance coverage and CD in the overall sample controlling for confounding variables and then in selected subcategories of maternal age, race/ethnicity, birth location and U.S. region. Differences were compared using adjusted odds ratios, 95% confidence intervals, and p-values. A discharge weight variable was applied to all analyses in order to produce national estimates as instructed by HCUP. Rather than excluding mothers with diagnoses (e.g., multiple pregnancy, previous CD, placenta previa or abruption) that are medical indications for performing CD, they were kept in the analysis and were controlled for in the logistic regression analysis. This analysis was performed using SAS version 9.4 (Cary, NC). The study was approved by the George Washington University Hospital Internal Review Board.

Results

After applying inclusion and exclusion criteria, hospital admission coding records from 12,450,349 deliveries were utilized. Of them 48.9% were covered with private and 51.1% with public insurance. 29.9% of patients in the study had CD. The majority of patients (82.6%) were between 18-34 years old and 49.5% were Caucasians. Private insurance was most common among pregnant women age 35 and above (65%) and least common among teenagers (21.5%). Women, who identified as Caucasians or Asians, were most likely to be covered with private insurance 60.7% and 62.9% respectively. Women, who identified as African, Latino, and Native American, were least likely to have private insurance. 2.4% of privately insured mothers had multiple gestation compared to 1.6% of publicly insured mothers, Table 1.

Maternal clinical conditions, behavioral confounders and health system factors were statistically different but not necessarily clinically significant between both groups. Thyroid dysfunction, bariatric surgery and large for gestational age infants were more prevalent among the private insurance group. Anemia, obesity, smoking, drug or alcohol use were more prevalent in the public insurance group. There were no significant differences in regard to health system factors except that pregnant women in rural areas and in the south were less likely to be covered by private insurance, Table 2

Table 1: Demographic and clinical characteristics of the study population by insurance type

	PRIVATE n= 6094739 (48.9)	PUBLIC n= 6355610 (51.1)	Adjusted OR	P-Value
Demographic variables				
Maternal Age				
18-34 years old	46.7	53.3	Reference Group	
<18 years old	21.5	78.5	0.37 (0.37-0.38)	<0.001
≥35 years old	65.0	35.0	2.0 (2.0-2.0)	<0.001
Race/ Ethnicity				
Caucasians	60.7	39.3	Reference Group	
African Americans	29.2	70.8	0.25 (0.25-0.25)	<0.001
Hispanic/Latino	28.3	71.7	0.22 (0.22-0.22)	<0.001
Asian/Pacific Islanders	62.9	37.1	0.83 (0.82-0.83)	<0.001
Native Americans	32.7	67.3	0.33 (0.32-0.34)	<0.001
Multiple Gestation	2.4	1. 6	1.5 (1.48-1.52)	<0.001
Medical and perinatal conditions				
Previous C-Section	15.9	16.8	0.91 (0.91-0.92)	<0.001
Hypertension/Preeclampsia	10.9	10.5	1.08 (1.08-1.08)	<0.001
Gestational/Diabetes Mellitus	7.8	7.9	0.93 (0.92-0.93)	<0.001
Cardiovascular Disease	0.7	0.7	0.98 (0.96-0.99)	0.004
Renal Infection or Disorders	1.7	3.2	0.61 (0.60-0.61)	<0.001
Maternal Anemia	10.7	14.8	0.79 (0.79-0.80)	<0.001
Thyroid Dysfunction	4.6	2.0	1.84 (1.82-1.85)	<0.001
Coagulation Defects	1.8	1.4	1.19(1.18-1.20)	<0.001
Abnormal Uterus	1.1	0.98	1.16(1.15-1.18)	<0.001
Chorioamnionitis	2.6	2.4	1.15 (1.14-1.16)	<0.001
Placenta Previa	0.8	0.6	1.16 (1.14-1.18)	<0.001
Placental Abruption	0.9	1.2	0.88 (0.86-0.89)	<0.001
Failed Medical Induction	1.2	1.1	1.13 (1.12-1.15)	<0.001
Failed Mechanical Induction	0.08	0.07	1.02 (0.98-1.07)	0.29
Premature delivery	5.2	6.2	0.85 (0.85-0.86)	<0.001
Large for gestational age	2.8	1.9	1.34-1.33-1.35)	<0.001
Fetal Distress	0.1	0.1	1.04 (0.99-1.07)	0.056
Behavioral factors				
Obesity	5.2	6.7	0.83 (0.82-0.83)	<0.001
Bariatric Surgery	0.2	0.1	1.56 (1.51-1.61)	<0.001
Smoking	2.4	8.7	0.21 (0.21-0.21)	<0.001
Alcohol Use	0.02	0.05	0.50 (0.46-0.54)	<0.001
Drug Use	0.2	0.97	0.22 (0.21-0.22)	<0.001

Table 2: Characteristics of health system elements by insurance type

	PRIVATE n= 6094739 (48.9)	PUBLIC n= 6355610 (51.1)	Adjusted OR	P-Value
Health system viabilities				
Hospital Bed Size				
Small	51.0	49.0	Reference Group	
Medium	48.9	51.1	0.98 (0.98-0.99)	<0.001
Large	48.5	51.5	0.97 (0.97-0.98)	<0.001
Hospital Location/Teaching status				
Rural	41.2	58.8	Reference Group	
Urban non-teaching	49.7	50.3	1.66 (1.65-1.67)	<0.001
Urban Teaching	49.9	50.1	1.74 (1.73-1.75)	<0.001
US Region				
Northeast	53.7	46.3	Reference Group	
Midwest	55.2	44.8	1.04 (1.03-1.04)	<0.001
South	43.7	56.3	0.79 (0.78-0.79)	<0.001
West	48.7	51.3	0.94(0.94-0.94)	<0.001

Women with private insurance had higher rates of CD (31.8%) compared to women with public insurance (28.3%). Overall, the adjusted odds ratios (aOR) of women with private insurance to have a CD was 1.30 (CI: 1.29-1.30, p<0.001), Table 3. This percentage was more significant in women 35 or older (aOR: 1.37) but not among teenagers. Although, higher in all race/ethnicity groups, African American, Hispanic and Native American women have higher association to receive CD when covered by private insurance compared to Caucasian women, Table 3.

Giving birth at an urban-teaching hospital was associated with a higher CD rate among women with private insurance (31.9% vs. 27.4%) with an aOR: 1.42 (CI: 1.41-1.42, p<0.001). Delivering an infant in the Northeast was associated with an increased CD (32.8% vs. 27.5%) when covered with private insurance (aOR: 1.43, CI: 1.42-1.44, p<0.001). While in the West, private insurance was associated with less CD rate compared to other U.S. regions, aOR: 1.17 (1.17-1.18, p<0.001), Table 3.

Table 3: Prevalence of cesarean section among pregnant females covered by private vs. public insurance in overall sample and in each subcategory by maternal age, race/ethnicity, hospital location, and US region*

	PRIVATE n= 6094739 (48.9)	PUBLIC n= 6355610 (51.1)	Adjusted OR	P-Value
C-Section	31.8	28.3	1.30 (1.29-1.30)	<0.001
Maternal Age				
18-34	29.6	27.6	1.29 (1.26-1.27)	<0.001
<18	16.5	17.2	1.01 (0.98-1.04)	0.50
>35	40.7	37.0	1.37 (1.36-1.38)	<0.001
Race				
Caucasian	31.5	28.1	1.26 (0.25-1.27)	<0.001
African American	34.5	29.1	1.38 (1.37-1.39)	<0.001
Hispanic/Latino	33.2	28.3	1.37 (1.36-1.38)	<0.001
Asian	*32.3*	*29.1*	1.18 (1.16-1.20)	<0.001
Native American	31.2	26.1	1.38 (1.33-1.44)	<0.001
Hospital Location/Teaching Status				
Rural	29.8	28.7	1.16 (1.15-1.17)	<0.001
Urban Non-Teaching	32.1	29.5	1.18 (1.18-1.19)	<0.001
Urban Teaching	31.9	27.4	1.42 (1.41-1.42)	<0.001
Region				
Northeast	32.8	27.5	1.43 (1.42-1.44)	<0.001
Midwest	29.3	26.1	1.33 (1.32-1.34)	<0.001
South	35.0	30.3	1.34 (1.33-1.35)	<0.001
West	28.8	26.9	1.17 (1.17-1.18)	<0.001

*Primary relationship between type of insurance and cesarean delivery (CD) was calculated using logistic regression while controlling for maternal age, race/ethnicity, previous CD, multiple gestation, uterine malformations, hypertension or preeclampsia, chorioamnionitis, diabetes mellitus, cardiovascular or renal disorder, anemia, thyroid dysfunction, coagulopathies, placenta previa or abruption, failed induction, premature labor, drug use, smoking, alcohol, obesity and bariatric surgery, fetal distress, excessive fetal growth, rural/urban or academic/non-academic settings and hospital region.

Discussion

This study aimed to explore the association of type of insurance coverage and CD rates in the U.S. The findings show that, after adjusting for predictive factors such as maternal age, previous CD, multiple gestation, and other clinical, behavioral and health system variables, pregnant women with private insurance have a 30% higher chance to have a CD than women who are publicly insured. Our hypothesis assumes that the type of insurance coverage, a delivering women may have, should not correlate with options of care for her birthing. After controlling for potential confounding factors, the observed variation in CD rates by type of insurance coverage may imply that one group received a more clinically appropriate rate of CD performance. However, assigning an "overutilization" of CD for women with private insurance assumes that those with public insurance received a more appropriate

percentage of CD. Conversely, an assignment of relative underutilization of CD in women with public insurance assumes that women with private insurance received a more appropriate percentage of CD. The first hypothesis reflects potential unwarranted healthcare utilization, risk and expenses, while the later reflects the potential underutilization of effective healthcare. Yet, neither circumstance can be assessed in the absence of outcomes. While our analysis cannot identify causation for differences in CD rates by insurance coverage, this finding raises the importance of considering unwarranted variation in CD rates within the context, and as a component of, improving maternal health quality, health care disparities and health equity

Variability in health system factors, such as urban/rural status, teaching/non-teaching, or geographic region of service, represent additional factors associated with CD rates. Our analysis shows that mothers delivered in an urban teaching hospital had the highest chance to have CD. One potential explanation may be the higher acuity of mothers attending or transferred to urban teaching delivery centers. Although women delivering in any part of the US and covered by a private insurance had a higher chance of CD compared to those with public insurance, it is not clear though why this association is least in the west region. A further qualitative analysis needs to be conducted to explore this finding of geographic variation.

Utilization of a large publicly available administrative database provides a powerful research tool which makes this retrospective research analysis feasible, inexpensive, and generalizable. Its sample size is large, and the discharge weights placed on the data and broad geographic distribution increases its representativeness of the entire population of women admitted to non-federal community U.S. hospitals.

Limitations to the study include potential sampling bias due to the sampling method of the HCUP dataset. The only data found in HCUP database, are data from 45 states plus the District of Columbia. Some populations included in our dataset may be underrepresented, such as hospitals that lack enough resources to report data to HCUP. Human error may occur when reporting ICD-9 codes in an administrative data set, which can result in missing variables, coding errors or misclassifications. In addition, ICD-9 codes are not detailed in defining clinical variables and comorbidities compared to the most recent ICD-10 codes.

The HCUP project does not have a separate site level validation process for their data. However, HCUP performs an extensive edit process through a third party to clean data before inclusion into their database.[15]

Due to the large sample size, minor clinical significance was shown to be statistically significant. While, previous CD, multiple gestation, abnormal uterus, placental previa or abruption, obesity, fetal central nervous system anomaly, fetal distress, poor or excessive fetal growth, failed mechanical or medical induction were significantly associated with cesarean delivery, when included in the logistic regression analysis, none

explained the association between insurance coverage and CD.

Although the data extraction was purposefully limited to a period of three years to avoid duplication of inclusion and maintain independence of data, an unknown proportion of women may have been represented more than once in the database during this timeframe secondary to repeated pregnancies. These women likely utilized the same type of insurance in subsequent pregnancies, and those with a prior CD likely received a repeat CD. This group represents an unknown proportion of the included population. Therefore, the degree to which the dataset became "enriched" for women within the same insurance category and for the same outcome of interest cannot be specified.

Conclusions

In conclusion, private insurance was associated with higher CD rates. Alternatively, public insurance was associated with lower CD rates. This association was after controlling for several confounders in adjusted analysis using logistic regression. The research implications of this work are that further in-depth qualitative study is justified and needed from both the subgroups of women with differing CD rates, and those physicians or institutions who perform differing rates of CD. Further, additional research attention should be directed to the potential impact upon CD rates played by differences in social drivers of health within populations served by physicians and institutions who work with majority privately or publicly insured populations. Future studies could also focus on the

role procedural reimbursement may play in the rates of CD. Clinically, understanding the factors that guide CD trends in the United States is crucial to maximize maternal and neonatal outcomes. To support recent campaigns to reduce CD rates, more targeted interventions may be warranted towards women who are privately insured, or at hospitals who serve a majority of privately insured populations.

Conflict of Interest: *Authors have no conflicts of interest relevant to this article to disclose*

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Supplemental Table 1

Clinical variables or procedures	*ICD-9 Procedural code*
Classical cesarean section	74.0
Low cervical cesarean section	74.1
Extra-peritoneal cesarean section	74.2
Cesarean section of other specified type	74.4
Cesarean Section Of Unspecified Type	74.9
Other cesarean section of unspecified type	74.99