The Relationship Between Health Insurance Type, Labor Induction and the Great Recession of 2008

The Relationship Between Health Insurance Type and Indications for Labor Induction

By

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This thesis by ***Leah Siegel-Reamer*** is accepted in its present form by the Brown University School of Public Health as satisfying the thesis requirements for the degree of Master of Public Health.

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PART I: The Relationship Between Health Insurance Type, Labor Induction and the Great Recession of 2008

List of Tables:

PART II: The Relationship Between Health Insurance Type and Indications for Labor Induction

List of Tables

PART I: The Relationship Between Health Insurance Type, Labor Induction and the Great Recession of 2008

Abstract

Objective
To study the impact that the U.S. economic recession ("Great Recession") had on the association between health insurance type (Medicaid versus other types) and labor induction

Study Design
This is a retrospective, cross sectional study that utilized hospital discharge data from 2006 to 2014. The analytic sample consisted of 78,352 deliveries. Chi-squared analyses were performed to assess independence between insurance type (Medicaid versus other) and inductions for each year of interest. A multivariable logistic model assessed the relationship between health insurance type and labor induction. Additionally, a multivariable logistic model illustrated the association between the recession and induction, and was further stratified by insurance type.

Results
The years 2009, 2011 and 2013 had significantly more inductions for Medicaid recipients compared to non-Medicaid Recipients. Women enrolled in Medicaid as likely to be induced compared to non-Medicaid recipients after controlling for study covariates. However, in 2009 and 2010, women had 0.93 times the odds of being induced compared to 2006 and 2007. After stratifying by insurance type, women without Medicaid had significantly lower odds of being induced in 2009 and 2010 compared to 2006 and 2007. That relationship did not exist for Medicaid recipients.

Conclusion
This study found that the economic recession may have had an impact on likelihood of labor induction.

Background

Research suggests that there is a relationship between Medicaid health insurance coverage periods of financial instability.[1] An estimated 9.3 million American adults lost health insurance during the Great Recession.[1] However, following loss of employer-sponsored health insurance, individuals may have qualified for Medicaid, thereby reducing the overall number of uninsured individuals during the recession.[2] The increased number of individuals qualifying for Medicaid, combined with periods of macroeconomic downturns, put a significant strain on the economy.[1] Data from the U.S. economic recession of 2007-2009 ("Great Recession") provide investigators with an opportunity to study the impacts of economic downturns on a population's health and use of medical care. The Great Recession began in December 2007, and extended beyond 2009 in many states. During the Great Recession there were changes in the nation's unemployment rates, overall economy, and housing market.[3,4] More than five years after the Great Recession officially ended in June 2009, states' recovery was slow and uneven.[5] The Recession disproportionately affected certain populations, exacerbating existing racial/ethnic income disparities[6] which have persisted for many years following the "official" end to the Great Recession.[7]

In the years following the start of the Great Recession, health insurance coverage and healthcare decision making regarding medical interventions may have been impacted by economic considerations.[8] Previous studies have found relationships between the Great Recession and the population's health (including total mortality, fertility and other conditions)[9,10,11] and health insurance coverage. [4,9,12] Studies have found that during times of economic downturns, more individuals may be left with inadequate coverage.[2, 13]

Research suggests that as a state's unemployment rate increased, there was a subsequent decrease in the probability that men would have health insurance coverage.[1] Since the Medicaid program was signed into law in 1965[14], certain low income pregnant women had varying coverage until 1990, when states were required to provide coverage for all pregnant women at certain poverty levels.[15]

Health insurance type has been shown to impact inpatient obstetric care, specifically with greater intervention, including cesarean delivery and labor induction, provided to those with private health insurance compared to women with public health insurance or the uninsured population.[16,17] Since 1990, rates of induction of labor have increased likely due to changes in obstetric practice patterns, almost doubling from 1990 to 2005.[18] Some groups suggest further research be conducted to understand the underlying reasons for an increase in labor inductions. [18]

Labor induction is the process of artificially initiating contractions and labor in order to prompt the delivery process for women who are not already laboring naturally. Labor induction can be performed by giving women Pitocin, or Oxytocin, via an IV and is coupled with a cervical ripening process when necessary.[19] The most common indications for labor induction are premature rupture of membranes, intrauterine growth restriction, late term pregnancy (≥41 weeks), maternal hypertensive disorders, maternal diabetic disorders, and elective induction. The upward trend in prevalence of labor inductions into the early 2010s was concerning due to the increase in number of inductions done at early term gestational ages, which may cause risks to an infant compared to a full-term

delivery.[20] Labor inductions are not always performed out of medical necessity, which may be associated with adverse outcomes.[21,22]

Additionally, those who undergo a labor induction typically spend a longer period of time in the hospital compared to those who deliver after a spontaneous onset of labor.[23] Type of health insurance coverage may affect which women undergo labor induction. A study conducted in Ohio between 2006 and 2010 found that rates of non-medically indicated inductions prior to 39 weeks for Medicaid insured women were well below rates for women with other insurance types.[22]

Our study examined the relationship between labor induction and insurance status from 2006 to 2014 in Rhode Island, focusing specifically on the complex relationships between the economic recession, insurance type, rates of intervention, and a pregnant woman's health status. In Rhode Island, the Great Recession lasted longer compared to other states in New England.[24] Additionally, at one point during the recession, Rhode Island had the highest unemployment rate in the nation.[24] Lack of employer-based insurance could potentially explain why 16% of the population in Rhode Island under 65 was uninsured in 2010.[25] In Rhode Island from 2006 to 2014, one would expect to see a smaller proportion of Medicaid recipients having labor inductions compared to those with private insurance, possibly due to lower rates of reimbursement among Medicaid inductions.[26] To our knowledge, this study is the first to explore the relationship between health insurance type and labor induction in relation to the economic recession.

Methods

This study analyzed hospital discharge data from Women & Infants Hospital in Providence, RI. The de-identified dataset contained information on maternal characteristics, hospital stay details, ICD-9 diagnostic codes and procedure codes for all deliveries by women who were discharged from Women & Infants Hospital between 2006 and 2014 inclusive.

The primary outcome of interest was labor induction. Labor induction was defined based on the presence of at least one ICD-9 procedure codes: 73.1 (cervical ripening), 73.4 (medical induction with Pitocin), or 73.01 (artificial rupture of membranes-excludes after onset of labor). If a woman did not have any of these ICD-9 codes she was considered to not have been induced. This type of categorization has been used in other studies assessing labor induction.[27] In addition to the binary induction variable, variables were generated for specific induction methods including: cervical ripening, medical induction, and artificial rupture of membranes.

Two exposure variables were explored: health insurance and time. In order to operationalize health insurance status, a binary variable was generated by combining categories of insurance type from the discharge data. The first group was recorded as "Medicaid" if the woman had Medicaid, or HMO/Medicaid. The second group consisted of all other insurance types including commercial insurance, Medicare, and self-insured among other types. The analytic sample was restricted to observations with non-missing information on type of health insurance at time of delivery. Time was the second

exposure of interest. In addition to an integer variable for calendar year of hospital discharge after delivery, a binary variable was generated to capture the pre-recession years (2006-2007) and the years after the recession began (2009-2010).

Demographics and confounders

Potential confounders were selected based on a review of the literature.[17,27, 28] The following variables were controlled for in models estimating likelihood of labor induction: maternal age at delivery, diagnosis of hypertensive disorders (ICD-9: pre-existing hypertension without mention of pregnancy: 401.x, 405.xx, 459.3x, pre-existing hypertension complicating pregnancy: 642.0x, 642.1x, 642.2x, GHTN: 642.3x, 942.2x, pre-existing hypertension with superimposed preeclampsia 642.7x, mild preeclampsia 642.4x, or preeclampsia 642.5x) , diabetic disorders (ICD-9: pregestational with no mention of pregnancy: 250.xx, 362.01, maternal diabetes: 648.0x, gestational diabetes: 648.8x), fetal growth restriction (ICD-9: 656.5x), late term pregnancy (gestational age ≥ 41 weeks), and premature rupture of membranes (ICD-9: 658.1x, 658.2x).

Maternal age was reported as a continuous variable and was also divided into six categories (<20, 20-<25, 25-<30, 30-<35, 35-<40, and 40+). Race was organized into three categories: white, black, or other racial/ethnic group. Marital status was categorized as: married, single, or other marital status. A binary variable was generated for whether or not a woman had a cesarean delivery using the following ICD-9 procedure codes: 74.0,

74.1, 74.2, 74.4, and 74.99. Similarly to the induction variables, patients were considered to have had a cesarean if they had at least one of their six procedure codes recorded as one of the above ICD-9 codes.

Data analysis

All data analysis was conducted in STATA 15.[29] We measured the frequency of each of the demographic and confounder variables in the dataset. Chi-square analyses of induction and insurance status were conducted for each year of interest (2006-2014). A multivariable logistic regression was conducted to assess the relationship between the odds of having a labor induction based on insurance type controlling for discharge year, maternal age, fetal growth restriction, maternal diabetic disorders, maternal hypertensive disorders, late term pregnancy and premature rupture of membranes. Logistic models were created looking at the years before (2006-2007) and during the recession (2009-2010), overall and stratified by insurance type, in order to measure the possible effect of the year on whether or not a labor was induced. We excluded 2008 because it was difficult to pinpoint a start to the recession and, more importantly, there would be lags in when effects of the recession would be realized. We limited the during-recession time period to through 2010 as an attempt to minimize the influence of other time trends that we feared would be an issue if the time period was extended through 2014.

Results

Description of Sample

The database consisted of 78,406 hospital discharges between 2006 and 2014 inclusive. Of the 78,406, 78,325 had valid data on insurance type (99.9%) and comprised the analytic sample. Of the total sample, 42.4% were Medicaid recipients and there were 15,546 inductions (19.8%) (Table 1).

For women who had Medicaid, 28.2% of the births were cesarean deliveries (n=9,367), while 37% of births among non-Medicaid recipients were cesareans for deliveries between 2006 and 2014 ($p<0.001$) (Table 1).

Regardless of insurance status, 26.4% of inductions had an ICD-9 code for cervical ripening, 76% had an ICD-9 code for medical ripening (including the use of Pitocin), and 2.4% had an ICD-9 code for artificial rupture of membranes (AROM) prior to onset of labor. There were significant differences in induction methods between the two insurance groups. Among women who were induced and had Medicaid, almost a third (27.2%) had an ICD-9 code for cervical ripening (compared to 25.8% of women with other insurance types who were induced) ($p=0.05$). Among the same group of women, 76.5% had an ICD-9 code for medical ripening (including Pitocin) (compared to 74.7% of women with other insurance types who were induced) and 2.1% had an ICD-9 code for AROM prior to onset of labor (compared to 2.6% of women with other insurance types who were induced) ($p<0.05$) (data not shown).

Impact of year

Shown in Table 3 are the proportion of women who had a labor induction by year for each insurance type. In 2009, 2011, and 2013, a higher proportion of women enrolled in

Medicaid were induced than women with all other types of health insurance ($p<0.05$) (Figure 1). In 2009, women with Medicaid had 13% higher odds (95% CI: 1.02, 1.26) of having an induction compared to women without Medicaid. Similarly, in 2011 and 2013, women with Medicaid had significantly higher odds of having an induction compared to women without Medicaid (2011- Crude OR: 1.15 95% CI: 1.02-1.29; 2013- Crude OR: 1.12, 95% CI: 1.00-1.25). Over the study years, the percentage of women who were induced showed an overall increase, with a slight decrease in 2011 and 2012. After 2012, there was a stark increase in the percentage of inductions overall and separately by insurance type.

Impact of Insurance

Among Medicaid recipients, 20.3% of births were inductions (n=6,748) while among non-Medicaid recipients 19.5% of births were inductions ($p=0.002$) (Table 1). The odds of having a labor induction were 6% (Crude OR: 1.06; 95% CI 2%, 9%) higher for those who had Medicaid compared to those who had any other insurance type. However, the odds ratio was attenuated slightly after adjusting for covariates (AOR = 1.02, 95% CI 0.98, 1.08; Table 4).

Before and After the Start of the Great Recession

Across the whole sample, the odds of having an induction in 2009 or 2010 were lower (AOR: 0.93; 95% CI: 0.86-1.00) compared to the years before the recession, after

adjusting for study covariates (Table 5). Among women with Medicaid, the odds of having a labor induction during the recession years were not significantly different compared to the years just before the recession (AOR: 1.06, 95% CI: 0.95-1.18). For women with other insurance types, the odds of having a labor induction between 2009 and 2010 were significantly lower than in the years just before the start of the recession (AOR: 0.84, 95 % CI: 0.77-0.92).

Secondary Analyses

Medicaid recipients had 0.67 times the odds of having a cesarean delivery compared to women who had other health insurance types (95% CI: 0.65-0.69) not controlling for potential confounders. Among women who were induced, Medicaid recipients had 0.79 times the odds of having a cesarean compared to all other insurance types (95% CI: 0.74-0.86).

The mean length of stay post-delivery was significantly shorter for Medicaid recipients compared to women with other health insurance types ($p<0.001$). However, the difference was very small, and may not be clinically significant. The mean length of stay post-delivery for women who had Medicaid and an induction was not significantly different from the mean length of stay for those with other health insurance types who also had an induction ($p=0.76$). Among women who had a cesarean, the mean length of stay for Medicaid recipients was not significantly different from that of women who had other insurance types ($p=0.123$). For women who were both induced and had a cesarean, there was no difference in the mean length of stay by insurance status ($p=0.24$).

Discussion

The Great Recession may have had an impact on a woman's likelihood of having a labor induction. Our primary research goals were to determine if women with Medicaid were more or less likely to be induced compared to women without Medicaid, and how that relationship was impacted during the Great Recession. Overall, we found that women with Medicaid did not have increased odds of having a labor induction compared to women with other insurance types. These results differ from other research studies that found that women with private health insurance had increased odds of interventions compared to women with public health insurance.[17]

When studying the impacts of the Great Recession on odds of labor induction, our study found that women of varying insurance types were impacted differently. Controlling for a number of study covariates, women who did not have Medicaid were less likely to have labor inductions in the years following the start of the Great Recession. That trend was not observed among women with Medicaid. A possible explanation for this difference is that there was general push in obstetric care to reduce the number of unnecessary labor inductions around that time. A number of new recommendations and guidelines were published that attempted to lower rates of unnecessary labor inductions.[30,31] It is possible that women with Medicaid already experienced more stringent approvals for labor induction prior to the start of the recession. It could be that women without Medicaid had lower odds of having their labors induced in 2009 and 2010 due to stricter clinical recommendations compared to those before the start of the recession.

When assessing the years from 2006 to 2014, we found variations in the proportion of women covered by Medicaid and differences in rates of labor induction over time. Overall, our study revealed that there was a greater proportion of Medicaid recipients being induced in 2009, 2011, and 2013 compared to non-Medicaid recipients. These results contradict other research studies that found lower rates of intervention among Medicaid recipients compared to women with private health insurance.[17]

A previous study found that overall utilization and spending on health care services did not increase dramatically in the years following the economic recession of 2008.[8] Our results may align with those findings because the overall proportion of women who had inductions increased only slightly during that time. Our study also found that the proportion of women on Medicaid increased marginally during the economic recession, with the highest proportion (44.7%) in 2009. These results may also align with previous research findings that more individuals qualified for Medicaid during the economic recession.[2]

The years between 2006 and 2014 were selected to determine if the recession impacted the proportion of Medicaid recipients having labor inductions in Rhode Island specifically. Compared to other New England states, Rhode Island was especially hard hit. Rhode Island had one of the highest unemployment rates across the country. While the financial recession occurred in 2008, and most of the country returned to economic stability in the following few years, Rhode Island felt the impacts of the recession for longer.[24]

Strengths of this study include the use of a population-based analysis of all deliveries at a tertiary care hospital from 2006 to 2014. These data may be representative of the state of Rhode Island, with approximately 75% of the state's deliveries occurring at Women & Infants Hospital. However, there are a few methodological limitations. First, the race and ethnicity variable was not well defined in the hospital discharge data. A large portion of the deliveries were coded as "other," which likely are largely mothers of Hispanic ethnicity. Of the whole sample, 24.4% were recorded as "other", with 11.5% of women with non-Medicaid insurance and 41.9% of Medicaid recipients recorded as "other". Additionally, we solely examined hospital discharge data. Previous studies have found that hospital discharge data may not accurately represent whether or not a woman underwent a labor induction.[32] Thus, this study may underestimate the true number of inductions.[32] In addition, the data available for this study did not specify clearly the reasons for induction in each patient's case. While we were able to control for some potential indications, the data are suggestive rather than definitive.

Conclusion

Overall, the Great Recession may have disproportionately impacted certain patient populations. We hypothesized that in the years following the economic recession, there would be a decrease in the odds of having a labor induction regardless of insurance status. This study found that between 2006 and 2007 and 2009 and 2010 the odds of labor induction decreased for the whole sample and specifically among the non-Medicaid recipients. Over the last few decades, labor inductions increased in popularity. However,

not all labor inductions are performed for medically necessary indications. It is possible that in the years following the start of the Great Recession, fewer women with non-Medicaid insurance were being induced for non-medically necessary indications, which may have been beneficial. Future studies should be conducted to determine if periods of economic downturn disproportionately harm certain patient populations or reduce the number of unnecessary inductions, as information on this topic can be used to guide public health policies that reduce unnecessary interventions.

Tables

Table 1. Demographic characteristics of study sample and mode of delivery by insurance type [1]

	Medicaid	All other insurance types	
Induction	6,748 (20.3)	8,788 (19.5)	p=0.002
Discharge Year			
2006	5,230 (11.6)	3,917 (11.8)	
2007	5,381 (11.9)	4,004 (12.1)	
2008	3,952 (11.9)	5,210 (11.5)	
2009	3,946 (11.9)	4,879 (10.8)	
2010	3,768 (11.4)	4,725 (10.5)	
2011	3,662 (11.0)	4,643 (10.3)	
2012	3,681 (11.1)	4,670 (10.3)	
2013	3,307 (10.0)	5,059 (11.2)	
2014	2,938 (8.9)	5,353 (11.9)	p<0.001
Age			
	25.7 [5.9]	30.9 [5.4]	p<0.001
Race			
White	12,722 (38.4)	35,268 (78.1)	
Black	4,418 (13.3)	2,170 (4.8)	
other	16,035 (48.3)	7,712 (17.1)	p<0.001
Marital Status			
Single	23,102 (69.9)	18,965 (9.9)	
Married	8,315 (25.1)	35,023 (77.5)	
Other	1,758 (5.3)	1,162 (2.6)	p<0.001
Late term			
Yes	2,616 (7.9)	3,323 (7.4)	p=0.021
Missing	4,379 (13.2)	6,040 (13.4)	
LOS[2] after delivery	2.69 [1.3]	2.81[1.3]	p<0.001

Cesarean	9,367 (28.2)	16,684 (37.0)	p<0.001
	Medicaid	**All other insurance types**	
Fetal Growth Restriction	1,606 (4.8)	1,836 (4.1)	p<0.001
PROM[3]	4,562 (10.1)	3,073 (9.3)	p<0.001

[1] N (%) for categorical variables and mean [SD] for continuous variables. P-values for chi-square (categorical variables) or t-test (continuous variables).
[2]LOS= length of stay
[2] PROM = premature rupture of membranes

Table 2. Demographic characteristics of study sample by induction status [1]

	Not induced (62,789)	**Induced** (15,536)	
Health insurance			
Medicaid	26,427 (42.1)	6,748 (43.4)	
Other insurance	36,362 (57.9)	8,788 (56.6)	p=0.002
Discharge year			
2006	7,482 (11.9)	1,665 (10.7)	
2007	7,546 (12)	1,839 (11.8)	
2008	7,369 (11.7)	1,793 (11.5)	
2009	7,097 (11.3)	1,728 (11.1)	
2010	6,766 (10.8)	1,727 (11.1)	
2011	6,688 (10.7)	1,617 (10.4)	
2012	6,797 (10.8)	1,554 (10)	
2013	6,694 (10.7)	1,672 (10.8)	
2014	6,350 (10.1)	1,941 (12.5)	p<0.001
Age			
	28.8 [6.2]	28.4 [6.2]	p<0.001
Race			
White	38,455 (61.2)	9,535 (61.4)	
Black	5,078 (8.1)	1,510 (9.7)	
Other	19,256 (30.7)	4,491 (28.9)	p<0.001

	Not induced (62,789)	**Induced** (15,536)	
Marital Status			
Single	25,242 (41.8)	6,825 (45.6)	
Married	35,197 (58.2)	8,141 (54.4)	
Other	2,350 (3.7)	570 (3.7)	p<0.001
Late term (n=67,906)			
Yes	2,692 (4.3)	3,247 (20.9)	
Missing	8,552 (13.6)	1,867 (12)	p<0.001
Preterm			
Yes	6,734 (10.7)	1,214 (7.8)	
Missing	8,552 (13.6)	1,867 (12)	p<0.001
LOS after delivery	2.65 [1.3]	3.22 [1.4]	p<0.001
Cesarean			
Yes	22,208 (35.4)	3,843 (24.7)	p<0.001
Fetal Growth Restriction			
Yes	1,913 (3.1)	1,529 (9.8)	p<0.001
PROM			
Yes	6,548 (10.4)	1,087 (7)	p<0.001

[1] N (%) for categorical variables and mean [SD] for continuous variables. P-values for chi-square (categorical variables) or t-test (continuous variables).
LOS= Length of Stay
PROM= Premature rupture of membranes

Table 3. Demographic characteristics of study sample by discharge year [1]

	2006	2007	2008	2009	2010	2011	2012	2013	2014
	9,147	9,385	9,162	8,825	8,493	8,305	8,351	8,366	8,291
Age									
	28.7 [6.4]	28.4 [6.3]	28.4 [6.3]	28.4 [6.3]	28.6 [6.2]	28.8 [6.1]	28.8 [6.0]	29.2 [6.0]	29.1 [5.8]
Race									
White	5,883 (64.3)	5,905 (62.9)	5,598 (61.1)	5,418 (61.4)	5,168 (60.9)	4985 (60)	5,106 (61.1)	5,000 (59.8)	4,923 (59.4)
Black	818 (8.9)	807 (8.6)	802 (8.8)	719 (8.1)	691 (8.1)	693 (8.3)	679 (8.1)	743 (8.9)	636 (7.7)
Other	2,446 (26.7)	2,673 (28.5)	2,762 (30.1)	2,688 (30.5)	2,634 (31)	2,627 (31.6)	2,566 (30.7)	2,623 (31.4)	2,728 (32.9)
Insurance Type									
Medicaid	3,917 (42.8)	4,004 (42.7)	3,952 (43.1)	3,946 (44.7)	3,768 (44.4)	3662 (44.1)	3,681 (44.1)	3,307 (39.5)	2938 (35.4)
Other	5,230 (57.2)	5,381 (57.3)	5,210 (56.9)	4,879 (55.3)	4725 (55.6)	4643 (55.9)	4,670 (55.9)	5059 (60.5)	5353 (64.6)
Marital Status									
Single	3,470 (39.4)	3755 (40)	3,725 (40.7)	3,659 (41.5)	3519 (41.4)	3351 (40.4)	3526 (42.2)	3504 (41.9)	3558 (42.9)
Married	5378 (58.8)	5,319 (58.7)	5063 (55.3)	4800 (54.4)	4,599 (54.2)	4,593 (55.3)	4,477 (53.6)	4,601 (55)	4508 (54.4)
Other	299 (3.3)	311 (3.3)	372 (4.1)	366 (4.2)	375 (4.4)	361 (4.4)	348 (4.2)	261 (3.1)	255 (2.7)
Cesarean									
Yes	3,014 (33)	3,094 (33)	3,207 (35)	2,977 (33.7)	2,865 (33.7)	2,836 (34.2)	2,723 (32.6)	2,727 (32.6)	2,608 (31.5)
No	6133 (67)	6,291 (67)	5,955 (65)	5,848 (66.3)	5,628 (66.3)	5,469 (65.9)	5,628 (67.4)	5,639 (67.4)	5,683 (68.5)
Induced									
Yes	1,665 (18.2)	1,839 (19.6)	1,793 (19.6)	1,728 (19.6)	1,727 (20.3)	1,617 (19.5)	1,554 (18.6)	1,672 (20)	1,941 (23.4)
No	7,482 (81.8)	7,546 (80.4)	7,369 (80.4)	7,097 (80.4)	6,766 (79.7)	6,688 (80.5)	6,797 (81.4)	6,694 (80)	6,350 (76.6)
Length of stay									
	3,923 (8.69)	2.76 (1.23)	2.81 (1.41)	2.81 (1.37)	2.81 (1.40)	2.78 (1.25)	2.72 (1.20)	2.69 (1.12)	2.69 (1.12)

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hypertensive disorder									
Yes	892 (9.75)	945 (10.07)	1,032 (11.26)	1,061(12.02)	1,082 (12.74)	1,194 (14.38)	1,089 (13.04)	1,172 (14.01)	1,215 (14.65)
Diabetic disorder									
Yes	806 (8.81)	798 (8.50)	832 (9.08)	802 (9.09)	853 (10.04)	1,051 (12.66)	908 (10.87)	760 (9.08)	790 (9.53)
Post dates									
Yes	424 (4.64)	510 (5.43)	567 (6.19)	728 (8.25)	688 (8.10)	901 (10.85)	705 (8.44)	1,280 (15.30)	1,214 (14.64)
PROM									
Yes	511 (5.59)	605 (6.46)	827 (9.03)	1,125 (12.75)	1,103 (12.99)	879 (10.6)	682 (8.2)	879 (10.5)	1.024 (12.4)

[1] Mean [standard deviation] for continuous variables and n (%) for categorical variables
PROM= Premature rupture of membranes

Table 4. The impact of Medicaid status on odds of labor induction

	Unadjusted Odds Ratio (95% CI)	**Adjusted Odds Ratio [a] (95% CI)**
Payer Type All others	1.00 (ref)	1.00 (ref)
Medicaid	1.06 (1.02-1.09)	1.02 (0.98-1.08)

[a] Controlling for age categories, discharge year, race, maternal diabetic disorders, maternal hypertensive disorders, fetal growth restriction, late term pregnancy and premature rupture of membranes.

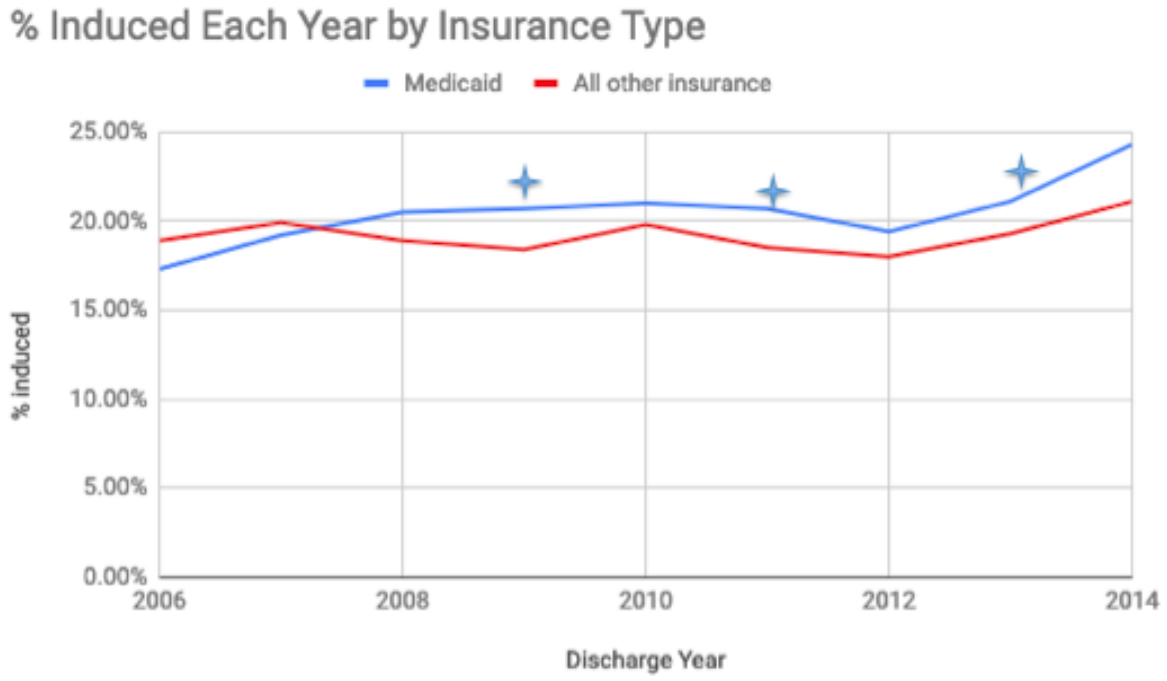
Table 5: The impact of time periods before (2006-2007) and during (2009-2010) the Great Recession on odds of labor induction.

OVERALL	Unadjusted	Adjusted [a]
Before (2006-2007)	1.00 (ref)	1.00 (ref)
During (2009-2010)	1.07 (1.01-1.13)	0.93 (0.86-1.00)

NON-MEDICAID	Unadjusted	Adjusted [b]
Before	1.00 (ref)	1.00(ref)
During	0.99 (0.92-1.06)	0.84 (0.77-0.92)
MEDICAID	Unadjusted	Adjusted [b]
Before	1.00 (ref)	1.00(ref)
During	1.18 (1.09-1.28)	1.06 (0.95-1.18)

a. Adjusting for payer type, age, race, maternal diabetic disorder, maternal hypertensive disorders, fetal growth restriction, late term pregnancy and premature rupture of membranes.
b. Adjusting for age, race, maternal diabetic disorder, maternal hypertensive disorders, fetal growth restriction, late term pregnancy and premature rupture of membranes.

Figure 1. Percentage of deliveries that had a labor induction by health insurance status between 2006 and 2014



* Significant differences in proportions induced by health insurance type

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PART II: The Relationship Between Health Insurance Type and Indications for Labor Induction

Abstract

Objective
To study the relationship between health insurance type and indication for labor induction

Study Design
This is a retrospective, cross sectional study that utilized hospital discharge data and labor induction request forms. The analytic sample consisted of 4,553 labor inductions. A multinomial logistic model was created to assess the relationship between health insurance type and indication for labor induction.

Results
The majority of the labor inductions were performed for late term pregnancy, hypertensive disorders and premature rupture of membranes. Before adjusting for covariates, Medicaid recipients were more likely to be induced for a number of indications, including late term pregnancy and hypertensive disorders compared to non-Medicaid recipients. After adjusting for covariates, there were no differences in risk for indication by insurance type.

Conclusion
This study did not find any evidence to support that there is an association between health insurance type and primary indications for labor induction.

Background

Labor induction is a medical intervention involved in over 20% of deliveries in the United States.[1] Induction of labor involves artificially engendering contractions and labor in a woman who is not already naturally laboring, with the goal of achieving a vaginal delivery. If a pregnant woman's cervix is not ready for delivery, labor inductions are sometimes coupled with a cervical ripening process. Labor inductions are typically recommended when there are greater maternal or fetal risks associated with being pregnant compared to the risks associated with interventional delivery and potential newborn prematurity.[2] The most common indications for labor induction are premature rupture of membranes, intrauterine growth restriction, late term pregnancy (≥41 weeks gestation), maternal hypertensive disorders, and maternal diabetic disorders. In some cases, elective inductions may be performed.[3,4,5] A recent study demonstrated potential health benefits to inducing at 39 weeks for elective indications, citing lower rates of cesarean section.[6] Labor inductions are of public health interest because of the affiliated costs, potential adverse outcomes, and increase in prevalence over time. [3, 7, 8, 9]

In contrast to potential health indications for labor induction, there are several obstetrical and personal factors that may impact one's likelihood of having a labor induction, such as health insurance type, patient and provider preference. Previous studies found that health insurance may impact inpatient obstetrical care.[10,11] A study published in 2013 found that women with private health insurance experienced greater rates of interventions, like cesarean delivery and labor induction, compared to women with public health

insurance.[10] One's type of health insurance has been associated with obstetrical outcomes, like preterm delivery.[12]

The two main sources of health insurance coverage for maternity care are private health insurance and publicly funded state Medicaid programs. In the United States, Medicaid provides health care coverage to a substantial portion of the low income population, especially low income mothers, and finances roughly half of births nationwide.[13,14] Women comprise the largest portion of the adult Medicaid population, with 25 million women receiving coverage through the program.[15] According to federal law, pregnant women are eligible for Medicaid coverage if they have incomes up to 133% of the Federal Poverty Line, and can remain covered for 60 days postpartum.[16] The guidelines for Medicaid coverage expanded following the implementation of the Affordable Care Act.[17] Under the Affordable Care Act, a pregnant woman's income could be up to 138% of the FPL and she could still be eligible for Medicaid. Because Medicaid is a federal-state partnership and some states expanded Medicaid access, there are differences in eligibility at the state-level. In Rhode Island, pregnant women with incomes up to 253% the FPL are eligible to be covered under Medicaid[18], which financed 50% of deliveries in 2014.[19]

Medicaid may reimburse hospitals at lower rates compared to commercial health insurance, which could potentially explain differences in rates of intervention among Medicaid recipients.[20] A number of studies have found that lower reimbursement rates associated with Medicaid impact whether or not providers accept Medicaid patients.[21, 22] It is possible that the impacts of lower reimbursement rates extend to the likelihood of

labor induction across and within given indications for induction. Studies have found that women who are induced remain in the hospital longer compared to women who deliver following spontaneous onset of labor.[9] The differences in length of stay could have subsequently different charges, depending on insurance bundle details.

This study explored differences in indications for labor induction between Medicaid recipients and those with other health insurance types in the state of Rhode Island. We hypothesized that there would be fewer elective inductions in the Medicaid population compared to other insurance types since there have been efforts to reduce the number of elective early indications among Medicaid recipients.[5,23] Therefore, we hypothesize there will be a greater proportion of inductions for medically indicated health conditions among Medicaid recipients compared to those without Medicaid.

Methods

Data were extracted from labor induction request forms and scheduling records at Women & Infants Hospital in Providence, Rhode Island from November 2015 to October 2017. Labor induction information was merged with hospital discharge data based on maternal medical record numbers. The de-identified analytic sample consisted of women who had non-missing information on both type of health insurance and recorded indication for induction. This study was conducted with IRB approval from Women & Infants Hospital.

The main exposure of interest for this analysis was health insurance type at the time of delivery, as noted in hospital discharge data. Health insurance status was coded as a

binary variable where 1= Medicaid or HMO/Medicaid and 0= all other insurance types including commercial insurance, Medicare, self-insured, and others.

The outcomes of interest were primary indications for labor induction. Reasons for labor induction entered as a text field on the induction request form were assigned into the following categories: premature rupture of membranes, intrauterine growth restriction, hypertensive disorders, diabetic disorders, and late term pregnancy (the top five indications for labor induction). The remaining indications were categorized into three levels by their clinical severity, or left as other if they could not be categorized. At Women & Infants Hospital, indications for labor induction are lumped into three overarching categories based on clinical severity and urgency: Level 1, Level 2 and Level 3, with level one being the most urgent. See Table 1 for categorization of indication variables used in this study.

Primary indication for induction was assessed as both a single categorical variable and as binary variables. The categories included premature rupture of membranes, late term delivery, intrauterine growth restriction, maternal diabetic disorders, maternal hypertensive disorders, elective inductions, other level 1 reasons, other level 2 reasons, other level 3 reasons, and other (Table 1). Binary variables for each of these categories were also created to assess baseline differences between insurance types.

Frequency and type of cervical ripening during the labor induction process were extracted from induction of labor scheduling information. Providers indicated whether or not they

would be ordering cervical ripening for a patient on the request form. Further, clinical staff indicated what type of cervical ripening each patient received after hospital admission on the same induction of labor scheduling documentation. A binary variable was generated where 1= cervical ripening and 0= no ripening. Cervical ripening was further explored by determining if there was documentation that a patient took Misoprostol or had a Foley catheter. Binary variables were generated for each of the cervical ripening methods of interest.

A binary variable was generated for whether or not someone had a cesarean using the following ICD-10 codes: 10D00ZX. If the ICD-10 codes existed in any of the 6 procedure code fields in the hospital discharge data, they were recorded as having a cesarean section.

Demographics and confounders

Maternal age at delivery, race, and requesting provider office were selected as potential confounders for this analysis. Maternal age and race were selected since they are common confounders seen in the literature. Race was categorized as white, black, and other based on hospital discharge data. Provider office was considered a potential confounder because a patient might select a specific practice based on whether or not their insurance is accepted. Additionally, the type of practice also may influence likelihood of induction for a given indication because the decision to induce varies by indication and provider preference. The largest provider groups in Rhode Island were left as individual categories. All of the federally qualified health centers were grouped

together. Small private provider groups were combined into a separate category due to small numbers.

Data Analysis

All data analysis was conducted in STATA 15.[23] Demographic and confounder variables were compared by insurance status. A multinomial logistic regression model estimated the relationship between the relative risk ratios of having certain primary indications for induction compared to an elective induction by health insurance, controlling for maternal age, race and provider office.

Results

Description of sample

The dataset consisted of 4,634 labor inductions between November 2015 and October 2017, 4,553 of which had non-missing data on insurance type and primary indication for induction (98.3%). Of the 4,553 deliveries, 46.2% were Medicaid recipients (data not shown). The mean age for all women was 29.3 years (stdev 5.8). There was a significant difference in age between Medicaid recipients (27.3, stdev 6), and non-Medicaid recipients (31.1 stdev 5) ($p<0.001$). There were significant differences in the race distributions between the two insurance groups ($p<0.001$). Among Medicaid recipients, the majority (49.2%) were in the "other" category for race while the majority of non-Medicaid recipients (71.7%) were white. The largest proportion (71%) of Medicaid

recipients were single while the majority (75.2%) of non-Medicaid recipients were married.

Across the whole study sample, 21.6% of the deliveries were by cesarean section. When assessing rates of cesarean sections by health insurance type, 19.4% of inductions by Medicaid recipients ended in cesarean section, and 23.5% of inductions to non-Medicaid recipients ended in cesarean section ($p<0.001$). (Table 2) Women who did not have Medicaid had 27% higher odds of having a cesarean delivery compared to women with Medicaid (unadjusted, 95% CI: 11% to 47%) (ORs not shown).

Medicaid recipients had a significantly shorter length of stay after delivery compared to women with other types of health insurance ($p=0.011$). However, the difference is very small and may not be clinical relevant. Additionally, Medicaid recipients were more likely to have a higher gravidity and parity compared to non-Medicaid recipients ($p<0.001$) (Table 2).

Of the inductions in the sample, 79% involved cervical ripening. There was no significant difference in the proportion of women who experienced ripening by insurance status. Among all inductions, 78.5% of Medicaid recipients and 80.1% of non-Medicaid recipients required ripening ($p=0.125$). Among women who required cervical ripening, 50% had a Foley balloon placed and 75% took oral Misoprostol. There were no differences in proportions of women who had a Foley balloon or Misoprostol by insurance type ($p>0.05$) (Table 2).

As shown in Table 2, the top three most common indications for labor induction were: late term pregnancies (25%), followed by hypertensive disorders (17%), and then premature rupture of membranes (15%). When stratified by insurance type, similar trends were seen. The proportion of those who were induced for late term was not significantly different when compared to insurance status (p=0.810). While hypertensive disorders category was the second most common indication for induction for both insurance groups, significantly more non-Medicaid recipients were induced for hypertensive disorders compared to Medicaid recipients (18.5% versus 14.6%, p<0.001). Similarly, significantly more non-Medicaid recipients were induced for premature rupture of membranes compared to Medicaid recipients (16.9% versus 13.1%, p<0.001).

Indications for labor induction

In the unadjusted model, Medicaid insurance was associated with significantly lower relative risk of having late term pregnancy as the primary indication compared to elective reasons than women with other types of health insurance. Similarly, women enrolled in Medicaid had significantly lower relative risks of having hypertensive disorders, diabetic disorders, other level 2, other level 3 and other indications for induction compared to elective reasons than women with other types of health insurance. Women with Medicaid had a lower relative risk ratio (RRR: 0.66; 95% CI: 0.52-0.84) of having late term as the primary indication compared to elective reasons than women with other types of health insurance coverage. None of the relative risk ratios were significant in the models after adjusting for study covariates. (Table 3)

Discussion

This study did not find any evidence to support an association between health insurance type and primary indications of labor induction. Medicaid recipients were as likely as women with other types of health insurance to be induced for any primary indication, after adjusting for maternal age, race, and provider office.

Medicaid plans have lower rates of reimbursement for medical care compared to commercial health insurance plans, which may impact provider acceptance of Medicaid patients and overall access to care.[21] Lower rates of reimbursement could potentially influence the types of care that Medicaid recipients receive. Kozhimannil et al. found that patients with Medicaid had significantly fewer interventions during the labor and delivery process, including cesarean deliveries and labor inductions, compared to those with private health insurance.[10] Our study found that a greater proportion of Medicaid recipients were induced for elective reasons compared to women with other types of health insurance. However, in the multinomial logistic regression, we found no differences in relative risk ratios for each indication compared to elective inductions between insurance types.

Hypertensive disorders were the second most common indication for labor induction. However, labor inductions for hypertensive disorders were more common among non-Medicaid recipients compared to Medicaid recipients. This difference in indication by insurance type may be explained by the fact that Medicaid recipients were significantly younger than non-Medicaid recipients. As one ages, the risk for developing hypertension

that can impact pregnancy increases.[1] Therefore, it is possible that more women who are not insured with Medicaid are more likely to be induced for conditions associated with an older age.

While this study had several strengths, including explicitly recorded indications for labor induction rather than ICD-10 codes, there were a number of limitations. First, the race and ethnicity variable was not well defined in the hospital discharge data. A large proportion of individuals who were recorded as "other" in this dataset prior to further categorization (25%). These women would likely identify as Hispanic, a category that otherwise had zero observations in the original data. Some scheduled labor inductions were not included in the final dataset as they could not be merged due to missing medical record numbers; however, only a small portion could not be merged (<5%). These data did not include information on reimbursement rates. Additionally, further information is needed to understand potential differences in care based on payment models (i.e. fee-for-service or managed care models). Additionally, no data existed on the timing for when women enrolled in their respective insurance plans. The data on health insurance type was taken at the time of delivery.

A CDC report published in 2015 by D'Angelo et al. described trends in health insurance coverage during the course of pregnancy, and argued that inadequate coverage prior to Medicaid qualification during pregnancy could have a significant impact on pregnancy outcomes.[25] Lastly, there are a number of factors that may increase one's likelihood for specific indications for induction that cannot be addressed with this data. For example, being overweight or obese may increase one's likelihood of having Type 2 or gestational

diabetes, and could increase one's likelihood of labor induction.[26] Medicaid recipients have the highest prevalence of obesity compared to other health insurance types.[27] Obesity screening and counseling services are provided and encouraged for Medicaid recipients, therefore one's weight could be associated with insurance type and indication for labor induction.[28] There may be additional unknown confounding not controlled for in this study.

Because a high proportion of pregnant women and women of reproductive age are insured through Medicaid programs, determining potential health differences between Medicaid and other insurance types is of great importance.[15] Understanding potential differences could inform Centers for Medicare and Medicaid Services (CMS) and state-level policy. These policies could impact women's health during pregnancy, thereby influencing roughly 50% of deliveries in the United States. As Kozhimannil et al. discussed in their paper from 2013,[10] Medicaid finances a large portion of pregnancies, so states have the opportunity to impact a large number of deliveries through Medicaid policy. It is important for states to analyze differences in rates of obstetrical intervention, and elucidate potential disparities by health insurance type.

Conclusion

While previous studies have found that private health insurance patients are more likely to be induced compared to patients with public health insurance, we did not find any significant differences in relative risk for indications of labor by insurance status after

adjusting for study covariates. While this study did not find differences in primary indications for labor induction between Medicaid and non-Medicaid members, further studies should be conducted to determine the source of the differences in rates of labor induction by insurance type seen in other studies.

Tables

Table 1: Categorization of indications of labor induction

Hypertensive disorders (Levels 1-2)	- Chronic hypertension - Gestational hypertension - Preeclampsia
Diabetic disorders (Levels 1- 2)	- Gestational diabetes - Type 1 diabetes - Type 2 diabetes
Postdates/Late Term (Level 2)	
Intrauterine Growth Restriction (IUGR) or Fetal Growth Restriction (FGR) (Levels 1-2)	
Elective (Level 3)	
Premature Rupture of Membranes (PROM) (Level 1)	
Other level 1	- Non-reassuring fetal status - Placental abruption - Isoimmunization - Fetal demise
Other level 2	- Oligohydramnios - Cholestasis - On anticoagulants - Prior stillbirth

	- Seizure disorder - Renal disease - Antiphospholipid syndrome	- Fetal anomaly - Thrombocytopenia
Other level 3	- Advanced maternal age - Prior shoulder dystocia - distance/risk of rapid labor	- Polyhydramnios - Pain
Other	- Other - Twins - Decreased fetal movement	- Macrosomia - Hyperemesis

Table 2: Characteristics of sample by insurance type

	Medicaid	**All other insurance types**	
Primary Indication			
Hypertensive disorder	307 (14.6)	453 (18.5)	p<0.001
Diabetic disorder	227 (10.8)	236 (9.6)	p=0.200
Intrauterine Growth Restriction	179 (8.5)	122 (5)	p<0.001
Late term	537 (25.5)	618 (25.2)	p=0.810
Premature Rupture of Membranes	275 (13.1)	413 (16.9)	p<0.001
Elective	199 (9.5)	152 (6.2)	p<0.001
Other Level 1	44 (2.1)	38 (1.6)	p=0.171
Other Level 2	215 (10.2)	224 (9.1)	p=0.218
Other Level 3	26 (1.2)	67 (2.7)	p<0.001
Other	94 (4.5)	127 (5.2)	p=0.264
Age			
	27.3 [6.0]	31.1 [5.0]	p<0.001
Race			
White	791 (37.6)	1,757 (71.7)	
Black	277 (13.1)	130 (5.3)	
Other	1,035 (49.2)	563 (23)	p<0.001
Marital Status			
Single	1,494 (71)	573 (23.4)	
Married	565 (26.9)	1,842 (75.2)	
Other	44 (2.1)	35 (1.4)	p<0.001

	Medicaid	All other insurance types	
C-section			
Yes	407 (19.4)	575 (23.5)	
No	1,696 (80.7)	1,875 (76.5)	p=0.001
Maternal length of stay after delivery			
	2.28 [0.7]	2.34 [0.8]	p=0.011
Gravidity			
	2.7 [1.9]	2.0 [1.3]	p<0.001
Parity			
	1.1 [1.3]	0.5 [0.8]	p<0.001
Gestational Age in Weeks			
	39.1 [1.8]	39 [2.1]	
Ripening Required			
Yes	1,650 (78.5)	1,963 (80.1)	
No	453 (21.5)	487 (19.9)	p=0.167
Misoprostol (n=3,613)			
Yes	1,467 (74.7)	1,242 (75.3)	
No	496 (25.3)	408 (24.7)	p=0.709
Foley (n=3,613)			
Yes	1,009 (51.4)	803 (48.7)	
No	954 (48.6)	846 (51.3)	p=0.954

N (%) for categorical variables and mean [SD] for continuous variables. P-values for chi-square (categorical variables) or t-test (continuous variables).
Misoprostol and Foley data are among those who were induced

Table 3.Unadjusted and adjusted relative risk ratios of having each indication compared to elective induction for Medicaid recipients compared to non-Medicaid recipients

Indication	**Unadjusted relative risk ratio**	**Adjusted relative risk ratio [1]**
HTN	0.52 (0.40-0.67)	0.87 (0.62-1.21)
DM	0.73 (0.56-0.97)	1.28 (0.89-1.84)
IUGR	1.12 (0.82-1.53)	1.37 (0.92-2.02)

Post Dates	0.66 (0.52-0.84)	0.87 (0.64-1.19)
PROM	0.51 (0.39-0.66)	0.81 (0.58-1.12)
Elective	1.00 (ref)	1.00 (ref)
Other Level 1	0.88 (0.55-1.43)	1.05 (0.58-1.90)
Other Level 2	0.73 (0.55-0.97)	0.90 (0.63-1.29)
Other Level 3	0.30 (0.18-0.49)	0.79 (0.43-1.45)
Other	0.57 (0.40-0.79)	0.82 (0.54-1.26)

1. Controlling for race, age, and provider office

Indications: HTN = hypertensive disorders; DM = diabetic disorders; IUGR: intrauterine growth restriction; PROM= premature rupture of membranes; Other level 1= oligohydramnios, cholestasis, seizure disorder, renal disease, antiphospholipid syndrome, on anticoagulants, prior stillbirth, fetal anomaly; Other level 2= pain, advanced maternal age, polyhydramnios, prior shoulder dystocia, distance/risk of rapid labor; Other level 3= other, twins, macrosomia, decreased fetal movement

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