

Threat of Malpractice Lawsuit, Physician Behavior and Health Outcomes: Testing the Presence of Defensive Medicine

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Summary

Theoretical and empirical studies suggest that risk of malpractice lawsuits encourages physicians to practice “defensive medicine”, utilization of medical resources beyond its optimal level of use. The purpose of this study is to examine the potential consequences of medical malpractice lawsuits on obstetric care interventions. Physician behavior in obstetrics is modeled as a fixed effects logit with claim frequency and claim severity as measures of malpractice fear in each state. To measure malpractice risk, we use the National Practitioner Data Bank (NPDB), a comprehensive data set of all paid claims for medical malpractice. For the inpatient data we use the Nationwide Inpatient Sample (NIS) which provides detailed information on all inpatient hospital stays. Because medical malpractice risk is greater for patients with severe medical complications, the data is divided into two groups: necessary C-section and unnecessary C-section. Results suggest that a higher degree of malpractice risk increases the probability of C-section delivery. For majority of patients (86% of all patients), we do not find evidence of defensive medicine. In fact, marginal benefit of additional resource use is much higher than its marginal cost. We find evidence of defensive medicine only for Medicaid patients with severe medical complications.

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1. Introduction:

The United States is going through its third medical malpractice insurance crisis (Thorpe, 2004). High rates of malpractice claims and increasing jury awards for these claims have increased the costs for insurance companies. Although these costs have been passed on to physicians in the form of higher insurance premiums, many insurance companies are not doing well². In some areas, malpractice premiums have become prohibitively high³. Obstetricians in Miami paid up to \$211,000 in 2002 for liability insurance, while general surgeons were charged up to \$124,000⁴. In 2002 alone, the malpractice insurance rates for internists increased by 24.6%, for general surgeons and obstetrics/gynecology physicians (ob/gyn) the increase was 25%, and 19.6% respectively⁵.

With an aim to reduce insurers' costs, many states have enacted medical malpractice reforms that reduce the number of malpractice claims and payments per paid claim⁶. However, the insurers' costs and the costs of administering medical malpractice system are less than 1 percent of total health care expenditure (OTA, 1993). While an overuse of medical care resources is alleged to be the major source of increase in healthcare expenditures⁷. Theoretical and empirical studies suggest that risk of malpractice lawsuits encourages physicians to practice "defensive medicine". Defensive medicine refers to the level of resource use where marginal social benefit (MSB) is less than marginal social

² St. Paul Insurance Company, America's largest malpractice insurer, announced in December 2001 that it would stop selling medical malpractice policies to improve its profitability.

³ US department of health and human services report, July 24, 2002.

⁴ US department of health and human services special update, Sept 25, 2002.

⁵ Medical Liability Monitor (Chicago), 2002 rate survey.

⁶ See the Office of Technology Assessment (OTA), 1993 report.

⁷ The OTA, 1995 report.

cost (MSC)⁸. Physicians may also practice “negative defensive medicine”, not performing high risk medical procedures or by avoiding patients with high risk of filing malpractice claims (OTA, 1994, page 21).

The medical malpractice crisis is severe in the field of obstetrics⁹. The Cesarean section (C-section) rate in USA has increased from 4.5% of all births in 1965 (Tussing and Wojtowycz, 1992) to 24.3% in 2001 (U.S. Census Bureau). Among 28 specialty groups in the medical profession, ob/gyn had the highest number of medical malpractice claims in the year 2000¹⁰.

In this paper we test for the prevalence of defensive medicine in Obstetrics. In particular, we look at the impact of malpractice liability risk (as measured by the medical malpractice claims frequency and claims severity) on the probability of C-section delivery. Additionally, the effect of malpractice risk on the health outcomes of mothers and neonates is also estimated. We combine the National Practitioner Data Bank (NPDB) with the Nationwide Inpatient Sample data of Healthcare Cost and Utilization Project (HCUP) for the years 1995 and 1997.

Medical malpractice risk is said to be higher for patients with severe medical complications (Dubay et al., 1999). Based on the severity of medical complications, the data is divided into two groups: necessary C-section and unnecessary C-section. Using this classification, we analyze the impact of medical malpractice risk on maternal and neonatal mortality and morbidity. Moreover, physician response may vary according to the insurance status of women. Reasons for this include the different reimbursement

⁸ See Dubay *et al.* (1999), Kessler and McClellan (1996), and the OTA (1994) report.

⁹ See OTA (1994) report and Dubay *et al.* (1999).

¹⁰ Harming patient access to care: The impact of excessive litigation. Statement of the ACOG to the subcommittee on health committee on energy and commerce, United States House of Representatives, February 27, 2003.

policies of Medicaid and private insurance, and different perception of physicians regarding the propensity of women in these two groups to file a malpractice (Dubay *et al.*, 2001).

2. A Model of physician behavior:

Patients do not have full information about the quality and amount of health care provided to them by physicians and hospitals. The costs (economic and noneconomic damages) of injuries caused by negligent care are imposed on providers by the legal system to create disincentives for negligent care. Under a negligence rule of liability, patients who suffer an adverse outcome are entitled to compensation if they can show that they incurred the injury as a result of physician's failure to take due care (defined as the care that is customarily practiced by an average member of the profession in good standing, given the circumstances of the doctor and the patient).

In this section we model physician behavior in obstetrics. The two main methods of delivery are vaginal delivery and C-section delivery. A C-section delivery uses greater resources than a vaginal delivery¹¹. Since there are two main delivery methods, we can represent the physician's choice set by

$$D = \{D^v, D^c\} \quad (1)$$

where D^v stands for vaginal delivery and D^c stands for C-section delivery.

The medical condition of a patient plays the most important role in the physician's choice of delivery method. Certain medical complications may require C-section delivery

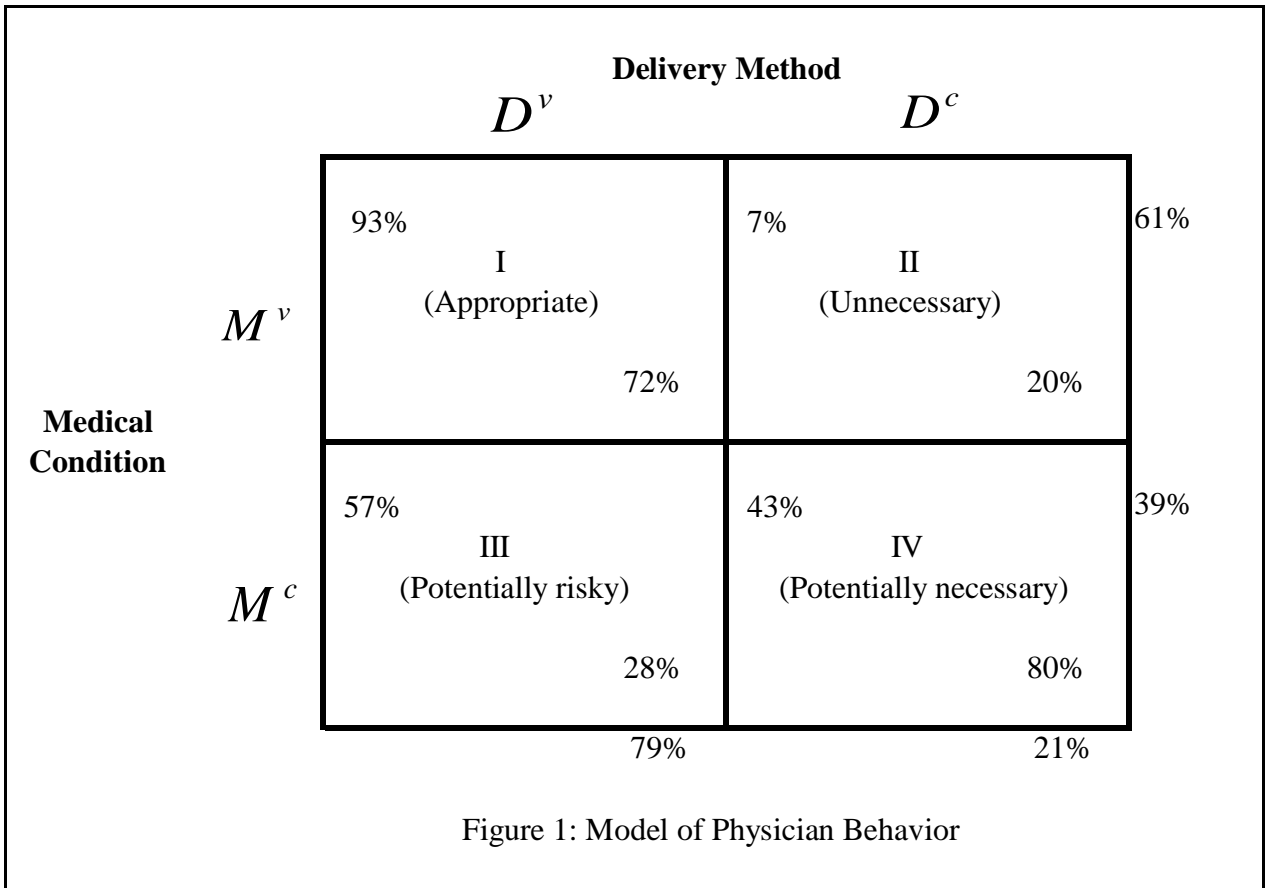
¹¹ In the 1997 NIS data, we find that hospital expenditure for C-section delivery is nearly twice that of vaginal delivery.

while others may not. Using the criteria given by Henry *et al* (1995), we can categorize medical complications into two broad groups:

$$M = \{M^v, M^c\} \quad (2)$$

where M^c represents the group of medical complications that might trigger C-section delivery and M^v is the group of all other medical complications. By implication, if a patient shows the presence of any of the medical complications in group M^c , then a physician should consider C-section delivery. If all of the medical complications in group M^c are absent for a patient then a physician should choose vaginal delivery. If a C-section is performed when any of the conditions in M^c are present, we call the C-sections as potentially necessary. Whereas, if a C-section is performed when all of the complications in M^c are absent (i.e. the patients' conditions belong to M^v), we call those C-sections as unnecessary.

The model of physician behavior is depicted in Figure 1. Cases in Cell I are termed "appropriate" as these cases correspond to the delivery method that is medically appropriate, given the patient's medical condition. The cases in Cell II are termed "unnecessary" because the medical conditions of the patients in this cell do not require a C-section delivery. The cases in Cell III are termed as potentially risky since the patients in this cell have medical conditions for which physicians should consider C-section but they perform a vaginal delivery. Thus physicians are putting themselves at risk for medical malpractice lawsuits by putting patients in Cell III. Although the patients in cell IV have medical conditions considered potentially necessary for C-section delivery, these medical conditions are not sufficient. Therefore, cell IV is termed "potentially necessary".



As shown in figure 1, twenty eight percent of all vaginal deliveries are potentially risky for the physicians and at least twenty percent of all C-section deliveries are unnecessary. Of all the potentially necessary C-section cases, only 43% actually have a C-Section delivery, while 93% of all unnecessary C-section cases have a vaginal delivery.

Medical malpractice may be the primary reason for some of the cases in Cell II and Cell IV in Figure 1. Physicians may perform more C-sections to reduce their risk of medical malpractice suits. To study the effect of a change in state's medical malpractice environment on physician behavior, we use medical malpractice claims frequency and claims severity in the state as a measure of the state's medical malpractice environment.

An increase in claims frequency or claims severity will increase a physician's medical malpractice risk. Theoretical and empirical studies suggest that the increased malpractice risk will prompt the physician to perform more C-sections¹². This is shown in Figure 1 as an increase in number of cases in Cell II (increase in unnecessary C-sections) and an increase in the number of cases in Cell IV (increase in potentially necessary C-sections). Therefore, an increase in claims frequency or claims severity should increase the probability of C-section delivery for a patient with any of the medical conditions in M^c (increase in potentially necessary C-sections) and also increase the probability of C-section delivery for patients not suffering from any of the medical conditions in M^c (increase in unnecessary C-sections).

Another interesting question is whether physician response to malpractice risk varies by the patient's social and economic status. Physicians may have a stronger defensive response to women with Medicaid and other low income women as they are more likely to have a bad birth outcome and physicians perceive them as more likely to file a malpractice claim (Dubay *et al.*, 1999). Moreover, physician may respond differently to the different reimbursement policies of Medicaid and private insurance (Dubay *et al.*, 2001). We use the patient's insurance type as a proxy for their social and economic status. The hypothesis is that physician response is higher for patients with Medicaid compared to patients with private insurance.

At the margin, we can estimate the impact of medical malpractice on difference in C-section rates for women with Medicaid and women with private insurance. Since physician response is said to be higher for Medicaid women, an increase in claims

¹² See Dubay *et al* (1999), and OTA (1994) report.

frequency or claims severity should lead to a larger movement of cases from cell I to cell II (increase in unnecessary C-sections) and cell III to cell IV (increase in necessary C-sections) for Medicaid patients. Thus, the probability of C-section delivery should increase more for Medicaid patients compared to patients with private insurance.

3. Previous Literature:

Previous studies on defensive medicine have mixed results. Rock (1988) used data for New York and Illinois hospitals for the years 1981 and 1983 and found that greater malpractice pressure leads to a higher probability of C-section delivery. Tussing and Wojtowycz (1992) used 1986 data on obstetric deliveries for New York State, excluding New York City, and found that higher malpractice liability pressure decreased the probability of C-section. Localio et al. (1993) used data on acute care hospitals in New York State for the year 1984 and found malpractice premiums and claims at the regional and hospital levels are positively associated with C-section delivery. Baldwin et al. (1995), using 1988- 89 data on Washington State obstetric providers, found that physicians' personal obstetrics suit experience and the defendant rate in the physicians' county of residence have no effect on the method of delivery and the prenatal care resource use. Sloan et al. (1997) used a 1992 survey on obstetrical care for women in Florida and found no significant effect of malpractice pressure on method of delivery.

Most of these studies are limited in their geographic coverage area and use a single cross section of data and therefore may not be representative of the entire country. Also, small coverage area may lead to spurious correlation between malpractice liability and defensive medicine. For example, high malpractice premiums in an area may reflect the

quality of physicians or the poor health of the population, each of which may also be associated with the rate of cesarean section (Dubay et al., 1999).

Studies that are not limited in their geographical coverage consistently support the hypothesis that physicians use more resources in response to medical malpractice pressure. Dubay et al. (1999) used the National Natality Files for the years 1990-1992 and found that greater malpractice pressure leads to a higher probability of cesarean delivery. Kessler and McClellan (1996) used the Medicare beneficiary data for years 1984, 1987, and 1990 and found that higher malpractice pressure is associated with higher medical expenditure for heart patients.

Some authors have also estimated the effect of malpractice pressure on health outcomes of the patients. Kessler and McClellan (1996) find that reduction in provider liability pressure has no substantial effect on mortality or medical complications of heart patients. Sloan et al. (1995), using mortality of the child and Apgar score as indicators of health outcome, found no systematic improvement in birth outcomes. Dubay et al. (1999), used Apgar score as an indicator of health outcome, and found no significant improvement in health outcome.

Apgar scores are a broad measure of morbidity of the newborn and may not provide all the information on morbidity¹³. Hence, the results of Sloan et al. (1995) and Dubay et al. (1999) may not adequately reflect the change in health outcomes. We include medical complications in the measure of morbidity of newborns. Additionally, none of the papers have studied the impact of malpractice pressure on the morbidity of the mothers. In this paper we bridge the gap by using medical complications of mothers as well as newborns to represent health outcomes.

¹³ Apgar score may not be a valid index of birth asphyxia (Pereira et al. 1996).

Socioeconomic status of the mother may have an impact on physician behavior. According to Dubay et al. (1999), women from the low-income group or those with Medicaid have a higher probability of filing malpractice lawsuits. They find that physician's response varies with the socioeconomic status of the mother. They use mother's education and marital status as proxy for income and insurance coverage. Because the data that we use has information on health insurance status of the patient, we study how physician behavior varies in response to different health insurance status of patients.

In the literature on defensive medicine, three broad measures of medical malpractice risk have been used: malpractice insurance premiums, malpractice claims frequency and claims severity, and tort law reforms. Baldwin et al. (1995), Tussing and Wojtowycz (1992), and Sloan et al. (1995, 1997) used claims frequency and claims severity. Rock (1988) and Dubay et al. (1999, 2001) used malpractice premiums as a measure of malpractice liability pressure. Localio et al. (1993) used both malpractice premiums and physician based measures. Kessler and McClellan (1996) used tort law reforms across different states as a measure of the change in malpractice liability pressure.

All three measures have some limitations. Since malpractice premiums are not experience rated they provide the same information as claims frequency and claims severity¹⁴. The majority of physicians buy excess limits of coverage for which rates are non-linear but fairly uniform across states (Danzon et al., 1990). Variations in insurer's investment income may affect medical malpractice premiums. Therefore, malpractice premiums may not be a good measure of liability pressure. Tort law reforms do not

¹⁴ Malpractice premiums are a product of claims frequency per physician and average payment per paid claim. They also include administrative costs and profit of the insurance firms.

represent the differences in liability pressure faced by physicians in different fields of specialization. Liability pressure varies a lot by a physician's field of specialization¹⁵. Claims frequency has a drawback that it is difficult to get an accurate measure of malpractice claims frequency on a state by state basis (OTA, 1993). The National Practitioner Data Bank (NPDB) public use files provide detailed information on all paid claims. Therefore, it provides a good measure of claims severity (mean payment per paid claim) in each state. We include only paid claims to measure claims frequency. Since paid claims are a small proportion of all claims filed¹⁶, our results will provide a lower bound of the effect of malpractice risk on defensive medicine.

4. Data:

Data for mothers and newborns comes from the Nationwide Inpatient Sample (NIS) provided by the Healthcare Cost and Utilization Project (HCUP) for the years 1995 and 1997. The NIS is a stratified sample of hospitals drawn from the subset of hospitals in states that make their data available to the HCUP project and that can be matched to the AHA survey data. NIS is the only national hospital database with charge information on all patients, regardless of payer, including persons covered by Medicare, Medicaid, private insurance, and the uninsured.

For malpractice pressure we use the National Practitioner Data Bank (NPDB) Public Use Data File, [2002], provided by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professions, Division of Practitioner Data Banks. The NPDB public use data files have information on

¹⁵ Section III of this paper shows that malpractice claims frequency and claims severity per paid claim are higher for ob/gyn than the rest of physician specialties taken together.

¹⁶ See the OTA, 1993 report on tort reforms.

malpractice payments involving all types of licensed health care practitioners. Malpractice payers are required to report this data to the National Practitioner Data Bank under the provisions of Title IV of P.L. 99-660, the Health Care Quality Improvement Act of 1986, as amended. Therefore, NPDB is a unique data set that provides information on all medical malpractice claims that result in a payment.

The mother and child data has been divided into two groups based on mother's medical condition at the time of delivery as defined by Henry *et al* (1995): necessary C-section group, and unnecessary C-section group. The necessary C-section group consists of all mothers having the medical conditions outlined in Table A.3, and the unnecessary C-section group consists of all mothers who do not have those conditions. For the child data, we consider the diagnoses given in Table A.4 in appendix as medical conditions for which C-section is necessary and divide the data into necessary C-section group, and the unnecessary C-section group. This classification helps us in estimating defensive medicine separately for patients with severe medical complications. Physicians are said to have a higher defensive response to patients with severe medical complications (Dubay *et al.*, 1999)

We further divide these four categories into two groups: those having private insurance and those who are insured by Medicaid. This means, that in all we have eight groups of patients.

4.1 Dependent Variables:

To study the effect of malpractice pressure on the change in physician behavior, we estimate the change in probability of C-section delivery associated with a change in malpractice pressure. To estimate the effect of malpractice pressure on health outcomes,

we look at the mortality and morbidity of mothers and neonates. Morbidity of the mother is described by the medical complications outlined in Table A.1 in the appendix. We create a binary variable, representing mother's morbidity, which takes a value 1 if any of the complications from Table A.1 are present in the patient's diagnosis; otherwise it takes a value 0. To look at mortality, we combine the mortality of mother and intrauterine fetal death into one single binary variable¹⁷.

We use five binary variables to represent neonatal health outcomes: neonatal mortality, cerebral hemorrhage, birth trauma, respiratory distress syndrome (RDS), and other complications due to asphyxia. Table A.2 in appendix describes conditions representing morbidity of the child. Birth asphyxia can lead to a number of perinatal injuries (Eden and Boehm, 1990). Birth asphyxia, intracranial hemorrhage and birth trauma can lead to brain damage and neurological damage (Eden and Boehm, 1990). Brain damage and neurological damage are the two most common injuries alleged in malpractice claims filed against obstetricians (Dubay et al, 1999).

4.2 Explanatory Variables:

We use claims frequency and claims severity to measure malpractice liability risk. Claims frequency is the number of paid claims (claims in which obstetrics was the reason for the claim) per 100 ob/gyn in a state¹⁸. Claims severity is the mean amount paid per paid claim (where the claim is for obstetric reasons) within a state. We use both claim severity and claim frequency at the state level as indicators of medical malpractice risk.

Since mother's medical condition is a major influence on physician behavior and health outcome, we need to control for medical complications in the necessary C-section

¹⁷ This is done because there are very few cases of mother's mortality and intrauterine fetal death.

¹⁸ Since NPDB has information on only claims that were paid, we can use only paid claims in calculating claims frequency.

group for both mother and child data. These medical complications are outlined in Tables A.3 and A.4 in appendix. We also control for previous C-section, and insufficient prenatal care in estimating the probability of cesarean delivery and mother's health outcome in both necessary C-section and unnecessary C-section groups.

The demographic characteristics of the patient are represented by: age of the patient, race of the patient, median income of the patient's zip code. We include a number of variables related to hospital: hospital bed size (small, medium, large), hospital ownership (government owned, not for profit, for profit), location (urban or rural), and hospital type (teaching or non teaching). For state characteristics, we have included percent population in each state enrolled with HMOs.

We also include the price differential between vaginal and cesarean delivery for Medicaid and private insurance. A higher price differential between vaginal and C-section delivery provides a financial incentive for the physician to perform C-section delivery. We converted the charge data for each patient to expenditure using the cost to charge ratio from Medicare files for each provider. The price of delivery is calculated from the average cost across each hospital and for states that do not provide hospital identifiers (Kansas and South Carolina), we calculate the mean prices by state¹⁹.

¹⁹ The price of vaginal delivery for each hospital is calculated by taking the mean expenditure for patients in that hospital with DRG 373. The price of cesarean delivery for each hospital is calculated by taking the mean expenditure for patients in that hospital with DRG 371. The prices are adjusted for inflation using the consumer price index for medical care prices provided in the Table No. 183 of Statistical Abstracts of the United States, 1999 .

5. Empirical model:

We want to estimate the effect of medical malpractice liability risk on physician behavior and health outcomes of mothers and newborns. Since all the outcomes of interest (C-section delivery and health outcomes) are binary variables, we use the logistic model for estimation. It is impossible to include all the variables that affect physician behavior and health outcomes and some variables will be inevitably omitted. If some of these omitted variables are correlated with malpractice claims frequency and severity in the state then we face the unobserved heterogeneity problem. We use fixed effects for state and time to control for unobserved heterogeneity.

The observation unit in the data is the individual $i = 1 \dots, N$ who has undergone obstetric treatment in hospital $j = 1 \dots, J$ in state $s = 1 \dots, S$ during the year $t = 1 \dots, T$. At the individual level we estimate equation (7) using logistic regression.

$$\ln\left(\frac{P_{ist}}{1 - P_{ist}}\right) = \alpha + \mu_s + \theta_t + \beta X_{ist} + \delta M_{ist} + \eta H_{jst} + \gamma R_{st} + \rho C_{st} + \varepsilon_{ist} \quad (3)$$

where P_{ist} is the probability of the event occurring, μ_s are the state fixed effects, θ_t are time fixed effects, X_{ist} is a vector of demographic characteristics of each patient, M_{ist} is a vector of variables representing the mother's medical condition, H_{jst} is a vector representing hospital characteristics, and price differential between vaginal and C-section delivery for Medicaid and private insurance, R_{st} represents the malpractice risk by state, C_{st} represents HMO concentration in each state, and ε_{ist} are the error terms.

Equation (3) is estimated separately for all seven health outcomes and C-section delivery in each group of patients. Since NIS is a stratified sample of hospitals, we take into account sample design and discharge weights in the estimation process.

5.1 Estimation Issues:

Assuming that malpractice claims frequency and severity affect physician behavior with a lag, we have combined data for years 1994 and 1996 from National Practitioner Data Bank files with years 1995 and 1997 data respectively from Nationwide Inpatient Sample.

We may have an endogeneity problem in our model. An increase in claims frequency and severity in obstetrics may increase C-section rates and also improve health outcomes. This increase in C-section rates and improvement in health outcomes will lower the claims frequency and severity in obstetrics. This may lead to downward bias in OLS estimates of the effect of claims frequency and severity in obstetrics on C-section rates and health outcomes. A solution is to estimate the models using instruments for claims frequency and claims severity. We use the malpractice claims frequency and severity for surgery as the instruments, since they are not influenced by outcomes in obstetrics²⁰. National Practitioner Data Bank public use files provide information on malpractice cases associated with surgery separate from obstetrics. Malpractice frequency and severity of surgery will not affect health outcomes of obstetrics patients. But due to unobserved factors (such as physician quality in obstetrics and surgery), claims frequency and severity in surgery may have some correlation with health outcomes in obstetrics. States with better quality of physicians in both obstetrics and surgery will have better health outcomes and vice versa. Thus, claims frequency and severity in surgery may not be a

²⁰ Claims frequency in surgery is defined as number of paid claims for surgery per 100 surgeons in the state. Claims severity for surgery in each state is measured by median payment per paid claim for surgery in the state.

perfect instrument for claims frequency and severity in obstetrics²¹. Also, for an individual physician claims frequency and severity in obstetrics measured at the state level may not be endogenous. Therefore, we present results for both logistic regression using instrument and logistic regression without using instrument.

6. Results:

Table 4 gives the results for the first stage of estimation for the logistic regression using instruments. In the first stage we use the NPDB public use data files. The NPDB files have information on malpractice payments for all the states. We use the claims frequency and severity data on 49 states for two years (1994 and 1996). We use claims frequency in surgery as instrument for claims frequency in obstetrics and claims severity in surgery as an instrument for claims severity in obstetrics.

Table 2: First stage results for estimation of logistic regression using instruments

<u>Dependent Variable</u>		<u>Coefficient</u>	<u>Standard Error</u>
Malpractice frequency in Obstetrics	Intercept	1.80500	0.30489
	Malpractice frequency in surgery	0.257*	0.07
	F value	13.60*	
Mean payment for malpractice in obstetrics	Intercept	247844	72073
	Mean payment for malpractice in surgery	0.957*	0.367
	F value	6.78*	

* Significant at 1% level of significance.

²¹ We also tried using tort reforms as an instrument but tort reforms did not have a significant effect on claims frequency and severity.

For the first stage we run two separate regressions for the two instruments. One regression takes claims frequency in obstetrics as the dependent variable and claims frequency in surgery as explanatory variable. The other regression takes claims severity in surgery as dependent variable and claims severity in surgery as explanatory variable. Table 2 provides the results from first stage regression. We find that the regression for claims frequency and the regression for claims severity are both overall significant. The coefficients of the explanatory variables are also significant.

In the second stage, we estimate the effect of malpractice claims frequency and claims severity on the probability of C-section delivery and health outcomes in obstetrics. We find that malpractice severity does not affect the probability of cesarean delivery and there is no clear trend for its effect on health outcomes²². Therefore, we provide the results for only malpractice claims frequency.

Table 3 and 4 provide estimates of the marginal effect of malpractice claims frequency on probability of C-section delivery and health outcomes of patients belonging to necessary C-section group and non-necessary C-section group respectively. In these tables we provide the results for both, the logistic regression using instrument and without instrument. We will focus on the results from the regressions using instrument but we will also discuss the results from estimation without the instrument wherever they are significant.

6.1 Effect of malpractice fear on probability of C-Section:

The results in Table 3 and Table 4 show that an increase in malpractice risk leads to an increase in both necessary and unnecessary C-sections and the impact is higher for Medicaid patients. Necessary C-sections increase for both Medicaid and privately insured

²² Results for malpractice claims severity are given in the appendix.

patients, though the level of significance for patients with private insurance is low (17% with OLS). In particular, an increase in number of malpractice cases by 1 case per 100 ob/gyn (a 35% increase) is associated with a 6.7 percentage point increase (a 16% increase) in probability of necessary C-section delivery for Medicaid patients and a 1 percentage point increase (a 2.3% increase) in probability of necessary C-section delivery for private insurance patients, all else constant.

A higher malpractice risk is associated with an increase in unnecessary C-sections for both Medicaid and privately insured patients. For a similar increase in malpractice risk (35%), probability of unnecessary C-section delivery increases by 2.6 percentage points (a 42% increase) for Medicaid patients and by 2.4 percentage points (a 32% increase) for patients with private insurance.

Because C-section deliveries use more resources than vaginal deliveries, an increase in malpractice fear is associated with an increase in use of resources in obstetrics. To say whether this increased use of medical resources is defensive behavior, we need information on health outcomes of mothers and newborns. Physicians practice defensive medicine if marginal social benefit from improvement in health outcomes is greater than marginal social cost from increased C-sections.

Table 3: Effect of Malpractice risk (claims frequency) on patients with medical conditions necessary for considering C-section

Dependent Variable (Probability of)	Logistic (with instrument) Coefficient (s.e)	Logistic (w/o instrument) Coefficient (s.e)
C-section delivery for mother with Medicaid	0.277** (0.17)	-0.004 (0.03)
C-section delivery for mother with private Insurance	0.107 (0.15)	0.040 (0.03)
Morbidity of mother with Medicaid	0.119 (0.22)	0.02 (0.03)
Morbidity of mother with Private insurance	-0.165 (0.13)	-0.037** (0.02)
Mortality of mother or fetal intrauterine death for mother with Medicaid	-0.385 (0.41)	-0.08 (0.07)
Mortality of mother or fetal intrauterine death for mother with private insurance	-0.363 (0.33)	-0.004 (0.06)
Birth trauma in a newborn with Medicaid	0.423 (0.52)	-0.072 (0.09)
Birth trauma in a newborn with Private Insurance	-0.312 (0.45)	0.010 (0.07)
Cerebral hemorrhage in a newborn with Medicaid	-0.107 (0.61)	0.094 (0.12)
Cerebral hemorrhage in a newborn with Private Insurance	-0.229 (0.5)	-0.002 (0.09)
Respiratory distress syndrome in a newborn with Medicaid	-0.164 (0.26)	0.094* (0.05)
Respiratory distress syndrome in a newborn with private Insurance	-0.322 (0.24)	0.034 (0.05)
Other complications due to asphyxia in a newborn with Medicaid	-0.068 (0.23)	0.012 (0.04)
Other complications due to asphyxia in a newborn with private Insurance	0.187 (0.2)	0.029 (0.04)
Mortality of a newborn with Medicaid	0.311 (0.4)	0.085 (0.06)
Mortality of a newborn with private Insurance	0.24 (0.36)	0.055 (0.07)

* $p < 5\%$

** $p < 10\%$

The above regressions have been controlled for state fixed effects, time fixed effects, patient's age and race, median income of patient's zip code, medical conditions of the patient, hospital characteristics, HMO concentration in the state, difference in Medicaid fee for C-section and vaginal delivery, and difference in private insurance fee for C-section and vaginal delivery.

Table 4: Effect of Malpractice risk (claims frequency) on patients with medical conditions unnecessary for C-section

Dependent Variable (Probability of)	Logistic (with instrument) Coefficient (s.e)	Logistic (w/o instrument) Coefficient (s.e)
C-section delivery for mother with medicaid	0.443* (0.2)	0.034 (0.04)
C-section delivery for mother with private Insurance	0.346* (0.14)	0.052** (0.03)
Morbidity of mother with Medicaid	-0.001 (0.19)	0.032 (0.03)
Morbidity of mother with private Insurance	-0.081 (0.11)	0.006 (0.02)
Mortality of mother or fetal intrauterine death for mother with Medicaid	0.129 (0.34)	-0.107** (0.07)
Mortality of mother or fetal intrauterine death for mother with private Insurance	-0.394 (0.31)	-0.087*** (0.06)
Birth trauma in a newborn with Medicaid	0.242 (0.54)	-0.086 (0.08)
Birth trauma in a newborn with private Insurance	-0.864**** (0.67)	-0.049 (0.07)
Cerebral hemorrhage in a newborn with Medicaid	-0.901**** (0.67)	0.053 (0.1)
Cerebral hemorrhage in a newborn with private Insurance	-0.53552 (0.5)	-0.012 (0.11)
Respiratory distress syndrome in a newborn with Medicaid	-0.489 (0.46)	-0.087 (0.08)
Respiratory distress syndrome in a newborn with private Insurance	-0.807* (0.41)	-0.159* (0.07)
Other complications due to asphyxia in a newborn with Medicaid	-0.281 (0.24)	-0.019 (0.04)
Other complications due to asphyxia in a newborn with Medicaid	-0.146 (0.20)	0.008 (0.04)
Mortality of a newborn with Medicaid	-0.914 (0.73)	-0.199** (0.12)
Mortality of a newborn with Private Insurance	0.727 (0.75)	0.001 (0.14)

* $p < 5\%$

** $p < 10\%$

*** $p < 15\%$

**** $p < 20\%$.

The above regressions have been controlled for state fixed effects, time fixed effects, patient's age and race, median income of patient's zip code, medical conditions of the patient, hospital characteristics, HMO concentration in the state, difference in Medicaid fee for C-section and vaginal delivery, and difference in private insurance fee for C-section and vaginal delivery.

6.2 Effect of medical malpractice fear on health outcomes of mothers and newborns

Overall, medical malpractice leads to improvements in health outcomes of the mothers and neonates, except for Medicaid patients in the necessary C-section group. There is an improvement in morbidity of mothers with private insurance in the necessary C-section group. In particular, an increase in number of malpractice cases by 1 case per 100 ob/gyn (a 36% increase) is associated with a 0.4 percentage points reduction (a 3.2% decrease) in the probability of a mother to suffer from medical complications after delivery.

Though physicians perform more unnecessary C-sections in response to malpractice risk, it improves health outcomes of both mothers and neonates. For Medicaid patients, an increase in malpractice risk is associated with a reduction in the probability of intrauterine fetal death or mortality of mother and a reduction in mortality of neonates. Specifically, an increase in number of malpractice cases by 1 case per 100 ob/gyn (a 38% increase) is associated with a 0.02 percentage points decrease (a 19.9% decrease) in the probability of mortality of a neonate and a 0.048 percentage points decrease (a 10.6% decrease) in the probability of mortality of mother or intrauterine fetal death. For privately insured patients, an increase in malpractice risk is associated with a reduction in probability of suffering from respiratory distress syndrome. An increase in number of malpractice cases by 1 case per 100 ob/gyn (a 35% increase) is associated with a 0.34 percentage points decrease (an 80% decrease) in the probability of a neonate to suffer from respiratory distress syndrome.

Higher malpractice risk is associated with a decline in health outcomes of neonates with Medicaid in the necessary C-section group. An increase in number of malpractice

cases by 1 case per 100 ob/gyn (a 38% increase) is associated with a 1.1 percentage points increase (an 8.1% increase) in the probability of a neonate to suffer from respiratory distress syndrome. Although physicians perform more necessary C-sections for Medicaid patients in response to an increase in malpractice pressure, it leads to a decline in health outcomes.

6.3 Cost benefit Analysis:

Increased medical malpractice risk is associated with an improvement in health outcomes for most patients. This improvement could be due to increased medical resource use during delivery (greater number of C-sections) and/or increased prenatal care. Dubay et al. (2001) estimate that an increase in medical malpractice pressure leads to reduction in prenatal physician office visits. This implies that increased medical malpractice risk leads to a decline in prenatal resource use. Hence, the costs of increased C-sections will be the upper limit of the costs of increased resource use. Therefore, we can approximate the marginal social cost of medical malpractice as the cost due to increased C-sections. Improved health outcomes of patients are the marginal social benefits.

In our data, the average hospital cost for a C-section delivery is \$4000 and for vaginal delivery, it is \$2000. If we project the regression results on total obstetric deliveries for the year 1997 in US, we can estimate whether physician behavior is defensive or not. Table 5 provides the cost benefit analysis of increased medical malpractice risk.

Table 5: Cost Benefit Analysis of an increase in frequency of paid claims

Patient Group	Marginal Social Cost	Marginal Social Benefit
Necessary C-Sections** (Medicaid)	\$70 million	Negative: 2,348 neonates suffer from RDS
All Patients*	\$106 million	Positive: \$241 million cost saving and 6,293 neonates do not suffer from RDS
All Patients**	\$176 million	Positive: \$151 million cost saving, 3,945 neonates do not suffer from RDS, 3,400 mothers saved from medical complications after delivery, and 634 lives saved [§] .

* Significant at 5% level

** Significant at 10% level

[§] Using the willingness to pay approach (Viscusi, 1993), the benefit from saving 634 lives is estimated to be in the range \$1.9 billion to \$4.4 billion.

At the 5% level of significance, physicians perform greater number of unnecessary C-sections for both Medicaid and privately insured patients in response to increased malpractice risk. In particular, the marginal social cost of a 35% increase in frequency of paid claims (an increase of 1 case per 100 ob/gyn) is \$106 million. This increase in frequency of paid claims saves 6,293 privately insured neonates from respiratory distress syndrome (RDS). In our data, the average difference in hospital costs for a neonate with RDS and a neonate without any medical complications is \$38,259. This implies that \$241 million are saved by preventing neonatal RDS. Thus, the net marginal social benefit of medical malpractice is \$135 million savings in cost, and 6,293 neonates saved from RDS.

At a 10% level of significance, we observe huge benefits in health outcomes for most patients. Overall, the marginal social cost is \$176 million and the marginal social benefit is \$151 million cost saving, 3,945 neonates saved from RDS, 3,400 mothers saved from medical complications after delivery, and 634 lives saved. Thus, at the margin, at a net cost of \$25 million medical malpractice saves 634 lives and additionally saves 3945

neonates from RDS and 3,400 mothers from medical complications after delivery. Viscusi (1993) estimates the value of one life between \$3 million to \$7 million in 1990 dollars²³. Therefore, the benefit alone from saving 634 lives is estimated to be in the range \$1.9 billion to \$4.4 billion.

If we do cost benefit analysis separately for different patients groups, we find that medical malpractice has a large net marginal benefit for most patients. We find evidence of defensive medicine only for patients with Medicaid in the necessary C-section group. For this group, the marginal social cost of a 35% increase in frequency of paid claims (an increase of 1 case per 100 ob/gyn) is \$70 million. At the same time, there is a negative marginal benefit due to an increase in number of neonatal RDS cases by 2,348.

7. Policy implications:

We used both claims frequency and claims severity as measures of medical malpractice risk. Claims frequency significantly affects physician behavior and health outcomes in obstetrics while claims severity does not affect C-sections and shows no trend for health outcomes. Increase in claims frequency has a net marginal benefit for most of the patients.

Tort reforms are often undertaken to control rising malpractice insurance premiums (OTA, 1993). Since different tort laws affect claims frequency and severity differently, tort reforms should be undertaken with great caution. Tort reforms that decrease claims frequency will reduce the beneficial effects of medical malpractice. In the literature on tort reforms, it has been shown that caps on damages have a significant effect on claims

²³ Viscusi uses the willingness to pay approach, which measures the amount of money individuals are willing to pay for small reductions in the probability of dying.

severity but no effect on claims frequency (OTA, 1993). A shortening of the statutes of limitations reduces claims frequency (Danzon, 1986).

Most victims of medical malpractice do not sue (OTA, 1993). Tort reforms that increase access to medical malpractice liability system for injured patients should be made a priority. This will increase claims frequency and move the liability system towards the “optimal”, where marginal benefit from medical malpractice is equal to marginal cost.

8. Conclusions:

We estimate the effect of medical malpractice liability risk on physician behavior and health outcomes in obstetrics. Theoretical and empirical studies suggest that risk of malpractice lawsuits encourages physicians to practice “defensive medicine”, utilization of medical resources beyond its optimal level of use. We divided the patients into two broad groups: necessary C-section group and unnecessary C-section group. Defensive medicine is said to be more widespread for patients with severe medical complications. Therefore, we should observe higher defensive medicine for the necessary C-section group. We further divided data on the basis of medical insurance coverage - Medicaid and private insurance. This is done to determine whether physician response varies by the socio-economic status of the patient or the different reimbursement policies of Medicaid and private insurance.

Physician behavior and health outcomes in obstetrics are modeled as fixed effects logit with claim frequency and claim severity as measures of malpractice fear in each of the States. Mother and neonate mortality and morbidity are taken as measures of health

outcomes. We do not find evidence of defensive medicine for most patients in obstetrics. In fact, marginal social benefit from medical malpractice is much higher than marginal cost. In particular, an increase in medical malpractice liability risk is associated with an increase in probability of C-section delivery. Also, the increase in probability of C-section is higher for Medicaid patients. Higher medical malpractice risk is also associated with changes in health outcomes of patients. For patients with Medicaid in the necessary C-section group, increased malpractice risk leads to a decline in health outcomes. Thus, we find evidence of defensive medicine for Medicaid patients with severe medical complications. For all other patients (86% of all patients), an increase in malpractice risk leads to an improvement in health outcomes and the marginal social benefit of medical malpractice is much higher than marginal social cost. Therefore, for most obstetric patients, there is no evidence of defensive medicine.

The policy implications of this research are that Tort reforms should be undertaken with great caution and the medical malpractice system should be made more accessible for injured patients. Specifically, we find that only malpractice claims frequency affects physician behavior and health outcomes. Therefore, only tort laws that do not decrease claims frequency may be reformed. Since the marginal benefit from medical malpractice is much higher than marginal cost, making the medical malpractice system more accessible for injured patients will move the system towards the optimal level of medicine, where marginal benefit of medicine is equal to marginal cost.

This is the first paper to study defensive medicine in obstetrics by focusing on certain medical complications as health outcomes in newborns and mothers. In this paper we have not ranked the different medical complications in estimating health outcome

measures. Future research can develop some method of assigning appropriate weights to different medical complications in developing health outcome measures. Also, we have not directly estimated the effect of malpractice liability pressure on negative defensive medicine (reduction in services for Medicaid patients). Future research could measure the extent of negative defensive medicine directly. Future research can also estimate the impact of medical malpractice on prenatal tests and procedures.

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APPENDIX

Table A.1: Complications associated with morbidity of mother

Morbidity	ICD-9-Code*
Third-degree perineal laceration	664.2
Fourth-degree perineal laceration	664.3
Vulval and perineal hematoma	664.5
Other specified trauma to perineum and vulva	664.8
Rupture of uterus before onset of labor	665.0
Rupture of uterus during and after labor	665.1
Laceration of cervix	665.3
High vaginal laceration	665.4
Other injury to pelvic organs	665.5
Damage to pelvic joints and ligaments	665.6
Pelvic hematoma	665.7
Other specific obstetrical trauma	665.8
Unspecified obstetrical trauma	665.9
Postpartum hemorrhage	
Other immediate postpartum hemorrhage	666.1
Delayed and secondary postpartum hemorrhage	666.2
Postpartum coagulation defects	666.3
Major puerperal infection	670.0
Deep phlebothrombosis	671.4
Disruption of cesarean wound	674.1
Disruption of perineal wound	674.2
Other complications of obstetrical surgical wounds	674.3

* International Classification of Diseases (ICD)-9 – codes are used to code and classify morbidity data from the inpatient and outpatient records, physician offices and most surveys.

Table A.2: Conditions representing morbidity of the child

Condition	ICD-9- Codes
Cerebral Hemorrhage	
Subdural and cerebral hemorrhage	767.0
Intraventricular hemorrhage	772.1
Birth Trauma	767, except 767.0
Respiratory Distress Syndrome	769
Other complications due to asphyxia	
Meconium aspiration syndrome	770.1
Other respiratory problems after birth	770.8
Hypocalcemia and hypomagnesemia of newborn	775.4
Neonatal hypoglycemia	775.6
Late metabolic acidosis of newborn	775.7
Disseminated intravascular coagulation in newborn	776.2
Convulsions in newborn	779.0
Other and unspecified cerebral irritability in newborn	779.1
Cerebral depression, coma, and other, abnormal cerebral signs	779.2

Table A.3: Mother’s medical conditions for which C-section delivery is necessary

Condition	ICD-9 code
Breech	652.2
Disproportion	653
Obstructed labor	660
Abnormality of forces of labor	661.0, 661.1, 661.2, 661.4, 661.9
Long labor	662.0, 662.1, 662.2
Malpresentation	652.0, 652.3-652.9
Failed Induction of labor	659.0, 659.1
Fetal distress	656.3
Cord prolapse	663.0
Antepartum hemorrhage/ placental abruption/placenta previa	641.0-641.3, 641.8, 641.9
Intrauterine growth retardation	656.5, 642.0-642.7, 642.9
Macrosomia	656.6
Genital herpes simplex virus	647.6, 054.1
Diabetes mellitus/abnormal glucose tolerance	648.0, 648.8
Hypertensive disorder	642
Oligohydramnios	658.0
Chorioamnionitis	658.4
Fetal central nervous system malformation affecting management	655.0
Other congenital/acquired anomaly	654.6
Rupture of uterus	665.0, 665.1
Congenital/acquired abnormality of vagina	654.7
Uterine scar	654.9
Rhesus (anti-D) isoimmunization	656.1
Cerebral hemorrhage/occlusions	430, 431, 432, 433, 434
HIV ²⁴	042

²⁴ We have added HIV to this list because according to ACOG (ACOG committee opinion, 2000), scheduled cesarean delivery reduces the chances of vertical transmission of HIV.

Table A.4: Mother's medical conditions considered necessary for C-section in the child data

Condition	ICD-9 code
Maternal hypertensive disorders	760.0
Maternal renal and urinary tract diseases	760.1
Other chronic maternal circulatory and respiratory diseases	760.3
Incompetent cervix	761.0
Oligohydramnios/polyhydramnios	761.2, 761.3
multiple pregnancy	761.5
Malpresentation before labor	761.7
Placenta previa	762.0
Abruptio placenta	762.1
Other and unspecified morphological and functional abnormalities of placenta	762.2
Placental transfusion syndromes	762.3
Prolapsed cord	762.4
Chorioamnionitis	762.7
Abnormal uterine contractions	763.7
Other specified complications of labor and delivery affecting fetus or newborn	763.8
Slow fetal growth and fetal malnutrition	764
Disorders relating to short gestation and unspecified low birth weight	765
Disorders relating to long gestation and high birthweight	766

Table A5: Effect of Malpractice claims severity (mean payment) on patients with medical conditions necessary for considering C-section

Dependent Variable (Probability of)	Logistic (with instrument) Coefficient (s.e)	Logistic (w/o instrument) Coefficient (s.e)
C-section delivery for mother with Medicaid	0.03 (0.06)	-0.011 (0.02)
C-section delivery for mother with private Insurance	0.063 (0.07)	0.007 (0.02)
Morbidity of mother with Medicaid	0.036 (0.09)	0.009 (0.01)
Morbidity of mother with Private insurance	-0.033 (0.06)	-0.009 (0.01)
Mortality of mother or fetal intrauterine death for mother with Medicaid	-0.244 (0.16)	-0.019 (0.05)
Mortality of mother or fetal intrauterine death for mother with private insurance	0.165 (0.11)	0.071* (0.02)
Birth trauma in a newborn with Medicaid	0.217 (0.19)	-0.06 (0.04)
Birth trauma in a newborn with Private Insurance	-0.089 (0.17)	-0.002 (0.05)
Cerebral hemorrhage in a newborn with Medicaid	-0.162 (0.28)	0.052 (0.07)
Cerebral hemorrhage in a newborn with Private Insurance	0.076 (0.21)	0.039 (0.05)
Respiratory distress syndrome in a newborn with Medicaid	-0.124 (0.11)	0.066* (0.03)
Respiratory distress syndrome in a newborn with private Insurance	-0.005 (0.14)	0.069* (0.03)
Other complications due to asphyxia in a newborn with Medicaid	-0.032 (0.08)	0.019 (0.02)
Other complications due to asphyxia in a newborn with private Insurance	0.053 (0.1)	0.009 (0.03)
Mortality of a newborn with Medicaid	0.003 (0.12)	0.022 (0.03)
Mortality of a newborn with private Insurance	0.21 (0.12)	0.026 (0.03)

* Significant at 1%

** $p < 10\%$

The above regressions have been controlled for state fixed effects, time fixed effects, patient's age and race, median income of patient's zip code, medical conditions of the patient, hospital characteristics, HMO concentration in the state, difference in Medicaid fee for C-section and vaginal delivery, and difference in private insurance fee for C-section and vaginal delivery.

Table A6: Effect of Malpractice claims severity (mean payment) on patients with medical conditions unnecessary for C-section

Dependent Variable (Probability of)	Logistic (with instrument) Coefficient (s.e)	Logistic (w/o instrument) Coefficient (s.e)
C-section delivery for mother with medicaid	0.033 (0.08)	-0.034 (0.02)
C-section delivery for mother with private Insurance	-0.013 (0.06)	-0.005 (0.02)
Morbidity of mother with Medicaid	0.015 (0.07)	0.023 (0.02)
Morbidity of mother with private Insurance	-0.007 (0.04)	-0.006 (0.01)
Mortality of mother or fetal intrauterine death for mother with Medicaid	0.009 (0.16)	-0.037 (0.04)
Mortality of mother or fetal intrauterine death for mother with private Insurance	-0.088 (0.12)	0.029 (0.03)
Birth trauma in a newborn with Medicaid	0.105 (0.17)	-0.021 (0.04)
Birth trauma in a newborn with private Insurance	0.057 (0.17)	0.031 (0.07)
Cerebral hemorrhage in a newborn with Medicaid	-0.064 (0.18)	0.031 (0.07)
Cerebral hemorrhage in a newborn with private Insurance	-0.038 (0.28)	0.009 (0.06)
Respiratory distress syndrome in a newborn with Medicaid	-0.054 (0.22)	-0.037 (0.05)
Respiratory distress syndrome in a newborn with private Insurance	-0.192 (0.22)	-0.055 (0.05)
Other complications due to asphyxia in a newborn with Medicaid	-0.104 (0.09)	0.042** (0.02)
Other complications due to asphyxia in a newborn with Medicaid	-0.115 (0.09)	0.01 (0.02)
Mortality of a newborn with Medicaid	-0.268 (0.3)	0.029 (0.09)
Mortality of a newborn with Private Insurance	0.102 (0.44)	-0.15** (0.07)

* Significant at 1%

** Significant at 5%

The above regressions have been controlled for state fixed effects, time fixed effects, patient's age and race, median income of patient's zip code, medical conditions of the patient, hospital characteristics, HMO concentration in the state, difference in Medicaid fee for C-section and vaginal delivery, and difference in private insurance fee for C-section and vaginal delivery.

Table A7: Means for Mother data

Variables	<u>Medicaid</u>				<u>Private Insurance</u>			
	<u>Necessary C-section</u>		<u>Non-necessary C-section</u>		<u>Necessary C-section</u>		<u>Non-necessary C-section</u>	
	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E
Year 97	44.01	1.44	44.04	1.37	50.10	1.35	49.76	1.26
Demographic Characteristics								
20<=AGE<30	55.42	0.29	59.28	0.22	43.71	0.55	46.30	0.58
30<=AGE<40	19.20	0.41	15.95	0.33	47.90	0.62	45.93	0.69
40<=AGE<50	1.56	0.09	0.90	0.04	3.25	0.09	2.19	0.06
Black	22.30	1.61	19.86	1.36	9.15	0.83	7.80	0.63
Hispanic	22.79	2.15	23.85	2.20	6.98	0.81	7.37	0.74
Native	0.39	0.09	0.33	0.06	0.22	0.02	0.21	0.02
Asian	1.92	0.36	2.25	0.39	2.40	0.26	2.52	0.25
Other	2.46	0.48	2.54	0.48	2.15	0.27	2.16	0.29
Norace	15.49	1.70	17.80	1.80	18.55	2.21	19.90	2.13
Median income of Patient's zip code								
"\$25,001 - \$30,000"	22.45	0.92	22.59	0.89	17.39	0.84	18.01	0.83
"\$30,001 - \$35,000"	14.36	0.81	13.87	0.82	16.90	0.76	16.74	0.73
"\$35,001 or more"	16.17	1.22	15.41	1.17	45.78	2.06	44.67	1.93
Medical Conditions of the mother								
Multiple Gestation	1.94	0.06	0.47	0.02	2.63	0.11	0.69	0.02
Previous C-section delivery	12.10	0.21	9.95	0.17	13.63	0.15	11.89	0.17
Insufficient prenatal care	3.02	0.25	3.22	0.25	0.52	0.05	0.57	0.05
Breech	8.65	0.13	-	-	9.98	0.16	-	-
Disproportion	7.93	0.51	-	-	9.66	0.28	-	-
Obstructed Labor	14.29	0.44	-	-	17.08	0.41	-	-
Abnormality of Labor	18.12	0.80	-	-	19.18	0.67	-	-
Long Labor	1.98	0.14	-	-	2.65	0.20	-	-
Malpresentation	4.88	0.22	-	-	4.65	0.13	-	-
Failed Induction	2.67	0.13	-	-	2.86	0.20	-	-
Fetal Distress	25.33	1.03	-	-	23.14	0.75	-	-
Cord Prolapse	0.81	0.03	-	-	0.88	0.03	-	-
Antepartum hemorrhage	5.00	0.12	-	-	4.45	0.08	-	-
Intrauterine growth retardation	4.59	0.16	-	-	3.22	0.09	-	-
Macrosomia	4.26	0.33	-	-	6.82	0.29	-	-
Genital herpes	3.26	0.21	-	-	2.20	0.09	-	-
Diabetes mellitus	9.12	0.27	-	-	9.59	0.17	-	-
Hypertensive disorder	17.65	0.43	-	-	16.74	0.26	-	-

Oligohydramnios	7.09	0.28	-	-	4.74	0.15	-	-
Chorioamnionitis	6.25	0.28	-	-	4.35	0.17	-	-
Fetal CNS malformation	0.22	0.02	-	-	0.16	0.01	-	-
Other congenital/acquired anomaly	5.19	0.21	-	-	5.15	0.17	-	-
Rupture of uterus	0.20	0.01	-	-	0.24	0.01	-	-
Congenital/acquired abnormality of vagina	0.16	0.02	-	-	0.20	0.02	-	-
Uterine scar	0.17	0.02	-	-	0.40	0.02	-	-
Rhesus (anti-D) isoimmunization	4.59	0.28	-	-	5.44	0.35	-	-
Cerebral hemorrhage/occlusions	0.02	0.00	-	-	0.007	0.001	-	-
HIV patient	0.21	0.03	-	-	0.03	0.00	-	-
Hospital Characteristics								
Small bed size hospital	15.09	1.87	16.62	1.68	10.53	1.12	11.58	1.12
Medium bed size hospital	31.58	2.38	32.43	2.17	31.80	2.18	31.74	1.91
Government owned hospital	20.91	2.30	19.20	2.00	7.70	0.94	7.85	0.98
Not for-profit hospital	68.72	2.62	67.54	2.55	83.49	1.47	82.54	1.46
Rural hospital	14.24	1.18	15.43	1.25	9.59	0.73	10.56	0.77
Nonteaching hospital	57.36	2.76	63.42	2.50	61.83	2.40	63.93	2.25
Malpractice risk								
Malpractice frequency	2.62	0.04	2.61	0.04	2.81	0.06	2.82	0.05
Malpractice severity (in \$100,000)	3.54	0.08	4.07	0.03	3.94	0.09	4.17	0.03
Instrument for Malpractice frequency	2.84	0.02	2.84	0.01	2.79	0.02	2.78	0.02
Instrument for Malpractice severity (in \$100,000)	4.05	0.03	3.59	0.08	4.16	0.03	3.97	0.09
Other variables								
HMO	23.89	0.55	23.73	0.52	23.30	0.43	22.94	0.41
Difference in Medicaid charges	1988	36	2019	40	1884	40	1894	39
Difference in private insurance charges	1881	45	1910	45	1789	34	1808	31
Health Outcomes								
C-section delivery	40.96	0.97	6.18	0.19	44.28	0.63	7.63	0.17
Mother's morbidity	12.66	0.42	10.71	0.35	12.66	0.26	11.96	0.22
mortality of mother or intrauterine death of fetus	0.84	0.04	0.45	0.02	0.50	0.02	0.35	0.01
Number of observations	181242		297538		308035		450148	

Table A.8: Means for child data

Variables	<u>Medicaid</u>				<u>Private Insurance</u>			
	<u>Necessary C-section</u>		<u>Non-necessary C-section</u>		<u>Necessary C-section</u>		<u>Non-necessary C-section</u>	
	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E
Year 97	44.54	1.56	43.72	1.38	51.07	1.45	49.74	1.26
Demographic Characteristics								
Black	23.47	1.72	19.88	1.38	8.87	0.84	7.42	0.63
Hispanic	19.49	1.78	22.92	2.32	6.83	0.85	7.27	0.73
Native	0.86	0.46	0.66	0.33	0.71	0.52	0.65	0.42
Asian	1.58	0.28	2.18	0.39	2.03	0.25	2.77	0.28
Other	2.87	0.55	2.89	0.55	2.34	0.36	2.34	0.32
Norace	17.42	1.98	16.96	1.65	21.79	2.90	19.56	2.02
Median income of Patient's zip code								
"\$25,001 - \$30,000"	22.50	0.91	22.52	0.89	17.40	0.87	17.57	0.81
"\$30,001 - \$35,000"	14.20	0.75	14.22	0.83	16.53	0.69	16.80	0.74
"\$35,001 or more"	15.66	1.15	15.85	1.18	45.69	2.10	45.87	1.92
Medical Conditions of the mother								
Maternal Hypertensive disorder	1.18	0.12	-	-	1.14	0.15	-	-
Maternal renal and urinary tract diseases	0.35	0.08	-	-	0.15	0.04	-	-
Other maternal circulatory and respiratory diseases	0.04	0.01	-	-	0.06	0.03	-	-
Incompetent cervix	0.05	0.01	-	-	0.05	0.01	-	-
Oligohydramnios/polyhydramnios	0.89	0.10	-	-	0.63	0.06	-	-
Multiple pregnancy	0.10	0.03	-	-	0.09	0.02	-	-
Malpresentation before labor	0.95	0.17	-	-	0.94	0.15	-	-
Placenta previa	0.23	0.03	-	-	0.24	0.02	-	-
Abruptio placenta	0.84	0.08	-	-	0.62	0.05	-	-
Other abnormalities of placenta	0.15	0.02	-	-	0.14	0.02	-	-
Placental transfusion syndromes	0.07	0.02	-	-	0.13	0.02	-	-
Prolapsed cord	0.32	0.03	-	-	0.29	0.03	-	-
Chorioamnionitis	1.19	0.24	-	-	0.61	0.08	-	-
Abnormal uterine contractions	0.16	0.04	-	-	0.11	0.03	-	-
Other complications affecting fetus or newborn	0.61	0.19	-	-	0.48	0.07	-	-
Slow fetal growth	11.40	0.37	-	-	7.80	0.23	-	-
Short gestation	55.42	1.34	-	-	49.66	1.16	-	-
Long gestation	31.57	1.26	-	-	41.54	1.24	-	-

Hospital Characteristics								
Small bed size hospital	13.73	1.91	16.20	1.66	11.38	1.46	12.85	1.17
Medium bed size hospital	30.97	2.52	31.90	2.15	30.70	2.48	31.42	1.90
Government owned hospital	20.83	2.38	19.19	2.00	7.71	1.07	7.53	0.93
Not for-profit hospital	71.09	2.51	67.78	2.57	84.16	1.66	82.91	1.43
Rural hospital	11.17	1.14	15.39	1.20	7.41	0.71	10.42	0.75
Nonteaching hospital	50.77	2.72	62.28	2.53	56.57	2.77	63.75	2.19
Malpractice risk								
Malpractice frequency	2.65	0.05	2.62	0.04	2.83	0.07	2.81	0.05
Malpractice severity (in \$100,000)	4.07	0.03	4.05	0.03	4.16	0.04	4.14	0.03
Malpractice frequency instrument	2.84	0.02	2.85	0.02	2.80	0.02	2.80	0.02
Malpractice severity instrument(in \$100,000)	3.56	0.08	3.55	0.08	3.93	0.10	3.91	0.09
Other variables								
HMO	23.36	0.56	23.74	0.54	23.06	0.48	23.35	0.41
Difference in Medicaid charges	2012	44	2002	37	1924	44	1897	38
Difference in private insurance charges	1886	49	1894	43	1825	38	1810	31
Health Outcomes								
Cerebral Hemorrhage	3.04	0.23	0.10	0.01	1.96	0.14	0.09	0.01
Birth Trauma	4.30	0.40	4.20	0.46	4.98	0.42	4.51	0.70
Respiratory distress syndrome	13.50	0.58	0.56	0.04	11.14	0.47	0.42	0.02
Other complications due to birth Asphyxia	24.50	0.75	4.86	0.20	21.98	0.62	3.93	0.12
Died during hospitalization	2.44	0.12	0.09	0.01	1.86	0.09	0.06	0.01
Number of observations	79695		425448		116141		685970	