PHYSICIANS TREATING PHYSICIANS: INFORMATION AND INCENTIVES IN CHILDBIRTH*

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Abstract

This paper provides new evidence on the interaction between patient information and financial incentives in physician induced demand (PID). Using rich microdata on childbirth, we compare the treatment of physicians when they are patients with that of comparable non-physicians. We exploit a unique institutional feature of California to determine how inducement varies with obstetricians' financial incentives. Consistent with PID, physicians are almost 10 percent less likely to receive a C-section, with only a quarter of this effect attributable to differential sorting of patients to hospitals or obstetricians. Financial incentives have a large effect on C-section probabilities for non-physicians, but physician-patients are relatively unaffected. Physicians also have better health outcomes, suggesting overuse of C-sections adversely impacts patient health.

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I Introduction

It has been proposed that as much as $210 billion, or nearly 10 cents of every health dollar, is spent on "medically unnecessary" treatment (IOM 2012, Table S-1).[1] This overuse is often ascribed to physicians who face financial incentives to over-treat. The extent to which physicians respond to financial incentives is a longstanding question in health economics. Much of the debate in this literature has centered on the physician-induced demand (PID) hypothesis.[2] Because patients do not have the necessary medical knowledge to make independent treatment decisions, physicians both recommend treatments and profit from performing them. The PID hypothesis posits that physicians can therefore shift patient demand and move treatment quantity in the direction of their own preferences. Much of the empirical literature on PID estimates the short-run change in quantity or intensity of treatment in response to shocks to physician incomes (Gruber & Owings (1996)) or fee changes (Nguyen & Derrick (1997), Yip (1998), Gruber et al. (1999), Jacobsen et al. (2010)). However, less is known about the overall level of distortion to care due to asymmetric information. This paper combines rich micro-data on the treatment of patients with differing degrees of medical knowledge with variation in physicians' financial incentives to measure PID in a stable market and to quantify impacts on patient health.

We use new data on physician-mothers giving birth to study the treatment decisions and health outcomes of medically informed patients. Physician-mothers are identified by merging confidential California Vital Statistics (VS) data with physician licensure data. These data allow us to compare the treatment and outcomes of physician-mothers and their infants with that of comparably educated parents, while controlling for a rich set

[1] The IOM defines care as unnecessary if it falls into any of the following categories: "beyond evidence-established levels, discretionary use beyond benchmarks, or unnecessary choice of higher-cost services" (IOM 2012, p. S-7).

[2] See McGuire (2000) or Chandra, Cutler & Song (2012) for a review of the literature.

of clinical and demographic information. We supplement the analysis with data from a second state, Texas.

Existing studies generally test for inducement by varying either the incentive to induce (e.g., shocks to physician incomes or fee changes) or the opportunity to induce (e.g., the degree of patient information). This paper merges the strands of the literature by jointly examining the opportunity and incentive to induce. We first compare Cesarean section (C-section) rates of physician-mothers with non-physician mothers. Under PID, we expect physician-mothers to have lower C-section rates. C-sections are typically more highly reimbursed than vaginal deliveries and physician-patients are more informed regarding their need for the procedure. A unique institutional feature of California then allows us to examine how inducement differs across financial incentive environments. Specifically, we compare the gap in C-section rates between physician and non-physician mothers inside and outside of a large system of HMO-owned hospitals. While C-sections are typically more highly reimbursed than vaginal deliveries under fee-for-service payment systems, within these HMO-owned hospitals neither the physician nor the hospital has a financial incentive to perform C-sections. Finally, we compare health outcomes of physician-mothers and their infants with those of non-physician patients.

In addition to being well-suited to studying inducement, medical decisions in childbirth are of interest by their own rights.[3] Nearly one in three U.S. births is delivered by C-section, up from one in five in 1996. Given the difference in costs between C-sections and vaginal deliveries, this has resulted in annual medical costs from childbirth that are as much as $3 billion higher today than in 1996. Adding to concerns, the C-section rate varies considerably across US states (from a low of 22.6% in Alaska to a

[3]Childbirth is a medical event that occurs for a pre-defined population (pregnant women) within a finite time frame. There is a finite set of treatment options, and patient outcomes are observable. Moreover, there is little opportunity for patients to do independent research or seek second opinions once labor has begun.

high of 39.7% in Louisiana in 2010), without commensurate variation in outcomes. Even within geographic areas notable variation across hospitals and across physicians has been documented (Epstein and Nicholson (2009), Kozhimannil et al. (2013)).

To date, clinical and demographic factors have been unable to fully explain variation in C-section rates across places, practices, and over time (Baicker, Buckles and Chandra (2006)). This has led to speculation that non-medical factors are at work. As the Chief Obstetrician for Sutter Health noted: "Cesarean birth ends up being a profit center in hospitals, so there's not a lot of incentive to reduce them" (LA Times, May 2009). In addition to financial incentives, maternal preferences, convenience, and malpractice concerns may also contribute to C-section rates.

We find that physician-mothers are significantly less likely to have a C-section than other highly educated patients. In California physician-mothers are 7% less likely to have a C-section; in Texas there is an 8% difference. This difference stems not from different preferences for attempting labor, but instead comes almost entirely from the two-thirds of C-sections that are performed after an attempt at labor (herein "unscheduled C-sections"). Doctors are 11% less likely to be ushered into surgery as a result of complications arising during labor or the failure of labor to progress. Moreover, even after accounting for differential sorting of patients to hospitals, physician-mothers have unscheduled C-section rates that are 9% lower than other educated mothers. After controlling for the attending obstetrician, the difference is just under 8% in Texas.

We also find a stark difference in the impact of the incentive environment on informed and uninformed patients. Financial incentives have a large effect on a non-physician's probability of receiving a C-section: in hospitals where there is a financial incentive to perform C-sections, they have much higher C-section rates. However physician-patients appear to be unaffected by the financial environment on net (they have the same risk-

adjusted C-section rates inside and outside of HMO-owned hospitals). These results suggest financial incentives are an important determinant of treatment; and that patient information is an effective counterweight.

The consequences of these treatment differences are not only financial. Physician-mothers and their infants have reduced morbidity compared with other patients. Moreover, it appears that physicians achieve these outcomes without using more hospital resources. Controlling for method of delivery (and netting out the substantial cost savings of fewer C-sections among physician-mothers), the hospital charges for physician-births are similar to those of non-physicians.

The remainder of the paper proceeds in five sections. Section II reviews the existing literature. Section III provides background on the clinical setting. Section IV presents the data and empirical methodology, Section V presents the results, and VI concludes.

II Previous Literature

The concept of induced demand is first attributed to Evans (1974). McGuire (2000) defines PID as:

> "when the physician influences a patient's demand for care against the physician's interpretation of the best interests of the patient."

Under induced demand a physician shifts the patient's demand curve in the direction of her own interests. Physicians can effect such a shift, because patients must rely on the physician to inform them of the treatment options and their expected risks and benefits.

In an ideal world, the econometrician would compare actual treatment quantity with the quantity the physician believes the patient would demand if she were perfectly in-

formed. Because this is not observable,[4] empirical tests for PID have followed one of two alternative approaches. The first approach exploits variation in physicans' incentives to induce. This literature began with researchers measuring the response of treatment choices to changes in physician availability (i.e., the physician-to-population ratio). All else equal, an increase in provider availability should decrease physician income and increase the incentive to induce through its impact on the marginal utility of income (McGuire & Pauly (1991)). Numerous authors have documented a positive cross-sectional correlation between physician supply and rates of surgery (Fuchs (1978), Cromwell and Mitchell (1986), Rossiter and Wilensky (1983)). Following Dranove and Wehner's (1994) critique, this empirical approach was superseded by studies exploiting exogenous shocks to physician incomes.[5] Gruber and Owings (1996) provides credible evidence of PID by exploiting the shock to obstetrician incomes resulting from the secular decline in fertility rates in the 1970s. They find that a 5% fall in incomes leads physicians to increase the C-section rate by 1 percentage point.

A related test for inducement exploits changes in physician fees. In response to a fee reduction, physicians have been found to make up lost revenue by increasing volume (Nguyen and Derrick (1997), Yip (1998), Jacobson et al. (2010)).[6] There are also studies which find little evidence of income effects, with physicians altering quantities in the direction of the fee change. For example, Gruber et al. (1999) finds an increase in the C-section rate in the Medicare population after C-sections became more highly reimbursed relative to vaginal deliveries. Specifically, they found a 0.7 ppt increase for a $100 increase in the fee differential. In both of these approaches identification comes from shocks to

[4]Due to heterogeneity in physician beliefs and skills and the inherent uncertainty in patient outcomes, even ex post it is not possible to determine the optimal treatment plan in many cases.

[5]Dranove and Wehner (1994) show that the aforementioned approach would lead one to conclude that increases in the supply of obstetricians are responsible for increases in the number of births in an area.

[6]Such exercises are more complicated than the simple income shock model as the fee change involves potentially offsetting income and substitution effects (see McGuire and Pauly (1991).

providers; as a result they cannot estimate the overall level of PID.

The second broad approach to testing for PID uses variation in the information asymmetry necessary for physicians to induce demand. These papers typically compare the treatment physicians choose for themselves with the treatment non-physicians receive (Bunker and Brown (1973), Hay and Leahy (1982), Chou et al (2006)).[7] For example, in a Swiss survey Domenigetti et al. (1993) find that physicians report receiving one of seven major surgical interventions one-third less often than non-physicians. In a more recent survey of U.S. physicians, Ubel et al. (2011) finds physicians want less intensive treatment for themselves than they would recommend to their patients in two fatal disease scenarios. This empirical approach has also been employed more generally to test for agency problems when employing experts. Levitt and Syverson (2008) find that houses are kept on the market slightly longer and sold for a higher price when the real estate agent is also the seller.

The above studies highlight the role of physicians' financial incentives in treatment decisions. Financial remuneration, however, is unlikely to be the only factor in the physicians' calculation of the marginal costs and marginal benefits of treatment choices. For example, Currie and MacLeod (2006) study malpractice in the context of childbirth and find that liability concerns are a significant determinant of treatment choices.

III Labor and Delivery in the U.S.

Under PID treatment quantities are determined in equilibrium by physicians equating the marginal cost of inducing demand with its marginal benefit. PID models predict over-provision of care under fee-for-service and under-provision of care under capitated

[7] Currie, Lin and Zhang (2011) take a different approach. They send simulated patients to physicians in China and compare the rates of antibiotic prescription for patients signaling their understanding of appropriate antibiotic use with that of similar patients who do not signal this understanding.

payment systems (Ellis & McGuire (1986), McGuire & Pauly (1991), McGuire (2000)).[8] In the setting of childbirth, the number of deliveries is fixed from the perspective of the physician; the physician's primary treatment margin is the method of delivery. Thus, in childbirth, overuse (underuse) takes the form of more (less) resource-intensive delivery methods.[9] This section provides an overview of the clinical decision-making process in labor and delivery, focusing on factors influencing the choice to deliver vaginally or via C-section.

There are several clinical situations in which a C-section is clearly indicated, and the medical guidelines recommend scheduling a C-section before labor begins for many of these cases.[10] In California approximately 10 percent of first-time mothers have scheduled C-sections, and the remaining 90 percent attempt vaginal delivery.[11]

An attempt at vaginal delivery most often begins with the natural onset of labor. However, in cases where waiting for the onset of labor could harm the mother or fetus, the patient and provider can schedule a medical induction of labor (15% of first births in California are medically induced).[12] In California nearly 80% of labor attempts result in a successful vaginal delivery. However, if the physician believes the risks associated with continuing labor outweigh the benefits of avoiding a Cesarean delivery, she can recommend

[8]Ellis & McGuire show under-provision results under capitation if physicians put more weight on profits than patient care.

[9]See Gruber & Owings (1996) for a model of the delivery method decision under fee-for-service.

[10]The conditions for which the American College of Obstetricians and Gynecologists (ACOG) recommends Cesarean delivery before a trial of labor are breech or transverse lie, placenta previa, triplets and higher order multiples, uterine rupture (or history of uterine rupture), three or more prior Cesarean sections, prior classical Cesarean section, and certain types of rare cardiac or neurologic conditions in the mother. A history of certain types of uterine surgery (such as a deep myomectomy or uterine reconstruction) is also an indicator for C-section (Source: Daniela Carusi, M.D., Brigham and Women's Hospital Department of Maternal Fetal Medicine, personal e-mail communication). C-sections may also be scheduled at maternal request, though survey evidence suggests maternal request C-sections are rare (Declercq et al. (2006)).

[11]The authors' tabulation, using California Hospital Discharge data for 1996-2005.

[12]Induction is most common in post-term pregnancies (42 or more weeks gestation). Induction is also indicated in cases of extreme maternal hypertension, in growth-restricted fetuses, and in cases when the mother's water breaks before the onset of labor and labor does not begin naturally within a specified time frame.

progressing to surgery. C-sections after a trial of labor are termed "unscheduled C-sections." Some of these are considered emergency C-sections, in the sense that not immediately progressing to surgery would likely compromise the health of the mother or fetus, but for most the indications for C-section are less urgent.[13]

While C-sections have been shown to unambiguously improve maternal and infant outcomes in some clinical situations (e,g, uterine rupture), unambiguous guidelines regarding the decision to leave the delivery room for the operating room are often lacking.[14] One thing that is clear is that the benefit of the C-section must be weighed against the risks of maternal mortality and morbidity associated with major abdominal surgery. While maternal mortality rates are very low, they are estimated to be two to four times higher in C-sections than in vaginal delivery. Mothers are also more likely to be re-hospitalized for infection, for cardiopulmonary and thromboembolitic conditions, and for surgical wound complications after a C-section (Lydon-Rochelle et al. (2000)). In addition, recovery times and hospital stays are twice as long for Cesarean deliveries, and C-sections may increase the risk of complications in future pregnancies as well as the ability to become pregnant (Alpay et al. (2008), Nielson et al. (1989), Ananth et al. (1997), Norberg & Pantano (2013)).[15] C-sections also carry risks for infants; for example, 1.1 percent of infants delivered by Cesarean are injured in the procedure (Alexander et al. 2006). However, these risks must be traded off against the uncertain consequences of allowing labor to progress, particularly for the infant.[16]

[13]For example, the life of the mother and fetus are clearly threatened in cases of uterine rupture and in some cord prolapse cases. Indications that the fetus is not tolerating labor well, though difficult to interpret, can be cause for emergency C-section as well.

[14]While guidelines for managing shoulder dystocia are quite clear, guidelines for cases when the first stage of labor fails to progress, or when the second stage of labor progresses past 1 or 2 hours are lacking. The former are often coded as failure to progress; the latter as cephalopelvic disproportion or obstruction. An emergency C-section is warranted in cases where the fetus is being deprived of oxygen, but fetal heart rate monitoring typically provide only a noisy indication of fetal distress (Prentice and Lind (1987)).

[15]The Healthcare Cost and Utilization Project estimates hospital stays range from 2.1 days for a vaginal delivery without complication to 4.4 for C-section with complication (HCUP (2009)).

[16]The largely observational medical literature provides little consensus regarding infant and maternal

In fee-for-service payment schemes, physicians are typically reimbursed more highly for C-sections than for vaginal delivery.[17] This difference in fees is not thought to be justified by increased costs incurred by the obstetrician in a Cesarean delivery. C-sections require surgical training and may be a more complex procedure than vaginal deliveries. However, they take less time on average, and the timing is more predictable.[18] Importantly for this study, in California 15% of births take place in an HMO-owned hospital setting, where physicians are paid by salary and the HMO directly operates hospitals.[19] In this setting both physicians and hospitals have the incentive to perform vaginal deliveries in lieu of C-sections.[20] Furthermore, since the hospital is owned by the insurance company it internalizes the cost of care provided.

C-sections are much more costly than vaginal deliveries in terms of hospital resources consumed. Hospital charges are $6,000 higher for a C-section on average (Baicker, Buckles and Chandra, 2006).[21] Hospital costs associated with C-sections are estimated to be approximately $1000 higher for uncomplicated deliveries and $3000 higher for complicated deliveries (Podulka et al. (2011)). These numbers include only direct medical costs incurred during the hospital stay, yet they suggest reducing C-sections to their 1996 levels could save between $1 and $3 billion per year in health costs.[22] While limitations

outcomes in long or difficult labors.

[17]Gruber et al. (1999) report a difference of $500 on average. A more recent estimate from the Healthcare Blue Book is $380. This is close to the differential reported by Medicare: Medicare pays physicians $2,295 for a C-section vs. $1,926 for a vaginal delivery (on average).

[18]The Medicare Resource-Based Relative Value scale assigns a higher score to C-sections compared with vaginal deliveries (49.26 vs. 43.78), but there is some debate regarding whether this reflects the difference in true work or complexity between the two procedures. Source: www.physicianspractice.com/display/article/1462168/1589375.

[19]Another 37% of births are to patients insured by an HMO, but delivering in a non-HMO-owned hospital.

[20]According to the HMO, 95% of their physicians are paid by salary (as of 2006), and medical groups whose costs consistently come in under-budget may use the surplus for additional compensation.

[21]In California average charges for the mother differ by $8,472. According to the Healthcare Blue Book, the average difference in the price paid by insurers is approximately $3,000.

[22]Hospital charges do not, for example, include the costs of readmissions, the substantially longer recovery time associated with C-sections or any increases in the risk of complications in future pregnancies.

of data and clinical evidence make it difficult to determine the optimal C-section rate, many experts believe these costs outweigh the benefit for many of the C-sections currently performed in the United States. For example, the United States Department of Health and Human Services has repeatedly included significant reductions in C-section rates in its Healthy People goals.[23]

Obstetric rotations are part of the core curriculum in U.S. medical schools and residency programs. This exposure combined with classroom learning means physicians have greater knowledge of childbirth than other educated parents. While non-obstetricians are likely not as informed as their doctors going into pregnancy, they can likely use their training to educate themselves on current treatment standards.[24] Moreover, physicians are likely better able to independently understand the treatment options presented to them by physicians and come to a decision.

IV Data and Methodology

IV.I Data

The empirical approach hinges on the ability to observe a sample of physicians as patients. We have identified physician-patients by merging the confidential California Vital Statistics data, which includes mothers' full names, with licensure data on physicians practicing in the state.[25] Specifically, we merge the California confidential Linked Patient Discharge Data-Birth Cohort File (PDD-Birth) from the California Office of Statewide

[23]The 2010 goal was to reduce Cesarean births to 15 percent of first births. Instead, the U.S. C-section rate rose from 1:5 births in 1996 to nearly 1:3 births in 2010 and is now over 27 percent of first births and 23 percent of low risk first births. The 2020 goal is a 10 percent reduction (or 2.6 ppts).

[24]8% of the physicians in the sample are obstetrician / gynecologists; 41% are general practice or internal medicine doctors; and 13% report a surgical specialty.

[25]It was not possible to reliably identify physician fathers in the VS data because the confidential PDD-Birth file does not include the father's first name.

Health Planning and Development (OSHPD), with the California Medical Board database of all licensed physicians in the state. In addition to the full name, the mother's zip code, approximate age and education were used in the merge process. Because names could not be released, the probabilistic record linkage between the two datasets was performed for this project by an OSHPD-approved contractor. A detailed description of the merge process is in the data appendix.

The linked data include the VS record for every birth registered in California from 1996-2005. Births taking place in hospitals are linked to the hospital discharge records for both mothers and infants for the 9 months prior through 1 year after the birth date. The VS record includes maternal and paternal demographic information, maternal pregnancy history, pregnancy risk factors, and delivery complications. The data also has information on the birth outcome, including method of delivery. The linked patient discharge data then adds discharge status and up to 24 diagnosis and 20 procedure codes for the mother and the infant for each admission, including the admission associated with the delivery. The data also include patient insurance type and hospital charges.

There were 5,372,478 registered births in California in the sample period. We focus on the 2,072,477 first births (birth to mothers with parity 0) in the sample, because of the path dependence of treatment in second births. We further restrict the analysis to singleton births over 20 weeks gestation taking place in California hospitals.[26] Next we restrict the sample to the 1,111,058 mothers between 24 and 50 years of age and exclude observations with missing maternal age, missing maternal zipcode, missing gestational age, or missing birthweight.[27] Finally, to reduce concerns about comparability between physicians and non-physicians our preferred sample is the 583,126 births to parents with

[26]The California restriction excludes 12,732 observations. Restricting to singleton births over 20 weeks gestation excludes 33,774 observations.

[27]Given the time necessary to complete medical school, there are virtually no physicians in their early twenties. Births to mothers over 50 are extremely rare. There were 51,212 observations outside the selected age range.

at least one college degree between them.[28] Of these, 3,296 mothers are identified as physicians in the probabilistic record linkage.

We complement the California data with VS data on all births in Texas from 1996-2003 and 2005-2007 (summarized in Appendix Table A.1).[29] The Texas data come solely from the birth certificate and its associated survey and are therefore less detailed than the linked PDD-birth data in California. In the Texas data it is not possible to reliably classify C-sections as scheduled or unscheduled, and we observe fewer clinical risk factors. However, the Texas data has two important variables that are unavailable in California: the name of the attending obstetrician (after 2004) and the self-reported occupations of both parents. We identify 2,628 births to physician-mothers, 5,915 births to physician-fathers and 1,475 births in families with two physician-parents.[30]

Table 1 summarizes the independent variables used in the California analysis. 15.8% of physician-patients and 14.7% of non-physicians deliver in an HMO-owned hospital. The differences between physicians and non-physicians are substantively similar in these two settings. Physicians are older (32.6 vs. 31.1 outside of HMO-owned hospitals and 32.6 vs. 30.7 inside HMO-owned hospitals). Physicians are also less likely to be hispanic, and they live in zip codes with higher income per capita. By definition, physicians are all highly educated, but they also have spouses who are more highly educated than spouses of non-physician mothers.

Physicians give birth to infants with lower gestational ages and lower birth weights on average. In terms of clinical risk factors,[31] physicians and non-physicians are fairly similar.

[28]Results are robust to including all education levels in the comparison group and to further restricting the comparison group to families with at least one highly educated parent or to highly educated mothers. See Supplementary Tables B.3 and B.4 for full sample results. See Supplementary Tables B.5 and B.6 for the sample of births to highly educated mothers.

[29]The hospital identifier was not available in 2004.

[30]We identify physician-mothers and fathers from self-reported occupations. See the data appendix for a detailed description of the process.

[31]The risk factors are coded using ICD-9-CM diagnosis codes from the discharge record. We exclude diagnoses that occur during labor indicating failure of the labor to progress, obstruction, and non-

Outside of HMO-owned hospitals, only 2 of 17 physician / non-physician differences are significant at the 5 percent level. For both of these, physicians have higher risk.[32] Inside HMO-owned hospitals, differences are slightly larger and 4 of 17 differences are significant.[33]

IV.II Econometric Model

We first estimate OLS regressions of a binary indicator for C-section delivery on an indicator for whether the mother is a physician along with demographic and clinical controls. For the initial analysis, we focus on births occurring outside of HMO-owned hospitals. OLS regressions are of the following form:

$$y_{iht} = \alpha + D_{iht}\beta + x_{iht}\gamma + \delta_t + \epsilon_{iht} \tag{1}$$

where y_{iht} is a dummy variable indicating that patient i had a C-section in hospital h in year t, D_{iht} is a dummy indicating that the delivering mother is a doctor, and x_{iht} is a vector of all the variables listed in Table 1 including maternal demographics, infant information, and clinical risk factors. x_{iht} also includes interactions between zip code income and race and clinical risk factors interacted with age, race and zip code. δ_t is a vector of year and month dummies. Hospital fixed effects, ν_h, are included as indicated in tables.[34] β is the coefficient of interest. It is the estimate of the difference in C-section rates for doctors and non-doctors outside of HMO-owned hospitals. We expect $\beta < 0$,

reassuring fetal heart rate, as these are subjective and are potentially endogenous to the treatment decision. This problem is exacerbated by the need for physicians to justify a Cesarean section with a diagnosis code.

[32]The two conditions are thyroid conditions and pre-existing maternal physical factors.

[33]These are placental / uterine rupture and hemorrhage, polyhydramnios, growth-restriction and pre-existing maternal factors.

[34]Results are not dependent on including interactions in the regression. Results are also robust to including zip code fixed effects instead of hospital fixed effects.

as agency theory predicts that informed patients will get less intense treatment when treatment intensity is reimbursed on the margin.

The regressions above employ a fairly flexible functional form. However, complex interactions between observed risk factors and demographics are possible. For this reason, we also run nonparametric nearest neighbor matching regressions. This approach exploits the large size of the control group (non-physicians) relative to the treatment group (physicians). Specifically, we estimate the average treatment-on-treated (TOT) effect by matching each doctor with the closest comparable non-doctor on a rich vector of demographic and clinical variables. This vector includes a full set of 2-year age bins, education and race indicators, clinical risk factors, term length indicators, indicators for low and high birthweight, and 5-year time bins. The TOT estimator is calculated as the mean difference in C-section rates between treatment and control observations in the matched sample.[35] Analytical standard errors are calculated following Equation 14 of Abadie & Imbens (2006).

To test whether physicians' treatment covaries with the treating physician's financial environment we next turn to the full sample of patients (delivering inside and outside of HMO-owned hospitals). We estimate the following OLS regression:

$$y_{iat} = \alpha + D_{iat}\beta_1 + D_{iat} * HMO_{iat}\beta_2 + HMO_{iat}\beta_3 + x_{iat}\gamma + \delta_t + \epsilon_{iat} \tag{2}$$

where HMO_{iat} is a variable indicating that the birth for patient i in hospital service area (HSA) a in year t took place in an HMO-owned hospital. Where indicated, fixed effects for the patient's HSA are also included. HSAs are used in lieu of hospital fixed effects,

[35]The Mahlanobis measure is used to determine closeness. In cases of multiple exact matches, a weighted average of exact matches is used as the control observation in the difference calculation. See Abadie & Imbens (2006) for a discussion of identification assumptions in nearest neighbor matching estimators.

because the latter are collinear with the HMO-owned hospital indicator.[36] As before, we expect lower C-section rates for physicians relative to non-physicians outside of HMO-owned hospitals ($\beta_1 < 0$). We also expect lower C-section rates for non-physicians in HMO-owned hospitals, where C-sections are not reimbursed on the margin, compared with non-physicians delivering elsewhere ($\beta_3 < 0$). Because informed patients should be unaffected by the incentive environment, agency theory predicts more intense treatment for informed patients relative to less-informed patients inside of HMO-owned hospitals ($\beta_2 > 0$). If informed patients are unaffected by the incentive environment, we expect ($\beta_2 + \beta_3 = 0$).

Finally, we examine how physicians' morbidity compares with that of non-physicians. Because the patient morbidity measures we observe are uncommon, we estimate logit regressions:

$$logit\left(I_{iat}\right) = \alpha + D_{iat}\beta_1 + D_{iat} * HMO_{iat}\beta_2 + HMO_{iat}\beta_3 + x_{iat}\gamma + \delta_t \tag{3}$$

where I_{iat} is an indicator variable for a maternal or infant morbid condition for patient i in HSA a in year t, and the remaining variables are defined as in equation (2). Under PID, informed patients should have fewer adverse outcomes under both fee-for-service and capitation as long as inappropriate levels of care affect morbidity ($\beta_1 < 0$ & $\beta_2 < 0$). If instead the marginal treatment is in the flat-of-the-curve region (net marginal benefit of treatment is near zero), then we would not expect differential morbidity for informed patients.[37]

[36]HSA fixed effects, while not a perfect proxy for the hospital, will control for the socio-economic status of patients in the hospital's area. The results are robust to using patient zip code in lieu of HSA fixed effects (see Supplementary Table B.2). The Dartmouth Atlas defines an HSA as "a collection of zip codes whose residents receive most of their hospitalizations from the hospitals in that area. HSAs were defined by assigning zip codes to the hospital area where the greatest proportion of their Medicare residents were hospitalized." There 3,436 HSAs in the U.S.

[37]It might also be the case that physicians place different weights than their patients on mothers' versus infants' outcomes. If that is the case predictions of effects of doctor status on infant and maternal

V Results

V.I Treatment Intensity

Table 2 summarizes raw C-section rates of physician and non-physician parents. The top and bottom panels present rates for the California and Texas samples, respectively. The California rates are displayed separately for HMO-owned and non-HMO-owned hospitals. Consistent with PID in non-HMO-owned hospitals, doctors have C-section rates that are 1.6 ppts lower than non-doctors (27.6% versus 29.2%). Also as predicted, patients in HMO-owned hospitals have much lower C-section rates (3 ppts) than those in non-HMO-owned hospitals, and physician-patients inside HMO-owned hospitals have substantially higher raw C-section rates than non-physicians in the same incentive environment (31.1% versus 26.1%). C-section rates in Texas are considerably higher than in California (32.7% versus 29.2%), but, as in California, physician-parents in Texas have lower raw C-section rates compared with non-physicians.

These raw comparisons are roughly in line with the predictions of the PID model. Next we turn to OLS regressions with a full set of controls for observed demographic and clinical factors that influence C-section rates. In all specifications, the comparison sample is non-physicians between 24 and 50 years of age, in families with at least one college-educated parent.[38]

OLS estimates of Equation (1) are in Table 3, Panel A. Consistent with PID, physician-mothers have C-section rates that are 2.13 percentage points (7 percent, Column 1) lower than educated non-physicians. It is also clear that the reduced C-section rate is coming entirely from unscheduled C-sections: doctors have risk-adjusted unscheduled

outcomes would differ accordingly.

[38]Results are unaffected by including all education levels in the comparison group or by further restricting the comparison group to families with at least one highly-educated parent or to highly-educated mothers. See Supplementary Tables B.3 and B.4 for full sample results. See Supplementary Tables B.5 and B.6 for the sample of births to highly-educated mothers.

C-section rates that are 2.14 percentage points lower than non-doctors (Column 5, an 11 percent effect).[39] Thus, it appears the effect is among mothers who have expressed a revealed preference for vaginal delivery by attempting labor. This decomposition is not consistent with the difference in C-section rates arising as a result of differences in maternal preferences for elective C-sections. Instead, it appears the difference arises from decisions made in the delivery room regarding when to stop laboring and progress to surgical delivery.[40] This is what we would expect from a PID model, as there is little time to gather additional information once labor has begun, and because clinical guidelines are less clear for unscheduled relative to scheduled C-sections.

C-section rates vary substantially across hospitals within California. We next ask whether this treatment difference arises from physician-mothers using their medical knowledge to differentially sort across medical facilities or whether physicians receive differential treatment within the same hospital.[41] The addition of hospital fixed effects reduces the disparity in unscheduled C-sections by only 20%. Physician unscheduled C-section rates remain 9% below rates of non-physicians (Table 3, Column 6). Thus, differential sorting does not appear to be the primary mechanism behind physicians' lower C-section rates.[42]

The OLS regressions employ a fairly flexible functional form with interactions of zip code income and race, and clinical risk factors interacted with age, race and zip code. However, there could still be complex interactions in the relationship between observed risk factors and C-section incidence. Nearest neighbor matching estimators do not require

[39] We classify scheduled and unscheduled C-sections using ICD-9-CM codes from the hospital record. See the data appendix for more detail.

[40] The difference in C-section rates between physicians and non-physicians does not appear to be driven by differences in medical judgment regarding how any particular complication should be handled. Instead, it appears as if a different threshold is being applied to physician and non-physician patients across the board.

[41] Physician-mothers choose hospitals that are larger (more births each year), and they are more likely to deliver in an academic medical center.

[42] The results are robust to the inclusion of patient zip code fixed effects in lieu of hospital fixed effects. See Supplementary Table B.1.

functional form assumptions and implicitly allow for complex interactions. Table 3, Panel B presents TOT nearest neighbor matching estimates. Even matching on a rich set of covariates, the exact match rate is 89% in the main specification (Table 3, panel B, Columns (1), (3), and (5)). Regressions that also match on hospital achieve 53% match rates (Columns (2), (4) and (6)).[43] Both sets of results are strikingly similar to the OLS.

These findings are not unique to California. Table 4 displays coefficients from OLS regressions for the Texas sample. As mentioned above, the following controls are excluded from regressions due to lack of availability in Texas: uterine rupture/ hemorrhage; ruptured membranes $\geq$ 24 hours; isoimmunity; oligohydramnios, polyhydramnios; growth restriction; thyroid condition; herpes, asthma, pre-existing maternal physical factors; and other maternal pre-existing conditions. The Texas specifications include an indicator for physician-fathers in addition to the physician-mother indicator. They also include indicators for whether the parents are married and whether the mother and father each report an occupation other than homemaking, which are not available in California. As in California, the comparison sample is non-physicians in families with at least one college degree.

Columns (1) and (2) display results for the full-sample and Columns (3) and (4) for years 2005-2007, the sample for which the name of the attending physician is available. As in California, physician-mothers in Texas have significantly lower C-section rates. The difference is 2.75 ppts overall (an 8% effect) and 2.06 ppts after controlling for the hospital of delivery (a 6% effect). After controlling for the attending obstetrician, the point estimate is only reduced by 18% (Table 4, Columns 3 and 4).[44] This suggests the treat-

[43]Hospitals with less than 100 births are excluded due to low match rates (this excludes 0.12% of the sample of births and 1 physician-parent). Hospitals with no physician-patients are also excluded.

[44]Attending fixed effects were created from the cleaned attending name field. Mothers treated by physicians delivering fewer than 20 babies are excluded from the attending fixed effect analysis. This specification does not include hospital fixed effects because the majority of attendings deliver at only 1 hospital.

ment gap arises from obstetricians treating their physician-patients differently rather than physicians selecting different obstetricians. Results are similar when teaching hospitals are excluded, further suggesting differential attention from attendings and residents in teaching hospitals is not driving results.

Interestingly, spouses of physician-fathers have C-sections at similar rates to non-physician mothers. The medical knowledge of physician-fathers does not appear to be used to avoid C-sections. This could occur for several reasons. Fathers may view avoiding a C-section as less important than mothers. Alternatively, physician fathers may not be as involved in prenatal care and therefore may not update their knowledge of current obstetric practice. Finally, fathers may not be in the room for the entire birth. Relatedly, while mother's occupation is almost always reported, fathers occupation is missing for 15% of observations. This measurement error could be responsible for attenuating the coefficient on physician fathers.[45]

The failure to find an effect for physician fathers raises the concern that physician mothers may be choosing a higher clinical threshold for C-sections due to their high cost of time away from work. Even among highly educated women, physicians are relatively highly compensated and often work either as sole proprietors or in group practices where maternity leave is costly. If this were driving results, one would expect to see similar results in higher paid occupations and for those who are self-employed. Neither lawyer mothers, who have high incomes and bill for their time, or self-employed women have lower C-section rates compared with other educated women. In fact, female lawyers have significantly higher C-section rates, though this result could reflect malpractice concerns.[46]

[45]More generally, we fail to find that father's occupation has any correlation with the C-section rate. For example, while lawyer mothers have higher C-section rates, wives of lawyer fathers have similar C-section rates to other highly educated women (see Supplementary Table B.8).

[46]Results for lawyers and self-employed are in Supplementary Table B.8. A natural group to look at is nurses, since they have more medical knowledge than the average person, but less than physicians.

The estimates thus far have shown the effect of physicians' medical knowledge is sizable. However, the above estimates may understate the true effect of patient information on treatment. Women have nine months to prepare for labor, and highly educated women are likely not completely uninformed. Thus, these effects capture the impact of full versus partial information. In addition, the estimates in California likely suffer from attenuation bias due to measurement error in the physician-patient identifier.

While time cost does not appear to be a driving factor, there are a number of other mechanisms, which could play a role in treatment differences. For example, physicians may alter recommendations in response to private malpractice concerns or convenience factors. It could also be the case that physicians have different preferences for intensive treatment. Physician financial incentives are thought to be the primary impetus behind PID. Thus, we now ask how the gap between physicians and non-physicians varies with the financial incentive of the treating physician.

V.II Financial Incentives

Next we test whether the treatment gap covaries with the treating physician's financial incentives. As discussed above, we expect lower C-section rates in HMO-owned hospitals compared with non-HMO-owned hospitals. We also expect physician-patients to be less affected by the incentive environment, because they are more informed about the relative benefits and costs of their treatment options.

Table 5 displays estimates of Equation (2). As one would expect, the coefficient on the HMO-owned hospital indicator is negative. Non-physician mothers delivering at HMO-owned hospitals have C-section rates that are approximately 5 ppts lower than

Given the self-reported occupation categories, we are not able to reliably distinguish hospital nurses or even registered nurses from nurses who have more limited medical knowledge. Nurses appear to have lower risk-adjusted C-section rates, but the point estimates are not significantly different from zero.

non-physicians delivering elsewhere (Columns (1) and (2)), with roughly half coming from lower scheduled and half from lower unscheduled C-sections.[47]

In contrast, physician-mothers have the same risk-adjusted C-section rates in and outside of HMO-owned hospitals. The coefficients on the HMO-owned hospital and physician-patient indicators are close in magnitude and of opposite sign.[48] Thus, unlike other patients, physician-patients appear to be unaffected by the contract environment of their providers. This is exactly what one would expect if demand inducement is only possible when information asymmetries are present. Moreover, for malpractice concerns to be driving results, one would have to believe that physicians are less concerned about physician-patients suing them (relative to non-physicians) outside of HMO-owned hospitals, but relatively more concerned about physician lawsuits inside of HMO-owned hospitals. When broken out into scheduled and unscheduled C-sections the same pattern holds, although the estimates are less precise.

V.III Maternal and Infant Morbidity

The estimates above demonstrate that physician-mothers receive different treatment in birth than comparable non-physicians. However, are physicians receiving better care or just different care? Are they using their medical knowledge to avoid over-treatment or are they being permitted to choose higher risk treatment plans? If physician-mothers were pursuing high risk treatment paths one would expect them and their infants to have higher morbidity rates. Similarly, if they were placing more weight on their own health

[47]It is important to note, in interpreting the effect of the HMO-owned hospital on treatment, that in addition to a different financial incentive for the attending, HMO-owned hospitals may have implemented broader processes or policies to reduce C-section rates. However, there doesn't appear to be a policy regarding treatment of any single diagnosis driving results. C-section rates are lower across a broad swath of diagnoses in HMO-owned hospitals.

[48]P-values from the test of the null that $\beta 2 + \beta 3 = 0$ are 0.79 and 0.92 for regressions displayed in Columns 1 and 2, respectively. For regressions in Columns (5) and (6), they are 0.90 and 0.80.

(relative to their infants') in their treatment decisions one would expect to see lower maternal morbidity coming at the expense of infant morbidity. We find neither.

Infant and maternal death in childbirth are incredibly rare in the United States. The overall maternal death rate in California is only 8 per 100,000 college educated women, and no physician-mothers died in our sample. Infant and maternal complications during and immediately following childbirth are more common. Table 6 summarizes morbidity morbidity measures that occur in at least 1% of births. Almost 9% of mothers have 3rd or 4th degree perineal lacerations, which are serious tears sustained during labor. Post-partum hemorrhage, a more serious complication, is less common (3%) as is maternal infection (4.5%). For infants, the only conditions prevalent enough to study are respiratory conditions, infection, and delivery trauma. We split respiratory conditions into the less serious conditions that require oxygen therapy or mechanical ventilation (2.7%) and the more severe cases that require intubation (2.5%).[49] Because even these conditions are still relatively infrequent, we estimate logit regressions as in equation (3).

Table 7 displays average marginal effects (AME) from these regressions. The values assumed for indicator variables in the AME integration are noted in parentheses under the variable name.[50] Overall, physician-mothers have better outcomes. Outside of

[49]This corresponds to the following ICD-9-CM codes: 3rd and 4th degree lacerations are the more serious of the tears associated with vaginal delivery (664.2 or 664.3), post-partum hemorrhage (666), infection (including pyrexia, generalized infection and major infection: 672, 659.2, 659.3, 670.3); respiratory assistance (including oxygen therapy and mechanical ventilation: 93.96 and 93.90), intubation (96.04), infection (771), trauma (all trauma to the infant excluding minor and relatively common scalp lacerations: 767 excluding 767.1). Respiratory assistance and intubation are procedures, not diagnoses. The following measures were observable using ICD-9-CM codes but occurred in less than 1% of the sample: obstetric wound complications and anesthesia complications (in mothers and infants).

[50]The estimates presented represent the average marginal effect of the variable listed, with the integration taken assuming a value for the other indicator variable (with the value given in parenthesis). The Doctor (HMOHosp=0) estimate is analogous to the coefficient on the doctor identifier in OLS regressions. The Doctor (HMOHosp=1) estimate is analogous to the sum of the coefficients on the doctor indicator and the interaction of doctor with HMO-owned hospital. This sum is the effect of being a doctor in HMO-owned hospitals. The difference between the Doctor (HMOHosp=1) and Doctor (HMOHosp=0) estimates is analogous to the coefficient on the interaction of doctor with HMO-owned hospital in the OLS regressions. The HMOHosp (Doctor=0) estimate is analogous to the coefficient on HMO-owned hospital in OLS regressions.

HMO-owned hospitals, physician-mothers have significantly lower rates of serious perineal lacerations and infection (just over 1 ppt). The laceration result is striking given physician mothers' higher rates of vaginal delivery. It suggests that the marginal vaginal delivery does not require extended or difficult active labors which would result in tearing. While lacerations typically occur only in vaginal deliveries, infection and maternal hemorrhage can arise in women delivering either vaginally or by C-section. Thus, the reduced rate of infection could arise from physicians having fewer C-sections and associated surgical wounds at risk for infection or they could have lower infection rates even within delivery method categories.[51] However, care should be taken in interpreting the infection estimates. While physician mothers are unlikely to be able to reduce their rates of laceration and hemorrhage through self-care, they maybe able to reduce their risk of infection through self-care after delivery.[52]

Infants born to physician-mothers also experience lower rates of trauma and are less likely to experience extreme breathing difficulties that require intubation.[53] These suggest that physician mothers are not achieving their lower C-Section rates by persisting in more perilous labors, nor are they improving their own morbidity by risking the health of their infants. Moreover, the results suggest overuse outside of HMO-owned hospitals adversely impacts patients: limiting demand inducement improves outcomes in addition to lowering treatment intensity.

Inside HMO-owned hospitals the health consequences of the lower C-section rate are less clear cut. Non-physician mothers delivering in this setting experience significantly higher rates of laceration and post-partum hemorrhage. Impacts on infant morbidity are

[51] Long active labors are associated with increased risk for maternal infection. Thus, the infection result is also not consistent with physician mothers reducing C-sections by persisting in long active labors.

[52] Readmission to the hospital is likely even more subject to the physician self-care concern. Although results are noisy, physician mothers and their babies are, if anything, less likely to be readmitted in the 30 days after delivery.

[53] The Texas VS data includes 1 and 5-minute APGAR scores. While estimates are imprecise, we find no evidence of differential APGAR scores (See Appendix Table B.9).

mixed: infants in HMO-owned hospitals have lower rates of infection and birth trauma, but higher rates of respiratory assistance. Even putting aside the mixed results for infants, we cannot draw any conclusions about patient welfare from the morbidity estimates inside HMO-owned hospitals. Mothers in this setting are after all avoiding major abdominal surgery (C-sections), and they may prefer an increased risk of complication to a guaranteed surgical incision.

Informed patients, on the other hand, do not face this tradeoff. Outside of HMO-owned hospitals physicians achieve lower risk-adjusted unscheduled C-section rates, and they do this without any measurable increase in morbidity for them or their infants. HMO-owned hospitals reduce the overall C-section rate beyond the rate of physicians outside of HMO-owned hospitals, and the differential patient morbidity in HMO-owned hospitals may be a result of this underuse. Physician-mothers in HMO-owned hospitals have risk-adjusted C-section rates similar to physicians outside of them, and they are able to avoid increases in the most serious complication, hemorrhage, though they may not completely avoid increases in laceration and respiratory assistance.[54] It is also possible that the C-section which is reduced in response to financial incentives is different from the C-section physician-patients avoid.

V.IV Additional Treatment Margins

The estimates above strongly suggest that physician-patients are able to mitigate demand inducement on the C-section margin. However, there are several other key treatment interventions in childbirth. A question is whether the difference in C-section rates could arise from differences on these other margins that then make a C-section less necessary for physician-patients. One such margin is induction. If the pregnancy has passed beyond

[54]The effect of HMO-owned hospital for physicians is -1.86+.03+1.77=-0.06.

an acceptable length of gestation, the patient and obstetrician may choose to medically induce labor. The medical literature suggests induction is associated with increased risk of C-section. Another key treatment decision arises in the delivery room. As the second stage of labor progresses, the attending can attempt to aid in the delivery through the use of forceps or a vacuum extractor (this is termed surgical vaginal delivery).

We estimate equations of the form of equation (2) using indicators for each of these interventions as the dependent variable.[55] Physician-mothers are significantly more likely to be induced, thus doctors are not avoiding C-sections through lower rates of induction (Table 8, Column (1)).[56] They are also not substituting forceps or vacuum extractions for C-sections. Physician-mothers are significantly less likely to be delivered by vacuum extraction, and there is no measurable difference in the use of forceps.

The treatment decisions investigated above constitute the major medical interventions in childbirth, but are not the only treatments provided. Moreover, while the average vaginal birth is cheaper than a C-section, safely performing the marginal vaginal birth could require more resources both during the birth and to treat any complications that arise. For example, if either physicians or their infants have adverse outcomes on margins not cataloged in the discharge data one would expect them to require additional medical care. Hospital charges provide a summary measure of total treatment provided. Though payers typically receive a large discount on hospital charges, in regressions with hospital fixed effects multiplicative discount factors should cancel out. Thus, within a hospital, one would expect patients with higher list charges to have had more or more intensive

[55]Though induction, forceps and vacuum are available on the birth certificate, we use the ICD-9-CM procedure codes from the discharge record (to avoid concerns of under-reporting of procedures in the VS data): induction (73.1, 73.4), vacuum (72.7), forceps (72.0-4).

[56]The Texas birth certificate contains information on the use of epidural anesthesia after 2004. We find physician-parents are more likley to get epidurals, suggesting differential use of epidurals is not behind physicians' lower C-section rate and that physicians are not opposed to medical interventions into birth more generally (see Appendix Table B.7).

care.[57]

Columns (4)-(6) of Table 8 display estimates from regressions of the form of Equation (1) with log hospital charges as the dependent variable. Hospital charges are only available for births outside HMO-owned hospitals so the analysis is limited to those births. Charges of physician mothers and their infants are nearly 2.6% lower than those of non-physician mothers delivering in the same hospitals (Column 2). If this reduction could be achieved in the broader U.S. population hospital charges would be reduced by two billion dollars per year.[58] Half of these savings are attributable to the difference in delivery method in the two groups. However, even after accounting for differences in the use of C-Sections, physician mothers and their infants have hospital charges that are 1.5% lower than other comparable patients, a difference of $497.

In addition, from a purely financial perspective, treatment decisions within HMO-owned hospitals appear to pass cost-benefit analysis. Estimates of the expected financial costs of treating patient complications, using the non-HMO data, suggest that the costs associated with differential morbidity are only $100 to $200.[59] These are well below the cost of a C-section.

[57]It is also important to note that hospital charges do not include physician charges or un-billed care, such as the amount of time a physician spends with the patient.

[58]This may overestimate the amount of hospital costs avoided, as costs are a fraction of charges. Percentages may be more informative, as insurers typically pay a fixed fraction of charges. On the other hand, this measure does not include any cost savings associated with reduced readmissions due to complications from C-sections.

[59]We regress hospital charges on indicators for observed morbidities using the specification of Column (2) in Table 6 in order to estimate the effect of each condition on hospital charges (coefficients are in Appendix Table B.7). Estimates of the increase in morbidity for each measure from Table 7 are then multiplied by the increased charges associated with treating each. Summing across all measures, the expected costs arising from differential morbidity is about $50 for the average patient. Even if one only considers the costs of increased morbidity (and ignores measures of improved morbidity), the expected cost is under $150.

VI Discussion and Conclusion

This paper tests whether treatment and outcomes covary with the patient's medical knowledge. After controlling for patient demographics and clinical risk factors, we find that physician-mothers are approximately ten percent less likely to have a C-section. Outside of HMO-owned hospitals the difference in C-section rates is entirely coming from unscheduled C-sections; it arises from treatment decisions made in the delivery room among mothers who chose to attempt labor. Sorting across hospitals and attendings explains only 20% of this difference. Thus, physician-patients are using information to make different treatment decisions, not simply to select different providers.

This difference is consistent with physicians being able to avoid over-treatment. Moreover, it appears informed patients are able to avoid the impact of their treating physician's financial incentives. While patients in HMO-owned hospitals have significantly lower C-section rates (5 percentage points), physician-patients have similar C-section rates inside and outside of HMO-owned hospitals. This also helps alleviate concerns that the difference in C-section rates is driven by unobservables.

Physician-mothers are not avoiding C-sections by substituting other forms of resource-intensive care. Thus, it appears physicians are able to achieve at least as good or better health outcomes while using less intensive treatment. This is consistent with the induced demand hypothesis - physicians are able to prevent being moved away from their optimum and avoid a utility loss.

Outside of HMO-owned hospitals, PID clearly lowers social welfare. C-section rates, morbidity and hospital costs are higher for the marginal patient, and the higher C-section rate means longer recovery times for mothers. It is importantly to note that, the socially optimal C-section rate may be even lower than the rate of physician-patients. Physician-patients are likely targeting a private optimum, and, like all patients with insurance, they

do not face the full marginal cost of their medical decisions.

One often proposed response to PID in childbirth is equalizing payments for C-sections and vaginal deliveries. This is essentially the incentive scheme within HMO-owned hospitals. In that setting the impact of PID on social welfare is less clear. In HMO-owned hospitals the provider's financial incentive is to provide fewer C-sections, and obstetricians do provide fewer C-sections to non-physicians in HMO hospitals. However, the lower C-section rate appears to come at a cost: higher patient morbidity. The socially optimal level of risk is not zero (it is the point at which the expected marginal benefit of reducing the risk is equal to the expected marginal cost of its reduction), therefore lower C-section rates with higher morbidity could be welfare-improving. Considering only financial costs borne by the hospital, this tradeoff appears to pass cost-benefit analysis: the increase in hospital costs associated with treating the additional morbid conditions are substantially lower than estimates of cost savings due to eliminated C-sections. This exercise, of course, does not take into account any non-hospital costs or benefits, including impacts on patient utility. Thus, while equalizing payments would likely be effective at reducing the C-section rate, further research is needed to determine whether such a policy would be welfare improving.

This study also provides suggestive evidence that efforts to improve patient knowledge and information could improve outcomes while reducing health costs. If all patients were treated the way physicians are treated, hospital and physician charges could be reduced by 3% or nearly $2B. [60] However, it is important to consider whether these results might be replicated in the broader population. Information interventions and empowerment programs are unlikely to provide patients with the same level of information

[60]Back-of-the-envelope calculations suggest inducement on the C-section margin represents only approximately $30M in physician fees (1% of physician incomes). Physician fees for vaginal deliveries on average are $1926 (Medicare). For C-sections fees are $2295 (Medicare). By inducing demand physicians increase their income from the average patient by .02 ($2295-$1926). This is compared with average fees of .292*2295+(1-.292)*1926.

that physicians have, and the effect of information is likely nonlinear. Finally, it is also possible that an information intervention in the broader population could achieve larger reductions in C-section rates. Hospital policies and standards of care may limit how far even a physician-patient can deviate from standard practice, but a broad policy intervention could affect standards.

An alternative to PID which we cannot rule out is one in which obstetricians choose to treat physician-patients differently for reasons other than the patient's information. For example, obstetricians may choose to treat their physician-patients differently out of professional courtesy. If professional courtesy is motivated by identification with the physician-patient rather than informational concerns it would not be PID.[61] However, the gap between physicians and non-physicians would still be informative as to the extent of over-treatment and its impact on patients. This paper demonstrates that 10 percent of C-sections represent overuse of healthcare, and that this overuse is not only costly but may have an adverse impact on patients. Moreover, if all patients were treated like physicians, we would nearly achieve the U.S. Government's Healthy People 2020 goal of reducing primary C-sections by 2.6 percentage points.

[61] If professional courtesy arises from the fact that a physician-patient will know if anything less than optimal care is provided, or related reputational concerns, then professional courtesy is a manifestation of PID. If, on the other hand, it arises from obstetricians choosing to provide physician-patients with different care on their own, it would not be PID.

A Data Appendix

A.I The California Physician Match

Physician-patients were identified by conducting a probabilistic merge of the California Vital Statistics (VS) data with a dataset of physicians practicing in California. The merge was performed by an OSHPD contractor for this project. The contractor was given access to a confidential version of the California VS data (that OSHPD does not release to researchers) that included the full name (first, last and maiden) of the mother.[62] We provided the contractor with a file of physicians practicing in California and worked with the contractor to develop the merge process.

The primary physician file is the California Medical Board physician licensure database. It includes the full name, zip code, and year of graduation from medical school for all physicians with active California state medical licenses during the sample period. We augmented this file with data purchased from BrightPath Marketing, a private company. The BrightPath Marketing data includes month and year of birth, physician specialty and gender and was available for 16% of the physician licenses. Only records with female gender or unknown gender were used in the merge.

The merge was undertaken in 4 blocks. First name matches were considered first; then maiden name matches; then last name matches; and then matches on year and month of birth.[63] Agreement weights were calculated for 5 variables in the merge process: first name, last name, year of birth, month of birth and commuting zone. First and last name were available in both databases. Because mothers could have multiple last names matches were considered using any of the mother's last names and her maiden name

[62] Only the last name of the father was available in the VS data.

[63] It was not computationally feasible to compare all potential pairs. Blocking on commuting zone and birth year range was also intractable. Also for tractability, very common names were excluded in the first three blocks. These were names with frequencies greater than 1,000 in the vital statistics data or greater than 300 in the physician data. A list of excluded names is available on request.

from the VS data. The full match weight was applied in cases of exact match, and the Jaro and bigram comparators were used to account for "close" matches.[64] The exact year of birth was only available in 16% of physician records. For the remaining 84% of records, an 8-year range of birth years was imputed from the year of graduation from medical school.[65] For month of birth only exact matches among the 18% of licenses with month available were assigned the full agreement weight. The final matching variable, the commuting zone, was calculated from the zip code in each dataset to account for moves and/or disagreements between work versus home addresses.[66] The full agreement weight was applied if the commuting zone in the physician file matched at least one of the commuting zones in the VS data.[67]

The confidential VS data included 412,376 unique mothers at least 25 years old and with either postgraduate education or unknown education at some point during the study period.[68] The physician data included 182,344 physicians of female or unknown gender with a unique combination of matching variables. The probabilistic record linkage identified 8,922 physician moms as matches using a probabilistic match weight cutoff of 0.4. 36% of identified doctors were exact matches on month and year of birth. The mean match probability for doctors is 0.63.

The match identifiers were then merged onto the full VS dataset. Births taking place in hospitals were then linked to the hospital discharge records for both mothers and babies for the 9 months prior through 1 year after the birth date. The final file provided to us

[64] A comparison was deemed a match if the maximum of the Jaro and bigram comparator was over 0.7, and in this case the comparator value was used to prorate the agreement weight.

[65] For the physicians with year of birth and year of medical school graduation in the physician file, 88% of birth years fell within the imputed 8-year range of birth years.

[66] This was done using the Census zip code to commuting zone crosswalk derived from 1990 commuting patterns.

[67] The U- and M-probabilities are available on request. The highest U-probability was 0.106 for year of birth and the lowest M-probability was 0.991 for year of birth.

[68] Mothers can appear in the data more than once if they give birth more than once during the sample period.

included the usual VS-PDD data elements as well as the doctor identifier and several indicators providing information on the merge matching process for doctors as well as the non-confidential data elements from the physician file, for example medical specialty and year of medical school graduation.

A.II Classification of Delivery Method in California

The final dataset provides two different methods for determining the delivery method of births. The birth certificate in California contains information on the delivery method, and C-sections are coded on the hospital discharge record associated with each delivery. Specifically, in the VS data C-sections, vaginal deliveries and surgical vaginal deliveries are coded. Then for 2005, when California switched to a new birth certificate form, an indicator for whether a trial of labor was attempted prior to C-section is also included on the birth certificate. While this would allow classification of C-sections into scheduled and unscheduled solely using the VS data (and not the PDD) in 2005, we instead chose to classify deliveries as C-sections using ICD-9-CM procedure codes in all years (any delivery with a procedure code of 74 was classified as C-section). We then classify scheduled and unscheduled C-sections following the methods of Henry et al. (1995) and Gregory et al. (2002). This method uses diagnosis codes indicating trial of labor to classify C-sections. This method was superior to classification using the trial of labor field in 2005.[69]

A.III Texas Vital Statistics Data

The Texas data come from the confidential VS file of the Texas State Department of Health Statistics. The data contain the birth certificate record for every birth registered

[69]Trial of labor appears to be substantially under-reported in the VS data, as many observations containing diagnosis codes indicating that labor was tried in the discharge data did not report attempting labor in the VS data.

in Texas from 1995-2003 and 2005-2007. The 2004 data was not used because a hospital identifier was not available in this year. The file includes maternal and paternal demographic information, including self-reported industry and occupation for both. Additionally, the data includes maternal pregnancy history, pregnancy risk factors and delivery complications, and the birth outcome, including method of delivery. The confidential files additionally include a hospital identifier for all hospital births.[70] A new birth certificate form was introduced in Texas in 2005, making additional variables available from 2005-2007. These include the name of the attending (confidential, but made available to us), and a variable indicating whether labor was tried for C-section deliveries.[71]

A limitation of this data compared with the California data is that the Texas VS record is not linked to the hospital discharge record. This means we cannot reliably split C-sections into scheduled and unscheduled categories. It also means we observe fewer patient risk factors in Texas compared with California - we can control only for risk factors included on the birth certificate form, not those appearing in the discharge record diagnosis codes. However, the Texas data is a valuable addition to the study. It provides another state for comparison with the California case, and it allows for a different method for identifying physicians giving birth. In Texas we identify physicians using the occupation field from the birth certificate form. We used a 3-step process to categorize occupations as physician or non-physician occupations. We first categorized all occupation entries appearing 100 or more times over the sample period. Next, for less common occupation entries, we categorized any entry including the text strings "med" or "phys." Finally, we categorized all entries for individuals with a doctorate after 2005.[72] Because this field is available for both mothers and fathers, we can use the Texas sample

[70]Due to the introduction of a new birth certificate form in Texas in 2005, the hospital identifier is not consistent across years. Hospitals were linked across years using the name, which is available both before and after 2005.

[71]We found the quality of the trial of labor field to be suspect and so this is not used in the analysis.

[72]Education is not categorized into masters/doctorate before 2005.

to study treatment of physician fathers as well as physician mothers. We also identified lawyers and nurses using the first step of the method.

There were 4,419,892 registered births in Texas in this period. We restrict the analysis to births taking place in a hospital in Texas (dropping 72,792 observations) and to singleton births over 20 weeks gestation (dropping 121,655 observations). Given the time necessary to complete medical school, there are virtually no physicians in their early twenties. The sample is therefore further restricted to the 2,623,090 mothers at least 24 years of age and 50 years of age or younger. We further exclude observations with missing maternal age, missing maternal zip code, missing gestational age, or missing birthweight (90,663 observations). Finally, we restrict our analysis to the 720,487 first births and then to reduce concerns about comparability between doctors and non-doctors to the 372,691 parents with at least one college degree. Of these roughly 2,628 are families with physician mothers, 5,915 are families with physician fathers, and 1,475 are families with physician fathers and mothers.

Table A.1 summarizes the independent variables used in the Texas analysis. The top panel displays means and standard deviations of parental demographics for physician parents, broken out according to the identity of the doctor (physician-mothers, physician-fathers and families with two physician parents), and non-doctors. As in California, physician-parents are slightly older, are less likely to be hispanic, and they live in zip codes with higher income per capita.

The second panel of Table A.1 summarizes information on the infant. As in California, physician-moms are slightly more likely to deliver before their pregnancies are considered full-term and slightly less likely to deliver post-dates (42 or more weeks gestation). Physician-mothers are also more likely to give birth to babies that are low or very-low birth weight.

The last panel in Table A.1 summarizes clinical risk factors that potentially affect the C-section treatment decision. While the risk factors for the California sample are derived from ICD-9-CM codes, the Texas risk factors come from the birth certificate survey. The risk factors available for comparison are limited, but physician-parents do appear to have lower rates of diabetes and smoking than non-doctors, and physician mothers may have infants with higher rates of congenital anomalies.

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Table I: Summary Statistics: California

	Non-HMO Hospitals				HMO Hospitals			
	Doctors		Non-doctors		Doctors		Non-doctors	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Demographics:								
Age	32.59*	[4.00]	31.13*	[4.28]	32.63*	[4.12]	30.69*	[4.28]
Mother's education (%):								
Some college	0	[0]	11.81*	[32.27]	0	[0]	12.51*	[33.08]
College graduate	0	[0]	44.68*	[49.72]	0	[0]	42.21*	[49.39]
High education	100	[0]	38.4*	[48.63]	100	[0]	40.1*	[49.01]
Father's education (%):								
Some college	5.081*	[21.97]	12.99*	[33.62]	4.798*	[21.39]	16.98*	[37.54]
College graduate	16.54*	[37.16]	39.66*	[48.92]	19.39*	[39.57]	37.20*	[48.33]
High education	71.6*	[45.10]	37.63*	[48.45]	71.21*	[45.32]	34.17*	[47.43]
Mother's race (%):								
Black	3.46	[18.28]	2.99	[17.02]	5.76	[23.32]	6.16	[24.05]
Hispanic	6.09*	[23.92]	13.78*	[34.47]	7.294*	[26.03]	17.79*	[38.24]
Other	38.67*	[48.71]	26.03*	[43.88]	47.22*	[49.97]	28.92*	[45.34]
Zip code income ($)	34,601*	[15,560]	29,524*	[13,765]	33,877*	[13,901]	26,648*	[10,975]
Insurance (%):								
HMO	42.95	[49.51]	43.98	[49.64]	98.46	[12.31]	98.37	[12.65]
Government	3.604*	[18.64]	8.52*	[27.92]			0.31	[5.55]
Indigent			0.024	[1.54]			0.0035	[0.59]
Infant information (%):								
Female	48.40	[49.98]	48.57	[49.98]	50.10	[50.05]	48.74	[49.98]
Very early term (20-36 weeks)	8.18	[27.41]	7.71	[26.68]	9.597	[29.48]	8.59	[28.03]
Early term (37-39 weeks)	25.37*	[43.52]	21.79*	[41.28]	23.03	[42.14]	19.76	[39.82]
Post-dates ($\geq$ 42 weeks)	5.87*	[23.52]	6.87*	[25.29]	5.76*	[23.32]	8.26*	[27.53]
Very low birth weight	0.901	[9.45]	1.01	[9.99]	0.96	[9.76]	1.25	[11.09]
Low birth weight	5.15	[22.11]	4.42	[20.55]	8.64*	[28.12]	5.01*	[21.81]
High birth weight	5.84*	[23.45]	8.97*	[28.57]	6.33*	[24.38]	9.77*	[29.69]
Prenatal care	99.71	[5.36]	99.78	[4.73]	100.00	[0]	99.73	[5.22]
Risk factors (%):								
Malpositioned fetus	4.36	[20.42]	4.57	[20.88]	3.84	[19.23]	4.12	[19.84]
Diabetes	4.40	[20.51]	4.70	[21.16]	5.76	[23.32]	7.08	[25.65]
Eclampsia	0.036	[1.90]	0.081	[2.84]	0.38	[6.19]	0.20	[4.41]
Smoking / substance abuse	0.14	[3.80]	0.19	[4.31]	1.54	[12.31]	1.43	[11.88]
Hypertension / pre-eclampsia	5.51	[22.83]	5.80	[23.35]	7.29	[26.03]	7.54	[26.40]
Congenital anomaly	0.14	[3.80]	0.08	[2.86]			0.12	[3.39]
Placental/uterine rupture/hemorrhage	1.44	[11.92]	1.19	[10.82]	2.11*	[14.39]	1.16*	[10.69]
Ruptured membranes $\geq$ 24 hours	2.27	[14.90]	2.27	[14.88]	3.84	[19.23]	4.22	[20.10]
Isoimmunity	1.84	[13.43]	1.89	[13.62]	0.38	[6.19]	1.07	[10.27]
Oligohydramnios	0.43	[6.56]	0.32	[5.65]	0.38	[6.19]	0.26	[5.12]
Polyhydramnios	15.24	[35.95]	13.62	[34.30]	24.18*	[42.86]	20.12*	[40.09]
Growth restriction	2.81	[16.53]	1.52	[12.22]	2.67*	[16.19]	1.21*	[10.93]
Thyroid condition	2.45*	[15.46]	1.50*	[12.14]	2.11	[14.39]	1.85	[13.48]
Herpes	0.47	[6.83]	0.51	[7.15]	0.96	[9.80]	1.43	[11.87]
Asthma	1.26	[11.16]	0.94	[9.64]	2.88	[16.74]	2.87	[16.70]
Pre-existing maternal physical factors	1.98*	[13.94]	1.47*	[12.04]	2.88*	[16.74]	1.19*	[10.83]
Other maternal pre-existing conditions	1.44	[11.92]	1.11	[10.49]	1.73	[13.04]	0.97	[9.82]
Observations	2,775		494,589		521		85,241	

Table contains means and standard deviations of independent variables used in the empirical analysis. "Pre-existing maternal physical factors" include previous uterine scar and physical anomalies. "Other maternal pre-existing conditions" includes heart disease, renal disease and liver disease. * denotes differences in doctor and non-doctor means that are significantly different from zero at the 5 percent level. The comparison of means is performed separately inside and outside of HMO-owned hospitals)

Table II: Raw C-section Rates

	Non-HMO Hospitals		HMO Hospitals	
Panel A: California	Doctors	Non-Doctors	Doctors	Non-Doctors
Any C-section	27.6	29.2	31.1	26.1
	[44.7]	[45.5]	[46.3]	[43.9]
Scheduled C-section	11.0	10.1	12.7	8.2
	[31.2]	[30.1]	[33.3]	[27.4]
Unscheduled C-section	16.6	19.1	18.4	18.0
	[37.2]	[39.3]	[38.8]	[38.4]
Observations	2,775	494,589	521	85,241

	Doctors			
Panel B: Texas	Moms	Dads	Both	Non-Doctors
Any C-section	31.8	30.0	28.9	32.7
	[46.6]	[45.8]	[45.3]	[46.9]
Observations	2,628	5,915	1,475	362,673

Mean C-section rates for births to families in which at least one parent is a college graduate calculated from California and Texas VS data. Standard deviations are displayed in brackets. Details on sample and physician identification are provided in Section 4.1 and in the Data Appendix.

Table III: C-sections and Physician Mothers: California

	Any C-section		Scheduled C		Unscheduled C	
Panel A: OLS	(1)	(2)	(3)	(4)	(5)	(6)
Doctor	-2.13**	-1.68*	0.013	0.021	-2.14**	-1.70*
	[0.78]	[0.69]	[0.60]	[0.54]	[0.65]	[0.66]
Hospital FE?		Yes		Yes		Yes
Observations	497,364	497,364	497,364	497,364	497,364	497,364
Adjusted R-squared	0.17	0.18	0.22	0.23	0.061	0.068
Panel B: Matching	(1)	(2)	(3)	(4)	(5)	(6)
Doctor	-2.11**	-1.75+	0.27	0.052	-1.88*	-1.81*
	[0.87]	[0.99]	[0.56]	[0.68]	[0.78]	[0.90]
Hospital FE?		Yes		Yes		Yes
Observations	94,377	16,920	94,377	16,920	94,377	16,920
Exact match rate	89%	53%	89%	53%	89%	53%

The sample is deliveries in non-HMO hospitals. Effects are displayed in percentage points. Standard errors are in brackets. Doctor is a dummy indicating the mother is a physician. Panel A displays results from OLS regressions, containing the controls summarized in Table 1 as well as their interactions as described in the paper, and month and year dummies. OLS standard errors are clustered by hospital. Panel B displays results from nearest neighbor matching regressions, with matching performed on variables as described in Section 4.2. Abadie & Imbens (2006) analytical standard errors are displayed (+ denotes significance at the .10 level, * at the .05, and ** at the .01).

Table IV: C-sections and Physician Parents: Texas

	Any C-section			
	(1)	(2)	(3)	(4)
Doctor Mother	-2.75**	-2.06**	-3.12*	-2.57+
	[0.83]	[0.61]	[1.58]	[1.52]
Doctor Father	-0.37	0.41	-0.24	0.71
	[0.72]	[0.53]	[1.21]	[1.20]
Hospital FE?		Yes		
Attending FE?				Yes
Observations	372,691	372,691	101,839	101,839
Adjusted R-squared	0.12	0.14	0.09	0.16

Table displays results from OLS regressions. Columns (1) - (2) are for the full sample; Columns (3) and (4) are for the subsample with attending name (years 2005-2007). All regressions include maternal demographic controls, infant information, and clinical risk factors and year and month effects (see Appendix Table A.1). Effects are displayed in percentage points. Standard errors, clustered by hospital in Columns (1) and (2) and by attending in Columns (3) and (4), are in brackets (+ denotes significance at the .10 level, * at the .05, and ** at the .01).

Table V: C-sections and Physician Mothers - HMO and non-HMO Hospitals

	Any C-section		Scheduled C		Unscheduled C	
	(1)	(2)	(3)	(4)	(5)	(6)
Doctor	-2.05*	-1.91*	0.11	0.11	-2.16**	-2.02*
	[0.81]	[0.77]	[0.51]	[0.48]	[0.77]	[0.78]
HMOHosp*Doctor	5.57*	4.80*	2.94*	2.50+	2.63	2.30
	[2.29]	[2.24]	[1.47]	[1.43]	[1.87]	[1.87]
HMOHosp	-4.93**	-4.57**	-2.05**	-1.74**	-2.88**	-2.83**
	[0.44]	[0.50]	[0.25]	[0.26]	[0.35]	[0.41]
HSA FE?		Yes		Yes		Yes
Observations	581,310	581,310	581,310	581,310	581,310	581,310
Adjusted R-Squared	0.16	0.17	0.21	0.22	0.064	0.066

Table displays results from OLS regressions, including controls as in Panel A of Table 3, with the exception of HMO patient which is excluded. Doctor is an indicator the mother is a physician and HMOHosp is an indicator that the birth took place in an HMO-owned hospital. Effects are displayed in percentage points. Standard errors, clustered by maternal HSA, in parentheses (+ denotes significance at the .10 level, * at the .05, and ** at the .01).

Table VI: Summary Statistics: Morbidity and Treatment Intensity

	Non-HMO Hospitals				HMO Hospitals			
	Doctors		Non-doctors		Doctors		Non-doctors	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Maternal morbidity (%):								
Laceration	7.60	[26.51]	8.44	[27.80]	10.94	[31.24]	11.68	[32.12]
Post-partum hemorrhage	2.85	[16.63]	2.81	[16.53]	3.07	[17.27]	4.93	[21.64]
Infection	3.35	[18.00]	4.37	[20.44]	5.95	[23.68]	5.35	[22.50]
Infant morbidity (%):								
Respiratory assistance	2.23	[14.78]	2.49	[15.56]	3.45	[18.28]	4.26	[20.19]
Intubation	2.38	[15.24]	2.48	[15.56]	1.73	[13.64]	2.80	[16.49]
Infection	1.87	[13.56]	2.14	[14.46]	0.77	[8.74]	1.22	[10.97]
Trauma	0.94	[9.64]	1.28	[11.22]	0.77	[8.74]	1.09	[10.38]
Treatment quantity (%):								
Induction	17.00	[37.58]	15.68	[36.36]	21.30	[40.98]	16.31	[36.94]
Vacuum extraction	15.57	[32.26]	16.79	[37.38]	12.67	[33.29]	11.66	[32.09]
Forceps	2.74	[16.32]	2.18	[14.59]	1.53	[12.31]	1.18	[10.79]
Hospital charges	18,010	[37,373]	19,130	[53,252]	-	-	-	-
Observations	2,775		494,589		521		85,241	

Table contains means and standard deviations of dependent variables used in Section 5.3. Maternal and infant morbidity measures are coded from ICD-9-CM codes. HMO-owned hospitals are not required to report hospital charges.

Table VII: Morbidity in HMO-Owned and Non-HMO-Owned Hospitals

	Maternal Morbidity			Infant Morbidity			
	Laceration	Hemorrhage	Infection	Respiratory assistance	Intubation	Infection	Trauma
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Doctor (HMOHosp=0)	-1.17** [0.43]	-0.03 [0.35]	-1.15** [0.41]	-0.064 [0.30]	-0.43* [0.21]	-0.25 [0.23]	-0.31+ [0.17]
Doctor (HMOHosp=1)	–0.97 [1.40]	-1.86* [0.80]	0.70 [1.01]	-0.82 [0.53]	-1.30* [0.76]	-0.57+ [0.33]	-0.26 [0.39]
HMOHosp (Doctor=0)	3.36** [0.54]	1.77** [0.43]	0.31 [0.45]	1.6** [0.53]	-0.026 [0.29]	-1.03** [0.35]	-0.26** [0.09]
HSA FE?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	581,281	581,204	580,801	580,147	580,783	580,669	579,168
R-squared	0.038	0.037	0.038	0.14	0.16	0.11	0.05
Mean of depvar	8.9	3.1	4.5	2.7	2.5	2.0	1.2

Table displays average marginal effects from logit regressions including controls as detailed in Table 5. Effects are displayed in percentage points. The values assumed for indicator variables in the AME integration are noted in parentheses under the variable name. The construction of the morbidity measures is described in Section 5.2. Sample sizes deviate from 581,310 when one or more HSAs is dropped during logit estimation. Standard errors, clustered by HSA, are in brackets (+ denotes significance at the .10 level, * at the .05, and ** at the .01).

Table VIII: Ancillary Procedures and Hospital Charges and Physician Mothers

	Ancillary Procedures			(Log) Hospital Charges		
	Labor Induction	Vacuum extraction	Forceps			
	(1)	(2)	(3)	(4)	(5)	(6)
Doctor Mom	1.6*	-1.5+	0.20	-3.9*	-2.6**	-1.5+
	[0.76]	[0.81]	[0.23]	[1.7]	[0.94]	[0.83]
HMOHosp * Doctor	3.4*	2.5	-0.10			
	[1.4]	[1.7]	[0.46]			
HMOHosp	-0.82	-4.9**	-1.0**			
	[1.1]	[1.0]	[0.38]			
Scheduled C						0.53**
						[0.01]
Unscheduled C						0.62**
						[0.008]
FE?	HSA	HSA	HSA		Hospital	Hospital
Observations	581,554	581,554	581,554	482,831	482,831	482,831
Adjusted R-squared	0.057	0.026	0.010	0.40	0.57	0.68
Mean of depvar	15.8	16.0	2.0		19,124	

Table displays results from OLS regressions including the full set of controls described in Table 3, Panel A. In Columns (1) - (3) the sample includes all hospitals, and these regressions exclude the HMO insurance variable due to collinearity; in Columns (4) - (6) the sample is all non-HMO-owned hospitals. Standard errors, clustered by HSA in Columns (1) - (3) and by hospital in Columns (4) - (6), are in parentheses (+ denotes significance at the .10 level, * at the .05, and ** at the .01).

Table A.1: Summary Statistics: Texas

	Doctors						Non-doctors	
	Moms		Dads		Both			
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Demographics:								
Age	32.37	[3.94]	31.12	[3.86]	32.10	[3.37]	30.29	[4.02]
Mother's education (%)								
Some college			10.94	[31.21]			11.19	[31.53]
College graduate			41.22	[49.23]			51.34	[49.98]
High education			43.01	[49.51]			32.41	[46.80]
Father's education (%)								
Some college	9.32	[29.08]					14.99	[35.70]
College graduate	31.24	[46.36]					41.73	[49.31]
High education	52.47	[49.95]					32.24	[46.74]
Mother's race								
Black	9.48	[29.29]	3.74	[18.97]	3.66	[18.79]	7.44	[26.24]
Hispanic	11.38	[31.76]	13.37	[34.04]	11.93	[32.43]	16.35	[36.98]
Other race	22.15	[41.53]	19.15	[39.36]	28.54	[45.18]	9.86	[29.82]
Zipcode income	29,818	[12,789]	28,904	[13,044]	31,223	[14,261]	25,312	[10,483]
Married	95.89	[19.85]	97.75	[14.83]	99.05	[9.699]	93.23	[25.13]
Mother working			72.71	[44.55]			81.44	[38.88]
Father working	96.19	[19.14]					96.79	[17.62]
Infant information:								
Female	48.10	[49.97]	48.66	[49.99]	50.24	[50.02]	48.67	[49.98]
Very early term (20-36 weeks)	9.17	[28.87]	7.59	[26.49]	7.19	[25.84]	8.19	[27.42]
Early term (37-39 weeks)	31.96	[46.64]	27.52	[44.67]	31.12	[46.31]	26.19	[43.97]
Post-dates ($\leq$42 weeks)	6.16	[24.06]	7.66	[26.60]	6.441	[24.56]	9.14	[28.82]
Very low birth weight	1.18	[10.80]	0.66	[8.09]	0.88	[9.35]	0.98	[9.86]
Low birth weight	6.20	[24.12]	5.17	[22.15]	5.83	[23.44]	4.90	[21.59]
High birth weight	5.67	[23.13]	5.46	[22.72]	4.68	[21.12]	8.26	[27.53]
Prenatal care	98.71	[11.30]	98.28	[13.02]	98.44	[12.39]	98.60	[11.77]
Risk factors:								
Malpositioned fetus	7.04	[25.59]	5.95	[23.66]	6.71	[25.03]	6.61	[24.84]
Diabetes	2.51	[15.65]	2.74	[16.32]	2.44	[15.44]	3.217	[17.65]
Eclampsia	0.30	[5.51]	0.15	[3.90]	0.14	[3.68]	0.26	[5.07]
Smoking	0.27	[5.16]	0.56	[7.45]	0.20	[4.51]	1.461	[12.00]
Hypertension / pre-eclampsia	6.55	[24.74]	4.48	[20.69]	4.81	[21.41]	6.30	[24.30]
Congenital anomaly	0.15	[3.90]	0.017	[1.30]	0.068	[2.60]	0.088	[2.96]
Observations	2,628		5,915		1,475		362,673	

Table contains means and standard deviations of independent variables used in the empirical analysis. The sample is described in the Data Appendix.