Transparency and Medical Interventions in Vital Statistics Reports: Quantitative Research and Analysis

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Abstract of Thesis

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Unnecessary medical interventions in childbirth carry substantial financial costs and can negatively affect health outcomes for childbearing women and their children. Transparency in the reporting of medical interventions has the potential to reduce incidences of unnecessary medical interventions and the poor outcomes associated with them by promoting accountability for maternity care providers and systems, and supplying health care consumers with information necessary for making informed decisions about their care. States publish annual vital statistics reports, and these reports vary in the extent to which they report on medical interventions in childbirth. The aim of this exploratory research is to test whether or not there is a relationship between the level of transparency as measured by state vital statistics reports, and the factors that contribute to and are indicative of high rates of unnecessary medical interventions in the maternity care system. Quantitative research using linear probability and binomial probit regression models are utilized to test for the presence of any such relationship. The results show that there is a slight association between cesarean section rates and level of transparency, with transparency levels being higher in states with very high or very low cesarean section rates. These findings may be helpful in directing advocates to work towards higher transparency in states were cesarean section rates are close to the national average. Future research should be directed to study what underlying factors might contribute towards the relationship between cesarean section rates and transparency.

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Chapter 1: Introduction

In the past century, the rise of the practice of obstetrics has led to a maternity care system that is dominated by the routine use of medical interventions, such as epidural analgesia, induction of labor, augmentation of labor, electronic fetal monitoring, and cesarean section.[12] This highly technical, medical model of birth is standard experience for American, childbearing women.[3] Although average rates and incidences of medical interventions in childbirth are consistently high, there exists wide variation in the extent to which these interventions are utilized at the facility and physician level that cannot be accounted for by medical health and risk factors.[456] Studies have suggested that this variation can be at least partially explained by such factors as a medical payment system that incentivizes quantity of medical procedures over overall outcome, and a legal system that finds physicians culpable for medical malpractice only in cases of under-treatment, even when over-treatment carries substantial costs and risks.[789] The variation in medical intervention utilization rates, as well as the influence of legal and financial factors in medical practice, support the claim that at least some portion of medical interventions in childbirth are unnecessary. Although medical interventions offer tremendous benefit to those who need them, in the absence of indicated need, medical interventions have the potential to cause overall harm.[10]

The movement for increased transparency in the health care system has gained momentum over the past several years.[11] Advocates for transparency argue that transparency holds health care providers accountable for the use of non-medically indicated procedures and sub-optimal outcomes.[12] Publicly accessible information on the

utilization rates of medical interventions in childbirth has the potential to inform maternity care consumers on the care that they can expect to receive and to dissuade physicians from performing unnecessary medical interventions.[1314] It is a worthy goal to strive for transparency in the maternity care system because a decrease in unnecessary medical interventions in childbirth can improve birth outcomes and the health of mothers and infants.

I will critically analyze the role of medical interventions in maternity care using a multi-disciplinary framework with literature from social sciences as well as public health sciences. My aim in doing this is to enrich and contextualize the contributions of these disciplines. The social science perspective draws from historical and feminist literature that includes the works of sociologists and medical anthropologists, and gives a theoretical framework for the negative effects of medical interventions. This framework is in turn supported by the public health literature, which offers concrete statistical information on rates, incidences, trends in, and effects of medical interventions. This in turn contextualized by the theoretical framework. I will use these disciplines to analyze the subjects of legal and financial influences on medical interventions.

This research attempts to answer the question of whether or not a state's transparency level in the reporting of medical interventions is influenced by the extent to which factors that shape the current condition of the maternity care system are present within that state. My methodology employs quantitative data to test whether there is a relationship between medical practice factors and the level of transparency as measured by state vital statistic reports. I have collected the most recent publications of every state vital statistic report, and I have measured their transparency based on whether or not the

states report on medical interventions in childbirth. I also take into consideration what level this information is reported on – either the state, county, or facility level. Based on this analysis, states are determined to be transparent or non-transparent. I then use a binary regression model to test whether a state's transparency level is associated with factors within that state that are indicative of medical practice for maternity care. These factors are cesarean section rate, percentage of births paid for by Medicaid, hospital expenditures per capita, and mean malpractice payment.

I intend to use my findings to help inform and frame advocacy efforts to increase transparency in maternity care. If the test results show one variable to have a stronger relationship with transparency levels than others, then quality maternity care activists can use this variable to frame transparency reform efforts. Furthermore, my research adds to the literature because to my knowledge there is no prior research that analyses the actual published vital statistic *reports* themselves. My research has the potential to illuminate heretofore-unknown patterns in medical practice and transparency, and such information may be best used to advocate for reform that will improve the lives of women and their children.

Social, Historical, Public Health, and Policy Perspectives: A Literature Review and Analysis

This section reviews and analyzes the literature on various perspectives on the background and issues with medical interventions in childbirth and the benefits of medical transparency. The review of these perspectives is divided into two main sections. The first is based in the social science and gives a theoretical and historical perspective for medical interventions in maternity care. The second section takes a public health approach by presenting facts and statistics related to current medical practices in childbirth. This section will also cover the current environment of medical reporting and transparency. Both of these disciplines are reflective of my inspiration for approaching this research topic. By using these two approaches in the literature review, I am better able to enrich and contextualize my research.

The first section of the review contains two components: a brief overview of the history of maternity care and childbirth practices in the last one hundred years. This review tracks a historical progression that illustrates how current medical practices in childbirth came to evolve. The second component is a review of major contributions of feminist scholars writing about medical interventions in childbirth. Issues of reproduction have typically been an important topic of feminist discourse, and this includes medical interventions in childbirth. By reviewing the work of prominent feminist theorist, I am able to convey the ideology that prompted me to address this particular research topic.

In the second section I review public health information related to medical interventions in childbirth. First I review the reasons that merit transparency as a

venerable aim for health care policy. Next, I review the vital statistics, including a brief history of vital statistics, as well as their merits and limitations for public health research. I then provide information for five medical interventions: induction of labor, augmentation of labor, epidural anesthesia, electronic fetal monitoring, and cesarean section. For each intervention, I provide a brief historical background, utilization rates, and associated risks. Lastly I analyze two factors assumed to have an influence in medical intervention utilization rates - economic and legal factors.

The aim of this review and analysis is to provide exhaustive background to both the inspiration for this research as well as to explain why certain variables were chosen to be used in the methodology.

Part I: Social and Historical Perspectives

History

Within the last century, maternity care in the United States has transformed from the midwifery model of birth, characterized by homebirths and a paucity of medical interventions, to the medical model of birth, in which birth is presented as being inherently dangerous and in need of active management by specialized physicians – obstetricians - in order to ensure maternal and fetal safety. In the medical model of birth, obstetricians obviate the capricious and hazardous nature of birth with medical interventions. The background of the rise of obstetrics and its accompanying philosophy

is important for contextualizing the role of medical interventions in contemporary birthing practices.[a]

During the colonial period midwives dominated as birth attendants; but the rise of the practice of obstetrics in the 1800s ensured that by 1900 the United States was divided, with half of births being attended by obstetricians and half by midwives.[15] The women who were able to solicit an obstetrician's services were far more likely to be middle and upper class, while midwives attended birth for women who were primarily poor, urban, and/or immigrants. Obstetricians at this time desired unchallenged authority over childbirth, and they saw the continuing practice of midwifery as a barrier to solidifying the legitimacy of obstetrics. They, in conjuncture with socially elite women, who attributed poor birth outcomes to the attending midwives rather than the circumstances of poverty, began to advocate for legal regulations to restrict, and at times, even outlaw the practice of midwifery. Unlike physicians, midwives were unorganized, and did not undergo any standard training. Many midwives were illiterate and poor, making them easy scapegoats for increasing rates of maternal mortality.[16] By 1936, midwives were attending 12 percent of births, and by 1952 this number had decreased to 4.5 percent of births.[17]

The waning influence and presence of midwives in the early half of the twentieth century coincided with an increase in the acceptance of allopathic medicine and hospitals, which, in combination, created a prime environment for the rise of obstetrics. Dr. Joseph DeeLee, the chair of Obstetrics and Gynecology at the University of Chicago, played a

[a] This review draws heavily from the book *Lying-in: A history of childbirth in America (Expanded edition)* (1989) by Richard and Dorothy Wertz, and to a lesser extent *Midwifery and Childbirth in America* (1997) by Judith Pence Rooks.

formative role in not only the practice of obstetrics, but also its underlying philosophy.[18] DeeLee called childbirth "pathogenic"[19] and argued that

> the powers of natural labor are dangerous and destructive in many instances to both mother and child, and that interference by a skilled [obstetrician] at the proper time can prevent a goodly portion of this danger and much of this destruction.[20]

Deelee believed that the safest birth was a heavily managed birth; birth began with sedation at the onset of labor, and then the administration of ether taking place at the second stage, followed by an episiotomy and assisted delivery with forceps.[21] Medical interventions were used, not to improve upon, but to correct for the physiologic process of childbirth. This can be witnessed in physician attitudes, for example a Texan obstetrician who wrote in 1937 that episiotomy "is unnecessary in approximately 10 percent of primipara."[22] The belief that it is an anomaly to *not* be in need of a medical intervention during childbirth was largely embraced by obstetricians as a community. Early editions of *Williams Obstetrics* in the first half of the twentieth century echo, though perhaps less intensely, the attitudes of DeeLee: that obstetrical control over birth is justified by its inherent pathology.[23] This view was further reinforced by the common outbreaks of puerpal fever around the turn of the century. Regardless of the actual health of their patients, obstetricians had to regard them as being at equal risk for developing this serious illness. They came to understand birth as being the principal cause for that illness, even though it was later determined that it was actually the increased use of medical interventions, and sanitary conditions in the hospitals that were largely responsible.[24]

Hospital births appealed to women because they offered them freedom from pain in childbirth, an attentive nursing staff, and most importantly, maximum safety. Like any other large institution however, many of the policies and procedures in hospitals were put in place to meet the needs of the hospital and its staff as opposed to the women it served. In addition to safety, speed and efficiency were also objectives in hospital birth. From the 1940s to the 1960s, women could expect to begin labor in one room where they would receive a mixture of an analgesic and scopolamine, known as "twilight sleep." When they were ready to delivery they would be wheeled into the delivery room, where they would be strapped on to a table with stirrups by the hands and feet in the lithotomy position. Women were allowed a fixed amount of time to be in the delivery room, and since they were often incapacitated, the speed of labor was artificially sped up and slowed down by medical interventions. Surrounding women in the delivery room would be an array of medical equipment used for anesthesia, infant resuscitation, and other medical interventions. Medical interventions were often used to counteract the effects of a primary intervention: the use of anesthesia required oxytocin, forceps and the lithotomy position required episiotomy, which required local anesthesia.[25] Thus began the phenomenon which is now referred to as the cascade of interventions.[26]

The movement towards safety through obstetric control and medical interventions in hospital births at times had the effect of creating a birth experience for a woman that was isolating and dehumanizing. After publishing a piece in 1957 on the subject of "cruelty in maternity wards," the *Ladies Home Journal* was flooded with letters from readers on their own experiences with the maternity care system. Only one in seven of these letters reflected positive experiences.[27] In the letters, the women reflected on

memories such as being left strapped down in the lithotomy position for hours, losing skin from fighting the straps, being snapped at and spoke to dismissively by nurses and physicians, being ready to deliver but having to wait because the staff was not prepared, and feeling as though their genitals had been put on display.[28] Women were usually alone during the birthing process; hospitals restricted visitation from spouses, family members, and friends, and women could be left in isolation for days postpartum.[29]

Given the frequency of these negative experiences, it is not surprising that it was during this time that the "natural childbirth" movement began to gain popularity. Grantly Dick-Read's book *Childbirth Without Fear* helped contribute to the growing momentum behind the movement. Dick-Read wrote about the "fear-tension-pain-syndrome," which introduced the notion that pain in childbirth is derived from psychological origins. In *Childbirth Without Fear* Dick-Read advised women on how to avoid pain and fear through the use of deep breathing and muscle strengthening. He attested to the virtues of natural childbirth, but did so with a Victorian sentimentality that glorified motherhood. Physicians feared that women influenced by Dick-Read still very much felt pain in childbirth, but were reluctant to express it for guilt of falling short of the natural labor that was presented as the moral and feminine ideal in *Childbirth Without Fear*. In 1959 Marjorie Karmel's *Thank You, Dr. Lamaze* was published, and the Lamaze technique soon became the method most associated with natural childbirth in the 1960s, an association that remains today. Both *Thank You, Dr. Lamaze* and *Childbirth Without Fear* instructed women on methods of gaining control and avoiding pain during childbirth, but *Thank You, Dr. Lamaze* lacked the moral reasoning of *Childbirth Without*

Fear and instead focused primarily on physical, rather than emotional, pain alleviation strategies, which made it more successful.[30]

Medical practice seemed to be little effected by the movement towards natural childbirth. Obstetricians reduced the use of forceps and amount of anesthesia administered, but both interventions along with episiotomy and Demerol, could still be used in what would be considered a natural childbirth. Interventions were so routine that "Probably only a Caesarean section or Twilight Sleep would not have qualified for natural birth in American practice."[31] Editions of *Williams Obstetrics* from 1950 onward acknowledge that role of social and psychological influences in childbirth, but lack a cohesive strategy for encompassing these factors into medical practice.[32] So while natural childbirth gained acceptance as a concept and ideology, it was largely unable to significantly change the medical model of birth.

In the 1970s, educated middle and upper class families starting turning to homebirth as an alternative to the widespread use of technology in birth and lack of family involvement and control.[33] Hospitals were responsive to this criticism, and began to incorporate birthing rooms into maternity wards,[34] and also permitted the presence of husbands in these rooms.[35] In 1978 a group of obstetricians, nurses, nurse-midwives, and other health professionals gathered to publish a booklet *Family Centered Maternity/Newborn Care in Hospitals*, which further emphasized the need in obstetrics to treat not just the patient, but the woman, and not just the woman, but also the family unit.[36] But just as in previous decades, movements towards achieving natural childbirth in hospitals proved to be superficial. Routine medical interventions were still standard; in 1979 almost two-thirds of women had an episiotomy during birth.[37] "Professional

dependence on technology and pharmacological methods of pain relief and chemical stimulation of labor" as well as medical interventions such as "elective induction of labor, the routine use of regional or general anesthesia for delivery, the routine use of forceps for delivery, routine episiotomy, early clamping of the umbilical cord, obstetrical intervention in placenta expulsion" continued to play an essential role in obstetric medical practice throughout the 1970s,[38] and continue to play a large role in maternity care today.

Feminist Interpretations of the Role of Medical Interventions

The concept of the medicalization of childbirth is a product of feminist scholars from anthropological and sociological disciplines. With the application of fundamental feminist principles and values to American childbirth, these scholars have been able to critically analyze the interconnected roles of power, gender, and technology in the medical practices for modern childbirth. The feminist literature on medical interventions during childbirth shares many of the same influences with broader feminist literature as well as its historical progression, beginning with Marxism and the culture versus nature dichotomy, and in later periods standpoint epistemology, and postmodernism.

Feminist sociologist Ann Oakley wrote extensively on the negative impacts of the medicalization of childbirth on women in the 1980s. Oakley criticized medical birth practices, and interpreted them as a "combination of biochemical theories and entrenched views on femininity which parade as diagnosis and explanation."[39] According to Oakley, the experience of motherhood is shaped by the context from which one enters motherhood. Medicalization has transformed childbirth from a social event to an isolated

one. Building on this understanding, Oakley was one of the first scholars to infer a connection between medical interventions during childbirth and postpartum depression.[40]

In a patriarchal society reproduction is used as a tool of oppression against women, and the medicalization of childbirth leads to a loss of autonomy.[41] Barbara Katz Rothman, another feminist sociologist from the 1980s, shared Oakley's beliefs that medicalization erodes women's autonomy.[42] Both Rothman and Oakley considered social support during childbirth as a superior alternative to medical interventions.[43] In spite of the fact that in both cases, women are relying on a third party for support during childbirth, only medical interventions are seen by them as negatively affecting autonomy.

Rothman understood choice and information to be the cornerstone of the reproductive health movement. She wrote that the introduction of new reproductive technologies and the presence of a greater variety of choices does not necessitate a better reality for women, since women who choose not to use the new technology can considered bad mothers as a result. Rothman gave the example of an electronic fetal monitor leading to a cesarean section indicated by fetal distress to illustrate her argument.[44] In this interpretation of reproductive technology and choice, there is no real choice because society reflexively assigns greater value to positivist and capitalist advancements in technology than to women's choices and autonomy. Therefore, when technology offers women a new choice for reproductive practices, in reality the pre-technological practice is no longer a valid option, and women's choices and autonomy are limited.

Both Oakly's and Rothman's theories are essentialist: all women who have medical interventions in childbirth are victims of patriarchy. Like their contemporary

feminist theorists, Rothman and Oakley were influenced by the nature/culture dichotomy, which asserts that women are associated with nature and men are associated with culture, and from this dichotomy men conclude their superiority over women based on the assumption that culture is superior to nature.[45] Therefore, the natural functioning of a woman's body in childbirth is inferior to the culturally produced medical interventions performed by a male physician. While the nature/culture dichotomy is a useful tool for understanding harmful and oppressive practices, its affect is to essentialize women as victims and men as supporting patriarchy. [b]

Influenced by the nature/culture dichotomy and Marxist theory, both Oakley and Rothman explained medical interventions during childbirth as an extension of the body-as-machine ideology. Oakley wrote that, "obstetrical interventions in delivery equals the repair of mechanical faults with mechanical skills"[46] and Rothman wrote that, "Electronic monitoring was widely accepted in medicine with almost no reservation because it fits so perfectly into the medical model of the body as machine."[47] These contributions were heavily expanded upon by medical anthropologist Emily Martin. Martin combined the western, Cartesian body-as-machine ideology with Marxist ideology to interpret the role of medical interventions in childbirth. In addition to understanding the body, or in the case of childbirth specifically the uterus, as a machine, Martin interprets the woman as the laborer, the physician as the foreman, the hospital as a factory, and the baby as the product/commodity. The separate roles of uterus as machine and woman as laborer ensure that women's feelings and emotions are abstracted from the labor process entirely. Martin writes that

[b] The review of the works of Ann Oakley and Barbara Katz Rothman was inspired by the review of their works from Fox, B., & Worts, D. (1999). Revisiting the critique of medicalized childbirth: A contribution to the sociology of birth. *Gender and Society*, 13(3), 326-346.

> medical metaphors applied to women's bodies ... involve a hierarchical system of centralized control organized for the purpose of efficient production and speed. Medical attention usually is given when his system undergoes breakdown, decay, failure, or inefficiency.[48]

If the pace of labor does not meet standardized rates, the labor is considered defective. The physician as foreman analogy ensures that the role of the physician is to manage labor and asses productivity, and this is done with the use of medical interventions, such as artificially breaking the bag of waters or administering Pitocin. Natural birth is assumed to be traumatic to the baby and therefore harmful to the product. The medical intervention of delivery by cesarean section is therefore superior to natural, physiologic birth. Physicians may can liberally use this and other interventions as long as the emphasis continually remains on the product – the healthy baby. Martin notes that the use of medical interventions in childbirth is an example of when "norms from the realm of production are inappropriately extended into other realms."[49]

Martin's extensive analysis of medical metaphors and Marxist ideology served as a foundation for anthropologist and birth activist Robbie Davis-Floyd. Davis-Floyd writes

> the labor process necessarily entails close monitoring of the mother by procedures that enact the underlying view that the female body-machine is inherently defective and generally incapable of producing perfect babies without technological assistance from professionals, even when such monitoring causes the mother considerable stress and increased pain.[50]

Expanding from this point, Davis-Floyd identifies the medicalization of birth as the technocratic model, representing a merger of technology and power. In the technocratic

model, the institution is the primary social unit and is more important than the individual or the family. Through use of obstetric interventions, the institution of the hospital is able to conform all those laboring within it to its own ideal. As Davis-Floyd explains, "In spite of the uniqueness of each birth and each woman who gives birth, standardized obstetrical procedures give this, the ultimately transformed process, the reassuring appearance of sameness and conformity to the socially dominant reality model."[51] Davis-Floyd identifies how each specific obstetric procedure sends messages to the woman that her body is defective, harmful to her baby, and the she needs medical interventions in order to correct for inherent flaws. Davis-Floyd also explains how these interventions negatively impact the wellbeing of the woman and further render her body incapable of delivery a baby on its own. The overall effect is to transform her "into a woman who has internalized the core values of American society: one who believes in science, relies on technology, recognizes her inferiority (either consciously or unconsciously), and so at some level accepts the principle of patriarchy."[52]

Like Oakley, Rothman, and Martin, Davis-Floyd exclusively interprets medical interventions during childbirth as having an entirely harmful and disempowering effect on women. Even after analyzing multiple birth stories in which women to at least some extent embrace medical interventions, Davis-Floyd acknowledges that she does not fully comprehend why women complacently subject themselves to interventions. Feminist scholars Bonnie Fox and Diana Worts who wrote after Davis-Floyd employed standpoint epistemology to study women's reasoning for accepting interventions. Fox and Worts are in line with other feminist theorists in the 1990s who were dissatisfied with the essentialist nature of second wave feminist theory. Instead of focusing on the oppressive

elements of medical interventions, Fox and Worts chose to examine how women employed agency by choosing to accept medical interventions while navigating through options during childbirth. They found that having or not having a medical intervention was not associated with a positive or negative experience during childbirth; instead, the most influential factors in satisfaction were the minimizing of pain and the feeling of clear-headedness and control. They further found that women who had significant social support were less likely to feel pain strongly and were more likely to feel in control. For women who lacked such support, medical interventions greatly increased their satisfaction with the labor experience. Fox and Worts therefore presented medical interventions as a substitution for traditional, social support in labor. Their critique of medicalized childbirth then was not solely focused on the use of medical interventions, but the lack of social support that causes women to rely exclusively on such interventions.[53]

As with many feminist works in general, more recent feminist interpretations of medicalized birth have been influenced by postmodernism. For example, in "Medicalization, Natural Childbirth, and Birthing Experiences" (2007), Sarah Jane Brubaker and Heather Dilaway aim to deconstruct the dichotomy of medicalized versus natural childbirth without taking for granted their historical connotations in the literature. Their re-definition is therefore based on how these two models "shape and conflict with women's subjective experiences of childbirth."[54]

The inspiration for this research is heavily rooted in this feminist literature of medicalized birth, but it does not follow the herein to now presented progression of feminist thought. "The vanishing mother: Cesarean section and 'evidence-based

obstetrics'" by Claire Wendland can be seen as a more direct recent influence for this research. In this piece, Wendland critically analyzes the medical construction of evidence-based medicine, particularly that which is used to promote an increased use of cesarean section. Wendland examines three studies that influenced hospital and insurance policy to no longer offer vaginal deliveries for women who had had a previous cesarean or women with breech positioning. She notes that when weighing the risks and benefits of cesarean section for these groups of women, these studies that fail to weigh the subjective quality of the birth experience, maternal-infant bonding, and long-term effects such as breastfeeding, and the injury associated with cesarean section itself as factors.[55] Similarly, this research too is primarily concerned with focusing on the factors that influence medical practice in order to contributed to a greater feminist understanding. Like Wendland, my research is focused on the medical practice itself, rather than analysis of it's symbolism or women's subjective experiences.

Part II: Public Health and Policy Perspectives

Vital Statistics

Vital statistics are composed of data derived from certificates of birth, death, marriage, marriage dissolution, and their related reports.[56] In 1902 Congress passed an act establishing the Bureau of the Census to "develop and maintain a system of registration (of births and deaths) that is uniform in such matters as law, forms, procedures, and statistical methodology."[57] In 1946 the Public Health Service Act moved this responsibility under the jurisdiction of the National Center of Health Statistics

(NCHS) with the creation of its Division of Vital Statistics.[58] State law requires the completion of the birth certificate for all live births, and federal law mandates collection of birth certificate data.[59] The standard certificate of live birth is produced by the federal government, and contains the basic minimum set of data that is deemed necessary for the collection and publication of vital statistics that are comparable at the local, state, and national level.[60]

The Standard Certificate of Live Birth includes a short form that collects demographic information, and a long form that collects medical information.[61] It has been modified twelve times since it was first introduced.[6263] The certificate has always collected information on the mother and child's name, time and location of birth, county, and race. It has been revised to include such information as the name of the facility of the birth setting, Apgar score, birth weight, and mother's education. In 1989 the certificate was revised to collect data on method of delivery and obstetric procedures, as well as prenatal care, maternal risk factors, complications, and neonatal anomalies.[64]

Birth certificate data "are a primary means of gathering uniform, population-based information on maternal and perinatal health."[65] In addition to being used to collect annual reports, vital statistics are used for legal and administrative purposes. They are used by public health agencies to plan and evaluate programs. Vital statistics have been used for such programs as the Centers for Disease Control (CDC) Safe Motherhood Initiative,[66] the Federal Maternal and Child Health Block grant program, the Prenatal Care Assistance Program, and Women, Infants Children (WIC).[67] They are also used for public health research and administration to measure population growth, demographic changes, and "social problems" such as teen pregnancy and out-of-wedlock births.[68] Vital

statistics are useful for perinatal and obstetric research because they are representative and give researchers the ability to study subpopulations. Vital statistics have been used extensively in research to measure such topics as cesarean section,[6970] birth attendants,[7172] and induction of labor.[7374]

The method for gathering birth certificate data exists within a decentralized, cooperative system.[75] Hospital personnel, such as unit secretaries, nursing staff, designated electronic birth certificate personnel, and physicians are responsible for collecting and entering birth certificate data.[76] The individual obtains the information from the medical chart or the mother, but there is no standardized method of collection.[77] Once collected, the data is sent electronically to the local and then state Bureau of Vital Statistics. The NCHS then purchases the information from the states.[78]

The accuracy of vital statistics varies. They tend to be accurate for measuring short form demographic data,[7980] such as race and ethnicity.[81] Studies have also found birth certificate data to accurately measure birth weigh,[828384] Apgar score, [8586] obstetric history,[87] method of delivery,[8889] and induction of labor.[90] Studies have shown birth certificate data to be unreliable for measuring gestational age, which is not standardized,[91] prenatal care,[9293] and maternal comorbidity[94] such as genital herpes[95] and pre-pregnancy and gestational diabetes.[96]Inaccurate data is generally underreported rather than over-reported.[97] The underreporting of birth certificate data stems from the problem that collection methods are not standardized and there is no standard training required for collecting birth certificate data. In particular, medical information is at risk of not being collected because individuals who are not familiar with medical terminology may not

recognize the presence of a medical complication or intervention if their sole point of reference is a physician's chart.[98]

Several studies have examined the role of birth certificates and vital statistics in influencing medical practice and policy. Starr & Starr (1995) have written on how information from birth certificates was used in government programs to establish paternity for the children of unmarried mothers.[99] Krieger et al (1997) analyzed ways in which information collected from birth certificates and vital statistics data can be used to address problems of social and economic inequalities in healthcare in order to inform welfare policy and advocate for financing and providing healthcare services.[100] Most recently, in 2008 Chapman et al studied the impact of the inclusion of breastfeeding status in the 2003 revision of the Standard Certificate of Live Birth on breastfeeding promotion policy.[101] Although this last study is the most similar to my research out of all of these, there is nothing in the literature that examines the annual vital statistics reports in any systematic way.

Transparency

My research is based on the assumption that transparency of medical practices is a worthy ideal. In recent years, there has been an influx in research and advocacy for transparency in the health care system in conjuncture with efforts for positive reform.[102][103] Public reporting of medical practices and outcomes has the potential to increase competition in the health care system, help providers with the use of performance benchmarks, motivate insurers to reward quality care with financial incentives, and assist health care consumers in making informed decisions.[104] Federal,

state and local government have begun to pilot programs for public reporting with largely successful results.[105][106]

Transparency needs to be a goal for not just the general health care system, but for maternity care specifically. Publicly viewable intervention rates at the facility or provider level increase accountability, which in turn influences medical practice to be evidence-based and in line with recommended levels.[107] Ultimately, the goal of public reporting for maternity care is to create increased safety and consumer satisfaction.[108] Without this information, it will be difficult to put into effect the quality improvements necessary to improve the value of maternity care.[109] Although there continues of be a lack of useful maternity care data,[110][111] study results have shown public reporting to have a positive impact on quality maternity care, even more so than other medical specialties.[112] A 2003 study showed that 88 percent of public-reporting hospitals engaged in quality improvements to reduce hemorrhage for mothers versus 9 percent of hospitals that did not publicly report.[113] The authors concluded that because hospitals desire to have a positive public image, public reporting motivates them to adopt quality measures.[114]

In addition to improvements in quality, safety, and consumer satisfaction, public reporting of medical practices and outcomes is essential in maternity care so that patients can make informed decisions about their care. In the "Ten Steps of Mother-Friendly Care," step two "insures that women will have accurate, descriptive, and statistical information about the practices and procedures for birth care at their place of birth, including measures of interventions and outcome."[115] Because there is wide variation in cesarean section and obstetrical intervention rates at the facility level,[116][117] women need access to maternity care data at the facility level in order to avoid potentially unnecessary

interventions, and to select a birth setting that will best suit their individual needs.[118][119] Studies have consistently demonstrated that consumers are interested in information on health care and hospital quality.[120][121] Even when consumer choice is limited by insurance plans, consumers can find publicly reported health care data useful for discussing their desired care with their providers.[122]

Currently two states, Massachusetts and New York, have legislation that requires hospitals to publicly report data on cesarean section and obstetric interventions to maternity care consumers. In 1987, Massachusetts passed An Act Requiring Certain Disclosures to Maternity Patients By Admitting Hospitals, which required hospitals to provide information on annual primary and secondary cesarean sections, vaginal birth after cesarean, utilization rates of external and internal electronic fetal monitoring, inductions, epidurals, as well as other maternity care information.[123] In 1989 New York State passed the Maternity information Act, which required hospitals to provide a pamphlet to prospective mothers and, by request, the general public, with the hospitals' cesarean section, and labor induction rate, as well as the rates of other obstetric procedures.[124] In 2005 an investigation by the Office of the New York City Public Advocate revealed that none of New York City's 44 hospitals were in compliance with this legislation.[125] Following the investigation and subsequent report, local maternity care quality advocacy organizations were able to change this so by 2007, all hospitals were fully compliant.[126]

Information on medical practices in maternity care are also made available by two grass-roots efforts: *The Guide to a Healthy Birth* and the Birth Survey. *The Guide to a Healthy Birth* is published by the organization Choices in Childbirth (CIC), and provides

expectant mothers with cesarean section rates at the facility level. However, there are only two editions of *The Guide*, and they cover the New York City and Philadelphia metropolitan area.[127] The Birth Survey was created in 2006 as a product of the Grassroots Advocates Committee of Coalition for Improving Maternity Services (CIMS). The goal of the Birth Survey is to obtain medical intervention rates for all states at the facility level, and to present the information online to help women make informed choices.[128] Because legislatively there are only two states that mandate intervention rates at the facility level, the role of activists and grass-roots organizations is essential for improving women's access to this information.

To my knowledge, there is nothing in the literature that specifically analyzes predictors of a state's transparency level. No prior research examines the factors that may make one state more likely to be transparent in medically reporting than another state. A 2002 study reported on the elements that lead to successful implementation of transparency policy within one state, but this was not comparative.[129] A 2008 study recommended that states need an environment of trust in order for transparency to be successful, but such a common factor is not quantitatively measureable.[130] A 2010 study found that regions were more likely to have publicly accessible medical reporting if professional medical associations within the state released their own reports, but there was no further inquiry into why some professional medical associations were more likely to conduct their own reporting than others.[131] As of the present, there is no information as to what factors are common within states that adopt successful medical transparency programs.

Because of the necessity, usefulness, and general lack of publicly reported information on rates of medical interventions during childbirth, publicly reported vital statistics have a potential to increase quality and assist consumer choice. Vital statistics do not require the creation of new information systems, and birth certificate data on medical interventions are already routinely collected. Improvement in the collection strategies and dissemination of data have the potential to make vital statistics reports an essential resource for those who need access to this important data. If all vital statistics reports reported on medical interventions in childbirth at the facility level, this would greatly improve transparency in maternity care.

Interventions: Development, Incidences, and Effects[c]

- **Induction of Labor**

In 1953, Vincent du Vigneaud invented a synthetic form of oxytocin, earning him the Nobel Prize for chemistry in 1955.[132] Synthetic oxytocin, trade marked as Pitocin, was incorporated into standard obstetric practice by the 1960s. Piticon was administered via IV in dilute solution form, a regimen which has remained largely unchanged.[133] Utilization rates of Pitocin for induction of labor were not nationally measured until the 1989 United States Standard Birth Certificate revision, however a New York City study from the 1950s found that almost half of laboring women used Pitocin for elective induction of labor.[134]

[c] Many of the sources for this section were originally found in Sakala, C., & Corry, M. (2008). *Evidenced-based maternity care: What it is and what it can achieve*. New York, NY: Milbank Memorial Fund.

In 1989, vital statistics recorded that 9 percent of women had their labors induced; this figure more than double by 2003 to 21 percent of women.[135] However validation studies with birth certificate data suggest that vital statistics underreport induction rates, and that actual rates of inductions hover between 24 and 61 percent.[136] A 2006 survey of over 1500 mothers reported that 41 percent of women felt pressure from their health care provider to induce labor, and 34 percent of women began their labors with medical induction. Of those that were induced, the most frequently used method was Pitocin (89 percent), followed by artificially breaking the amniotic sac (49 percent). The most common reasons given for induction were the maternity care provider's belief that the pregnancy was post term[d] (25 percent), maternal health reasons (19 percent), the mother's desire to end the pregnancy (19 percent), and the maternity care provider's concern over fetal size (17 percent),[137] despite research that shows that inductions done for a large fetus have no clinical benefits.[138]

Inducing for fear of a post term pregnancy (over 42 weeks) is also problematic because prenatal estimates of gestational age have a margin of error of ± two weeks, therefore an induction of labor may result in the birth of a pre-term infant.[139] Between 35 and 41 weeks gestation the fetal brain increases its size by five times, so inducing a pregnancy before 41 weeks, even if inadvertently, can have negative developmental effects for an neonate.[140] In comparison with induction at 42 weeks gestation, induction of labor at 41 weeks has no observable benefits and is associated with a greater likelihood of the use of other medical interventions and complications.[141] Despite these risks, from 1990 to 2002 the average gestational age for induction of labor fell from 40 to 39 weeks.[142] Induction of labor is positively associated with postpartum hemorrhage and

[d] Average 41 weeks

transfusion, increased length of postpartum hospital stay, costs, utilization of electronic fetal monitoring, epidural anesthesia, assisted delivery, and cesarean section.[143144145146] Research also shows that rates of induction of labor vary widely by facilities and providers, and that the variation cannot be explained for by health reasons.[147]

- **Augmentation of Labor**

In the 1950s, obstetrician Emmanuel Friedman conducted studies on the average length of labor. His conclusion that labor should progress by one-centimeter dilation per hour largely influenced the practice of active management of labor in obstetrics.[148] In 1969, Keiran O'Driscoll, MD, condocted the Dublin trials at the National Maternity Hospital in Dublin to test Friedman's theory under the application of active management. In the trials, women in active labor were admitted to the hospital and had their amniotic sac artificially broken, and then were given synthetic oxytocin if labor did not progress at Friedman's suggested pace. O'Driscoll's belief that a quicker labor resulted in fewer complications was confirmed by his study findings,[e] and he coined the phrase *dystocia*, meaning prolonged labor lasting more than twelve hours,[149] which is now widely referred to as "failure to progress."[150]

In the 1950s the upper normal definition of labor was considered 36 hours. It then dropped to 24 hours in the 1960s and was 12 hours by 1972. At that time, active management of labor with synthetic oxytocin for the augmentation of labor was standard medical practice, and it is also at that time that the cesarean section rate begins to grow in the United States.[151] As the number of cesarean sections steadily increased, the diagnoses

[e] It is worthwhile to note that the mothers laboring in the Dublin Trials received continuous labor support, a practice that is rarely utilized in contemporary American maternity care.

of *dystocia* more than tripled from 3.8 percent in 1970 to 11.6 percent in 1989,[152] and then grew to 16.1 percent by 1995.[153] In 2006, 55 percent of women reported having their labors augmented with synthetic oxytocin.[154] Twelve hours is still the widely accepted maximum allotted time for a safe delivery to occur, and labor that has not completed by that time is treated with cesarean section.[155] This continues despite the fact that the twelve-hour time frame was invented when the use of epidural anesthesia, which has been shown to lengthen the process of labor, was less prevalent than it is today. Furthermore, the twelve-hour figure was invented without reference to how much time women spent laboring at home before arriving at the hospital.[156] Today, *dystocia* is the diagnosis responsible for over half of primary cesarean sections.[157] The effects of synthetic oxytocin on labor are similar to the side effects of synthetic oxytocin for induction of labor.

- **Pain Medication**

In the early half of the twentieth century women were drawn to give birth in hospitals because of technological advancements in medicine. On par with, or perhaps even more important than the promise of safety was the promise of a pain-free birth. In the 1850s, physicians began to use chloroform and ether to relieve pain in childbirth.[158][159] In 1914 *McClure's Magazine* published an article praising the use of "Twilight Sleep" in Germany.[160] Twilight Sleep involved the application of morphine and scopolamine at the onset of labor. The morphine was used for pain relief and the scopolamine erased the memory of labor. Ether or chloroform were applied at the second stage of labor for further pain relief.[161] However, while under scopolamine women continued to be

conscious. The drug had the effect of lowering inhibitions, and though they would fail to remember afterwards, women would often kick, scream and cry, during labor and would be physically restrained by staff.[162]

After hearing the use of Twilight Sleep overseas, American women campaigned for the right to have access to a pain-free delivery. Although physicians were at first wary of its safety, women, many of them feminists and suffragists, were able to successfully influence obstetricians to incorporate Twilight Sleep into their practice.[163] By the 1920s, relief from pain was considered an integral aspect of obstetrics. A 1926 edition of *Williams Obstetrics* stated that "all intelligent women at present demand to be spared as far as possible from the suffering incident to the completion of labor."[164] By the 1940s, Twilight Sleep was routinely used. Physicians appreciated it for making women less assertive during labor and delivery and it allowed for the routine use of other interventions, such as the routine use of forceps.[165]

The natural childbirth movement in the mid-twentieth century influenced physicians to use lower doses of anesthesia, but pain medication continued to be widely applied in labor.[166] Technological advancement such as the use of plastic catheters in the 1960s and epidural blocks in the 1980s made the use of epidural anesthesia even safer and more predictable.[167] Today, 86 percent of women report using some kind of pain medication. Seventy-six percent of women elect to use epidural or spinal anesthesia, making it the most commonly used medication for childbirth. Narcotics and general anesthesia are less frequently used.[168]

Epidural anesthesia can negatively affect a woman's ability to push, lead to complications and the use of other interventions,[169] and lengthen labor.[170] Other

undesirable impacts on the mother are immobility, fever, itching, and perineal tears. Epidurals are also associated with fetal risks such as rapid heart rate and newborn disadvantages such as lower newborn assessment.[171]

- **Electronic Fetal Monitor**

In 1969, Corometrics Medical System introduced the electronic fetal monitor to the market. The product raised a profit of $467,000 in its debut year, and by 1973 the revenues increased over 1000 percent to $5 million.[172] In the 1970s electronic fetal monitors were staples in maternity care units in the United States.[173]

The electronic fetal monitor is used to diagnose preterm labor,[174] and its routine, continuous use has been shown to reduce neonatal seizures.[175] However, experts recommend that continuous use of the electronic fetal monitor throughout the labor process is only appropriate for high-risk pregnancies,[176] and its continuous use amongst low-risk maternity care patients is controversial in the medical literature.[177] Continuous electronic fetal monitoring on low-risk patients has no effect on reducing cerebral palsy or perinatal death,[178] and is associated with an increase of other medical interventions, such as augmentation of labor, epidural anesthesia, instrumental delivery, and cesarean section.[179] Furthermore, continuous use of the electronic fetal monitor can negatively impact a woman's experience of labor and delivery by decreasing mobility, contact with her partner, and time spent with labor nurse staff.[180] Other problems with the electronic fetal monitor include the lack of standardization of its interpretation.[181] When electronic fetal monitors are interpreted correctly, they are used to detect reversible fetal hypoxia, which occurs in no more than 2 percent of all births.[182] The lack of standardized

interpretation and the infrequency of detectable complications result in a Type I error – detecting a problem when truly one does not exist.

Despite these controversies, the electronic fetal monitor is pervasive in present day maternity care units. In 2006, 94 percent of women reported the use of the electronic fetal monitor during their labors, and of those women who were monitored 79 percent reported that the electronic fetal monitor was the only method used to monitor their labors. The vast majority of women who are monitored reported continuous electronic fetal monitoring as opposed to intermittent electronic fetal monitoring.[183] Although 72.4 percent of labor and delivery nurses believe that intermittent fetal monitoring should be the standard of care, and 87 percent are willing to provide intermittent fetal monitoring, 53.9 percent feel as though low nurse to patient ratios serve as a barrier in providing this care.[184] Because a reduced nursing staff benefits hospitals economically, and because it is believed to reduce medicolegal risk, and because hospitals lack nursing staff trained in intermittent fetal monitoring, continuous electronic fetal monitoring continues to be standard practice in maternity care.[185]

- **Cesarean Section**

Historically, the cesarean section has been an extremely dangerous procedure,[186] performed mostly on dead and dying women.[187] However, by the 1930s, medical improvements had reduced the mortality rate associated with cesarean section to 20 percent.[188] By 1965 the national cesarean section rate was 4.5 percent, with an associated mortality rate of less than 1 percent.[189] As the cesarean section steadily became safer, if indicated, it was more frequently performed during early labor or at the onset of labor.[190]

The cesarean section rate grew steadily from 5 percent in 1970, to 10 percent in 1975, and to 17 percent by 1980.[191] By 1983 the cesarean section was the second most common surgery in the United States.[192] The cesarean section rate peaked in 1985 when 25 percent of births were delivered via major abdominal surgery,[193] but began to decline afterwards. In 1995, the cesarean rate dropped to its lowest point since it had begun to rise at 20 percent.[194] However, this was short lived, and between 1997 and 2007 the number of annual cesarean deliveries performed grew by over 107 percent,[195] representing nearly a third of all births.[196]

The drop and then rise in cesarean sections in the 1990s can be accounted for by a drop in vaginal birth after cesarean (VBAC). When the cesarean section rate hit a low point in 1995 this corresponded with the highest rate of VBAC in United States history at 35 percent.[197] A decade later this figure dropped below 10 percent,[198] and 92 percent of women with previous cesarean delivery who gave birth had a secondary cesarean delivery.[199] Academic journal articles from the turn of the twenty-first century contributed to the decline of VBACs. McMahon et al (1996) found that women who had had a previous cesarean delivery for their first pregnancy and who underwent a trial labor for their next birth were twice as like to experience major complications than women who had a planned secondary cesarean section (1.6 versus 0.8 percent). Overall maternal complications were not statistically significantly different, and Apgar scores, admissions to the neonatal intensive care unit, perinatal and maternal mortality were the same for both groups.[200] In 2001, another study found that uterine rupture occurred in 1.6 per 1000 women with planned secondary cesarean delivery, versus 5.2 per 1000 women with spontaneous onset of labor, 7.7 per 1000 women with labor induction without

prostaglandins, and 24.5 per 1000 women with labor induction with prostaglandins.[201] Although the authors stressed in their conclusion the point of avoiding VBAC with induction of labor with prostoglandins, hospital and insurance policymakers, and maternity care providers took this to be further evidence that VBAC was dangerous and legally risky. Subsequently, official and de facto bans on VBAC were put into place into many hospitals throughout the country.[202]

Vaginal birth was further limited by a 2000 study that recommended cesarean sections for breech positioning. The study compared 121 birth centers in 26 countries, both developed and developing, and found that while cesarean section for breech positioning did not significantly affect perinatal outcomes in countries with high rates of perinatal morbidity and mortality, it did have a positive affect in countries with relatively low perinatal morbidity and mortality. The study did not include incidences of external cephalic versin, a procedure in which the birth attendant manually turns the fetus. [203] Largely based on these findings, a 2001 position statement from the American College of Obstetrics and Gynecology (ACOG) recommended cesarean section for all cases of breech positioning.[204]

Cesarean delivery in the medical literature is associated with many adverse physical and psychological outcomes. Vaginal birth offers infants certain health benefits. For example, when infants are born vaginally, fluid is cleared from their lungs while passing through the birth canal, and since infants born via cesarean section do not experience this benefit, they are more prone to developing respiratory problems.[205] Mothers who deliver by cesarean section are more likely to experience the short-term effects of emergency hysterectomy, blood clots and stroke, surgical injury, and

infection.[206] There are also long-term physical effects associated with cesarean delivery for mothers with subsequent pregnancies, such as ectopic pregnancy, placentia previa, uterine rupture, hemorrhage, low birth weight, and preterm birth.[207]

There are also negative emotional and psychological issues associated with cesarean section. Compared to women who deliver vaginally, women who deliver by cesarean section are more likely to have negative perceptions of their birth experience and are at a higher risk for postpartum depression.[208] Women who delivery via cesarean section are less likely than women who deliver vaginally to feel powerful and capable during labor and delivery.[209] Women who deliver via cesarean section are also less likely to have skin-to-skin with their infants within the first house after birth, and experience a greater time lapse between delivery and breastfeeding initiation.[210]

Given the significant and numerous risks associate with cesarean delivery, it is important that the benefits outweigh the risks. However, the most common reasons given for performing primary cesarean sections - previous cesarean, breech positioning, dystocia, and fetal distress - are associated with the least obvious medical benefit.[211] Furthermore studies have shown that there is large variance in cesarean section rates amongst birth facilities and maternity care providers that cannot be explained by differences in health factors. Studies have found that nonmedical factors strongly contribute to the high cesarean section rate. Economic factors and work policy factors seem to have an affect on cesarean section rates, as shown by a 2001 study comparing Kaiser Permanente physicians with private physicians. Kaiser Permanente physicians work on scheduled shifts rather than being continually on call, and rely heavily on midwives. The study found that the patients of Kaiser Permanente physicians overall had

lower rates of cesarean section, fetal distress and dystocia than did the patients of private physicians. Furthermore, Kaiser Permanente physicians were the only group of physicians in the study who did not perform on average more cesarean sections in the evening.[212] Even when controlling for payment policies, there is high variance in cesarean rates between physicians, further supported the claim that at least a portion of cesarean sections are medically unnecessary. For example, a 2005 study found that the individual physician attending the birth was an independent risk factor for having an unplanned cesarean section.[213] A 2008 study reaffirmed this finding and in addition showed that physicians with anxious personalities were more likely to perform unplanned cesarean sections.[214] Multiples studies have estimated that overall a startlingly high percentage of cesarean sections are unnecessary, with estimates ranging from 40 to 50 percent.[215][216][217][218] Given the serious risks associated with cesarean delivery, it is troubling that so many cesarean sections are performed in absence of any valid medical indication.

Financial Incentives for Medical Interventions[f]

Hospital discharges for maternity and perinatal care are some of the most frequent in the United States, as well as the most costly, with 9.7 million related discharges in 2007, costing $34.2 billion combined. This represents 10 percent of all hospital costs and almost a quarter of hospital discharges. [219] Hospitals stays for pregnancy, childbirth, and newborn care are more common than stays for circulatory, respiratory, and digestive

[f] Many of the sources for this section were originally found in Sakala, C., & Corry, M. (2008). *Evidenced-based maternity care: What it is and what it can achieve*. New York, NY: Milbank Memorial Fund.

care.[220] In 2005, the average cost of birth in a hospital ranged between approximately $6,000 for a vaginal birth without any complications to $15,000 for a complicated cesarean delivery.[221] In contrast, the average cost for a birth in a birthing center[g] was approximately $1,500.[222223] Conditions for pregnancy, childbirth, and perinatal/newborn care represent almost one third of all charges for private insurers.[224] Pregnancy is a Medicaid eligibility category, and all states are must provide Medicaid services to pregnant women who have incomes 185 percent below the federal poverty level.[225226] About 43 percent of births are covered by Medicaid, representing 2.05 million maternal discharges.[227] More than half of all Medicaid discharges are related to pregnancy, childbirth, and newborn care.[228] About 4 percent of births in the United States are not covered by any insurance type.[229]

Because lower-income women are generally assumed to be at a higher risk for pregnancy complications, one would expect to see lower-income women receive a greater amount of medical interventions designed to mitigate the likelihood of serious complications for high-risk pregnancies. This, however, is not the case.[230] Physicians provide more obstetric services, including those that are part of standard care, to women with private insurance, regardless of medical risks or complications.[231] Low-income women who are at the highest risk for experiencing pregnancy complications or poor birth outcomes, such as low birth weight or infant mortality, are the least likely demographic for having a cesarean section.[232] One study showed that women who lived in census tracts with median family incomes under $11,000 were almost less than half as

[g] Women in birth centers are less likely to have medical interventions in labor and delivery. (Walsh, D, & S.M. Downe. (2004). Outcomes of free-Standing, midwife-led birth centers: A structured Review. *Birth*, 31(3), 222–29)

likely to have a cesarean delivery as were women living in census tracts with a median family income of $30,000 or over.[233] Multiple studies support the finding that Medicaid insurance is negatively associated with medical interventions during childbirth, especially when compared to private insurance. Those with private insurance are the most likely to have cesarean sections, followed by those who are publicly insured, followed by those without insurance.[234235] Women who are covered by Medicaid are also less likely than women covered by private insurance to have inductions, augmentation of labor, electronic fetal monitoring.[236] The effect of private insurance versus Medicaid is most profound when the medical intervention is elective.[237] In addition to insurance, the impact of private versus public on the likelihood of medical interventions during labor and delivery is also extended to private versus public hospitals. Private hospitals are more likely than public hospitals to have higher rates of cesarean section and induction, even when including Medicaid patients.[238239240]

Unnecessary medical interventions not only have the potential to negatively affect maternal and infant health and birth outcomes, but they are also tremendously costly. It is estimated the medically unnecessary cesarean sections cost the health care system over a billion dollars every year.[241] Considering the significant and serious consequences, it is worth while to inquire why physicians continue to perform unnecessary medical interventions and procedures. The literature shows that physicians are incentivized to perform cesarean sections because they are generally reimbursed at higher rates than vaginal births,[242] and that this effect is especially pronounced for women with private insurance.[243] A 2001 study showed that physicians employed by Kaiser Permanente had lower cesarean rates, as well as lower rates of diagnoses of fetal distress and dystocia,

than did physicians paid by private insurance plans. While the other physicians in the study generated income by accumulating medical services, Kaiser Permanente physicians participated in profit sharing, so it was in their financial interest to keep costs low. The results of this study suggest that fee-for-service reimbursement is positively correlated with cesarean delivery, and may even account for unnecessary cesarean sections.[244]

Studies have shown that reimbursement rates have measurable effects on the care received by women who are covered by Medicaid. Depending on the service that is being reimbursed, higher reimbursement rates for Medicaid may produce more optimal birth outcomes or may cause more unnecessary medical interventions. For example, women who are covered by Medicaid have better birth outcomes in states where prenatal services are reimbursed at higher rates,[245] but women who are covered by Medicaid in states where Medicaid reimburses cesarean delivery at a higher rate than vaginal delivery experience more cesarean sections.[246] Another suggested explanation is that some insurance plans charge fewer out-of-pocket costs to their consumers when a cesarean delivery occurs as opposed to a vaginal delivery, thus prompting an increase in the utilization of medically unnecessary cesarean sections and their associated costs.[247] Another explanation comes from a study from the 1990s that hypothesized that declining fertility rates lowered obstetrician income, thus prompting them to perform a greater number of reimbursable services in order to secure income. The authors found this hypothesis to be supported by statistical data that showed an association between increased cesarean section utilization and decreased fertility.[248]

There are various economic factors that support an increase in the utilization of cesarean section and by extension other medical interventions for labor and delivery. It is

most likely that these various factors reinforce one another to create a highly technological and medical model of childbirth. Regardless of these reasons for why this may be, what is certain is that increasing incidences of cesarean section and medical interventions during childbirth cannot be explained by medical factors alone, and that this increase is responsible for generating enormous costs to states and the health care system as a whole.

Legal Incentives for Medical Interventions

Defensive medicine is the practice of medicine characterized by an overuse of tests and procedures in order to avoid medical malpractice lawsuits.[249] The practice of obstetrics is particularly susceptible to the threat of lawsuits, especially in cases of complicated deliveries[250]. Although the number of obstetrics related malpractice payments falls behind malpractice payments that are related to diagnosis, surgery, and treatment, the average mean and median obstetrics related malpractice payment is higher than any of these with a mean payment of $558, 035 and a median payment of $333,334.[251] Nine out of ten obstetricians report having a claim filed against them at some point in their careers, with an average of 2.69 claims over the span of a career.[252]

Medical interventions are both a cause and a product of defensive medicine in obstetrics. The authors of "Defensive medicine during hospital obstetrical care: A by-product of the technological age" wrote that defensive medicine is an inevitable outcome of "a road that rewards technological definitions of human functioning, adopts a managerial approach to healing, institutionalizes practices based on fear of failure and encourages dependency on medical authority."[253] The authors point largely to the role of

the electronic fetal monitor in contributing the growth of medical malpractice claims and payments in obstetrics. The increase of the utilization of the electronic fetal monitor is positively associated with an increase in obstetric litigation,[254] and the electronic fetal monitor is the most common factor associated with an obstetric malpractice lawsuit.[255] Although electronic fetal monitors are explicitly clear in their recordings of fetal heart beats, it is less clear how exactly this information should be interpreted by obstetricians.[256] This ambiguity of interpretation in combination with a lack of precise, uniform guidelines and protocols for standard practice in light of complications makes obstetricians particularly vulnerable to litigation.[257] The strip which is produced the electronic fetal monitor is "public and permanent:"[258] whereas a decision made by an attending physician during labor and delivery very much reflects the pain, anxiety, emotions, and desires of the moment, the strip is able to remove any decision from this context. An alternative reading of the electronic fetal monitor strip in the courtroom emphasizes the failure of an obstetrician to decide what could only be determined in hindsight to be the best course of action.

In terms of legal liability, it is safer for obstetricians to overact through the use of medical interventions than to not take action, even if the medical indicators for the medical interventions are dubious. The desire to avoid lawsuits may cause obstetricians to perform medical interventions that are not necessarily medically warranted. For example,

> an obstetrician's anxiety about malpractice claims leads to increased concern about prolonged labor, which in turn induces the physician to begin pitocin induction. The Pitocin then precipitates a dysfunctional labor pattern, which results in dystocia and in cesarean delivery.[259]

The ever-present threat of malpractice lawsuits has prompted measurable and official changes in the practice of obstetrics. A 2001 bulletin from *The American Journal of Obstetrics and Gynecology* on the topic of avoiding litigation advised obstetricians that, "difficult vaginal delivery is not appropriate when an easy cesarean delivery is an option," and to "use cesarean liberally for individual cases of labor arrest and abnormal fetal heart rate tracings."[260] In a 2009 professional survey, almost two-thirds of obstetricians reported that liability concerns had affected their practice, and of those who had been affected, a fifth reported performing more cesarean sections and fewer VBACs, or none at all.[261] Studies have shown higher malpractice risks to be associated with more cesarean sections and worse birth outcomes.[262][263][264][265] The extent of the financial risk of medical malpractice lawsuits, in addition to the reported connection between the risk of medical malpractice lawsuits and an increase in cesarean section, supports the assertion that the practice of defensive medicine in obstetric at least partially explains the wide variation in rates and incidences of medical interventions in the absence of health indicators.

Medical Interventions and Transparency

This review of the literature establishes several underlying premises that are necessary to build the foundation upon which this research is based. The first premise is that unnecessary medical interventions in childbirth are harmful. This is established by three major sub premises:

1) The pervasive and routine use of medical interventions is engrained within medical practice in maternity care. Interventions were an integral component of the rise of obstetrics and high rates are persistent through the present.
2) Medical interventions in childbirth are routinely used not only because of traditions in practice, but because they are incentivized by nonmedical factors. Financial and legal incentives in particular promote high rates of medical interventions, and this produces interventions that are medically unnecessary.
3) Medical interventions have the potential to cause harm to childbearing women and their babies. Feminists interpret medical interventions as signals to women that their bodies are defective. Interventions also pose significant health risks that cause net harm to health when the intervention is medically unwarranted.

Transparency is presented as a potential strategy for reducing harmful, unnecessary medical interventions in childbirth. Promising, albeit limited, research has shown that increased transparency and public reporting has a positive impact in the level of quality of hospital care, particularly for obstetrics. Furthermore, public health experts tout that transparency in health care shows much promising for improving healthcare outcomes and quality. These justifications for promoting transparency can be easily applied to the case of maternity care. Increased transparency in the reporting of medical interventions in childbirth notifies policymakers of the extent of the current situation, supplies maternity care consumers with information that is necessary in making informed decisions about health care, and puts pressure on maternity care providers to keep their

practice based on evidence. Vital statistic reports are a current existing avenue to increase transparency and promote positive change in the maternity care system.

Methodology

This purpose of this research is to investigate the possibility that a state's transparency level in the reporting of medical interventions in childbirth is affected by factors within that state that are indicative of modern medical practice in maternity care. This research employs quantitative methodology to test for a relationship between a state's level of transparency, as measured by the extent to which a state reports on medical interventions in childbirth in a state's annual vital statistics report, and factors, which include cesarean section rate, percent of births paid for by Medicaid, mean malpractice settlement payment, and hospital expenditures per capita. These factors constitute the independent variables. Level of transparency is the binary, dependent variable. The state is the unit of analysis. Because this research is exploratory, no attempt is made to hypothesize the direction of the association between the dependent and independent variables, and strongly affirmative results are not expected. The aim is primarily to gauge the presence of any kind of relationship between the dependent and independent variables and the nature of that relationship.

- **Data**

The data used for this research are all publicly accessible and came from a variety of sources. In order to measure states' levels of transparency, I located the most recent vital statistics reports for all 50 states. I used the *Birth Survey*'s "State by State Resources"[266] to find the reports, in combination with searching the state's department of health website. After searching a state vital statistics report for medical interventions, I

then made attempts to confirm my findings with a representative from that state's department of public health.

I measured the level of transparency using three main categories of variables: method of delivery, obstetrical procedures, and location of delivery. Each variable category included several sub-categories. States earned points depending on whether or not the state reported on the items listed in the sub-categories. Each variable category is worth a potential total of four points, so that each variable category is weighted equally.

The first variable category, method of delivery, includes four subcategories: delivery by cesarean section, vaginal birth after cesarean, primary or secondary cesarean section, and assisted delivery with either use of vacuum or forceps. For each subcategory that a state reports information on, that state is awarded one point for a total of four points.

The second variable category, obstetric procedures, also includes four subcategories: use of epidural/spinal anesthesia, induction of labor, augmentation of labor, and use of electronic fetal monitoring. For each obstetric procedure that is reported on, the state earns one point for a total of four points.

The third variable category, location of delivery (by method of delivery), includes two subcategories: method of delivery reported on by the county, or facility (hospital or birth center) level. States that report on medical interventions only at the state level earn no points for the category. States that report on method of delivery on the county level earn two points. Although reporting on the county or city level certainly shows more transparency than reporting only on the state level, there still can exist wide ranges of diversity in method of delivery even within a county. Reporting by facility is the highest

level of transparency, and therefore states that report on method of delivery at the facility level earn twice the point value of states that report on the county level, and receive the maximum of four points.

States also have the opportunity to earn "extra credit" points. Some levels of reporting are so rare that it would not be reasonable to systematically include them, for to do so would give points very few states, thus unfairly diminishing the overall score of states that would otherwise have a pristine level of reporting transparency. There is one "extra credit" subcategory and one additional variable category. The subcategory is under method of delivery, and would award one extra point to a state that reports on whether or not labor took place for a cesarean section. The additional variable category is obstetrical procedure by location – either the county or facility level. A state that reports on obstetrical procedures on the county or city level will earn one additional point, and a state that reports on obstetrical procedures on the facility level will earn two additional points.

Depending on its level of transparency for reporting on method of delivery, obstetrical procedures used during labor, location of delivery (by method of delivery), and extra points earned, a state can earn in between zero and twelve points. States are scored and ranked based on total point value. States that earn between zero and three points are considered to have a "low" level of transparency, states that earn between four and six points are considered to have a "moderately low" level or transparency, states that earn between seven and nine points are considered to have a "moderately high" level of transparency and states that earn ten or more points are considered to have a "high" level of transparency. States with low and moderately low transparency are determined to be

non-transparent, and state with high and moderately high transparency are determined to be transparent. This binary categorization of transparent or non-transparent is the dependent variable.

The data used to measure the independent variables are all publicly accessible and can be accessed online. For the first independent variable, cesarean section rate, the data come from *The National Vital Statistics Report* published by the National Vital Statistics System of the National Center for Health Statistics.[267h] This variable is used to measure whether medical interventions themselves have an effect on transparency. Cesarean section is used to represent all medical interventions because, more so than other interventions, they have received the greatest amount of public attention and national interest. Furthermore, because, as stated in the literature review, many medical interventions have been shown to be associated with cesarean sections, it is safe to assume that the variable cesarean section rate also to some extent reflects overall intervention rate. Therefore, overall presence of medical interventions in a state is operationalized with the variable state cesarean section rate.

The data used to measure the second variable, percent of births paid for by Medicaid, come from the report "Maternal and Child Health (MCH) Update: States Increase Eligibility for Children's Health in 2007," published by the National Governors Association for Best Practices.[268] This variable is used to operationalize the influence of economic factors in state transparency. States with higher percentages of birth paid for by Medicaid are assumed to be poorer states, and states with lower percentages of birth paid for by Medicaid are assumed to be wealthier states. Therefore, percentage of births paid

[h] The most recent data for cesarean section were not used so that the data used to measure the variables could be comparable to the other variable data.

for by Medicaid measures the impact of community wealth on a state's reporting of medical interventions. Furthermore, a higher percentage of births paid for by Medicaid represents a drain on the state budget, and this impact too is measured.

The data used to measure the third variable, mean malpractice settlement payment, come from "The National Practitioner Data Bank 2006 Annual Report," published by the Division of Practitioner Data Banks of the Bureau of Health Professions.[269] This variable is used to operationalize the impact of malpractice lawsuits and defensive medicine on transparency levels. I choose to use mean malpractice rate rather than malpractice payments per provider because, as stated in the literature review, while obstetric payments are only the fourth most common reason for a malpractice settlement, on average the highest payments are those related to obstetrics. It can therefore be assumed that it is not the likelihood of being sued, but the high potential for paying a hefty settlement if sued that prompts obstetricians to practice defensive medicine. The mean payment rather than the median payment was chosen because the mean is more sensitive to extremes, and the potential for paying an extremely costly settlement affects the policies of medical malpractice insurers and triggers the anxiety of practicing obstetricians. Therefore, mean malpractice settlement payment measures the impact of the practice of defensive medicine in obstetrics within a state on transparency levels.

The data used to measure the fourth and final variable, hospital expenditures per capita, come from "U.S. per Enrollee State Estimates by State of Residence – Hospital Care per Enrollee," published by the Centers for Medicare and Medicaid Services.[270] This variable is used to operationalize the impact of hospital spending on transparency levels.

Higher hospital spending indicates that a hospital performs a greater number of billable medical interventions. It also indicates that hospitals are incentivized to provide a greater number of medical services because of reimbursement payments. Therefore, hospital expenditures per capita measure the impact of maternity services providers financial incentives to provide medical care on a state's level of transparency.

I also chose to use control variables. The first control variable is median family income per state, reported by the U.S. Census Bureau in the "2008 American Community Survey."[271] This variable is intended to operationalize state resources. States with higher incomes have greater resources to fund data collection and health information technology. This variable is not indication of current trends in maternity care practices, so it is able to serve as a control variable. Furthermore, median family income measures the wealth of a state. This can control for the variable percentage of births paid for by Medicaid because, different states have different eligibility requirements for Medicaid, whereas median family income is remains consistent.

The other control variable is regional grouping. This variable can measure the impact of demographic, geographic, and political factors (factors which are not related to modern practices in maternity care) on sates' level of transparency. The regions that are used are those used by the National Health Statistics Group, which are as follows: New England (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont), Mideast (Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania), Great Lakes (Illinois, Indiana, Michigan, Ohio, Wisconsin), Plains (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota), Southeast (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina,

South Carolina, Tennessee, Virginia, West Virginia), Southwest (Arizona, New Mexico, Oklahoma, Texas), Rocky Mountain (Colorado, Idaho, Montana, Utah, Wyoming), and Far West (Alaska, California, Hawaii Oregon, Washington).

- **Estimation Model**

Because the dependent variable (transparent/non-transparent) is qualitative and dichotomous, it is necessary to use a binary regression models. Two common binary regression models are the linear probability model and the binomial probit model. Even though the binomial probit model is generally considered to be the preferable over the linear probability model, both models offer advantages and drawbacks, so I run regressions for both models. I mainly focus on the linear probability model because and measure the estimated results with ordinary least squares (OLS). Although OLS can be problematic for interpreting the results of linear probability regression models, I choose to use this estimation method in order to better interpret my results, particularly in regard to the shape of polynomials.

- Linear probability estimated equation:

$$BT_i = B_0 + B_1(CES_i) + B_2(MED_i) + B_3(MAL_i) + B_4(HOSP_i)$$

- Linear probability estimated equation with polynomials:

$$\beta TRAN_i = \beta_0 + \beta_1(CES_i) + \beta_2(CES_i)^2 + \beta_3(MED_i) + \beta_4(MED_i)^2 + \beta_5(MAL_i) + \beta_6(MAL_i)^2 + \beta_7(HOSP_i) + \beta_8(HOSP_i)^2$$

- Binomial probit estimated equation:

$$Z_i = \Phi^{-1}(PTRAN_i) = \beta_0 + \beta_1(CES_i) + \beta_2(CES_i)^2 + \beta_3(MED_i) + \beta_4(MED_i)^2$$
$$+\beta_5(MAL_i) + \beta_6(MAL_i)^2 + \beta_7(HOSP_i) + \beta_8(HOSP_i)^2$$

Results

Descriptive Statistics

Overall, representatives from the majority of states (n=36) responded to my request to confirm my findings. Many of the responses indicated that while the state did not routinely publish information on a specific medical intervention, that the data were collected and were available by request (n=15). Some representatives from those states explained that data were not routinely published because of low demand. Five states did not collect information on the interventions epidural anesthesia or electronic fetal monitoring because that information was not collected from birth certificate data. Some representatives also indicated that due to confidentiality and/or legal reasons, the state was not able to publish intervention information at the facility level (n=5).

Sixteen states were found to have low transparency and fifteen states were found to have moderately low transparency, equaling a total of 31 states determined to be non-transparent. Fourteen states were found to have moderately high transparency, and five states were found to have high transparency, equaling a total of 19 states determined to be transparent. The average transparency score for the 1-12 ranking was 5.1 (moderately low transparency). The average transparency value (1=transparent, 0=non-transparent) was 0.4.

Except for one state, the only state that did not report on cesarean section rates or incidences were those states that were awarded zero transparency points because they did not publish publicly accessible on-line reports. The exception was Kansas, which did not report on cesarean section rates or incidences but did report on VBAC at the county level.

Thirty-three states reported on rates and incidences of both VBAC and primary versus secondary cesareans. Of the states that did not report on VBAC and cesarean order, none were determined to have moderately high or high transparency. Of the states that reported on VBAC, only three did not report on cesarean order, and of the states that reported on cesarean order, only three did not report on VBAC. Seventeen states reported on assisted delivery, delivery with the use of vacuum or forceps. All but three of these states were found to have high or moderately high transparency (Figure 1). All of these states but one, Nebraska, also reported on cesarean section, VBAC, and primary/secondary cesarean.

Induction of labor was the obstetric intervention most frequently reported on, with 15 states including it in their reports. Every state that reported on an obstetrical intervention reported on induction of labor. Fourteen states reported on augmentation of labor, 11 states reported on electronic fetal monitoring, and only three states reported on the use of epidural anesthesia. All but two states that reported on obstetrical interventions were found to have moderately high or high transparency (Figure 1). The exceptions, Arkansas and Nebraska, were found to have moderately low transparency. Four states reported on whether or not there had been a labor before a cesarean section.

. Twenty-seven states reported on method of delivery at either the county or facility level. Fifteen states reported method of delivery at the county level. Of these states, 9 were found to have moderately low transparency, 3 were found to have low transparency, and 3 were found to have moderately high transparency. Twelve states reported on method of delivery at the facility level. Of these states, 5 were found to have high transparency, 3 were found to have moderately high transparency, and 4 were found

to have moderately low transparency (Table 1). Only two states reported on any obstetric interventions at the facility level.

Table 1: Breakdown of state transparency level by method of delivery, method of delivery by location, and obstetric procedures

	Non-transparent States			Transparent States			Total for transparent and non-transparent states
	Low transparency	Moderately low transparency	Total for non-transparent states	Moderately high transparency	High transparency	Total for transparent states	
Method of delivery							
Cesarean	7	15	22	14	7	21	43
VBAC	4	10	14	14	5	19	33
Cesarean: primary or second	5	9	14	14	5	19	33
Assisted delivery	1	4	5	9	3	12	17
Method of delivery by location							
State level	13	2	15	8	0	8	23
County level	3	9	12	3	0	3	15
Facility level	0	4	4	4	4	8	12
Obstetric procedures							
Epidural anesthesia	0	0	0	3	0	3	3
Induction of labor	0	2	2	10	3	13	15
Augmentation of labor	0	2	2	10	2	12	14
Electronic fetal monitoring	0	1	1	7	3	10	11

The average cesarean section rate was 29.9 percent, with a range of 21.5 percent to 37.4 percent. States with a cesarean section rate between 20 and 25 percent, or between

35 and 40 percent, were more likely to have higher transparency than states with a cesarean section rate between 25 and 30 percent (Table 2).

Table 2: Breakdown of cesarean section rate by transparency level							
	Non-transparent States			**Transparent States**			**Average transparency score (1-12)**
	Low transparency	Moderately low transparency	Total for non-transparent states	Moderately high transparency	High transparency	Total for transparent states	
Cesarean section rate							
20%-25%	0	2	2	3	0	3	6.4
25-30%	8	7	15	4	2	6	4.7
30-35%	5	9	14	14	5	19	5
35-40%	1	0	1	4	0	4	6.8

On average, Medicaid paid for 41.1 percent of births, ranging from 21 to 66.8 percent. A roughly equal number of transparent states were found in each range of percent of births paid for by Medicaid. However, there was more than twice the number of non-transparent states found in the 30-50 percent range of births covered by Medicaid (n=10, 12) than in the ranges of 20-30 (n=5) percent and 50+ percent (n=4) (Table 3).

Table 3: Breakdown of percent of births paid for by Medicaid by transparency level							
	Non-transparent States			**Transparent States**			**Average transparency score (1-2)**
	Low transparency	Moderately low transparency	Total for non-transparent states	Moderately high transparency	High transparency	Total for transparent states	
Percent of births paid for by Medicaid							
20%-30%	3	2	5	4	0	4	5.3
30-40%	5	5	10	5	0	5	5
40-50%	8	4	12	2	4	6	4.8
50%+	0	4	4	0	4	4	6.1

The average malpractice payment in a state was $314, 580.50, with a range of $125,795 to $619, 205. Like with the other independent variables, the highest transparency scores were found in the lowest and highest ranges of malpractice payments, the highest score being found in the highest range. The score associated with the $300,000 - $400,000 range was the lowest transparency score found for any range for any variable (Table 4).

Table 4: Breakdown of mean malpractice payments by transparency level							
	Non-transparent States			**Transparent States**			**Average transparency score (1-12)**
	Low transparency	Moderately low transparency	Total for non-transparent states	Moderately high transparency	High transparency	Total for transparent states	
Mean malpractice payment							
$100,000 - $200,000	1	3	4	1	1	2	6.2
$200,000 - $300,000	3	6	9	7	1	8	5.4
$300,000 - $400,000	10	3	13	3	0	3	3.6
$400,000+	2	3	5	4	2	6	6.6

The average hospital expenditure per capita was $1994.36, ranging from $1432 to $2620. The smallest number of non-transparent states (n=2) was found in the highest range of hospital expenditures ($2,300+), and the smallest number of transparent states (n=1) was found in the lowest range of hospital expenditures ($1,400-$1,700). The transparency scores for all ranges were similar, except for the highest range, which had the highest transparency score for all of the ranges of all of the variables (Table 5).

Table 5: Breakdown of hospital expenditures per capita by transparency level							
	Non-transparent States			**Transparent States**			**Average transparency score (1-12)**
	Low transparency	Moderately low transparency	Total for non-transparent states	Moderately high transparency	High transparency	Total for transparent states	
Hospital expenditures per capita							
$1,400 - $1,700	3	4	7	1	0	1	4.6
$1,700 - $2,000	4	5	9	4	2	6	5.3
$2,000 - $2,300	8	4	12	7	0	7	4.3
$2,300+	1	1	2	3	2	5	7.9

Transparency levels did not differ greatly by region. For every region, the number of transparent and non-transparent states did not vary more than a range of two, except for the Rocky Mountain region. The Rocky Mountain region had the highest number of non-transparent states (n=4) along with the Far West, as well as the lowest number of transparent states (n=1) along with the Southwest. The Mideast had the highest transparency score, and the Plains had the lowest transparency score (Table 6).

Table 6: Breakdown of regions by transparency level

	Non-transparent States			**Transparent States**			**Average transparency score (1-12)**
	Low transparency	Moderately low transparency	Total for non-transparent states	Moderately high transparency	High transparency	Total for transparent states	
Region							
New England	3	0	3	2	1	3	5.2
Mideast	2	0	2	2	1	3	6.4
Great Lakes	1	2	3	2	0	2	5.8
Plains	2	3	5	2	0	2	4.4
Southeast	4	3	7	4	1	5	4.9
Southwest	0	3	3	1	0	1	5.5
Rocky Mountains	2	2	4	1	0	1	5
Far West	2	2	4	1	1	2	5

Inferential Statistics

The regressions were at first run using the linear probability regression model. The first regression model showed none of the variables to have a statistically significant with the dependent variable. The variables cesarean, malpractice, and Medicaid all had p values greater than 0.7. The coefficient for hospital expenditures teetered on statistical

significance at the 0.10 level with a p value of 0.106. All of the coefficients were positive except for malpractice. None of the coefficients had values larger than 0.006 (Table 7).

The second regression model included the control variable state income. The coefficient for this variable was positive though very miniscule, and the p-value was over 0.7. There was not considerable change in the coefficients for the independent variables, although the p value of the coefficient for hospital expenditures rose slightly to 0.127 and the p value for the coefficient for malpractice lowered slightly to 0.680.

Model three included all of the four independent variables as well as their polynomials. Under this model, the coefficient for the variable cesarean had a negative sign, and the magnitude of the coefficient increased dramatically to 0.3803. The p value also decreased to 0.207. The coefficient for the variable cesarean squared was positive, smaller in magnitude and had a p value of 0.194. The coefficient for the variable hospital expenditure also had a negative sign and increased in magnitude, though not to the scale as the coefficient for the variable cesarean. Its associated p value rose to 0.556. Like the coefficient for the variable cesarean squared, the coefficient for the variable hospital expenditure squared had a negative sign. Its associated p value was 0.462 (Table 7). For the variables Medicaid and malpractice, the magnitude of the coefficients decreased and the associated p values increased to values over 0.9 (Table 7).

Model four added the control variables state income and state income squared to model three. The coefficients for both state income and state income squared were very low in magnitude and had p values greater than 0.7. The p values for the independent

Table 7: Regression Coefficients							
	Linear Probability Model						Probit Model
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	
cesarean	0.005842	0.006380	-0.3803	-0.4482	-0.4574	-0.3907	-1.675
(standard deviation)	0.01906	(0.01936	-0.2969	0.3453	0.2480	0.2627	0.9394
Cesarean squared			0.00662	0.007850	0.007863	0.006802	0.02923
(standard deviation)			-0.005008	0.005932	0.004193	0.004416	0.016127
Medicaid	0.002014	0.003365	0.001028	-0.006091			
(standard deviation)	0.07682	0.00911	-0.05111	0.05491			
Medicaid squared			-0.00000295	0.0000798			-0.0051013
(standard deviation)			-0.0006139	0.0006573			0.01376
Malpractice	-2.70e-07	-3.21e07	6.84E-08	0.000000381			-0.000000214
(standard deviation)	7.4e-07	7.75e-07	-0.00000354	3.74E-06			0.00001
Malpractice squared			-3.5E-13	-7.1E-13			-1.01E-12
(standard deviation)			4.92E-12	5.21E-12			1.42E-11
Hospital expenditures	.0004308	0.0004176	-0.001975	-0.001854	0.0004632	-0.002011	0.0027243
(standard deviation)	0.0002613	0.0002681	0.003323	0.003519	0.0002463	0.003118	0.01064
Hospital expenditures squared			0.000000608	0.000000588		0.000000613	-0.000000182
(standard deviation)			0.000000818	0.000000866		0.000000769	0.00000261
State income				0.0000501			0.0001645
(standard deviation)		2.75e-06		0.0001362			0.0003432
State income squared		9.71e-06		3.89E-10			-1.27E-09
(standard deviation)				1.01E-09			2.54E-09

variables did not significantly change. The only coefficients to change considerably in magnitude were those for malpractice, malpractice squared, hospital expenditures, and hospital expenditures squared, which all decreased in value (Table 7).

Based on the findings of the first four regression models, it was determined that the variables malpractice, Medicaid, state income, and their associated polynomials were extraneous. Regression models five and six focused on the effect on cesareans and hospital expenditures on transparency level. Like in regression models three and four, the coefficient for the variable cesarean section in model five was considerably higher in magnitude than it was in the first two regression models, with a value of 0.4574. Also like in regression models three and four the sign for the coefficient was negative. The coefficient for the variable cesarean squared also remained the same in sign and similar in magnitude. The p-values of the coefficients for both variables dropped (p-value of cesarean=0.072, p-value of cesarean squared = 0.0672), making both coefficients significant at the 0.10 level. The coefficient for hospital expenditure rose back to a magnitude similar to the magnitude of the coefficient for the variable seen in the first two regression models. Similarly to the coefficients for cesarean and cesarean squared, its p-value also decreased to a value significant at the 0.10 level (p-value of hospital expenditures = 0.066).

In model six, the variable hospital expenditure squared was added to the regression of model five. The coefficients for the variables cesarean and cesarean squared retained the same signs and lowered slightly. Their p-values doubled in magnitude and were no longer significant at the 0.10 level (p-value of cesarean=0.144, p-value of cesarean squared = 0.130). The coefficients for hospital expenditure decreased in

magnitude, and its sign was again negative, as in models three and four. Its p-value also increased to a value similar to the p-vale for model one (hospital expenditure p-value =0.522). The coefficient of the variable hospital expenditure squared had a very small and positive value. Its statistical significance was similar to the statistical significance of the coefficient for the variable hospital expenditure, with a p-value of 0.430 (Table 7).

Table 7 also shows the results of the probit regression model. Although it is not possible to interpret the OLS coefficients of the probit model, the signs of the coefficients for the independent variables are similar, indicating a similar result with the probit model as with the linear probability model. (MORE PROBIT)

Nature of Cesarean's Polynomial Shape

Of all the regression models, the most interesting results stemmed from model five. The use of OLS allows for the measurement of a standard change in the value of cesarean/cesarean squared on transparency level, while holding the other most relevant independent variable, hospital expenditure, constant. The predicted probability of transparency being equal to one (the state is transparent), is measured by a 0.5 percent point increase in the value of cesarean. The value for cesarean begins at 19.6 and goes up to 38.6. On average, states that have a cesarean section rate under 25 percent have 0.68 likelihood of being transparent. This ranges from a likelihood of 0.99 for a state with a cesarean section rate of 19.6 percent (the lowest cesarean section rate in the sample was 21.5 percent) to a likelihood of 0.44 for a state with a cesarean section rate of 24.6 percent. About a third of states with a cesarean section rate between 25 and 30 percent are likely to be transparent. This ranges from a likelihood of 0.44 for a state with a

cesarean section rate of 25.1 percent to a likelihood of 0.29 for a state with a cesarean section rate of 29.6 percent. States with a cesarean section rate between 30 and 35 percent are more likely to be transparent than states with a cesarean section rate between 25 and 30 percent, with an average likelihood of 0.38 for being transparent. This ranges from a likelihood of 0.29 for a state with a cesarean section rate of 30.1 percent to a likelihood of 0.52 for a state with a cesarean section rate of 34.6 percent. States with a cesarean section rate over 35 percent are most likely to be transparent with a 0.77 predicted probability that transparency will be equal to one. This ranges from a likelihood of transparency of 0.57 for a state with a cesarean section rate of 35.1 percent to a likelihood of transparency of 0.99 for a state with a cesarean section rate of 38.6 percent (the highest rate in the sample was 37.4 percent) (Table 8).

Table 8: Predicted Probability that Transparency = 1

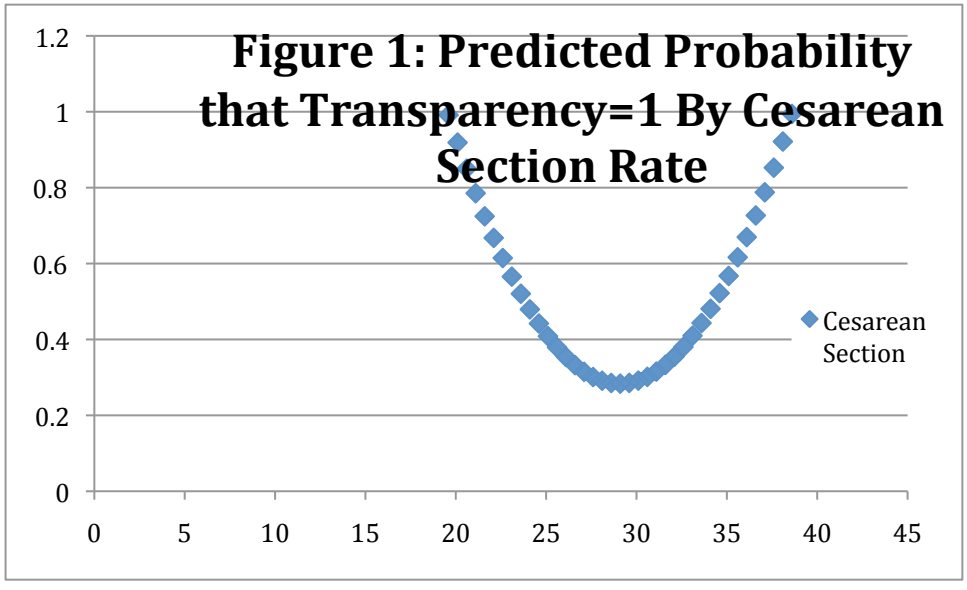
State cesarean section rate	Mean predicted probability that transparency =1	Mean change in predicted probability	Number of states that fall into this range
<25%	0.69	-0.55	5
25%-30%	0.33	-0.15	22
30%-35%	0.38	0.23	18
>35%	0.77	0.59	5

Though it contains a wide range, the change in predicted probability of transparency from one value of cesarean to a 0.5 percent point higher value of cesarean was for the most part gradual and consistent. However, for certain ranges of cesarean section the change in predicted probability was steeper than in others. Generally

speaking, the change in predicted probability was more dramatic when the value of cesarean was either very low or very high (Table 9).

Table 9: Mean changes in the predicted probability of transparency =1 by cesarean section range	
Cesarean range values	**Mean change in predicted probability of transparency=1**
19.6-22.6	-0.63
23.1-26.1	-0.37
26.6-30.1	-0.075
30.6-33.6	0.21
34.1-36.1	0.46
36.6-38.1	0.64

The decreasing and then increasing predicted probability than transparency=1 based on a steady increase in cesarean rate creates a polynomial shape (Figure 1). The tipping point for this polynomial, the point at which the value for cesarean increases to a point where it is no longer associated with a decreasing predicted probability that transparency=1 is a cesarean section rate of 29.09.



Conclusion

The results suggest a possible relationship between cesarean section rate and a state's level of transparency, when holding hospital expenditures constant. Because the results of the quantitative methods are only marginally significant, it is important to emphasize that any reflections on the nature of this relationship are mostly speculative, which is not to be unexpected for such exploratory research. This relationship is not linear in form but rather it is quadratic. Low rates of cesarean section are associated with a high likelihood of a state being transparent. As the rate of cesarean sections increases, this likelihood decreases, until it reaches the tipping point – a cesarean section rate of 29.09 percent, which is also the mean cesarean section rate. After this point, as cesarean section rate increases, so does the likelihood that a state will be transparent.

Although this relationship is suggestive rather than definitive, it is worthwhile to consider why such a pattern might be observed. In order to interpret this finding it is useful to return to the concepts presented in the literature review. High rates of and large variation within cesarean section and other medical interventions in childbirth cannot be solely explained by medical factors. Non-medical factors, such as financial and legal factors, incentivize maternity care providers to perform high rates of interventions regardless of medical need. If transparency in a state vital statistic report reveals high rates of medical interventions in childbirth, this may alarm women's health advocates and policy makers and inspire them to reduce these rates.

Maternity care providers and systems may reasonably be wary of policies that aim to reduce intervention rates, such as policies that set quotas and penalize providers and systems for performing excess interventions.

It is a standard stance of obstetricians and physicians who care for childbearing women to be against target cesarean rates,[272273] but it is also worthwhile to question how non-medical factors for cesareans and other interventions contribute to this attitude. Because legal and financial factors incentivize the over-use of interventions, a reduction in usage may translate into a loss of benefits for maternity care providers and systems, or may even introduce considerable disadvantages. For example, overusing medical interventions in childbirth provides financial rewards and protection from legal liability for maternity care providers. A policy that solely limits the use of interventions may not only lower income, but also increase vulnerability to lawsuits. A decrease in income may also make a provider financially insolvent for malpractice liability insurance. Furthermore, arbitrary limits on the use of interventions may make providers hesitant to provide interventions when they are needed, which could have serious detrimental health effects on childbearing women and their children. If maternity care providers and the systems in which the operate see such policies as being a potential outcome of increased transparency, transparency may be treated as the first step in a slippery slope towards potentially harmful changes in practice.

Obstetricians and other physicians who treat childbearing women, and the hospital systems that they work within, hold a solid amount of political clout. The ACOG boast 52,000 members and has been an influential voice in policymaking for issues such as health care reform, malpractice reform, and legislation related to midwifery and

homebirth.[274275276] Their opposition to policies that would increase transparency in the reporting of medical interventions in childbirth could prove to be a substantial obstacle to increasing transparency.

Building from this understanding of the relationships between non-medical factors for interventions, maternity providers and systems, and policies aimed to reduce interventions, it is possible to posit a potential explanation for the quadratic association between cesarean section rate and likelihood of transparency. States with low levels of medical interventions in childbirth, represented in the research by cesarean section, may have a low cesarean section rate because they are not strongly affected by the financial and legal factors that promote the overuse of interventions. Therefore, maternity care providers and systems need not be fearful of the emergence policies that could negatively affect their practice. However, as cesarean rate increases, this could signify an increasingly influential role of non-medical factors. As the influence grows, so does the magnitude of the potential loss providers would suffer if they were mandated to change practice by policy. It may be that, because of their political power and desire to maintain the status quo, transparency remains low.

The tipping point represents the point in which the public interest in reducing the negative public health effects caused by medical interventions outweighs the sway of those who oppose transparency. As the cesarean rate increases, it becomes more and more necessary for policy makers and advocates to use transparency as a tool to reduce the overuse of medical interventions in childbirth.

Hospital expenditures factor into this analysis are indicative of the level of care received in a hospital. High expenditures represent a greater amount of care (procedures,

tests, interventions) and a higher technical complexity of care than do low hospital expenditures. When hospital expenditures are held constant at the mean value, a cesarean rate above the mean may draw attention because it falls out of line with the level of care expected. However, if a cesarean rate above the mean rate exists within a hospital with expenditures higher than the mean, this quality of care may be expected and therefore less likely to draw negative attention and inspire efforts for increased transparency.

Limitations

The data used to measure the effect of the variables for Medicaid and malpractice on transparency may have masked their actual effects. More significant associations may have been produced if the data used were more relevant to maternity care practice. For example, instead of using the percentage of births covered by Medicaid to represent the influence of Medicaid and certain economic incentives on the likelihood of transparency, it may have been more appropriate to use the ratio of the reimbursement rate for vaginal delivery to cesarean delivery. However, this information was not readily accessible. Instead of using the mean malpractice payment per state to measure the effect of legal factors on the likelihood of transparency, it may have been more fitting to use the mean malpractice payment for obstetricians/maternity care providers specifically, or the number of malpractice payments per maternity care provider, or an interaction term measuring their joint influence. However, this information too was not readily accessible. It is very possible that because the available data on Medicaid and malpractice payments were not specific enough to maternity care, these variables were found to have no impact on the likelihood of transparency in the regression models.

In addition to the aforementioned issues, problems with accuracy and inconsistency of data may have affected the results of the research. Possible problem areas include

a) The necessary qualifications for transparency: Transparency is measured according to a specific set of guidelines that I created. Experts in public health transparency may disagree with the appropriateness of my criteria for measuring transparency. Furthermore, because not all state representatives answered my request to confirm my findings, the categorizing of transparent or non-transparent to a state may not be valid even based on my own criteria.

b) Data inconsistency: Vital statistics reports from different states reflected data from different years. The data from used to measure the independent variables were also inconsistent in regards to publication year. The lack of data that are consistent within a one-year period can make it difficult to find significant relationships between the dependent and independent variables.

Future research

Future research on this topic is needed in order to measure the role of organized, professional strength of maternity care providers on transparency levels. Future researchers may also want to use more data that are more specific to maternity care practice to measure to impact of Medicaid and legal liability on transparency. Greater resources would allow for researchers to more surely confirm the transparency level of

vital statistics reports, and may grant wider access to data sources necessary to ensure the consistency of data. Future research that experiments with different criteria for transparency could also enrich the findings presented here.

Implications for Advocacy

These findings have the potential to aide women's health and consumer advocates in increasing state transparency levels and reducing the overuse of medical interventions for childbirth. Based on the findings, advocates are recommended to focus efforts to increase transparency in states where the cesarean section rate does not fall significantly above or below the national average, as these are the states that are the least likely to be transparent. When advocating for increased transparency, it is important to address the nonmedical factors that create an environment that promotes the overuse of interventions. Advocates must work to change these environmental factors so as not to place an undue burned on maternity care providers and systems. If higher transparency proves to be a successful strategy in eliminating the use of medically unnecessary interventions in childbirth, it could improve not only the maternity care healthy system, but the lives and health of childbearing women and their families.

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Introduction

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