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The Influence of Obstetrician and Gynecologists' Avoidance Behaviors on Maternal Morbidities

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Abstract

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MBA/MHA, Pfeiffer University, 2008

BA, University of North Carolina at Chapel Hill, 1998

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

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Abstract

The prevalence of maternal morbidities continues to increase in U.S. women of lower socioeconomic status and non-Hispanic Black women despite the efforts of health care practitioners to reduce the disparities. Two decades of research has shown that physicians avoid patients based on insurance and socioeconomic status or their malpractice history. Reducing maternal illness and complications is one of the federal government's top 10 maternal health indicators in the *Healthy People 2020* initiative. The purpose of this study was to evaluate the influence of malpractice allegations on patients at high-risk for maternal morbidity. Supported by the theoretical foundation of human factor theory, the focus of the research questions was on the relationship between obstetrics-related malpractice allegations and maternal and severe maternal morbidities in Black/African American women or women who have Medicaid or Medicare. The study involved a retrospective secondary analysis of data from the National Practitioner Data Bank, years 2006 and 2007 and the National Hospital Discharge Survey, years 2006-2008, from the Inter-University Consortium for Political and Social Research, as well as National Plan and Provider data from the Centers for Medicare and Medicaid Services. A logistic regression analysis indicated an association between bed size and days of care with maternal morbidities and severe maternal morbidities; however, no association with malpractice allegations was found. This study contributes to social change by raising awareness of continued morbidity disparities in women of lower social economic status and non-Hispanic Black women and contributes to the current literature.

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Dedication

I would like to dedicate this dissertation to my parents, Robert and Sandra Boulware, Jr, who taught me to never give up on my dreams and to always trust in the Lord, and He will direct my path.

To my son, Cameron, thank you for your patience and understanding while I traveled this journey. You taught me perseverance in that the greater the obstacle the more glory in overcoming.

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My dissertation would never have been completed without the guidance of my committee, support from my family and friends.

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I want to thank my family, friends, and Sorors of Sigma Gamma Rho Sorority, Inc. for your unwavering support, prayers and encouragement.

Lastly, I thank the almighty God for giving me the ambition and the courage to compete this journey.

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Chapter 1: Introduction of Study

The trend of United States maternal morbidities or poor and adverse outcomes has increased in the United States over the past several years (Berg et al., 2009; Bruce et al., 2008, 2012; Bryant et al., 2010; Cabacungan et al., 2012; Callaghan et al., 2008, 2012; Centers for Disease Control and Prevention [CDC], 2014; Creanga et al., 2014; Fridman et al., 2014; Gray et al., 2012; Kuklina et al., 2008, 2009; Shen & Wei, 2008; Zhang et al., 2013.) According to the CDC (2014), severe maternal morbidities affect over 50,000 women each year in the United States and are 50 times more common than maternal death (Callaghan et al., 2008). The prevalence of severe maternal morbidities in the United States is increasing despite the Healthy People 2010 and 2020 goals (National Hospital Discharge Survey, 2014) to reduce maternal illness and complications. The lack of maternal morbidity and severe maternal morbidity research in the United States indicates a gap in the knowledge in the field of maternal and child health (Gray et al., 2012).

Literature is more scarce on the risk factors for maternal morbidity. Past studies have shown that minorities and individuals of lower socioeconomic status (SES) have poorer health outcomes (Bruce et al., 2008, 2012; Cabacungan et al., 2012; Creanga et al., 2014; Dhankhar & Khan, 2009; Dubay et al., 2001; Fridman et al., 2014; Gray et al., 2012; Nagahawatte & Goldenberg, 2008; Shen & Wei, 2008; Yang et al., 2012; Zhang et al., 2013). However, despite efforts to reduce racial and social class disparities in the United States, women of lower social economic status and non-Hispanic Black women have significantly higher rates of adverse maternal outcomes (Bruce et al., 2012; Bryant et al., 2010; Cabacungan et al., 2012; Callaghan et al., 2008; Creanga et al., 2014; de Jongh et al., 2012; Fridman et al., 2014; Gray et al., 2012; Nagahawatte & Goldenberg, 2008; Messer et al., 2008; Nanyonjo et al., 2008; O'Campo et al., 2008; Shen & Wei, 2008; Zhang et al., 2013). They also have longer lengths of stay (Gray et al., 2012; Zhang et al., 2013) due to their comorbidities or preexisting conditions (Bryant et al., 2010; Fridman et al., 2014). Non-Hispanic Black women are 3-4 times more likely to die from a pregnancy complication compared to non-Hispanic White women (Bruce et al., 2012; Creanga et al., 2014; Nagahawatte & Goldenberg, 2008).

Physician avoidance practices only increase these risks for adverse maternal outcomes (Philips et al., 2004). Avoiding specific patient populations out of fear or the perceived increased risk of litigation and reducing or eliminating high-risk patients, or only providing gynecological care, further increases the patient's risk of adverse outcomes (Dhankhar & Khan, 2009; Dubay et al., 2001; Philips et al., 2004). According to Dubay et al. (2001), physicians should not risk making medical decisions that differ from safe operating practices, procedures, or rules to avoid malpractice litigation. Dhankhar and Khan (2009) and Dubay et al. (2001) both found that physicians in the United States modified their behavior for patients based on insurance and SES. They suggested that more research on the impact of physician defensive medicine behaviors on vulnerable populations be conducted (Dhankhar & Khan, 2009; Dubay et al., 2001). I sought to address this call for research by conducting this study to raise awareness in minorities and their higher propensity for maternal morbidities.

In this chapter, I provide background information on the study topic and research problem. I also state the purpose of the study and the research questions and hypotheses. The chapter also includes an overview of the study's theoretical foundation and nature and a discussion of the study's assumptions, scope and delimitations, limitations, and significance. A more thorough review of the literature surrounding maternal adverse outcomes and the effects of defensive medicine practices and physician-perceived malpractice risk is provided in Chapter 2.

Background

Women of lower socioeconomic class are more affected by negative defensive medicine practices (Bruce et al., 2012; Bryant, Worjoloh, Callaghan, MacKay, & Berg, 2008; Messer et al., 2008; Caughey, & Washington, 2010; Creanga, Bateman, Kuklina, & Callaghan, 2014; Cabacungan, Ngui, & McGinley, 2012; de Jongh, Locke, Paul, & Hoffman, 2012; Dubay et al., 2001; Fridman et al., 2014; Gray, Wallace, Nelson, Reed, & Schiff, 2012; Nagahawatte & Goldenberg, 2008; Nanyonjo et al., 2008; O'Campo et al., 2008; Shen & Wei, 2008; Stulberg, Zhang & Lindau, 2011; Zhang et al., 2013). Racial and ethnic minority women and women using public insurance are more likely to have maternal complications and infections (Bruce et al., 2012; Bryant et al., 2010; Cabacungan et al., 2012; Creanga et al., 2014; Gray et al., 2012; Shen & Wei, 2008; Zhang et al., 2013) and prolonged lengths of stay (Gray et al., 2012; Zhang et al., 2013) due to their comorbidities or preexisting conditions (Bryant et al., 2010; Fridman et al., 2014). Despite this research, and based on my review of the literature, there remains a gap in knowledge around the association between OB-GYN avoidance practice decisions and maternal morbidities.

In addition, there still remain significantly higher rates of adverse birth outcomes (specifically, preterm birth, infant mortality, and low birth weight) in non-Hispanic Black women and women of lower social economic status in the United States (Dhankhar & Khan, 2009; Messer et al., 2008; O'Campo et al., 2008) and adverse maternal outcomes such as preeclampsia/eclampsia, postpartum hemorrhage, placenta previa, and placental abruption (Callaghan, Mackay, & Berg, 2008). Maternal race/ethnicity, age, SES, and insurance are important factors in determining adverse birth and maternal outcomes (de Jongh et al., 2013; Shen & Wei, 2008; Zhang et al., 2013). These risk factors are important in the field of maternal and child health; however, based on my review of the literature, there remains a gap in the literature after 2008. This study provides some insight on the importance in understanding the relationship between these risk factors, OB-GYN-related malpractice allegations and the severity of the malpractice injuries, and maternal morbidities.

Problem Statement

Obstetrics and gynecology physicians (OB-GYNs) have a higher risk for medical malpractice claims or allegations compared to other physician specialties due to the inherent risk and unpredictability of their profession. As Yang et al. (2008) noted, on average, OB-GYNs are sued 2.5 more often than other physicians. As such, they are more likely than other specialties to practice defensive medicine avoidance behaviors, according to researchers (Baicker & Chandra, 2005; Gimm, 2010; Yang et al., 2008). Previous obstetrics malpractice claims and their severity influence the practice of defensive medicine (Dhankhar & Khan, 2009). OB-GYN doctors' malpractice premiums are higher than those of doctors in other specialties due to the high damages awarded in "bad baby cases," a term commonly used to refer to adverse newborn outcomes such as neonatal deaths or babies being born with neurological disorders (Dhankhar & Khan, 2009).

Defensive medicine is a deviation from day-to-day clinical decisions, which involves alternating the scope and style of evidence-based procedures to reduce the probability of litigation (Mello & Brennan, 2002). Defensive medicine practices can consist of both positive and negative behaviors. Positive practices or assurance behaviors include offering medically unnecessary tests to patients who do not need them or overly referring patients to other specialists to cut down on their malpractice risk (Studdert et al., 2005). Negative defensive medicine practices are comprised of avoidance behaviors such as eliminating procedures that are more prone to complications or refusing to treat patients who have complex medical problems such as diabetes, obesity, congestive heart failure, heart failure, or other heart conditions because these conditions pose a higher risk of having medical complications (Studdert et al., 2005). Avoidance behaviors can also include avoiding patients with lower incomes or those with Medicaid because they have a higher propensity of having adverse outcomes (de Jongh et al., 2012; Nanyonjo et al., 2008; O'Campo et al., 2008; Shen & Wei, 2012; Stulberg, Messer et al., 2008; Zhang & Lindau, 2011; Zhang et al., 2013) or patients who have a higher probability of filing malpractice lawsuits (Baicker & Chandra, 2005; Dhankhar & Khan, 2009).

OB-GYN physician supply has decreased due to practicing restrictions such as physicians who cease to practice obstetrics but continue to provide gynecological care or only perform normal deliveries (Yang et al., 2008). Blanchard et al. (2012) found that physicians entering the workforce are limiting their scope of practice because of their fear or perceived risk of litigation. In the view of Blanchard, physicians should not risk making medical decisions that deviate from safe operating practices, procedures, or rules out of fear of malpractice litigation. Such decisions can result in preventable patient errors or adverse outcomes, Shouhed et al. (2012) noted.

Additional research on the effects of scope of practice changes on patient outcomes is needed (Yang et al., 2008). Studies have been performed on how and why OB-GYNs change their practice patterns. However, many researchers have not investigated the patient impact of these behaviors beyond the association between paid malpractice claims or tort reform laws on adverse events (Currie & MacLeod, 2008; Dubay et al., 2001; Mello et al., 2007; Sakala et al., 2013a, 2013b; Wu, 2010; Yang et al., 2012; Yang et al., 2009; Yang et al., 2008). Researchers conducting empirical studies have primarily measured defensive medicine practice changes through malpractice allegations or claims and claims severity, insurance premiums, and tort reform laws and have shown mixed results (Currie & MacLeod, 2008; Dhankhar & Khan, 2009; Dubay et al., 2001, Mello et al., 2007; Sakala et al., 2013a, 2013b; Wu, 2010; Yang et al., 2008, 2009, 2012). The few researchers who have looked at how these changes impact patient outcomes (Currie and MacLeod, 2008; Dhankhar & Khan, 2009; Dubay et al., 2001; Wu, 2010; Yang et al., 2012) have focused on malpractice liability and the use of cesarean section or other assurance behaviors; very few have explored the relationship between the liability system and maternal outcomes (Sakala et al., 2013b). Yang et al. (2012) and Dubay et al. (2001) both conducted national studies on birth outcomes; however, based on the research I have conducted, Currie and McLeod (2008) are the only researchers thus far who have compared birth outcomes by normal and high-risk pregnancies defined by ICD-9-CM diagnosis codes. Additional research is needed on how physician practice patterns affect patient outcomes.

Purpose of the Study

This research was a cross-sectional, retrospective, quantitative study. The purpose of this study was to examine the relationship between OB-GYNs who engaged in defensive medicine avoidance behaviors defined by obstetrics-related malpractice allegations and the severity of the malpractice injuries and their influence on maternal morbidities and severe maternal morbidities after adjusting for hospital characteristics such as bed size, ownership, and location and patient days of stay. The malpractice data included all female inpatients with an obstetrics-related malpractice allegation, a malpractice injury severity with a range from 1 (*emotional injury*) to 9 (*death*), and a malpractice payment.

The pregnancy population included all female patients aged 15-49 with delivery or postpartum hospitalizations. The population is identified in Appendix A using the enhanced delivery identification method (Kuklina et al., 2008), as well as primary or secondary ICD-9-CM diagnosis code V24 for postpartum hospitalizations and diagnosis-related (DRG) delivery codes 367, 377, 769 or 776 (postpartum and post abortion diagnoses without operating room procedure; Callaghan et al., 2012). The dependent variables were maternal morbidities and maternal severe morbidities, and the independent variables included age, race, insurance status as defined by principal expected source of payment, and number of delivery and postpartum hospitalizations. Maternal morbidities during hospitalization were measured using the primary and secondary ICD-9-CM-CM discharge codes found in Appendix B. Severe maternal morbidities including antepartum, intrapartum, and postpartum were measured using the ICD-9-CM discharge diagnosis codes and procedure codes in Appendix C.

Research Questions and Hypotheses

I designed the research questions to examine the relationship between OB-GYNs who engaged in defensive medicine avoidance behaviors defined by obstetrics related malpractice allegations and the severity of the malpractice injuries and its influence on maternal morbidities and severe maternal morbidities in high-risk females aged 15-49 who are Black/African American or have Medicaid or Medicare as their principal expected source of payment. Researchers have found that these avoidance behaviors increase the patient's risk for the adverse outcomes found in Appendices B and C (Callaghan et al., 2012). I adjusted for hospital characteristics such as hospital region, bed size, and ownership and patient days of care.

Descriptive Questions

RQ1. What is the average percentage of obstetrics malpractice allegations per region year?

RQ2. What is the average severity of obstetrics malpractice allegations per region year?

RQ3. What proportion of obstetrics malpractice allegations led to permanent injury (severity injury rank 5 – 8) per region year?

RQ4. What proportion of obstetrics malpractice allegations let to death (severity injury rank 9) per region year?

RQ5. What proportion of delivery and postpartum hospitalizations are high-risk defined by race and insurance status (principal expected source of payment) per region year?

RQ6. What proportion of delivery and postpartum hospitalizations has one or more maternal morbidity, measured using the ICD-9-CM discharge codes found in Appendix B and severe maternal morbidity diagnosis, measured using the ICD-9-CM discharge codes found in Appendix C per region year?

RQ7. What percentage of high-risk pregnancy maternal morbidities is severe, measured using the ICD-9-CM discharge codes found in Appendix C per region year?

RQ8. Which hospital characteristics, such as hospital region, bed size, ownership, or patient days of care are strongly associated maternal morbidities, measured using the ICD-9-CM discharge codes found in Appendix B and severe maternal morbidities, measured using the ICD-9-CM discharge codes found in Appendix C in the high-risk pregnancy population per region year?

Relationship Question and Corresponding Hypotheses

RQ9. Is there a relationship between OBGYN physician avoidance behaviors (obstetrics related malpractice allegations and the severity of the malpractice injuries) and maternal morbidities?

$H9_0$: There is no relationship between OBGYN physician avoidance behaviors (obstetrics related malpractice allegations and the severity of the malpractice injuries) and maternal morbidities.

$H9_A$: There is a relationship between OBGYN physician avoidance behaviors (obstetrics related malpractice allegations and the severity of the malpractice injuries) and maternal morbidities.

Theoretical Framework

Human Factor Theory is the study of applied information and human behavior, abilities, limitations, and errors that occur in work environments (Reason, 1995). Adverse events or occurrences are directly or indirectly the result of human errors or factors. According to the theory, errors are natural consequences, of system breakdowns not the causes (Shouhed et al., 2012). Human Factors research provides a framework for analyzing and assessing risk and reducing error by considering where the system design could better count for human error. The most common model of Human Factors Theory is Reason's (2000 & 1997a) Swiss Cheese Model of accident causation, which has been proven useful in medical accidents and incidents (Reason, 2000).

Human decisions and actions are a major contributor of all accidents through active or latent failures. Active failures or violations and deviations from safe operating practices, procedures, standards, or rules (Cuschieri, 2000; Reason, 1995, 2000; Shouhed et al., 2012) have a direct impact on safety and have immediate adverse effects (Reason, 1997a; 2000). These violations can be classified as necessary, routine, or optimizing (Reason, 1995; 1997b), however routine violations, such as physicians avoiding certain high-risk population can increase the likelihood of errors occurring especially in high stress situations when the consequences of the errors are more severe (Alper & Karsh, 2006). Despite these consequences very few human factor studies have been performed in medicine. The studies that have been performed only focus on surgery and are not specific to violations and only include slips and lapses in judgment or mistakes on behalf of the surgeon or anesthesiologist.

The research that is on routine violations or rule-based errors in healthcare is restricted. The literature on rule violations occurring in work settings is limited and there are fewer studies where the causes of violations are studied in work settings. Alper and Karsh (2009) conducted a systematic review of safety violations in healthcare, commercial driving, aviation, mining, railroad, and construction industries and found five studies on healthcare out of thirteen articles that met their inclusion criteria. Even though many the healthcare studies were self-reported accounts of violations, their analysis found that most predictors of healthcare violations were multi-factorial and generally included individual characteristics such as personal goals, the organization, the worker's task or the organization's rules (Alper & Karsh, 2009). The researchers concluded that more research was needed on which variables consistently predict unsafe violations. The current literature was limited on the patient impact of OBGYN physician avoidance behaviors on adverse events, however did provide information on violation predictors and human factors research and human errors on adverse events. There remained a gap in the literature on the human factor theory of physicians avoiding high-risk patients for personal gain. These routine violations and rule-based errors are affecting the health of high-risk pregnancies.

Nature of the Study

This cross-sectional retrospective quantitative study examined the relationship between OBGYN avoidance behaviors and adverse outcomes at a single point in time to measure the prevalence of maternal morbidities within the population. Retrospective cross-sectional research is frequently used to show the impact of morbidities and diseases in the United States. The purpose of this study was to examine the relationship between OBGYNs who engaged in defensive medicine avoidance behaviors defined by obstetrics related malpractice allegations and the severity of the malpractice injuries and its influence on maternal morbidities and severe maternal morbidities in high-risk females age 15-49 who are Black/African American or have Medicaid or Medicare as their insurance status defined by principal expected source of payment, after adjusting for hospital characteristics such as bed size, ownership, and location and patient days of stay. The study population included all inpatient females with an obstetrics related malpractice claim, a malpractice injury severity with a range from 1 – emotional injury to 9 – death and a malpractice payment included in the National Practitioner Data Bank Public Use Data File, 2017 (NPDB-PUDF) for years 2006 and 2007. Inpatient females with a delivery or postpartum hospitalization as defined in Appendix A and whose ICD-9-CM procedure diagnosis codes or DRG codes were also included from the National Discharge Survey data for years 2007 and 2008 whose race was specified as Black/African American and principal expected source of payment as Medicaid or Medicare. The study was restricted to women with a hospital stay of at least 1 day (2 days being the median length of stay among women who delivered) or who had been transferred to another facility after delivery (Callaghan et al 2008). Women with at least one of the ICD-9-CM codes listed in Appendix A and a minimum one-day length of stay or a postpartum transfer were also included in the study.

The inpatient delivery hospitalizations were identified using a previous published algorithm which uses both ICD-9-CM diagnosis and procedure codes, and DRG codes to identify selected delivery- related procedures (Callaghan et al., 2012; Kuklina et al., 2008). The “postpartum hospitalizations were identified using the fifth digit = 4 in ICD-9-CM codes for primary or secondary diagnosis, an ICD-9-CM code V24 for any listed diagnosis", as well as postpartum diagnosis-related group codes 376, 377, 776 or 769 for the 2007-2008-period (Callaghan et al., 2012). This was a simple probability sample where each sample had a fair and equal opportunity to be a part of the study.

The dependent variables were maternal morbidities and severe maternal morbidities, and the independent variables found in Appendix A included age, race, insurance status defined as principal expected source of payment, and number of delivery and postpartum hospitalizations. Maternal morbidities during hospitalization were measured using the ICD-9-CM discharge codes found in Appendix B and severe maternal morbidities occurring antepartum, intrapartum, and postpartum were measured using ICD-9-CM discharge diagnosis codes and procedure codes in Appendix C.

Operational Definitions

In this study, the following definitions apply:

Apgar score: A test performed on a newborn within 5 minutes after birth to see how the baby tolerated the birth process (Dubay et al., 2001; Wu, 2010; Yang et al., 2012).

Antepartum: The period before labor during pregnancy (Callaghan et al., 2008; Gray et al., 2012; Kuklina et al., 2009).

Birth injury: An impairment of the infant's body function or structure due to adverse influences that occurred at birth (Yang et al., 2012).

Defensive medicine: A deviation from day-to-day clinical decisions, which involves alternating the scope and style of evidence-based procedures to reduce the probability of litigation (Mello & Brennan, 2002).

Diagnosis related group (DRG): An inpatient diagnosis grouping methodology used to properly bill patients for insurance reimbursement purposes based on the care and services they are provided (Kuklina et al., 2008).

International Classification of Diseases, Ninth Revision- Clinical Modification (ICD-9-CM-CM): A group of routinely used diagnosis and procedure codes to identify inpatient delivery and postpartum patients (Berg et al., 2009; Callaghan et al., 2008, 2012; Creanga et al., 2014; Dhankhar & Khan, 2009; Gimm, 2010; Kuklina et al., 2009; Wu, 2010; Zang et al., 2013).

Indemnity payments: For the purposes of this study, these are payments made to patients by insurance companies due to physician malpractice (Jena et al., 2011).

Insurance premiums or malpractice premiums: For the purposes of this study, these are payments made by physicians for malpractice insurance coverage (Dubay et al., 2001; Gimm, 2010; Mello et al., 2007; Yang et al., 2008, 2009, 2012).

Intrapartum: The period during the birth process (Callaghan et al., 2008; Gray et al., 2012; Kuklina et al., 2009).

Low birth weight: Birth weight of less than 2,500 grams at birth (Dubay et al., 2001; Wu, 2010; Yang et al., 2012).

Malpractice allegation: For the purposes of this study, these are the number of patient physician malpractice allegations (Dhankhar & Khan, 2009; Gimm, 2010; Jena et al., 2011).

Malpractice severity: For the purposes of this study, this is the severity of the malpractice injury on the patient (Dhankhar & Khan, 2009).

Malpractice insurance crisis state: States most affected by physician increases in insurance premiums (Sakala, 2013b).

Maternal morbidity: Any physical and psychological condition or complication that results from or is aggravated by pregnancy and has an adverse effect on a women's health (CDC, 2014). Maternal morbidities or complications can increase hospital length of stay and healthcare costs, as well as cause emotional distress to the family and long-term rehabilitation for the mother (Callaghan et al., 2012; CDC, 2014; Gray et al., 2012).

Negative defensive medicine: For the purposes of this study, this term refers to physicians' avoidance of certain populations because of their risk to poorer outcomes or their higher probability of filing malpractice lawsuits (Bruce et al., 2012; Bryant, Worjoloh, Caughey, & Washington, 2010; Cabacungan, Ngui, & McGinley, 2012; Callaghan, MacKay, & Berg, 2008; Creanga, Bateman, Kuklina, & Callaghan, 2014; de Jongh, Locke, Paul, & Hoffman, 2012; Fridman et al., 2014; Gray, Wallace, Nelson, Reed, & Schiff, 2012; Messer et al., 2008; Nagahawatte & Goldenberg, 2008; Nanyonjo et al., 2008; O'Campo et al., 2008; Shen & Wei, 2008; Stulberg, Zhang & Lindau, 2011; Zhang et al., 2013).

Placenta abruption: An uncommon complication that occurs during pregnancy where the baby is deprived of oxygen and nutrients and the mother suffers from heavy bleeding (Mayo Clinic, 2013).

Placenta previa: A pregnancy complication where the placenta either partially or totally covers the opening in the mother's cervix (Mayo Clinic, 2013).

Positive defensive medicine: For the purposes of this study, this term refers to physicians performing cesarean sections instead of vaginal deliveries or overly ordering tests or referring patients to other specialists to cut down on their malpractice risk (Sakala et al., 2013b).

Preeclampsia/eclampsia: A pregnancy complication of high-blood pressure (Mayo Clinic, 2013).

Preexisting complication: For the purposes of this study, this term includes any condition characterized as a complication that existed prior to the pregnancy (Mayo Clinic, 2013).

Prenatal utilization: The amount of prenatal services or visits the mother had while pregnant (Dubay et al., 2001; Wu, 2010; Yang et al., 2012).

Preterm birth: Babies born before 37 completed gestational weeks (Dubay et al., 2001; Dhankhar & Khan, 2009; Messer et al., 2008; O'Campo et al., 2008; Wu, 2010; Yang et al., 2012).

Postpartum: The period just after delivery (Callaghan et al., 2008; Gray et al., 2012; Kuklina et al., 2009;).

Preventable errors or *complications*: For the purposes of this study, these include complications or errors that could have been avoided if proper protocols or evidence-based practices were followed (Currie & MacLeod, 2008; Shouhed et al., 2012).

Tort reform: A practice that occurs when procedural limits are imposed on the ability to file claims and caps the amount that damages can be awarded to claimants (Currie & McLeod, 2008; Dubay et al., 2001; Wu, 2010; Yang et al., 2008, 2009).

Assumptions

Since this study used secondary data assumptions were made related to the quality and the representativeness of the data. The primary assumption in this study was that the malpractice data was an accurate representation of the physician's malpractice allegation, the patient's injury severity and the malpractice payments by physician specialty. It was also assumed that the hospital data collected was reported by physicians and coded accurately by coding staff properly representing female patients diagnosed with a delivery and/ or postpartum hospitalization or adverse medical outcomes. It was assumed that the same survey methodology was used for both years in each of the datasets as well as editing procedures. In addition, it was assumed that the malpractice allegations and malpractice severities were an accurate representation of females and the patient cases in the study were an accurate representation of females age 15 – 49 delivery and postpartum hospitalizations and maternal and severe maternal morbidities. It was assumed that any conclusions drawn from this research can be applied to the general U.S. population. In addition, an assumption was made that the quantitative cross-sectional research design and statistical analyses in this study were the best possible tools to address the research hypotheses and research questions**.**

Scope and Delimitations

The purpose of this study was to determine if there was a negative relationship between OBGYN physician avoidance behaviors defined malpractice allegations and the severity of the malpractice injuries and maternal morbidities and severe maternal morbidities defined by ICD-9-CM within the high-risk patient population. The study population included all inpatient females with an obstetrics related malpractice allegation and malpractice injury severity with a range from 1 – emotional injury to 9 – death with a malpractice payment included in the National Practitioner Data Bank Public Use Data File, 2017 (NPDB-PUDF) for years 2006 and 2007. As well as female patients between the ages of 15 and 49 who had a delivery and postpartum hospitalization included in the National Hospital Discharge Survey (NHDS) for years 2007 and 2008. The study population included hospitals across the United States and as such it was expected that the study findings would be generalizable across the US as well as the study methodology replicated.

Limitations

Administrative data is often rich in information and generally free to use, however it does have its limitations. Within all the data that is provided it may be difficult to locate the correct measure or variable for your research question. Often researchers must search through many fields of data and databases to find just the right measure or research question that fits their study, however still not knowing how reliable the original researcher's work truly is. Per Smith, Ayanian, Covinsky, Landon et al (2011), it is difficult for researchers to locate good data sources for research questions or to determine the quality of someone else's work. In addition, sometimes administrative data needs cleaning, as it may be incomplete, missing, or wrong (Billings, n.d.).

There are constraints associated with a retrospective cross-sectional study. When using secondary data, the research is limited to the data available within the dataset. The researcher is limited to the data quality of the original researcher and must be aware of missing data, data lags, incorrect coding, population exclusions, etc. with the dataset (Aponte, 2010). The National Practitioner Data Bank (NPDB) maintains a comprehensive security system and is consistent with recognized standards and guidelines. Billings (n.d), urges caution will using secondary data and to perform a data analysis to reveal any inconsistencies or anomies such as frequency distributions and cross tabulations of the variables of interest to identify any data that are incomplete in the needed data fields. To address this limitation the NHDS study data was edited by hospital and NHDS staff as well as computer software for completeness and accuracy and all incomplete and duplicate records were removed as well as any hospitals that were out of the scope of the survey. When data is reported in the NPDB system it is processed in the same way it was reported and the reporter must make any changes or corrections. Once the NPDB processes a report the subject of the report, which includes health care practitioners, entities, providers, and suppliers are notified (United States Department of

Health and Human Services [USDHHS], 2017). To address incomplete and missing data within the study population, all nulls, unknowns, incomplete and missing data were removed as well as duplicates.

Another limitation of using secondary data is that it often requires further analysis, as it often never tells the entire story. The primary weakness of the cross-sectional design is that the exposure and disease are examined simultaneously, so it is impossible to determine the direction of association (Frankfort-Nachmias & Nachmias, 2008). The limitation of association was addressed in the statistical analysis by accessing the association of the independent and dependent variables.

Significance of Study

Maternal morbidities continue to affect thousands of women in the United States (CDC, 2014) and are fifty times more likely to occur than maternal death (Callaghan et al., 2008). Callaghan et al (2008) found that during 1991-2003, 5 out of every 1,000 women who delivered babies in the United States had at least one severe maternal morbidity during their hospitalization. Furthermore, for every maternal death there were 50 women who experienced a severe morbidity. This means that approximately 20,000 women each year have a severe maternal morbidity. In 2012, Callaghan conducted another study utilizing 1998-2009 data and found that 5,600 women die during a delivery or a postpartum hospitalization, which suggests that for 4,000,000 births in the United States, 129 episodes of severe maternal morbidity will affect an estimated 52,000 women.

Despite these alarming data there is limited research on maternal morbidity and severe maternal morbidity in the U.S. (Gray et al., 2012) and its risk factors.

Since 2010, the United States has had a Healthy People 2020 goal to reduce maternal illness and complications due to pregnancy, however the rate of maternal complication or morbidity continues to increase and disproportionally affect non-Hispanic Black women more than others. In the United States, non-Hispanic Black women and women of lower social economics are significantly disproportionately affected when compared to non-Hispanic White women specifically preterm birth, infant mortality, and low birth weight (Messer et al., 2008; O'Campo et al., 2008). Non-Hispanic Black women are 3-4 times more likely to die from a pregnancy related complication compared to non-Hispanic White women (Creanga et al., 2014; Bruce et al., 2012; Nagahawatte & Goldenberg, 2008). Zhang et al (2013) found that among Medicaid pregnancies, non-Hispanic Black women still have poorer outcomes compared to non-Hispanic White or Hispanic women. Maternal morbidities affect thousands in the United States, but there are still large racial disparities and very few quantitative population-based studies that investigate the rate of maternal complications and morbidity by race or insurance status.

Any information on the underlying relationship between independent factors and maternal morbidities and severe morbidities has the potential to be used for clinical reviews, development of quality-of-care indicators, and identifying future research priorities in obstetrics and/or quality of care. According to Adwok and Kearns (2013), it is unlikely that defensive medicine practices will be eliminated; however, major policy changes in the current medical liability system could positively influence its practice. Acknowledging the patient outcomes of physician avoidance behaviors may be the bridge between medical liability and health policy. Models of patient quality or costs of services may be useful in analyzing the effect of defensive medicine practices (Mello & Brennan, 2002).

Summary

There were several studies published on the types of defensive medicine practices, physician and patient perceptions of assurance and avoidance behaviors, the impact of the behaviors on healthcare costs, quality of care, and the decrease of the physician workforce and the availability of healthcare services. Many of these studies, however, used data prior to 2005 and focused on multiple physician specialties. The studies conducted on OB/GYNs exclusively, primarily focused on their propensity for malpractice risk, the effects of liability premiums and tort reforms on the availability of services, and the declining OB/GYN workforce. The studies on defensive medicine avoidance behaviors and patient outcomes or adverse events were limited, especially on high-risk populations.

My study measured the relationship between obstetrics malpractice allegations and the severity of the injuries and maternal morbidities and severe maternal morbidities defined by ICD-9-CM within the high-risk patient population. The results of this study may provide support for medical liability policy changes, encourage physicians to follow evidence-based practices, have open and honest conversations with their patients and inform them of any potential risks as well as encourage prenatal services especially in high-risk populations.

Chapter 2 provides a review of the literature relevant to this study on the characteristics of OBGYNs and their decision to practice defensive medicine through a human factor theoretical framework and the adverse morbidities that occur due to patient population avoidance. The chapter also summarized the association between OBGYN defensive medicine avoidance behaviors and high-risk pregnancy outcomes, measured by obstetrics allegations and the severity of the malpractice injuries (independent variables) and maternal and severe maternal morbidities measured by ICD-9-CM-CM diagnosis codes (dependent variables). The chapter also included a discussion on the literature gap that this study addresses.

Chapter 2: Literature Review

Introduction

OB-GYNs are more likely to practice avoidance behaviors, a form of defensive medicine, because they are 2 to 3 times more likely to have medical malpractice allegations compared to other physician specialties and have higher indemnity payments due to their increased risk of adverse patient outcomes (Gimm, 2010; Jena et al., 2011; Sakala et al., 2013a; Yang et al., 2008). However, avoiding specific patient populations out of fear or the perceived increased risk of litigation and reducing or eliminating high-risk patients, or only providing gynecological care, further increases the patient's risk of adverse outcomes (Dhankhar & Khan, 2009; Dubay et al., 2001; Philips et al., 2004). Defensive medicine is a deviation from day-to-day clinical decisions, which involves alternating the scope and style of evidence-based procedures to reduce the probability of litigation (Mello & Brennan, 2002). According to Blanchard et al. (2012), physicians should not risk making medical decisions that deviate from safe operating practices, procedures, or rules out of fear of malpractice litigation. Errors in judgment can result in preventable patient errors or adverse outcomes, especially for high-risk patients.

The purpose of this study was to determine if there is a relationship between OB-GYN physician avoidance behaviors as defined by high-risk patient delivery and postpartum hospitalizations and maternal adverse outcomes as defined by the ICD-9-CM codes in Appendices B and C. After establishing whether a relationship existed, I sought to determine if there was a statistically significant relationship between maternal morbidities, including severe morbidities and socioeconomic status within the high-risk patient population.

Medical malpractice risk is higher for patients with severe medical complications (Dhankhar & Khan, 2009). Dubay et al. (2001) found that prenatal care and patient outcomes in women of lower socioeconomic status are affected more by negative defensive medicine practices. Despite efforts to reduce racial and social class disparities in the United States, non-Hispanic Black women and women of lower social economic status have significantly higher rates of adverse birth outcomes, specifically preterm birth, infant mortality, and low birth weight (Dhankhar & Khan, 2009; Messer et al., 2008; O'Campo et al., 2008) and adverse maternal outcomes such as preeclampsia/eclampsia, postpartum hemorrhage, placenta previa, or placental abruption (Callaghan, Mackay, & Berg, 2008). Maternal race/ethnicity, age, SES, and insurance are important factors in determining adverse birth and maternal outcomes (de Jongh et al., 2013; Shen & Wei, 2008; Zhang et al., 2013).

- In the literature review in this chapter, I summarize the association between OB-GYN defensive medicine avoidance behaviors and high-risk pregnancy outcomes, as measured by insurance and SES (independent variables), and maternal morbidities as measured by ICD-9-CM diagnosis codes (dependent variables). The literature review also includes a discussion on the characteristics of OB-GYNs and their decision to practice defensive medicine through the human factor theoretical framework (Reason, 1995) and the adverse pregnancy outcomes or morbidities that may occur due to patient population avoidance. Negative defensive medicine practices or avoidance behaviors can put patients at risk for having adverse conditions. Avoidance behaviors include avoiding patients with lower incomes or those with Medicaid because they have a higher propensity of having adverse outcomes (Bruce et al., 2012; Cabacungan, Ngui, & McGinley, 2012; Callaghan, MacKay, & Berg, 2008; Creanga, Bateman, Kuklina, & Callaghan, 2014; Bryant, Worjoloh, Caughey, & Washington, 2010; de Jongh, Locke, Paul, & Hoffman, 2012; Fridman et al., 2014; Gray, Wallace, Nelson, Reed, & Schiff, 2012; Messer et al., 2008; Nagahawatte & Goldenberg, 2008; Nanyonjo et al., 2008; O'Campo et al., 2008; Shen & Wei, 2008; Stulberg, Zhang & Lindau, 2011; Zhang et al., 2013). Racial and ethnic minority women and women using public insurance are more likely to have maternal complications and infections (Bruce et al., 2010, 2012; Cabacungan et al., 2012; Creanga et al., 2014; Gray et al., 2012; Shen & Wei, 2008; Zhang et al., 2013;) and prolonged lengths of stay (Gray et al., 2012; Zhang et al., 2013) due to their comorbidities or preexisting conditions (Bryant et al., 2010; Fridman et al., 2014). Defensive medicine practices can increase the risk of adverse patient outcomes (Philips et al., 2004). Despite this previous research, there was a gap in knowledge about the association between OBGYN avoidance practice decisions and maternal morbidities. I conducted this study to address this gap.

Literature Search Strategy

The literature review includes an examination and summary of current literature related to the following key terms: *defensive medicine*, *liability*, *malpractice*, *legislation*, *litigation*, *obstetrics*, *gynecology*, *high-risk pregnancy*, *socioeconomic*, *ethnicity*, *race*, *insurance*, *risk*, *adverse*, *outcome*, *sentinel event*, *postpartum*, and *human factor theory*. I systematically searched a variety of online sources and databases to find peer-reviewed research published from January 1, 2008, to February 28, 2014. Earlier literature and studies are included to provide historical background on the topics and context regarding significant research results. Online databases included Medline, Google Scholar, ProQuest Full-Text, and PubMed. I used the following search strings with full text selected for publication dates between 2008-2014:

("Defensive medicine" OR Liability OR Malpractice OR Legislation OR Litigation) AND (Obstetrics OR Gynecology OR Cesarean) AND (Risk OR Adverse OR Outcome) as well as (High risk pregnancy) AND (Adverse OR Outcomes) AND (Risk OR Factors OR Predictors) AND (Social OR Socioeconomic OR Insurance) AND (Obstetrics OR Gynecology); (*Disparities OR Race OR Ethnicity OR Income OR Social OR Socioeconomic OR Insurance OR Medicaid OR Medicare OR Prenatal care) AND (Obstetrics OR Gynecology) AND (Risk OR Adverse OR Outcome OR Predictors); (Maternal health services OR Maternal health outcomes OR Maternal complications OR*

Adverse perinatal outcomes) and (Insurance Or Medicaid OR Medicare OR Race OR Disparities OR Income OR Ethnicity OR Socioeconomic); (allintitle: postpartum conditions OR complication OR problems OR Insurance OR Medicaid OR Medicare OR Race OR Disparities OR Income OR Ethnicity OR Socioeconomic -depression -depressive). Searches were also performed for +*Theory "Human factor" + (Obstetrics OR Gynecology OR Surgery) + (Risk OR Adverse OR Outcome*). Self-reported surveys, opinion and editorial articles, presentations, government reports, policy statements were excluded to focus solely on articles based on empirical evidence, with emphasis on retrospective studies on OB-GYN physicians' practice of avoidance defensive medicine behaviors in the United States and adverse pregnancy outcomes of women of low socioeconomic status.

Survey and commentaries on physician defensive medicine behavior raised concerns about its true impact on patients and if the behavior was real due to low response rates and other factors influences physician practice decisions, such as malpractice claim history, insurance premiums, and physician characteristics (Sakala et al., 2013a). Cesarean procedures are considered assurance behaviors and as such were not included in the literature review (Sakala et al., 2013b). According to Sakala et al. (2013b), assurance behaviors or positive defensive medicine behaviors included offering medically unnecessary tests to patients that do not need them, performing cesarean sections instead of vaginal deliveries or overly referring patients to other specialists to cut down on their malpractice risk. The theoretical framework was limited to human factor theory and violations that occur in healthcare. The high-risk population was limited to Medicaid and Medicare insurance payers, socioeconomic status defined by income or race/ethnicity. The combined search strategy yielded 44 papers that met the inclusion criteria for the literature review.

Theoretical Foundation

Adverse events or occurrences are directly or indirectly the result of human errors or factors. Human Factor Theory is the study of applied information and human behavior, abilities, limitations, and errors that occur in work environments (Reason, 1995). Human Factor is the study and design of environments and processes to ensure saver, more effective, and efficient use by humans, with the objective of maximizing human performance and system efficiency while also promoting health, safety, comfort, and quality of life (Shouhed, Gewertz, Wiegmann & Catchpole, 2012). Per the theory, errors are natural consequences, of system breakdowns not the causes (Shouhed et al., 2012). Human Factors research provides a framework for analyzing and assessing risk and reducing error by considering where the system design could better count for human error. The most common model of Human Factors Theory is Reason's (2000 & 1997a) Swiss Cheese Model of accident causation. The methodology is grounded in a systemic approach to see how humans contribute to the wider technical and organizational context (Lyons, Adams, Woloshynowych & Vincent, 2004). The Human Factors Model has been proven useful in medical accidents and incidents (Reason, 2000).

Failures and Violations

Human decisions and actions are a major contributor of all accidents through active or latent failures. Active failures include slips, lapses and mistakes, errors and violations (Reason, 1995; Shouhed et al., 2012). Latent failures are created out of organization decisions made by upper management (Cuschieri, 2000; Shouhed et al., 2012; Reason, 1995, 2000) or from poor system design (Cuschieri, 2000). These conditions unknowingly create unsafe working conditions such as understaffing, fatigue, shortfalls in training and equipment, unworkable procedures, or time pressure (Reason, 1997a; Reason, 2000). These conditions become more apparent when they are combined with an active failure (Reason, 1995, 2000). Active failures can include unsafe practices or omissions by the physician or nursing staff, slips in memory or performance, or violations and deviations from safe operating practices, procedures, standards, or rules (Cuschieri, 2000; Shouhed et al., 2012; Reason, 1995, 2000). These failures are committed by front-line staff and have a direct impact on the safety of the system as well as immediate adverse effects (Reason, 1997a, 2000). Reason (1995) also associates violations with motivational problems such as low morale.

These short-lived failures combined with latent conditions create a ‘Swiss Cheese Model’ (see Figure 1). The holes in each layer shift, shrink, and expand in response to operator actions and demands through active and latent conditions (Reason, 1997a). Each slice of the cheese represents a systematic defense against an error; the holes within each slice represent a combination of both active and latent failures (Shouhed et al., 2012). Sometimes these holes line up with each layer of defense and allow an error to bypass the system's defenses and an accident occurs (Shouhed et al., 2012). Latent conditions may be present for years and they increase the likelihood of an active failure occurring by creating local conditions that can promote errors and violations (Reason, 1997a). While we cannot change the human condition, we can change the conditions under which humans works (Reason, 2000).

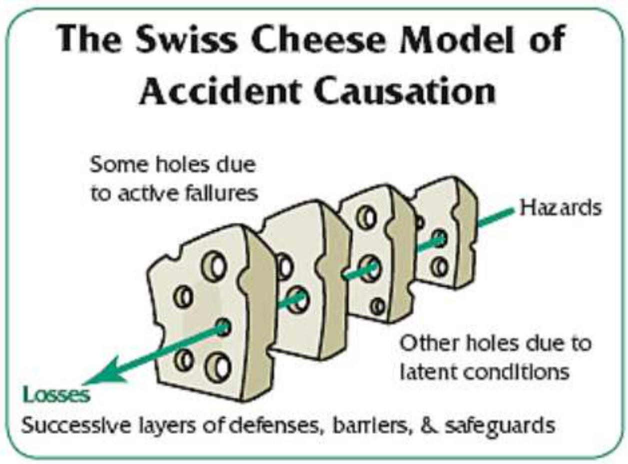

Figure 1. The Swiss cheese model of accident causation. Adapted from *Managing Risks of Organizational Accidents* (p. 12), by J. Reason, 1997a, Ashegate.

Human errors consist of slips, lapses in judgment, mistakes, as well as errors and violations. For the purposes of this study we focused on physician violations. Violations are deliberate deviations from standard procedure (Amalberti, Vincent, Auroy & de Saint Maurice, 2006; Reason, 1995). Reason (1995 & 1997b) classified intentional violations as necessary, routine and optimizing. Necessary or situational violations are actions taken to complete a task whose procedures are not in the rulebook (Reason, 1997b). Violations have been the cause of serious healthcare incidents. Reason, Parker and

Lawton (1998) referred to these violations as actions essential to getting the work completed. Routine violations occur when the person takes the path with least effort and cuts corners to save time. Optimizing violations occur to alleviate boredom or for the thrill of disobeying for personal gain (Reason 1995; 1997b). Routine and optimizing violations are linked to personal goals - least effort (routine) and thrill (optimizing). Failures in judgment and negligence are opportunist violations by the responsible party to deviate from established rules and procedures for selfish gain (Reason, 1995).

A person's level of performance determines their propensity for errors and violations. There are three levels of performance where errors and violations can occur: skill-based, knowledge-based, and rule-based (Reason, 1997b). Skill-based errors are errors that occur because the person lacks the skills to perform the task, whereas knowledge-based errors occur when there are no rules or procedures for the current situation and the incorrect action leads to an error (Reason, 2008a). Rule-based errors or violations occur when the rules are inappropriate for the circumstances or there are no established rules, when the perception of the correct action is subjective, or when it is psychologically rewarding to deviate from the rules (Reason, 2008b & Reason et al., 1998). Rule-based errors are intentional acts to deviate from standard procedures and are brought on by stress, fatigue, fear, and noise (Reason, 2008a). Reason et al (1998) stated that rule-related violations occur when there is a conflict between internal and external goals. The researchers discussed examples such as employees trying to get a bonus to meet their organizations deadlines and cutting corners to get their bonus.

I can compare this to physicians trying to meet safety and malpractice liability goals by cutting back on risky procedures or limiting their practice patient population. Per Reason (2008a), the reason behind the error or violation is just as important as the act itself. Reason (2008a), further stated that professionals in risky situations have a ‘duty of care’ towards their peers and clients that require them to be aware of all environmental and cognitive conditions. Routine violations over time become habitual working behavior especially when complying with the established rules is not rewarded (Reason, 1997b). Routine violations and rule-based errors increase the likelihood of errors especially in high stress situations when the consequences of the error are more severe. According to Alper and Karsh (2006), there is evidence that violations can lead to unwanted outcomes. Errors are a part of human behavior and while we cannot eradicate errors or violates, we can better anticipate and manage them (Reason, 2008a; Amalberti et al., 2006).

Human Factor Studies

Very few human factor studies have been performed in medicine and most of them were focused on healthcare surgeries and not specific to violations. The studies that were found only included slips and lapses in judgment or mistakes on behalf of the surgeon or anesthesiologist. The research on routine violations or rule-based errors in healthcare are restricted as well. There was limited research literature investigating rule violations in work settings and less in work settings where the causes of violations are studied. This is alarming because 70% of accidents can be attributed to violations (Alper & Karsh, 2009). Per Amalberti et al (2006), violation data in healthcare are sparse because healthcare has fewer explicit rules than other high-risk industries. There are many rules in healthcare; however, they are flexible guidelines and protocols that that leave room for clinical judgment which make it difficult to determine if a violation occurs (Amalberti et al., 2006). This is true; however, the rules should not be flexible when the physician is operating for their own selfish gain.

Evidence-based practiced are guidelines on how to care for patients in the best way possible given their condition(s), not to ignore certain patients because they are more risky; patient outcomes should not suffer. Amalberti et al. (2006), also stated that there was not much data on healthcare errors to analyze as many healthcare safety problems were derived from incident reporting system narration summaries and it was difficult to determine the true nature of the violation. In addition, healthcare is a very accusatory environment and people are less likely to report issues for fear of reprimand or the accusation of negligence. Holden (2009) provided another perspective on violations stating that individuals were not always the cause of violations; instead, it may be socially acceptable to violate to get the work done.

Deliberate violations are very important in safety analysis, however not been well studied in healthcare (Amalberti et al., 2006). Shouhed et al (2012) reviewed studies and analyzed how human factors influenced adverse events in surgery. Reviewing only empirical prospective studies the researchers found 77 articles on how human factors affect surgical errors (Shouhed et al., 2012). They found that a lack of communication and teamwork greatly increased the risk for surgical errors especially in the operating room were physicians and nurses work closely together. These high stress environments coupled with poor communication and clashing personal motivations increased the risk of surgical errors (Shouhed et al., 2012). Shouhed et al (2012) found that 54% of the errors found in the 77 studies were preventable, largely due to human error. Their research supports Reason's assessment that human factors play a huge part on occurrence of errors.

Taylor-Adams, Vincent, and Stanhope (1999) found similar results when they applied human factors methods to the investigation of clinical adverse events. The study showed that safety is evolving in all aspects of medicine and found that the root cause of adverse medical events is poor communication, supervision, excessive workload, as well as deficiencies in education and training (Taylor-Adams et al., 1999). These errors occurred due to active failures such as slips or failures including cognitive failures for example, memory lapses, mistakes made of ignorance or misreading the situation.

Alper and Karsh (2009) conducted a systematic review of safety violations in healthcare, commercial driving, aviation, mining, railroad, and construction industries to determine the cause of these violations. Thirteen articles met their inclusion criteria and 57 different variables were examined as predictors of safety violations, five of which were on healthcare. The predictors were categorized as individual characteristics, information/education/training, design to support worker needs, safety climate, competing goals, and problems with rules (Alper & Karsh, 2009). Safety violations clearly exist, however not all violations are bad because not all violations lead to adverse outcomes. Some violations occur due to the systems inability to keep up with the changing environment and the violator will be credited for their resilience or ingenuity, which is why the researchers wanted to study “why” violations occurred (Alper & Karsh, 2009). Historically individuals are examined as to why a violation occurred, however characteristics of the work system may be the cause of the violation (Alper & Karsh, 2009). In healthcare, individual blame is the norm when an error or violation occur (Holden, 2009).

Human Factor Healthcare Studies

In the five healthcare studies that were reviewed, the major predictors of violations were individual characteristics and competing goals. Some of the predictors for individual characteristics were experience, attitude towards compliance previous accidents and perceived behavioral intention to comply with the rules (Alper & Karsh, 2009). Alper and Karsh (2009) found that time pressure, compensation, perceived risk, workload, conflicting demands on time, physical exhaustion and competing goals were predictors for violations. Conflicting goals can lead to violations when their personal goals clash with organizational goals. According to Alper and Karsh (2009), two determinants of goal commitment were the importance of the goal and the individual’s self-efficacy.

Their analysis found that most the predictors of violations were multi-factorial and generally included individual characteristics, the organization, the worker’s task or the organization’s rules (Alper & Karsh, 2009). The researchers agreed that more research was needed on which variables consistently predict unsafe violations. Many the healthcare studies were self-reported accounts of violations. Self-reported studies are very pone to biases because participation is voluntary and may not honestly represent a true account of the events. However, the study did show that individual characteristics such as personal goals were a major predictor to violations occurring.

While these studies provided good information on violation predictors, human factors research and the impact human errors have on adverse events, it did not consider OBGYN scope of services. These studies also did not show the patient impact of physician violations, other than the competition of personal and organizational goals leading to adverse events in surgery. My study focused on the human factor theory of physicians making the deliberate choice to refrain from accepting high-risk patients or cutting back on risky procedures for personal gain and their fear of an increased risk of malpractice. These routine violations and rule-based errors are affecting the health of high-risk pregnancies.

The inadequate management of malpractice premiums is shrinking the availability of physicians that serve high-risk patients and perform risky procedures (Currie & MacLeod, 2008; Cuschieri, 2000; Dubay et al., 2001; Mello et al., 2007; Sakala et al., 2013a; Wu, 2010; Yang et al., 2008, 2009, 2012). The malpractice premium and litigation system is a broken system. Reason (2000) stated that we are too busy focusing on the individual, blaming them for their mistakes and not looking at how we can improve the system. The Swiss Cheese Model demonstrates how latent conditions can be dormant in a system for years until an active failure, such as a routine violation or rule-based error occurs and highlights the deficiencies of the system. Violations are indications that high-level safety deficiencies or latent conditions may be present (Amalberti et al., 2006). Human factors theory allows us to see how humans contribute to errors and accidents within the system (Reason, 1995).

Literature Review Related to Key Variables and/or Concepts

Scope of Practice Decisions

Empirical studies have mostly measured defensive medicine practice changes through insurance premiums and tort reform laws and have shown mixed results (Currie & MacLeod, 2008; Dubay et al., 2001; Mello et al., 2007; Sakala et al., 2013a, 2013b; 2013b; Yang et al., 2008, 2009, 2012; Wu, 2010) however, very few have looked at how these changes impact patient outcomes (Currie and MacLeod, 2008; Dubay et al., 2001; Wu, 2010; Yang et al., 2012). Previous literature has focused on malpractice liability and the use of cesarean section or other assurance behaviors, very few have explored the relationship between the liability system and maternal outcomes (Sakala et al., 2013b). Many factors influence physician practice decisions and it is hard to determine if insurance premiums or tort reform laws are independent predictors (Sakala et al., 2013b). Other factors such as patient risk factors (Currie & MacLeod, 2008; Dhankhar & Khan, 2009; Mello et al., 2007; Wu, 2010; Yang et al., 2009, 2012), socioeconomic status (Dhankhar & Khan, 2009; Dubay et al., 2001; Yang et al 2012,), hospital characteristics (Dhankhar & Khan, 2009; Yang et al., 2008), healthcare market (Yang et al., 2008), physician fear of malpractice litigation (Currie & MacLeod, 2008; Dhankhar & Khan, 2009; Gimm, 2010; Jena et al., 2011; Wu, 2010) physicians retiring or relocating (Mello et al., 2007), as well as claims frequency and severity (Dhankhar & Khan, 2009; Jena et al., 2011) influence practice decisions. Per Sakala et al (2013a), only two national studies have explored maternal outcomes, mainly birth outcomes and more research is needed to study the impact (Dubay et al 2001; Yang et al., 2012). I found that Currie and McLeod (2008), Dhankhar and Khan (2009) and Wu (2010) also conducted studies on defensive medicine outcomes, however, Currie and McLeod (2008) were the only ones that compared birth outcomes by normal and high-risk pregnancies defined by ICD-9-CM diagnosis codes.

Insurance premiums. Dubay et al (2001) conducted the first national evaluation on malpractice premiums, prenatal care utilization, and infant health using National Natality Files for 1990 – 1992. Dubay et al (2001) hypothesized that if OBGYNs limit their prenatal care services that it would have a negative relationship on infant health, measured by low birth weight (<2500g) and five-minute Apgar score (<7), due to patient increased travel, scheduling, and wait times as well as increased prices in services due to the limited OBGYN supply. The number of prenatal visits and late prenatal care (care initiated after the first trimester) was used to measure prenatal utilization. They did not find a correlation between insurance premiums and infant health; however, they found that a decrease in malpractice premiums would also significantly decrease the incidence of late prenatal care between 3.0% and 5.9% for black women and between 2.2% and 4.7% for white women (Dubay et al., 2001).

The study controlled for socioeconomic (mother's education and marital status) and health insurance status by race, as well as family income, however, did not look at geographic areas, hospital characteristics, or by normal and high-risk pregnancies. Although insurance premiums had a small but significant effect on prenatal utilization, Dubay et al (2001) found that negative defensive medicine practices are more affected by unmarried and lower socioeconomic status mothers. Medicaid patients have a higher propensity of filing medical malpractice claims and as such, physicians have been known to reduce care to Medicaid patients to minimize their malpractice risk (Dubay et al., 2001). Considering this, studies should also look at physicians by hospital characteristics and further explore the relationship between avoidance behaviors, pregnancy outcomes, and insurance status.

Mello et al (2007) analyzed Pennsylvania insurance cost to see if physician scope of practice changes where influenced by insurance premiums. Administrative data from the 1999 and 2002 Medical Care Availability and Reduction of Error Fund (MCARE) was used to analysis physician procedure shifts, market departments as well as the overall supply of OBGYNs. These data were restricted to eighteen specialties including OBGYN physicians, however, also included medical residents, which have been suggested to have skewed the number of physicians (Yang et al., 2008). These data included 64,803 physicians extracted from the state-run secondary-layer insurance fund, which represents all physicians practicing at least 50% of their services in the Pennsylvania. Mello et al., (2007) found a significant decrease (-7.7%) in the number of OBGYNs, however the number of deliveries increased when comparing the two periods. They included family medicine physicians that delivered babies in their OBGYN count and could not distinguish between physicians relocating or retiring during the study period, which suggests contributed to the mixed results of an increase in deliveries, but a decrease in OBGYN specialists.

In their shift analysis, Mello et al (2007) analyzed OBGYNs providing a full range services, normal deliveries only, and no deliveries for the two years and found that 4% of OBGYNs shifted from full range procedures to normal deliveries only or to no deliveries and 10.6% of OBGYNs shifted from normal deliveries to no deliveries. Both shifts were significant, $t = -15.3$, $p < 0.01$ for full range to normal and $t = 3.71$, $p = 0.034$ for normal to no deliveries, even though the number of physicians shifting was small. The results are guarded because it only contains 7% of OBGYNs and is restricted to only Pennsylvania. Pennsylvania is considered a malpractice insurance crisis state as they have been most affected by the increases in premiums (Sakala, 2013b), which makes them an outlier across states. Pennsylvania as well as Florida, Arkansas, Ohio, Oregon, Texas, Montana, New Mexico, and Virginia had an increase of more than 45 percent in OBGYN malpractice premiums from 1999-2002 (Yang et al., 2008). Mello et al (2007) noted that the shifting could be attributed to the changing malpractice environment and physicians looking to decrease their malpractice risk. These data also used residents, which Mello et al (2007) suggested in the sensitivity analysis was controversial since residents were more at liberty to stop seeing patients than physicians were. They were unable to conduct a separate analysis of residents. These results suggested that OBGYNs were shifting their scope of practice behavior in Pennsylvania and the shift analysis of procedure types between two periods does warrant further study on a larger dataset.

Yang et al (2008) conducted a national longitudinal study using several data sources to construct regression models to examine the effects of liability pressure on the decision for an OBGYN to relocate or shut down their practice. Yang et al (2008) dependent variables were the number of OBGYNs per 10,000 births and the number of OBGYNs per 100,000 women of childbearing age (15-44 years old) constructed from American Medical Association (AMA) Physician Masterfile data to obtain a complete listing of all practicing OBGYN physicians, birth counts by state from the Natality Detail File (NDF), and U.S. Census. These data were combined with OBGYN malpractice premium annual survey data from the Medical Liability Monitor from each state and weighted per market share from the National Association of Insurance Commissioners database instead of averaged in previous studies. Yang et al (2008) also used state tort reform data from the National Conference of State Legislatures, the American Tort Reform Association and law firm websites. Explanatory variables such as OBGYN practice premiums, tort reform, healthcare market factors, minority status, and socioeconomic factors were used to construct regression models to examine the extent of liability pressure on the supply of OBGYNs in each state while also seeing which if any tort reform model is most effective in attracting and retaining OBGYNs. Neither model found a significant correlation. The descriptive statistics reported on average 80.9 OBGYN per 10,000 births and 51.4 OBGYNs per 100,000 childbearing women during 1992-2002. These data showed that the numbers of OBGYNs increased during the study period and were positively correlated with OBGYN malpractice premiums; Pearson coefficients of 0.22 and 0.21. Yang et al (2008) noted that these results in the changes in OBGYNs do not imply access for high risk pregnancies, patient wait times, or other obstetrical services were unaffected, as these specific measures were not measured. They suggested that further research should examine if OBGYNs were changing their scope of practice, such as reducing high-risk deliveries, instead of relocating because there was no evidence that malpractice premiums were associated with OBGYN supply.

In 2009, Yang et al used Natality Detail Data from 1991-2003, as well as the annual obstetrics malpractice premium survey data, and tort reform legislation used in their 2008 study (Yang et al., 2008) and found an association between OBGYN delivery choice and liability pressure. Their longitudinal study controlled for hospital ownership, location, and type of delivering clinician, patient socioeconomic factors, and patient medical risk factors such as obesity and 14 clinical factors such as chronic hypertension, excessive bleeding, fetal distress, and diabetes. Fifty-two million birth records from 663 state-year observations were analyzed and they found that a decrease in liability premiums in increments of $10,000 is correlated with a 1.45% increase in the rate of vaginal deliveries after cesarean (VBAC), however is positively associated with the cesarean section rate (0.07%) and the number of primary cesarean section procedures (1.18%). Multivariate regression analysis found a positive association between malpractice premiums and the rate of cesareans (β=0.15, p=0.02) and primary cesareans procedures (β=0.16, p=0.009) and a negative association with VBACs (β= -0.35, p=0.01). Although the study was focused on cesarean procedures and VBACs, defensive assurance behaviors instead of avoidance behaviors (Sakala et al., 2013a; Wu, 2010) the researchers found that physician fears of liability concern influences their obstetrics delivery decisions and in turn, their practice decisions (Yang et al., 2009). The study had an ample sample size, a long data period and can be generalized across multiple states, however the researchers could not control for malpractice history, or clinician characteristics such as gender that can influence delivery and practice decisions (Yang et al., 2009).

Yang et al (2012) further expanded their 2008 and 2009 study to analyze the relationship between liability pressure measured by insurance premiums and tort reform laws on birth outcomes using the same Natality Detail Data that was used in their 2009 study. They found that adverse birth outcomes are not associated with premiums and state tort reform, however they suggest that the liability pressure does cause physicians to be cautious which I hypothesized is due to physician fear of malpractice litigation and not insurance premiums or tort reform laws. The study dependent birth outcome variables were birth injury, low Apgar scores, low birth weight, and preterm births. Yang et al (2012) controlled for prenatal care utilization, tobacco and alcohol use, multiple births, maternal age, socioeconomic factors and other complications related to pregnancy and birth. The study sample contained 2.35 million births over 12 years in 51 jurisdictions (Yang et al., 2012).

Birth injuries, categorized as an impairment of the body or structure that occurs at birth and recorded by attending clinicians affected 0.03% of all births, low (<7) 5-minue Agar scores- 2%, low birth-weight (<2500 grams) – 7%, and preterm births (<37 weeks gestation) affected 11 % of all births. Although the birth outcomes were not statistically significant, there is a significant relationship between both clinical risk and all four adverse birth outcomes ($p<0.01$). Multiple births were significantly associated with low birth weight ($p<0.01$) and nonwhite births were statistically associated with low Apgar scores, low birth weight, and preterm birth all at $p< 0.01$ (Yang et al., 2012). These results contradict Currie and MacLeod, 2008, Dubay et al., 2001 and Wu, 2010 whose studies showed that liability pressure reduces adverse birth outcomes. Yang et al (2012) suggested that these differences were due to physician practice decisions that reduced their liability risk, which were mostly in the form of defensive medicine. Additionally, studies on the patient outcomes of these populations due to physician avoidance behaviors are warranted especially due to results of minority race and birth outcomes.

Tort reform. Currie and MacLeod (2008) used a variety of tort reform laws and National Center for Health Statistics Natality data sets from 1989-2001to determine if birth outcomes were affected by varies reform laws. The researchers used seventeen different variables to define high-risk mothers, such as anemia, cardiac or lung conditions, diabetes, herpes, eclampsia, incompetent cervix, previous large or preterm deliveries, renal failure, Rhesus (Rh) factor problems, uterine bleeding or other medical risk factors (Currie & MacLeod, 2008). Currie and MacLeod (2008) reviewed the birth data to determine if the birth outcomes were preventable or non-preventable because tort reform laws would have a larger effect on preventable complications. From this final dataset, they conducted a random sample of 10% to use in the final study to explore the relationship between tort reform laws and birth outcomes. They found that direct tort reform laws have an average reduction of 10% of the incidence of labor and delivery complications and suggest that this supports that certain complications can be prevented by physician effort, which is influenced by the tort system. This study showed that certain measures can be used to identify high-risk mothers as well as separate preventable and non-preventable outcomes. The study should have also explored labor and delivery complications by race/ethnicity, insurance status and hospital characteristics.

Wu (2010) randomly selected 10% of state data from the National Center for Health Statistics Natality data sets from 1989-2004 to measure the impact of tort reforms on physician behavior and its effect on prenatal care utilization. She found that tort reform law increases defensive behavior; however, these behaviors have no meaningful impact on infant health as measured by prenatal utilization. These results coincided with Dubay et al (2001) who found that insurance premiums do influence prenatal care utilization but not infant health. Wu (2010) found no statistical significant association between physician behavior and infant Apgar scores, low birth weight or gestational age.

Prenatal utilization was measured by the total number of prenatal care visits per month using the Adequacy of Prenatal Care index of inadequate, intermediate, adequate, and adequate+. Adjustments were not being made for maternal risk factors or clinical necessity so the volume of adequate or adequate+ could be overestimated.

Wu (2010) suggested that further research adjust for clinical applicability of outcome measures as well as other factors influencing defensive medicine. Wu (2010) used the standard International Classification of Diseases, Ninth Revision- Clinical Modification (ICD-9-CM) diagnosis codes to determine the procedure and diagnosis of their patient population, which gave the data validity. Eighty percent of the pregnant women were between 19-34 years old and 12% were 35 years old or older, in addition, 80% of the women were white and 15% were black, and 40% had some college education, which could skew the data. Wu (2010) could have made some adjustments in the sample size to make the population more diverse or look at the women by race and socioeconomic status as Dubay et al (2001) tested to see if there were contributing factors. Dubay et al (2001) and Wu (2010) both found that defensive medicine behaviors did not have an impact on infant outcomes, however prenatal health is essential to both the mother and the child during pregnancy, additional studies should investigate the effect of defensive behaviors on maternal outcomes.

Malpractice claims. Dranove and Gron (2005) and Gimm (2010) both conducted OBGYN practice patterns studies, on a single state, whose results are also skewed because Florida is one of the states largely impacted by the malpractice premium increases. Florida is a crisis insurance premium state, due to their rapidly escalating medical malpractice premiums compared to other states (Dranove & Gron, 2005; Gimm, 2010; Sakala et al., 2013b;). Dranove and Gron (2005) compared two periods, 1997-2000 with 2000-2003 to see how high-risk procedures were impacted by malpractice premiums. They used Florida State Center for Health Statistics data by diagnosis-related group (DRG) and primary and secondary diagnosis to identify high-risk procedures by physician as well as obtain patient demographic data. They were able to separate patients that had cesarean and vaginal deliveries with complications by using DRG codes 370 and 372 respectively to accurately account for patients that had pre-existing complications. This allowed them to monitor the effects by patient complexity, using well-established diagnosis groups.

In addition to separating out the patient population they also categorized the physician activity levels into very high (minimal of 52 high-risk procedures annually), high (25-51), medium (12-25), and low, less than 12 procedures annually. This allowed them to see the fluctuations by activity level. They found that high activity OBGYNs increased their practice during the 2000-2003 periods by 25%, but the low activity OBGYNs cut back their activity by 75%. There were many missing physician identifiers in the low activity category so their results are difficult to interpret (Dranove & Gron, 2005). The researchers also looked at patient travel times and did not find an increased in travel times when comparing the two-time periods.

Gimm (2010) conducted a study of Florida OBGYN practice patterns using secondary data for years 1992-2000 from Florida Hospital Inpatient Discharge File, Florida Medical Professional Liability Insurance Claims File, and the AMA Master File. He found that OBGYNs had a decrease of six annual deliveries three years following a malpractice claim and performed 14 fewer deliveries after a malpractice indemnity payment of $250,000 or more. The dataset contained 1.2 million records and a total of 10,100 OBGYN, family practice, maternal-fetal, and other physician-year observations, however, 93% of the physicians were OBGYNs. Gimm (2010) limited the dataset to physicians that perform at least ten deliveries a year, while excluding physicians older than 75 years of age, nurses, midwives, and residents. The dataset also excluded non-insured physicians and those that are self-insured such as teaching hospitals, as well as outpatient procedure and delivers that may have accounted for the shift. While it only represented Florida physicians, such a direct negative impact on delivery volume suggests that the physicians' fear of another malpractice claim outweighed the financial benefit of performing additional surgeries (Gimm, 2010). The dataset controlled for maternal clinical risk factors and used ICD-9-CM codes to classify patients with complex comorbidities.

Dhankhar and Khan (2009) analyzed medical malpractice claims from the National Practitioner Data Bank, which contained a comprehensive set of malpractice claims by physician specialty combined with the Nationwide Inpatient Sample data of Healthcare Cost and Utilization Project (HCUP) for years 1995-1997 to study the impact of liability pressure on obstetric outcomes on individual states. The inpatient data allowed them the opportunity to include newborn medical complications as a comorbidity as well as control for the mother's education and marital status as a proxy for income and insurance coverage (Dhankhar & Khan, 2009). Using surgery claims frequency and severity as a measure of obstetrics claims frequency and severity Dhankhar and Khan (2009) found a statistically significant association in liability pressure and health outcomes in the Medicaid population; the higher the malpractice risks the steeper the decline in neonate health outcomes with a medical necessity for a cesarean section.

They defined the neonate health outcomes using five clinical variables and ICD-9-CM diagnoses: mortality, cerebral hemorrhage, birth trauma, respiratory distress syndrome, and other complications due to asphyxia. Using insurance status as a variable, they were able to asses that physicians treat Medicare patient differently due to their propensity of having more severe outcomes and filing medical malpractice suits as well as see the difference in outcomes. They concluded that physicians may perceive how to treat their patients differently based on insurance and further studies should look at the impact of malpractice pressure on the morbidity of the mothers (Dhankhar & Khan, 2009). Further research should be conducted to see how maternal morbidities are affected by insurance status and hospital characteristics. The quality of care offered and received by Medicare patients can differ by hospital ownership (Bayindir, 2012; Horwitz & Nichols, 2009; Sloan, Picone, Taylor, & Chou, 2001)

Most literature on malpractice fear was limited to self-reported data, however, Jena et al (2011) was one of the only empirical studies on United States physicians on the cumulative malpractice risk and physician fear. Jena et al (2011) conducted a retrospective analysis of 40,916 physician claims and determined that high-risk specialists have a 99% chance of being sued. This national representative sample contained claims data from one insurer, however included data from years 1991-2005 and 25 specialties, 200 claims from each specialty, but only 5% of the study contained OBGYNs (Jena et al., 2011). The size of the payments was adjusted for outliers, i.e. claim payouts that were extremely high or low compared to the others and claims over $1 million were excluded from the data set, to not skew the results. The study suggested that the fear of malpractice risk by high-risk physicians was warranted, and not subjective. High-risk specialties, such as OBGYNs have a high probability of being sued and the fear of malpractice can influence their decision-making. The study did however find that OBGYN and neurosurgeons were more likely sued, but also found that their indemnity payments were less than the other specialties, which could be due to their payments being higher and being removed from the dataset. Jena et al (2011) should have categorized the specialties by low and high risk and keep all the indemnity payments. The study did not mention analyzing the data by geographical location.

Sakala et al (2013a) summarized the best available empirical research on the influence that the liability environment has on maternal care and found that OBGYNs were at higher risk than other specialties to experience high and fluctuating insurance premiums. Limited empirical studies have mostly measured physician defensive medicine behaviors through insurance premiums and tort reform laws (Currie & MacLeod, 2008; Dubay et al., 2001; Mello et al., 2007; Sakala et al., 2013a, 2013b; Wu, 2010; Yang et al., 2008, 2009, 2012; Yang et al., 2009;). Within these studies only five assessed the impact on patient outcomes, but the focus was on neonatal outcomes or prenatal care (Currie and MacLeod, 2008; Dhankhar & Khan, 2009; Dubay et al., 2001; Wu, 2010; Yang et al., 2012). Dhankhar and Khan (2009), Dubay et al (2001) and Yang et al (2012) all found that minority women and women with public insurance are adversely affected by OBGYN avoidance behaviors. Liability pressure increased the risk of poor outcomes in the Medicaid population (Dhankhar & Khan, 2009) and non-White mothers had higher rates of preterm births and low birth weight babies compared to White mothers (Yang et al., 2012). Jena et al., (2011) found that the fear of malpractice litigation does alter physician practice decisions after analyzing of over 40,000 physician claims from years 1991-2005 and 25 specialties. Physicians are altering their behavior for patients based on insurance and socioeconomic status, (Dhankhar & Khan, 2009; Dubay et al., 2001) more research is needed on the impact of physician defensive medicine behaviors on vulnerable populations.

High-Risk Patient Maternal Morbidities

The National Institute of Health (NIH, 2013) defines a high-risk pregnancy as any pregnancy where complications are more likely than normal and conditions that put the mother or fetus at increased risk for poor health during pregnancy or childbirth, including a mother who has chronic health conditions such as high blood pressure, obesity, or diabetes is high-risk. Women who suffer from preexisting conditions such as diabetes, anemia, eclampsia, or cardiac or lung conditions are considered high-risk (Bryant et al., 2010; Currie & MacLeod, 2008; Fridman et al., 2014; Gray et al., 2012). NIH (2013) divided high-risk pregnancy into four categories: preexisting conditions, age, lifestyle factors, and conditions of pregnancy. Women with high blood pressure, polycystic ovary syndrome, diabetes, kidney disease, autoimmune disease, thyroid disease, infertility, obesity, or have HIV/AIDS have existing health conditions that make them high-risk pregnancies. Six-eight percent of pregnant women in the United States have high blood pressure, of which 70% of them are pregnant for the first time (NIH, 2013). Women under the age of 20 and over the age of 35 are also considered high-risk because their ages put them at an increased risk for complications or inadequate prenatal care (NIH, 2013).

Socioeconomic status defined by race/ethnicity, education, insurance or marital status can also be used as a determinant of high-risk (Bruce et al., 2012; Bruce et al., 2008; Bryant et al., 2012; Cabacungan et al., 2012; Creanga et al., 2014; Dhankhar & Khan, 2009; Dubay et al., 2001; Fridman et al., 2014; Gray et al., 2012; Nagahawatte & Goldenberg, 2008; Shen & Wei, 2008; Yang et al., 2012; Zhang et al., 2013). The trend of maternal morbidities or poor and adverse outcomes have increased over the past several years (Berg et al., 2009; Bruce et al., 2012; Bruce et al., 2008; Bryant et al., 2010; Cabacungan et al., 2012; Callaghan et al., 2012; Callaghan, et al 2008; Centers for

Disease Control and Prevention [CDC], 2014; Creanga et al., 2014; Fridman et al., 2014; Gray et al., 2012; Kuklina et al., 2009; Kuklina et al., 2008; Shen & Wei, 2008; Zhang et al., 2013). The Centers for Disease Control and Prevention (CDC, 2014) defines maternal morbidity as any physical and psychological condition or complication that results from or are aggravated by pregnancy and have an adverse effect on a women's health. The more severe morbidities are referred to as severe maternal morbidities (CDC, 2014). Maternal morbidities can occur during antepartum (before labor), intrapartum (during the birth process), or postpartum (period just after delivery) (Callaghan et al., 2008; Gray et al., 2012; Kuklina et al., 2009). Maternal morbidities or complications can increase hospital length of stay and healthcare costs, as well as cause emotional distress to the family and long-term rehabilitation for the mother (Callaghan et al., 2012; CDC, 2014; Gray et al., 2012).

Serious maternal morbidities have a greater effect on immediate and lifelong well-being and pose a greater risk (Callaghan et al., 2008). They can also lead to serious organ failure, shock, pulmonary embolism, seizure, acute myocardial infarction, eclampsia, and other complications, even death (Gray et al., 2012). Severe maternal morbidities are increasing due to combinations of increase maternal age, pre-pregnancy obesity, preexisting chronic medical conditions (Berg et al., 2009; Bryant et al., 2010; Callaghan et al., 2012; Fridman et al., 2014; Gray et al., 2012; Kuklina, et al., 2009), and cesarean deliveries (Berg et al., 2009; CDC, 2014; Gray et al., 2012). Severe maternal morbidities are referred to as 'near miss' events and have been used as an indicator of the quality of maternal health (Callaghan et al., 2008; Gray et al., 2012; Kuklina et al., 2009).

In rare instances, severe maternal morbidities can lead to death, which is a sentinel event in obstetrics, and surveillance protocols of severe maternal morbidities or conditions could be developed to further prevent maternal deaths (Callaghan et al., 2008; Gray et al., 2012). Mothers experience 38% of adverse event negligence; 0.6% of childbearing women and 0.2% of newborns sustain negligent injury during care in U.S. hospitals (Sakala et al., 2013a). Furthermore, childbearing women are three times as likely to face an injury in the hospital compared to newborns; however, the payout is less due to the severity of newborn injuries (Sakala et al., 2013a).

Maternal morbidity trends. In the United States, severe maternal morbidities affect over 50,000 women each year (CDC, 2014) and are fifty times more common than maternal death (Callaghan et al., 2008). Per the CDC (2014), between 1998-1999 and 2010-2011 there was a clinically and statistically significant increase in severe maternal morbidities ($p=0.014$). The U.S. last reported (2010-2011) maternal complication or morbidity rate is 31.1 and our goal was to reduce it to 28.0 (National Hospital Discharge Survey [NHDS], 2014). Reducing maternal illness and complications due to pregnancy is a Healthy People 2020 goal and has been since 2010, however there were very few quantitative population-based studies on the topic. It was difficult to find U.S. empirical studies on maternal morbidity during 2008-2014, and even more difficult to find literature on the risk factors. The lack of maternal morbidity and severe maternal morbidity research in the U.S. indicates a gap in the knowledge in the field of maternal and child health (Gray et al., 2012).

Kuklina et al (2008) assessed the accuracy of maternal morbidity estimates from hospital discharge data and developed an algorithm that enhanced the current method of identifying maternal hospital deliveries (Appendix A) and maternal morbidities (Appendix B). The method is currently being used by the CDC to quantify hospital deliveries and estimate maternal morbidities. Prior researchers used only the maternal outcome ICD-9-CM classification delivery codes V27.0-V27.9 to identify hospital deliveries (live births, stillbirths, multiple births and unspecified delivery outcomes). Kuklina et al (2008) determined that many maternal morbidity discharges were being missed due to ICD-9-CM coding errors within the classification disease method. ICD-9-CM codes are predisposed to missing in patient's charts, especially when multiple procedures and diagnoses are present for one admission.

The method added an additional nine to 30 procedure codes and six to 30 diagnosis codes to each state's hospital discharge data (Kuklina et al., 2008). The algorithm effectively identified additional 3.4% inpatient deliveries from the 1998-2004 Healthcare Cost and Utilization Project Nationwide Inpatient Sample data (Kuklina et al., 2008). The researchers compared the V27 method with the enhanced method in the seven-year dataset and found that the V27 method underrepresented 9% of major puerperal infections (OR = 3.1[95% CI 2.8, 3.4]) and 40% of respiratory distress syndrome (OR = 6.6; 95% CI 14.4, 19.2). Hysterectomy (OR = 6.0; 95% CI 5.3, 6.8) and sepsis (OR = 11.9; 95% CI 10.3, 13.6) were also strongly associated with deliveries not found by the V27 method (Kuklina et al., 2008). Deliveries with severe obstetric complications were 3-17 times more likely to be missed by only using the V27 method (Kuklina et al., 2008). The magnitude of the associations increased with the severity of the complications. Kuklina et al (2008) were not able to validate any of the coded deliveries and complication diagnoses with medical records, however their estimate of U.S. deliveries for 1998-2004 using the enhanced method was similar to the number estimates by the National Center for Health Statistics (NCHS) birth certificate data.

The following year, Kuklina et al (2009) examined the 1998-2005 trends in the rates of severe obstetric complications in the U.S. using the enhanced delivery identification method to determine if maternal characteristics or mode of delivery contributed to the increase of maternal morbidities. A cross-sectional study of severe obstetric complications from the Healthcare Cost and Utilization Project Nationwide Inpatient Sample data found a trend in the prevalence of pregnancy complications in age groups, insurance status and mode of delivery. An increase proportion of older women and women on Medicaid/Medicare, multiple births, hypertension, diabetes, and cesarean deliveries were found when comparing data from 1998-1999 with 2004-2005 data ($p = 0.01$) (Kuklina et al., 2009). There was also an increase in hospital delivery complications, 0.64% in 1998-1999 compared to 0.81% in 2004-2005 ($p<0.01$) (Kuklina et al., 2009). Blood transfusions had the largest increase in rates at 92%, however there was also a dramatic decrease in severe complications of anesthesia (more than 40%)

between the two periods (Kuklina et al., 2009). This study like Kuklina et al. (2008) was prone to coding errors and lacked validation from medical records, however the dataset contained eight-years of national data and the results were consistent with Kuklina et al. (2008).

Berg et al. (2009) conducted a trend analysis using the V27 method and found similar trends when comparing 2001-2005 National Hospital Discharge Survey data with their previously published 1993-1997 analysis. Aimed to assess the U.S. progress towards our Healthy People 2010 goal to reduce the rate of maternal morbidity during antepartum or at delivery they found that, the rate of maternal morbidities continues to increase. The researchers used ICD-9-CM procedure codes V27.0- V27.9 (live births, stillbirths, multiple births, and unspecified delivery outcomes) to identify hospital deliveries and ICD-9-CM diagnosis codes found in Appendix B were used to identify morbidity conditions of obstetric complications and preexisting conditions that could be adversely affected by pregnancy (Berg et al., 2009). After dividing the ICD-9-CM diagnosis codes into clinical categories the researchers found the percentage of postpartum hemorrhage, severe preeclampsia, transient hypertension of pregnancy, postpartum fever of unknown origin, gestational and preexisting diabetes mellitus and asthma each increased significantly, however third- and fourth-degree lacerations and other types of infections decreased (Bert et al., 2009).

Berg et al. (2009) also found that significant hemorrhages increased from 3 to 5 per 1,000 deliveries between 1991 and 2003. They assessed, just as Kuklina et al. (2009)

that the frequency of blood transfusions during delivery hospitalization is an indicator of a clinically significant hemorrhage (Berg et al., 2009). These findings are reinforced by a U.S. report on severe maternal morbidity and the link between blood transfusion and severe hemorrhages (Berg et al., 2009). When comparing the 1991 to 2003, the prevalence of preexisting medical conditions at delivery increased from 4.1% to 4.9%, however, the rate of maternal complications remained unchanged at 28.6%, which contradicts Kuklina et al. (2008). Since both datasets contained national samples of inpatient deliveries with several years of data, I can only speculate that the contradiction in the rate of maternal morbidities found between the two studies is due to the additional deliveries identified in the Kuklina et al. (2008) enhanced delivery identification method.

Callaghan et al. (2008) used the enhanced delivery method to identify hospital deliveries and complications using 1991-2003 National Hospital Discharge Survey (NHDS) data. This data set contained 423,480 hospital delivery discharges of which 2,235 deliveries also met the inclusion criteria of three days or greater length of stay, specific delivery procedure and diagnosis codes as well as women who were transferred to another facility (Callaghan et al., 2008). Indicators of severe maternal morbidity were determined a priori based on previously published models of procedure and diagnosis codes and reviews by medical epidemiologists (Callaghan et al., 2008) (Appendix C). Most of the women were defined as having a severe maternal morbidity because of ICD-9-CM codes of transfusion, hysterectomy, or eclampsia. Non-Hispanic Black women less than 20 or greater than 40 years of age and residents of the South or Northeast were at a greater risk of having a severe maternal morbidity diagnosis and a cesarean delivery (Callaghan et al., 2008).

Callaghan et al. (2008) also found that the severe morbidity rate increased from 4.5 per 1,000 deliveries between 1991-1994, 4.7 per 1,000 deliveries between 1995-1998 and 5.9 per 1,000 deliveries between 1999 – 2000 ($z = 2.84$; $p = 0.002$). From 1999-2008 there were 5.1 severe maternal morbidities per 1,000 deliveries (95% CI, 4.7-5.5) (Callaghan et al., 2008). After further investigation into the increased trend of severe maternal morbidities, Callaghan et al. (2008) found a statistically significant increase in the proportion of women who had a diagnosis of blood transfusion during their delivery hospitalization ($p = 0.009$). The prominent influence of blood transfusions on severe maternal morbidities further highlights how much obstetric hemorrhages contribute to maternal morbidities (Berg et al., 2009; Callaghan et al., 2008; Kuklina et al., 2009).

Callaghan et a. (2012) further expanded on their previous research by grouping severe maternal morbidities into categories and adding postpartum diagnoses to the intrapartum diagnoses already established in the enhanced delivery identification method developed by Kuklina et al. (2008). Callaghan et al. (2012) proposed a new standard of monitoring severe maternal morbidity in the U.S. during both the antepartum and postpartum hospitalization by identifying both delivery and postpartum hospitalizations. A full listing is provided in Appendix A. Callaghan et al. (2012), used the list of ICD-9-CM procedure and diagnosis codes that he and his colleagues developed in 2008 to identify severe maternal morbidity in the U.S. Examples of these maternal morbidities include acute renal failure, septicemia, or respiratory failure (See Appendix C for full listing). The researchers used Nationwide Inpatient Sample (NIS) data for years 1998-2009 and compared hospitalizations from 1998-1999 with 2008-2009 data and found that severe maternal morbidity increased by 75% for delivery hospitalizations and 114% in postpartum hospitalizations both at $p<0.05$ (Callaghan et al., 2012). The rate of mortality during postpartum period increased 66% ($p<0.05$) within the study period (Callaghan et al., 2012). In 2008-2009 there were 129 deliveries and 29 postpartum hospitalizations with at least one complications for every 10,000 deliveries compared to 1998-1999 (Callaghan et al., 2012). The only ICD-9-CM diagnosis codes that decreased between the two time-periods were severe anesthesia complications, pulmonary edema, and eclampsia; there were also not significant decreases for any category of severe complications for postpartum hospitalizations (Callaghan et al., 2012).

Blood transfusions were the leading reason for the classification of severe maternal morbidity in both the antepartum and postpartum hospitalizations, which coincides with other findings of blood transfusions and hemorrhages (Berg et al., 2009; Callaghan et al., 2012; Callaghan et al., 2008; Kuklina et al., 2009). The reason behind the correlation between blood transfusions and severe maternal morbidities was unclear; however, researchers suggested it could be due to the underlying risk profiles of the women giving birth during 1991 and 2003, such as age and preexisting conditions (Berg et al., 2009). Regardless, four studies using national data and several time-periods found a correlation between blood transfusions and obstetric hemorrhages of which could be used as a surveillance tool for severe maternal morbidities (Berg et al., 2009; Callaghan et al., 2008, 2012; Kuklina et al., 2009)

The prevalence of severe maternal morbidities in the United States is increasing despite the Healthy People 2010 and 2020 goals to reduce maternal illness and complications. Maternal antepartum, intrapartum and postpartum infections and complications are a huge concern within field of maternal and child health, however, there have been limited U.S. empirical studies published after 2008 on the topic; literature is scarcer on the risk factors. The lack of literature indicates a gap in the knowledge on maternal morbidities and its risk factors. Berg et al.(2009), Callaghan et al. (2012), Callaghan et al. (2008) and Kuklina et al. (2009) were able to show a significant relationship between blood transfusions and severe maternal morbidities and acknowledge that this could be used as a surveillance tool to further enhance our knowledge of the risks associated with maternal morbidities.

Maternal morbidity risk factors. Past studies have shown that minorities and individuals of lower socioeconomic status have poorer health outcomes (Bruce et al 2008, 2012; Bryant et al., 2012; Cabacungan et al., 2012; Creanga et al., 2014; Dhankhar & Khan, 2009; Dubay et al 2001; Fridman et al., 2014; Gray et al., 2012; Nagahawatte & Goldenberg, 2008; Shen & Wei, 2008; Yang et al., 2012; Zhang et al 2013). Socioeconomic status is often assessed by education level, income, occupation, and neighborhood (Dhankhar & Khan, 2009; Dubay et al., 2001; Nagahawatte & Goldenberg, 2008; Yang et al., 2012). Messer et al. (2008) and O’Campo et al. (2008) found that ethnic and racial minorities reside in more economic and socially deprived neighborhoods and have less access to health-enhancing resources. Individuals on public insurance such as Medicaid or Medicare have also been found to be at a greater risk of having adverse outcomes (Bruce et al., 2012; Bryant et al., 2010; Cabacungan et al., 2012; Callaghan et al., 2008; Creanga et al., 2014; ; de Jongh et al., 2012; Dhankhar & Khan, 2009; Dubay et al., 2001; Fridman et al., 2014; Gray et al., 2012; Messer et al., 2008; Nagahawatte & Goldenberg, 2008; Nanyonjo et al., 2008; O'Campo et al., 2008; Shen & Wei, 2008; Stulberg et al., 2011; Zhang et al., 2013).

Despite all efforts to reduce racial and social class disparities in the United States, women of lower social economic status and non-Hispanic Black women have significantly higher rates of adverse maternal outcomes (Bruce et al., 2012; Bryant et al., 2010; Cabacungan et al., 2012; Callaghan et al., 2008; Creanga et al., 2014; de Jongh et al., 2012; Fridman et al., 2014; Gray et al., 2012; Messer et al., 2008; Nagahawatte & Goldenberg, 2008; Nanyonjo et al., 2008; O'Campo et al., 2008; Shen & Wei, 2008; Zhang et al., 2013). As well as longer lengths of stay (Gray et al., 2012; Zhang et al., 2013) due to their comorbidities or preexisting conditions (Bryant et al., 2010; Fridman et al., 2014). Non-Hispanic Black women are 3-4 times more likely to die from a pregnancy complication compared to non-Hispanic White women (Bruce et al., 2012; Creanga et al., 2014; Nagahawatte & Goldenberg, 2008). Maternal race/ethnicity, age, socioeconomic status (SES), and insurance are important factors in determining adverse birth and maternal outcomes (de Jongh et al., 2013; Shen & Wei, 2008; Zhang et al.,

2013) and substantial financial and social barriers to access to adequate health services and desired health outcomes (Shen & Wei, 2008).

Regardless of insurance-related disparities in healthcare, few studies have examined the maternal complication differences in women with public insurance or no insurance with women with private/commercial insurance (Zhang et al., 2013). Zhang et al. (2013) explored the racial and ethnicity disparities in adverse pregnancy outcomes in Medicaid recipients to estimate the additional costs associated with the disparities. The researchers conducted a cross-sectional study of 2005-2007 Medicaid inpatient hospital data from fourteen southern states: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Missouri, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia and found that although they have the same social economic status, defined by Medicaid insurance status, non-Hispanic Black women still had poorer outcomes compared to non-Hispanic White or Hispanic women (Zhang et al., 2013). The dataset did not contain enough American Indian, Asian, or Pacific Islanders patients for analysis and as such were excluded from the statistical analysis (Zhang et al., 2013). The Medicaid Analytic eXtract dataset consisted of 1,472,912 pregnant Medicaid enrolled patients with hospital delivery ICD-9-CM procedure codes as well as outpatient and prescription drug expenditures incurred nine months before the delivery date with a diagnosis of adverse pregnancy outcomes and complications. Zhang et al. (2013) defined adverse pregnancy complications as preeclampsia, gestational diabetes mellitus, placental abruption, maternal death, and other adverse outcomes including neonatal outcomes such as preterm birth, small birth size, and fetal death/stillbirth. None of the previous studies included neonatal outcomes (Berg et al., 2009; Callaghan et al., 2008, 2012; Kuklina et al., 2009).

In their ANOVA analysis, Zhang et al. (2013) found that non-Hispanic Black women were younger, incurred more Medicaid costs as well as longer stays in the hospital (3.4 days) compared to non-Hispanic White or Hispanic women ($p < 0.01$). The study also showed that non-Hispanic Black women had the highest prevalence of overall adverse pregnancy outcomes at 25.6% ($p < 0.01$) compared to their counterparts. Non-Hispanic White women had the lowest cost of admission, prevalence of adverse outcomes when compared to non-Hispanic Black women. Hispanic women had the lowest prevalence of adverse pregnancy outcomes with exception to gestational diabetes (Zhang et al., 2013). After adjusted for maternal age, state of residence, length of hospital stay, and Caesarean section status non-Hispanic Black women still had the highest risk out of all adverse pregnancy outcomes except for gestational diabetes mellitus; non-Hispanic White women had the highest prevalence of gestational diabetes (10.6% at $p < 0.01$) (Zhang et al., 2013).

The study revealed that racial/ethnicity disparities continue to exist and addressing them is important for improving the health of the entire population (Zhang et al., 2013). The data however, only represented fourteen southern U.S. states and per Zhang et al. (2013) these states have the worst rates of pregnancy outcomes. Complications of pregnancy and adverse perinatal outcomes affect 13-20% of women in the U.S. every year (Zhang et al., 2013); however, the study dataset is skewed because nearly one-third of the states in the dataset were comprised of non-Hispanic Blacks and other minorities. Other studies have also been performed at the state level on racial/ethnicity disparities within the Medicaid population.

Creanga et al. (2014) conducted a study of inpatient hospitalizations within seven states using the enhanced delivery identification method to examine racial/ethnical disparities. The researchers identified the delivery hospitalization procedures and diagnoses per the algorithm developed by Kuklina et al. (2008) and the severe morbidity outcomes used by Callaghan et al. (2012) (Appendix A). The dataset included 3,476,392 hospital deliveries from State Inpatient Databases for years 2008-2010 from Arizona, California, Florida, New Jersey, New York, and North Carolina representing between 88.9-95.3% of all state and year live births and 72.3-72.9% from Michigan (Creanga et al., 2014). To ensure consistency the researchers only reviewed the first fifteen ICD-9-CM diagnoses and procedures on the patients' medical records and excluded hospitals with less than thirty deliveries within a given year where more than fifty percent of the delivery records were missing or contained invalid race/ethnicity data.

The analysis showed that Hispanic and Asian/Pacific Islanders have an increased risk of gestational diabetes mellitus, placenta previa and postpartum hemorrhage, which is consistent with Zhang et al. (2013) and Bryant et al. (2010). The data also showed that age (less than 20 and greater than 30), self-pay or Medicaid, low socioeconomic status, and the presence of chronic medical conditions were also predictors of severe maternal morbidity (Creanga et al., 2014). Severe maternal morbidities disproportionately affect minority women, specifically non-Hispanic Blacks and maternal mortality and morbidity stem from multiple factors including social, medical, clinical care, and health system-related (Bryant et al., 2010; Creanga et al., 2014). Creanga et al. (2014) also analyzed severe maternal morbidities with and without blood transfusions based on the data results from Callaghan et al (2012) and found that blood transfusions were a major indicator of severe obstetric hemorrhages. Berg et al., 2009, Callaghan et al., 2008, and Kuklina et al., 2009 also arrived at the same correlation between blood transfusions and obstetric hemorrhages.

Creanga et al. (2014) found that among non-Hispanic Black, non-Hispanic White, Hispanic, Asian/Pacific Islander, and American Indian/Alaska natives' racial/ethnic groups that blood transfusions were the most common indication for a severe maternal morbidity. Non-Hispanic Blacks had 2.1 times higher rates of severe maternal morbidity with blood transfusion compared to non-Hispanic Whites, Hispanic 1.3, Asian/Pacific Islander 1.2, and American Indian/Alaska natives 1.7 times higher rates (all at $p < 0.001$) (Creanga et al., 2014). Severe maternal complications without blood transfusions showed similar rates. Creanga et al. (2014) utilized a proven method that is also endorsed by the CDC for the identification of delivery hospitalization procedures and severe maternal diagnoses (CDC, 2014); however, this dataset only included seven states and cannot be generalized across the country. The study nonetheless is consistent with the other race/ethnicity disparity studies included in this literature review.

Cabacungan, Ngui, and McGinley (2012) and Gray et al. (2012) also used the enhanced delivery identification method to identify maternal morbidity disparities using state data and found severe maternal morbidities disproportionately affected non-Hispanic Blacks. Cabacungan, Ngui, and McGinley (2012) conducted a retrospective cohort study analysis using Wisconsin 2005-2007 Healthcare Cost and Utilization Project State Inpatient Dataset (HCUP_CID). The researchers found that non-Hispanic Blacks had a significantly higher likelihood of infections (OR = 1.74; 95% CI, 1.60-1.89), preterm labor (OR = 1.42; 95% CI, 1.33-1.50), antepartum hemorrhage (OR = 1.63; 95% CI, 1.44-1.83), and hypertension complication pregnancy (OR = 1.39; 95% CI, 1.31-1.48) compared to non-Hispanic Whites (Cabacungan, Ngui, and McGinley, 2012). Gray et al (2012) also found that non-Hispanic Blacks (OR = 1.82; 95% CI, 1.64-2.01), American Indians (OR = 1.52; 95% CI, 1.07-1.27), Asian/Pacific Islander (OR = 1.30; 95% CI, 1.19-1.41), and Hispanics (OR = 1.17; 95% CI, 1.07-1.27) were at greater risk of having a severe maternal morbidity compared to non-Hispanic White women.

Gray et al (2012) used 1987-2008 hospital discharges from Washington State. The data analysis also showed that older women age 35-39 (OR = 1.65; 95% CI, 1.52-1.79 and 40+ (OR = 2.48; 95% CI, 2.16-2.81) were at an increased risk of a severe maternal morbidity (Gray et al., 2012). The receipt of blood transfusions was the most common qualifying severe maternal morbidity and occurred in nearly half of all cases (Gray et al., 2012). Even though Gray et al. (2012) and Cabacungan, Ngui, and McGinley (2012) conducted single state studies they still arrived at the same conclusions regarding the racial/ethnic disparities around minorities and severe maternal morbidities. Gray et al. (2012) also found as Creanga et al. (2014), Callaghan et al. (2012), Berg et al (2009), Kuklina et al (2009), and Callaghan et al (2008) that most patients with a severe maternal morbidity also incurred blood transfusions.

Fridman et al. (2014) conducted a retrospective analysis of 1,551,071 California births for years 1999, 2002, and 2005 to also examine the racial/ethnic trends in maternal comorbidities. The researchers used ICD-9-CM codes to identify maternal hypertension, diabetes, asthma, thyroid disorders, obesity, mental health conditions, substance abuse and tobacco from the state-linked vital statistics and hospital discharges and determined that the prevalence of maternal comorbidities before and during pregnancy increased in California; however, there were no obvious trends (Fridman et al., 2014). Fridman et al. (2014) were not able to distinguish if any of the conditions were preexisting and they included two risky behaviors that other studies did not. Substance abuse and tobacco usage could have potentially skewed the results; both are correlated with increasing the risk of maternal and neonatal pregnancy complications (Fridman et al., 2014). In the analysis of 2005 data, Fridman et al. (2014), found that hypertension affected more than 10% of all births regardless of race/ethnicity, however, maternal diabetes affected nearly 10% of Asians/Pacific Islanders. Zhang et al. (2013) and Bryant et al. (2010) also found that Asian/Pacific Islanders had a higher prevalence of diabetes compared to other minorities and non-Hispanic Whites.

Fridman et al. (2014) also found that Native Americans had the largest increase in chronic hypertension, diabetes, obesity, mental health conditions and tobacco usage; however, non-Hispanic Blacks had the highest prevalence of hypertension, asthma, obesity, mental conditions, and substance abuse. Even after controlling for demographic shifts in maternal age there were still significant increases in the prevalence of comorbidities during pregnancy (Fridman et al., 2014). Fridman et al. (2014) concluded that the prevalence of maternal comorbidities increased dramatically in California and that they are independent of demographic shifts in maternal age, race/ethnicity, education, or other maternal characteristics; however, there are still racial/ethnic disparities among minorities. These results were consistent with other studies on racial/ethnic disparities in maternal morbidities; however, these data only included one state and as such cannot be applied to the general population. These data were also missing 5% of racial/ethnicity data.

Shen and Wei (2008) conducted a one year logistic regression analysis of 2004 hospital discharges from Nevada state inpatient data on a state that is running behind other states in regards to population growth and have an increased population of uninsured and minorities. The dataset included women who had any of the following adverse pregnancy outcomes: preterm labor, hypertensive disorders, gestational diabetes, antepartum hemorrhage, membrane disorders, cesarean section, prolonged labor, postpartum hemorrhage, and fetal death. The researchers found that both Medicaid and uninsured women experienced poorer outcomes when compared to women with private insurance after controlling for maternal age and other comorbidities, of which they did not specify. Women on Medicaid were more likely to have abruption placenta (OR = 1.67; 95% CI, 1.24- 2.26), prolonged labor (OR = 1.16; 95% CI, 1.03- 1.31), and fetal death (OR = 1.59; 95% CI, 1.11- 2.27); uninsured women had prolonged labor (OR= 1.20; 95% CI, 1.01- 1.42) and fetal death (OR= 1.70; 95% CI, 1.05- 2.74) (Shen & Wei, 2008). Women on Medicaid were also younger with an average age of 24.5 compared to women with private insurance with an average age of 28.7 years and uninsured women had the highest percentage of living in large urban areas (82.5%); both Medicaid (43.1%) and uninsured (31.6%) women delivered in public hospitals (Shen & Wei, 2008). The researchers used only one year of data, did not distinguish patient race/ethnicity and only categorized patient residence as metropolitan and non-urban (Shen & Wei, 2008); patient zip codes could have been used to give more information on the patients. The researchers could have also controlled for hospital characteristics such as ownership and location.

Maternal morbidity racial/ethnicity studies were also performed on states or large metropolitan areas that had specific electronic medical records systems and insurance plans. Bruce et al. (2008, 2012) conducted two separate studies using Kaiser Permanente Health Management Organization (HMO) inpatient and outpatient data. The researchers used a computerized algorithm which could only be used on HMO electronic medical data (Bruce et al., 2008, 2012) to identify pregnancy and pregnancy-related complications within the HMO population. The defined population made the results more accurate (Bruce et al., 2012), however, it included outpatient complications that are less severe, therefore the algorithm did not target the most serious maternal morbidities as it mostly identified complications that usually do not require hospitalization (Bruce et al., 2012).

Bruce et al. (2008) analyzed pregnancy patients who were enrolled in the Washington Basic Health Plan, any commercial employer-sponsored plans, Medicare, or Medicaid in Kaiser Permanente Northwest. The data comprised of 21,011 women who had a maternal comorbidity from 1998-2001; however, most the race/ethnicity data came from patients in Oregon and Washington State. The researchers defined the pregnancy outcomes as live birth, stillbirth, spontaneous abortion, therapeutic abortion and then analyzed their adverse outcomes. Bruce et al. (2008) found that among women who had a live birth, the Medicaid insurers were diagnosed more often with anemia and mental health conditions than women with other insurance within the HMO. In addition, Asian women had a higher prevalence of pelvic and perineal trauma and fewer health conditions compared to other racial/ethnic groups, however Asians only made up 7% of the dataset.

The researchers used the same approach in the Bruce et al (2012) study, which used Kaiser Permanente Georgia data from 2000-2006 from Atlanta insurers and found similar results. The algorithm identified 37,741 pregnancies of which like Bruce et al (2008) over 50% of them had at least one complication; however, the most common complications were urinary tract infections, anemia, mental health conditions, pelvic and perinatal complications and obstetrical infections that did not require hospitalization. Bruce et al. (2012) were more focused on race/ethnic disparities than Bruce et al. (2008)

and as such found that complications were more likely in non-Hispanic Black women with low socioeconomic status compared to non-Hispanic Whites. The researchers stratified the data by race/ethnicity using multivariable models and found that pregnancies among non-Hispanic White women with low socioeconomic status had a modest effect on the odds of having preexisting medical conditions (adjusted odds ratio (AOR) = 1.3; 95% CI, 1.2- 1.5 or having any morbidity (AOR= 1.3; 95% CI, 1.2- 1.4) (Bruce et al., 2012). Low socioeconomic status had little effect on complications among non-Hispanic Black women. Bruce et al. (2012) concluded that these effects are due to the dataset; patients with health insurance were less likely to have dramatic unfavorable impacts. The data was limited to only Kaiser Permanente HMO plans which limit the ability to generalize the data. Neither studies analyzed the results by hospital ownership, size or type, which could have provided more information on maternal characteristics since the data was already limited to HMO plans and certain states/areas.

Summary and Conclusions

Negative defensive medicine practices, such as avoiding high-risk patient populations with increased risk for adverse events further increases their risk for adverse outcomes. Empirical studies have mostly measured defensive medicine behaviors through insurance premiums and tort reform laws, however other factors, such as patient risk factors (Currie & MacLeod, 2008; Dhankhar & Khan, 2009; Wu, 2010; Mello et al., 2007; Yang et al., 2012; Yang et al., 2009;), socioeconomic status (Dhankhar & Khan, 2009, Dubay et al., 2001; Yang et al 2012;), hospital characteristics (Dhankhar & Khan, 2009; Yang et al., 2008), physician fear of malpractice litigation (Currier & MacLeod, 2008; Dhankhar & Khan, 2009; Gimm, 2010; Jena et al., 2011, Wu, 2010;), as well as claims frequency and severity (Dhankhar & Khan, 2009; Jena et al., 2011) influence physician practice decisions. Regardless of these influencing factors, there were minimal studies that investigated the affect patient outcomes.

Dubay et al. (2001) and Yang et al. (2012) conducted the only two national studies on physician defensive medicine behaviors and its relationship to maternal outcomes; however, they both only focused on birth outcomes. Dubay et al. (2001) found that mothers who were unmarried or of lower socioeconomic status were more affected by negative physician avoidance behaviors. Dubay et al. (2001) and Dhankhar and Khan (2009), both found that patients with Medicaid insurance were also highly effected by physician avoidance behaviors. Additional studies on patient outcomes on these populations are needed to explore the relationship between physician avoidance behaviors and high-risk patient adverse outcomes.

Adverse events are directly or indirectly the result of human error and physician violations are deliberate deviations from standard procedures play a huge role in healthcare incidents. Alper and Karsh (2009) reviewed five healthcare studies for the influence of human factors on healthcare surgical errors and the major predictors of violations were physician or staff individual characteristics and competing personal and organizational goals. The research only contained surgical healthcare studies, however concluded that more healthcare research was needed to consistently predict unsafe physician violations and its effect on patient adverse outcomes.

There have been limited U.S. empirical studies published after 2008 on maternal morbidities and severe morbidities within high-risk populations, which illustrates a gap in the knowledge. High-risk patients defined by race/ethnicity and insurance are at an increased risk of having adverse patient outcomes or morbidities. Kuklina et al. (2008) developed an algorithm to more accurately identify maternal hospital deliveries and in turn maternal morbidities. The method added additional ICD-9-CM diagnosis codes and DRGs to effectively identify hospital deliveries. Callaghan et al. (2012) further developed the algorithm by adding maternal postpartum diagnosis codes to identify the pregnancy population and maternal morbidities that may occur after the original delivery discharge. By using the enhanced delivery method and adding postpartum diagnoses codes, Callaghan et al (2012) was able to evaluate severe maternal morbidities.

Callaghan et al. (2012) found that severe maternal morbidities increased by 75% for delivery hospitalizations and 114% in postpartum hospitalizations in a Nationwide Inpatient Sample (NIS) of data for years 1998-2009. Creanga et al. (2014) later used Callaghan et al. (2012) enhanced delivery identification method on inpatient hospitalizations in two-year dataset of seven states to examine racial/ethnical disparities. Creanga et al. (2014) found that severe maternal morbidities disproportionately affect minority women and that blood transfusion were the most common indicator for a severe maternal morbidity. Callaghan et al. (2012) and Creanga et al. (2014) have attempted to close the gap on the available literature on maternal delivers and morbidities; however, more literature is needed. Callaghan et al. (2012) and Creanga et al. (2014) both used the enhanced delivery identification method created by Callaghan et al. (2012) to effectively identify maternal delivery and postpartum hospitalizations, however they only studied severe maternal morbidities. The enhanced delivery and postpartum method needs to be used to assess both maternal morbidities and severe maternal morbidities to truly evaluate the impact on maternal adverse outcomes. My study built on the research conducted by Callaghan et al. (2012) and Creanga et al. (2014) on physician avoidance behaviors, as well as focused on human factor theory and how physicians refrained from accepting high-risk patients out of fear of medical malpractice litigation and personal gain.

Chapter 3 includes a description of the research design, setting, and population that was studied, including the 2006 and 2007 data from the National Practitioner Data Bank Public Use File, 2016 and the 2007 and 2008 data used from the National Discharge Survey dataset. A statistical analysis and data management of the data were also included. The guidelines of the study were determined by the problem statement, research questions, and hypotheses (Creswell, 2009). Chapter 4 consisted of a discussion on the study results and the techniques used to test the research questions. Chapter 5 included an interpretation of the findings, implications for social change, as well as future research recommendations.

Chapter 3: Research Method

Introduction

The purpose of this cross-sectional quantitative study was to examine the relationship between OB-GYNs who engaged in defensive medicine avoidance behaviors, as defined by obstetrics-related malpractice allegations, and the severity of the malpractice injuries and its influence on maternal morbidities and severe maternal morbidities, after adjusting for hospital characteristics such as bed size, ownership, and location and patient days of stay. The malpractice data included all female inpatients with an obstetrics-related malpractice allegation and malpractice injury severity with a range from 1 (*emotional injury*) to 9 (*death*) where a malpractice payment was included in the report in the NPDB. The pregnancy population included all female patients, aged 15-49, with delivery or postpartum hospitalizations. The pregnancy population is identified in Appendix A using the enhanced delivery identification method (Kuklina et al., 2008), as well as primary or secondary ICD-9-CM diagnosis code V24 for postpartum hospitalizations and diagnosis-related (DRG) delivery codes 376, 377, 769 or 776 (Callaghan et al., 2012).

The independent variables included obstetrics-related malpractice allegations and the severity of the injuries, as well as the pregnancy population patient age, race, and insurance status defined as principal expected source of payment. The dependent variables, maternal morbidities and maternal severe morbidities, can be found in Appendices B and C. Maternal morbidities during hospitalization were measured using the ICD-9-CM discharge codes found in Appendix B while severe maternal morbidities occurring antepartum, intrapartum, and postpartum were measured using ICD-9-CM discharge diagnosis codes and procedure codes in Appendix C. I accessed the 2006 and 2007 obstetrics malpractice allegations and injury severity data from the National Practitioner Data Bank Public Use Data File, 2017 (NPDB-PUDF) by region with the 2007 and 2008 regions of the patient hospitalizations and diagnoses data from NHDS to address the knowledge gap in the relationship between OB-GYN defensive medicine avoidance behaviors and adverse maternal outcomes. According to Dhankhar and Khan (2009), a year, on average, is needed for malpractice data to show an impact on the patient. As such, I used the 2006 NPDB-PUDF to show the impact on the 2007 NHDS patient data and the 2007 NPDB-PUDF to show the impact on the 2008 NHDS patient data.

Addressing this gap could allow information on maternal morbidities and severe maternal morbidities to be better targeted towards Black/African American communities. In this chapter, I begin by describing and justifying the research study design and restating the research questions and hypotheses. I then discuss the population, sample and sampling procedures, methods for analyzing data, threats to validity, ethical procedures, and plans for dissemination of findings.

Research Design and Rationale

I examined the relationship between OB-GYN avoidance behaviors and adverse outcomes at a single point in time to measure the prevalence of maternal morbidities within the population.

Dependent Variables

For this study, the dependent variables were the maternal morbidities and severe maternal morbidities as defined by ICD-9-CM discharge codes reported for each female patient who had an inpatient delivery or postpartum hospitalization. A full listing of these codes can be found in Appendices B and C.

Independent Variables

The independent variables that were investigated included age, race, and insurance status as defined as principal expected source of payment, obstetrics-related malpractice allegations, and the severity of the injuries.

Research Design

The research design was a retrospective cross-sectional study. Researchers conducting cross-sectional studies examine the associations between variables at a single point in time and, as such, measure the prevalence of diseases, which allow the researcher to determine the association between the measures (Aschengrau & Seage, 2008). Most cross-sectional studies, such as this study, are retrospective and involve the use of secondary data (Aschengrau & Seage, 2008). Cross-sectional study designs utilizing secondary data are normally quicker and cheaper to conduct than other types of research because the data represent a single point in time and often are available free of charge on government and university websites (Aschengrau & Seage, 2008). The biggest benefit to cross sectional studies is that they can establish the prevalence of study phenomena, which helps to suggest and direct further research (Aschengrau & Seage, 2008). Most of these datasets include codebooks, manuals, and reports that discuss the data's quality and its limitations (Aschengrau & Seage, 2008). Other benefits to using secondary data are that the data have large sample sizes and are diverse in terms of ethnicity, socioeconomic status, family structure, and employment; therefore the results can be generalized across populations (Hofferth, 2005).

Retrospective cross-sectional research is frequently used to show the impact of morbidities and diseases in the United States. Healthy People 2010 and 2020 goals show that the prevalence of severe maternal morbidities has increased in the United States despite the goals to reduce maternal illness and complications (National Hospital Discharge Survey [NHDS], 2014). The CDC used the enhanced delivery method identified by Kuklina et al (2008) to quantify delivery hospitalizations and estimate maternal morbidities in the United States. Berg et al. (2009), Callaghan et al. (2012), Callaghan et al. (2008), and Kuklina et al. (2009) all used retrospective cross-sectional data to show the impact of maternal morbidity and/ or severe maternal morbidity on women in their studies discussed in the literature review. Coincidently, Berg et al. (2009) and Callaghan et al. (2008) both used the National Hospital Discharge Survey as their datasets, however Berg et al. (2009) identified their dataset using only the V27 method and conducted a trend analysis comparing 1993-1997 with 2001-2005. While Callaghan et al. (2008) did use the enhanced delivery method to identify delivery hospitalizations and complications from 1991-2003 their dependent variables consist only of severe maternal morbidities not maternal morbidities and severe morbidities. My study also used the National Hospital Discharge Survey discharges for years 2007 and 2008; however, the dependent variables were both maternal morbidities and severe maternal morbidities. The study did not just isolate the most severe complications as shown in Callaghan et al. (2008).

Cross-sectional studies are mostly identified with survey research in which a random sample is drawn from a population based on predetermined criteria and a set of questions are asked about their backgrounds, past experiences, and attitudes (Frankfort-Nachmias & Nachmias, 2008). Some studies used data to describe patterns between variables to establish causal relationships. Callaghan et al. (2008) used the 1991-2003 National Hospital Discharge Survey data set in their research to identify severe maternal morbidity trends. Archival data was collected from the National Hospital Discharge Survey (NHDS) for years 2007 and 2008 to identify the delivery hospitalizations by region in conjunction with the archival data from the National Practitioner Data Bank Public Use Data File, 2017 (NPDB-PUDF) for years 2006 and 2008 to identify the claims frequency and severity of the injuries by region to access the impact on potential maternal morbidities and severe maternal morbidities by region. By using this type of study design, maternal morbidity and severe maternal morbidity cases were examined retrospectively with the number of obstetrics related malpractice allegations and the severity of the injuries, by hospital region, bed size, and ownership for each independent variable to determine if there was a causal relationship. The scope of the study was limited to the data reported to the National Practitioner Data Bank Public Use Data File, 2017 (NPDB-PUDF) for years 2006 and 2007 as well as the 2007 and 2008 survey questions in the National Hospital Discharge Survey found in Appendix D, as well as the fields and data that were available.

Methodology

Population

According to Frankfort-Nachmias and Nachmias (2008) a population includes content, extent and time. The malpractice study population included all inpatient females with an obstetrics related malpractice allegation, malpractice injury severity range from 1 – emotional injury to 9 – death, and a malpractice payment included in the National Practitioner Data Bank Public Use Data File, 2017 (NPDB-PUDF) for years 2006 and 2007. The pregnancy study population included females age 15-49 who had an inpatient delivery or postpartum hospitalization as defined in Appendix A and whose ICD-9-CM procedure diagnosis codes or DRG codes are included in the National Discharge Survey data for years 2007 and 2008. The inpatient delivery hospitalizations were identified using a previous published algorithm which uses both ICD-9-CM diagnosis and procedure codes, and DRG codes to identify selected delivery- related procedures (Callaghan et al., 2012; Kuklina et al., 2008). The "postpartum hospitalizations were identified using the fifth digit = 4 in ICD-9-CM codes for primary or secondary diagnosis, an ICD-9-CM code V24 for any listed diagnosis", as well as postpartum diagnosis-related group codes 376, 377, 776 or 769 for the 2007-2008 time period (Callaghan et al., 2012).

Sampling Procedure

A sampling design needs to be representative of the population so that the sample results can be generalized across the entire population (Frankfort-Nachmias & Nachmias, 2008). Sampling designs are defined as probability or nonprobability designs. This study included a simple probability sample design in which all records within the population (database) were included in the study unless there were duplicate, missing, or incomplete records. Probability sample designs consist of simple random samples, systematic samples, stratified samples, and cluster samples and with these sampling designs all units of the population have an equal chance of being a part of the sample (Frankfort-Nachmias & Nachmias, 2008).

Inclusion and exclusion criteria. The malpractice study population included all inpatient females with a malpractice allegation and malpractice injury severity included in the National Practitioner Data Bank Public Use Data File, 2017 (NPDB-PUDF) for years 2006 and 2007. The study was restricted to allegations that are obstetrics related with a reported malpractice payment. The data only included allegations where there was also a malpractice injury severity reported with a range from 1 – emotional injury to 9 – death. The pregnancy study population included females age 15-49 that had an inpatient delivery or postpartum hospitalization as defined in Appendix A for years 2007 and 2008 in the National Hospital Discharge Survey whose race was specified as Black/African American and primary insurance as Medicaid or Medicare. The study was restricted to women with a hospital stay of at least 1 day (2 days being the median length of stay among women who delivered) or who had been transferred to another facility after delivery (Callaghan et al 2008). Women with at least one of the ICD-9-CM codes listed in Appendix A and a minimum one day length of stay or a postpartum transfer were included in the study.

Years 2007 and 2008 are selected for the pregnancy population from the National Hospital Discharge Survey because these years were electronically available from the Inter-University Consortium for Political and Social Research (ICPSR). Years 2006 and 2007 were selected for the malpractice study population from the National Practitioner Data Bank Public Use Data File, 2017 (NPDB-PUDF) because these years are electronically available to researchers from the National Practitioner Data Bank (NPDB). It takes malpractice data an average of a year to show an impact on the patient (Dhankhar & Khan, 2009), and as such 2006 and 2007 NPDB-PUDF data was used to show the impact on the 2007and 2008 NHDS patient data respectively. The ICPSR is an international consortium of more than 700 academic institutions and research organizations (Inter-university Consortium for Political and Social Research [ICPSR], 2013). They are the world's largest archive of computerized social science data and are a great resource for obtaining quality and reliable free datasets (Rudestam & Newton, 2007). The NPDB is an information clearinghouse created by Congress to improve the quality of health care, protect the public, and reduce health care fraud and abuse in the United States (United States Department of Health and Human Services [USDHHS], 2017).

Power analysis. A power analysis is used to determine if the sample size is sufficient to achieve adequate statistical power in the study. A power analysis has four main parameters: effect size, sample size, alpha significance, and the power of the statistical test (Ellis, 2010). If the value for one of the parameters is known than the other three can be calculated. Effect size is the practical significance of the study on the population; will the study or outcome be beneficial. Statistical power is the probability that a given statistical test can be able to detect that a difference does exist in the population.

Callaghan et al (2008) conducted a study on severe maternal morbidities using NHDS data for years 1991-2003 with a sample size of 425,715 delivery hospitalizations, an average of 35,476 records per year that met their exclusion criteria and found both a practical and statistically significant (p=0.002) trend in the severe morbidity rate. Berg et al (2009) later compared 2001-2005 NHDS data with their previously published 1993-1997 analysis and found an increase in maternal morbidity using only the V27 method of delivery hospitalization identification. The V27 method identified 183,431 unweighted sampled delivery hospitalizations or 36,686 annually (Berg et al., 2009). Overall the percentage of morbidity complications increased, however the rate was not statistically significant ($p < 0.01$). The estimated sample of 2007 and 2008 hospitalized deliveries were 40,033 and 16,234 respectively (United States Department of Health and Human Services [USDHHS], 2011, 2010). This averaged to 10,000 deliveries per region year for 2007 and 4,058 deliveries per region year for 2008. The estimated sample size was sufficiently large enough to use an analysis of partial correlation and logistic regression statistics to evaluate the null hypothesis.

I used G*Power (Faul, 2013) to calculate an estimated sample size for a multiple logistic regression analysis utilizing nine predictor variables and two tested predictors. The inputted parameters of an effect size $f^2 = 0.15$, significant level of $p = 0.05$ and a power of 0.95 resulted in an estimated sample size of 107 for each study year, or 214 for the entire data set with a critical F value of 3.090 and denominator df = 97 for the multiple logistic regression a priori required sample size (see Figure 2).

F tests – Linear multiple regression: Fixed model, R² increase

Analysis:	A priori: Compute required sample size		
Input:	Effect size f²	=	0.15
	α err prob	=	0.05
	Power (1−β err prob)	=	0.95
	Number of tested predictors	=	2
	Total number of predictors	=	9
Output:	Noncentrality parameter λ	=	16.0500000
	Critical F	=	3.0901867
	Numerator df	=	2
	Denominator df	=	97
	Total sample size	=	107
	Actual power	=	0.9514464

Figure 2. G*Power computation (Version 3.1.6).

Procedures for Recruitment, Participation, and Data Collection

The 2007 and 2008 pregnancy population data sets were obtained from the ICPSR website. Walden University is a member of the consortium and as such students have full direct access to all ICPSR's services and datasets free of charge. ICPSR also processes, preserves and disseminates the data and documents as well as provide education, training, and instructional resources to help researchers analyze research data (ICPSR, 2013). As a student, I searched ICPSR website for hospital discharge studies and found the National Hospital Discharge Study series was available for years 1987-2008. National Hospital Discharge Survey, 2007 (ICPSR 28162) and National Hospital Discharge Survey, 2008 (ICPSR 30182) were selected for the study because the survey questions were unchanged for the two-time periods. ICPSR provided both datasets free of charge in both SAS, SPSS, Stata, and ASCII delimited format, as well as provided the documentation of the measures within the file and the Codebook which documented how the codes were cleaned, manipulated, recoded, and or missing within each measure.

The 2006 and 2007 malpractice data sets were obtained from the National Practitioner Data Bank website. The National Practitioner Data Bank Public Use Files were available free for public use in SPSS format as well as the Codebook with documentation of the measures with the file. The National Practitioner Data Bank (NPDB) maintains a comprehensive security system and is consistent with recognized standards and guidelines. Malpractice payments and adverse actions are required to be reported to the NPDB under Title IV of Public Law 99-660, the Health Care Quality Improvement Act of 1986 (Title IV); Section 1921 of the Social Security Act (Section

1921); Section 1258E of the Social Security Act (Section 1128E; and their implementing relations found at 45 CFR Part 60 (United States Department of Health and Human Services [USDHHS], 2015). The NPDB has intense operational, management, and technical controls to ensure the security of the transactions over the Internet and the sensitivity of the financial and personal information from unauthorized access. The NPDB is committed to maintaining accurate information and ensuring that subjects of reports are informed when the NPDB receives reports concerning them. Reporting entities, which includes medical malpractice payers, hospitals, and other health care entities, professional societies, health plans, peer review organizations, private accreditation organizations, quality improvement organizations, and certain Federal and State agencies are responsible for the content they report and its accuracy 60 (USDHHS, 2015). Each report is processed by the NPDB system in the same way it was reported, and the reporter must make any changes or corrections. Once the NPDB processes a report the subject of the report, which includes health care practitioners, entities, providers, and suppliers are notified 60 (USDHHS, 2015). A copy of the report was made available for verification and instructions on obtaining an official copy of the report through the NPDB website (USDHHS, 2015). The subject of the report is instructed to review the report for accuracy, including demographic information.

National Hospital Discharge Survey Data Collection. The National Hospital Discharge Survey (NHDS) has been conducted annually by the National Center for Health statistics since 1965 to collect medical and demographic information from a sample of inpatient discharge records selected from a national probability sample of non-Federal, short-stay hospitals (United States Department of Health and Human Services [USDHHS], 2010, 2011). These data provide data for United States inpatient hospital utilization statistics. The NHDS included discharges from non-institutional hospitals excluding Federal, military, and Veterans Administration hospitals, located in the 50 states and the District of Columbia (USDHHS, 2010, 2011). Only hospitals with an average length of stay for all patients of less than 30 days or with a specialty of general, medical, surgical, or children's general are included in the survey. In addition, the hospitals must also have six or more beds staffed for patient use (USDHHS 2010, 2011). Hospitals send the data manually through data abstraction electronic submission. In 2007, of the hospitals that manually abstracted data 23% of the data was performed by their own medical records, other hospitals opted to allow the U.S. Bureau of the Census abstract the data for them on behalf of NHDS (USDHHS, 2010). In 2008, only 16% of hospitals chose to manually abstract their own data (USDHHS, 2011). Hospitals that used the electronic or automated system used NHDS purchased files containing machine-readable medical record data where systematically sample were sent to NHDS (USHHS, 2010, 2011). Appendix D displays the Medical Abstract Form that the manual and automatic systems were completing.

Medical Coding Edits and Data Cleaning. Within each sample patient only a maximum of seven ICD-9-CM diagnosis codes and a maximum of four ICD-9-CM procedure codes were assigned (USDHHS, 2010, 2011). The diagnoses and procedures are normally presented in the way they were ordered in the patient abstract, and as such women with delivery procedure and diagnosis codes would normally appear last on a discharge abstract so manually modifications had to be made. Women with a code of V27, which normally appears last on a discharge abstract, were entered as the first listed code within the patient sample dataset, with the appropriate accompanying delivery code listed second designating either normal or abnormal delivery (USHHS, 2011, 2010). These manual changes made by the NHDS staff there were noted in the Codebook documentation. Once edits on the manual and automated system files were completed, these data were merged. Data that was received from the manual system was first entered into a computer file and combined with the automated data files. Medical edits were conducted by computer inspection and by then by a manual review of the rejected records.

Once cleaned, the data contained 501 sample hospital records for 2007, however 24 facilities were found to be out-of-scope or ineligible because they went out of business or failed to meet the NHDS criteria. Of the 477 sample hospitals, 422 responded to the survey for an unweighted response rate of 88%, the weighted response rate is 82% (USDHHS, 2010). In 2008, the sample contained 239 hospitals due to funding limitations the hospital sample size had to be cut in half. Within the 239 sample, one hospital was out-of- scope and 207 responded to the survey, for an 87% unweighted response rate and a weighted response rate of 79% (USDHHS, 2011). Due to the reduced sample size, the USDHHS (2011), stated that the error estimates for statistics for the survey had increased and, in some cases, the relative standard errors (RSEs) doubled. USDHSS (2011) stressed caution when analyzing the 2008 data particularly when making estimates for children under 15 and for the West Census region as a variety of the estimates for these populations did not meet NHDS standard of reliability due to unacceptable large RSEs). To meet the NHDS standards for reliability, estimates should be based on at least 30 discharge records and have a relative standard error (RSE) of less than 30% (USDHSS, 2011).

National Practitioner Data Bank Public Use Data File Collection. The National Practitioner Data Bank Public Use Data File (NPDB PUDF) contained selected variables from the National Practitioner Data Bank Reports received from September 1, 1990 – December 31, 2017 (United States Department of Health and Human Services [USDHHS], 2017). These data contained 1,351,402 cases on health care practitioners, entities, providers, and suppliers registered in the National Practitioner Data Bank (NPDB) (USDHHS, 2017). This included federal and non-Federal short-term and long-term care, general and specialty licensed hospitals, long-term skilled nursing facilities and hospice facilities, as well as ambulatory, outpatient care centers, and one-day surgery centers (USDHHS, 2017). Health providers included HMO, health insurance, or other prepaid health plan programs. A health care practitioner is defined as an individual who is licensed by the state to provide health care services. Any of these entities, providers, suppliers, or practitioners could report a claim on a registrant as required by law (USDHHS, 2017). These data were published as the data is reported in the system and it was the responsibility of the reporter or the claimant to validate. The NPDB cautioned that the information in the NPDB should only serve as an alert of an issue with the performance of a health care practitioner, entity, provider, or supplier (USDHHS, 2015).

Operationalization of the Study Variables

These research variables described in this study was used to determine the relationship between OBGYN patient avoidance behaviors and maternal morbidities in high-risk patients, defined by race and insurance status. The research variables were based on ICD-9-CM procedure and diagnosis codes, and DRG codes, and selected variables in the 2007 and 2008 NHDS dataset and the 2006 and 2007 NPDB PUDF dataset.

Dependent variable. Maternal morbidities are ICD-9-CM procedures or diagnoses codes that indicate physical or psychological conditions that result from or are aggravated by pregnancy and have an adverse effect on women's health (CDC, 2014). Wound complications can increase length of stay and chronic hypertension could increase the risk for preterm labor. Severe maternal morbidities, such as septicemia (038) are the morbidities that are the most severe and are potentially life-threatening. These ICD-9-CM codes were coded during a patient's hospital stay and reported and charted on their medical record at discharge. For this study, this variable was analyzed as a binary variable, maternal or severe morbidity. The specific codes and distinct categories are found in Appendix B and C. ICD-9-CM procedure and diagnosis codes were identified using previously published International Classification of Diseases, 9th Revision (ICD-9-CM-CM) for years 2007 and 2008.

Independent variables. The independent variables were age, race, and insurance status, defined by principal expected source of payment. The obstetrics related malpractice allegations and the severity of the malpractice injuries were the main predictor variables and was used to define OBGYN physician patient avoidance behaviors. Avoidance behaviors such as reducing or eliminating the number of high-risk patients, or only providing gynecological care further increases the patient's risk of adverse outcomes (Dhankhar & Khan, 2009; Dubay et al., 2001; Philips et al., 2004). Dhankhar and Khan (2009) and Dubay et al. (2001) found that physicians were modifying their patient practices based on patient insurance and socioeconomic status.

Race of patient (NHDS). The race of the patient was reported as the variable RACE. The study used the minority reported race of Black/African American (2). Race was nominal and used to compare to White (1), (American Indian/Alaskan Native (3), Asian (4), Native Hawaiian/Other Pacific Islander (5), Other (6), Multiple race indicated (8), coded 'Other Minorities'. Patients with categories of Not stated (9) and unknown values were treated as missing and excluded from the study.

Patient Age (NHDS). The age of the patient on the birthday prior to admission to the hospital inpatient service (AGE). The patient age was limited to 15 – 49 years of age and grouped as follows: 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49 as noted by Martin et al (2013) in the 2012 final National Vital Statistics Reports. Age was an interval variable for this study.

Insurance Status/Principal expected source of payment (NHDS). The expected source of payment was reported as (ESOP1) and was nominal. The study used the primary expected payers of (02) Medicare and (03) Medicaid and compared it with the other sources of payments. The other principal expected sources of payment were Worker's compensation (01), Other government (04), Blue Cross/Blue Shield (05), HMO/PPO (06), Other private insurance (07) and Self-pay (08). No charge (09) and Other (10) were excluded from the study. Not stated (99). Any unknown values were treated as missing and excluded from the study.

Malpractice Allegation Group (NPDB PUDF). The malpractice allegation group was reported as the variable (ALGNNATR). The study treated this as a nominal variable. Obstetrics Related (50) was used to identify obstetrics related malpractice allegations. The other groups were (1) Diagnosis Related, (10) Anesthesia Related, (20) Surgery Related, (30) Medication Related, (40) IV & Blood Products Related, (60) Treatment Related, (70) Monitoring Related, (80) Equipment/Product Related, (90) Other Miscellaneous, and (100) Behavioral Health Related.

Severity of Alleged Malpractice Injury (NPDB PUDF). The severity of the alleged malpractice injury was reported as (OUTCOME). This was an interval variable and used to identify the severity of the malpractice injury with the following: (1) Emotional Injury Only, (2) Insignificant Injury, (3) Minor Temporary Injury, (4) Major

Temporary Injury, (5) Minor Permanent Injury, (6) Significant Permanent Injury, (7) Major Permanent Injury, (8) Quadriplegic, Brian Damage, Lifelong Care, (9) Death, (10) Cannot Be Determined from Available Records. Values of (10) were treated as unknowns and removed from the study.

Malpractice Allegation Region (NPDB PUDF). This variable (MAL_REGION) was created to represent the region location of the reported allegation, utilizing the LICNSTAT variable. The NPDB_PUDF only reported the US state of the malpractice allegation, therefore the region was created utilizing the same methodology in the NHDS files as show below:

The geographic regions for NHDS were as follows:

(1) Northeast: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania

(2) Midwest: Michigan, Ohio, Illinois, Indian, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, South Dakota, Nebraska, Kansas

(3) South: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas

(4) West: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Hawaii, Alaska (USDHHS, 2010, 2011)

Control variables. The control variables were hospital region, hospital bed size, hospital ownership and patient days of care from the NHDS.

Hospital region. The hospital location (REGION) was reported as (1) Northeast, (2) Midwest, (3) South, and (4) West. Any unknown values were treated as missing and excluded from the study.

Hospital bed size. The hospital bed size (BEDSIZE) was reported as (1) = 6-99, (2) = 100-199, (3) = 200-299, (4) = 300-499, (5) = 500 and over. Any unknown values were treated as missing and excluded from the study.

Hospital ownership. The hospital ownership (OWNER) was reported as (1) proprietary (2) government (3), nonprofit, including church. Any unknown values were treated as missing and excluded from the study.

Days of care. The days of care were coded as the actual days of care (DOC). Values were limited to at least 1 day. Any unknown values were treated as missing and excluded from the study.

Archival Data

The National Hospital Discharge Survey dataset for the research was retrieved from ICPSR and arranged individually by years for 2007 and 2008. The files were downloaded onto SPSS and stored for analyses and the codebooks saved in Adobe Portable Document Format (.pdf). The codebook format for the NHDS was dependent on the year of publication; however, the codebook is published yearly as was the data and other supporting documentation. The file format varied depended upon the year of publication; however, the data was applicable within all the years. The NHDS variables contained in the numeric string of the dataset were listed within the codebook documentation and are listed as follows:

(1) Survey Year (last two digits of the survey year)

(2) Newborn status (coded as 1 = newborn, 2 = not newborn)

(3) Units for age (coded as 1 = years, 2 = months, 3 = days)

(4) Age in years, months, or days (coded as units = years,00-99, if units = months 01-11, if units = days, 00-28) ages 100 and over were recoded to 99

(5) Sex (coded as 1 = male, 2 = female)

(6) Race (coded as 1 = White, 2 = Black/African American, 3= American Indian/Alaskan Native, 4 = Asian, 5 = Native Hawaiian or other Pacific Isldr, 6 = Other, 8 = Multiple race indicated, 9 = Not stated)

(7) Marital status (coded as 1 = Married, 2 = Single, 3 = Widowed, 4 = Divorced, 5 = Separated, 9 = Not stated)

(8) Discharge month (coded as 01-12 = January to December)

(9) Discharge Status (coded as 1 = Routine/discharged home, 2 = Left against medical advice, 3 = Discharged/transferred to short-term facility, 4 = Discharged/transferred to long-term care institution, 5 = Alive, disposition not stated, 6 = Dead, 9 = Not stated or not reported

(10) Days of care (coded as actual number of days of care)

(11) Length of stay flag (coded as 0 = Less than 1 day, 1 = One day or more)

(12) Geographic region (coded as 1 = Northeast, 2 = Midwest, 3 = South, 4 = West)

(13) Number of beds, recode (coded as 1 = 6-99, 2 = 100-199, 3 = 200-299, 4 = 300-499, 5 = 500 and over)

(14) Hospital ownership (coded as 1 = Proprietary, 2 = Government, 3 = Nonprofit, including church)

(15) Analysis weight (used to obtain weighted estimates)

(16) First two digits of survey year

(17-23) Diagnosis codes (2007-2008 ICD-9-CM diagnosis codes)

(24-27) Procedure codes (2007-2008 ICD-9-CM procedure codes)

(28) Principal expected source of payment (coded as 01 = Worker's compensation, 02 = Medicare, 03 = Medicaid, 04 = other government, 05 = Blue Cross/Blue Shield, 06 = HMO/PPO, 07 = other private insurance, 08 =Self-pay, 09 = no charge, 10 = other, 99 = not stated)

(29) Secondary expected source of payment (coded as 01 = Worker's compensation, 02 = Medicare, 03 = Medicaid, 04 = other government, 05 = Blue Cross/Blue Shield, 06 = HMO/PPO, 07 = other private insurance, 08 =Self-pay, 09 = no charge, 10 = other, 99 = not stated)

(30) Diagnosis-Related Group (DRG) – grouper version 24.0

(31) Type of Admission (coded as 1 = Emergency, 2 = Urgent, 3 = Elective, 4 = Newborn, 9 = not available)

(32) Source of Admission (coded as 01 = Physician referral, 02 = Clinical referral, 03 = HMO referral, 04 = Transfer from a hospital, 05 = Transfer from a skilled nursing facility, 06 = Transfer from other health facility, 07 = Emergency room, 08 = Court/law enforcement, 09 = other, 10 = not available) (United States Department of Health and Human Services [USDHHS], 2011, 2010)

The type of hospital ownership was defined in NHDS as follows:

(1) Not for profit: hospitals operated by a church or another not for profit organization

(2) Government: hospitals operated by State and local government

(3) Proprietary: hospitals operated by individuals, partnerships, or corporations for profit (USDHHS, 2010, 2011).

The geographic regions for NHDS were as follows:

(1) Northeast: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania

(2) Midwest: Michigan, Ohio, Illinois, Indian, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas

(3) South: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas

(4) West: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Hawaii, Alaska (USDHHS, 2010, 2011)

The National Practitioner Data Bank Public Use File, 2017 was retrieved from the National Practitioner Data Bank in one data set for years September 1, 1990 – December 31, 2017. The files were downloaded into SPSS and stored for analyses and the codebook saved in Adobe Portable Document Format (.pdf). The codebook is updated each time the file is updated and contains all the data in the same format for the data periods. The NPDB PUDF variables contained in the numeric string of the dataset were listed within the codebook documentation and are listed as follows:

(1) Year of record (coded as the year of the record; a reasonable substitute for year of judgement or settlement)

(2) Practitioner’s work state (coded as the state where the practitioner worked)

(3) Practitioner’s work country (coded as the country where the practitioner worked)

(4) Practitioner’s home state (coded as the same as practitioner’s work state)

(5) Practitioner’s home country (coded as the practitioner’s home country)

(6) Practitioner’s state of license (code as the first state of the practitioner’s license; same as work state)

(7) Practitioner’s field of license (coded as the field of the practitioner’s practice)

(8) Practitioner's age group (coded as 10 = ages 19 and under, 20 = 20-29, 30 = 30-39, 40= 40-49, 50 = 50-59, 60 = 60-69, 70 = 70-79, 80= 80-89, 90 = 90-99)

(9) Practitioner's professional school graduation year group (coded as 1900 = 1900-1909, 1910 = 1910-1919, 1920 = 1920-1929, 1930= 1930-1939, 1940 = 1940-1949, 1950 = 1950-1959, 1960 = 1960-1969, 1970 = 1970-1979, 1980 = 1980-1989, 1990 = 1990-1999, 2000 = 2000-2009, 2010 = 2010-2019)

(10) Malpractice allegation group (coded as 1 = Diagnosis Related, 10 = Anesthesia Related, 20 = Surgery Related, 30 = Medication Related, 40 = IV & Blood Products Related, 50 = Obstetrics Related, 60 = Treatment Related, 70 = Monitoring Related, 80 = Equipment/Product Related, 90 = Other Miscellaneous, 100 = Behavioral Health Related.

(11) Severity of alleged malpractice injury (coded as 1 = Emotional Injury Only, 2 = Insignificant Injury, 3 = Minor Temporary Injury, 4 = Major Temporary Injury, 5 = Minor Permanent Injury, 6 = Significant Permanent Injury, 7 = Major Permanent Injury, 8 = Quadriplegic, Brian Damage, Lifelong Care, 9 = Death, 10 = Cannot Be Determined from Available

(12) Year of act or omission 1 (coded as the beginning year of acts or omissions)

(13) Year of act or omission 2 (coded as the end year of acts or omissions; may be blank if same as year of act or omission 1)

(14) Amount of reported payment (coded as the amount of the specific payment that led to the filing of the malpractice payment report)

(15) Total payment by this payer of this practitioner (coded as the payment made or the total payments)

(16) Single or multiple payment (coded as S = Single payment, M = Multiple payments, U = Unknown)

(17) Number of practitioners included in the payment (coded as the total number of practitioners involved in a case)

(18) Payment a result of judgment or settlement (coded as B = Before settlement, J = Judgment, O = Other, S = Settlement, U = Unknown or Before Settlement)

(19) Relationship of paying entity to the practitioner (coded as 1 = Insurance Company, 2 = Guaranty Fund, 3 = Self-insured Organization, 4 = State Medical Malpractice Fund, E = Insurance Company – excess insurer, G = Insurance Guaranty Fund, M = State Medical Malpractice Payment Fund – primary insurer, O – State Medical Malpractice Payment Fund – secondary payer, P = Insurance Company – primary insurer, S – Self-insured Organization)

(20) Patient age in groups of years (coded as -1 = Fetus, 0 = Under 1 year, 1 = age 1-9, 10 = 10-19, 20 = 20-29, 30 = 30-39, 40= 40-49, 50 = 50-59, 60 = 60-69, 70 = 70-79, 80= 80-89, 90 = 90-99)

(21) Patient gender (coded as F = Female, M = Male, U = Unknown)

(22) Patient type (coded as B = Both, I = Inpatient, O = Outpatient, U = Unknown)

(23) Year of adverse action (data is blank in malpractice payment records)

(24-28) Adverse action classification 1- 5 (data is blank in malpractice payment records)

(29-33) Basis for action 1 - 5 (data is blank in malpractice payment records)

Data Analysis Plan

The 2007 and 2008 NHDS SPSS dataset files were downloaded from the ICPSR website individually by year. These data were uploaded and combined into SPSS as one dataset and stored for analyses. The hospital survey year and malpractice year was used as a primary key to identify the two separate dataset years. These data was screened and cleaned appropriately for the study to ensure that all records have complete hospital geographic and ownership data, as well as patient days of care over one day and contained all patient gender, race and ages. Records with missing or incomplete data, unknown values and duplicate records were removed from the datasets. The 2006 and 2007 NPDB PUDF SPSS dataset file was downloaded from the NPDB website and uploaded to SPSS and stored for analysis. The malpractice year (MALYEAR1) and region (MAL_REGION) was used as primary identifiers. These data was screened and cleaned appropriately for the study to remove all incomplete, unknown values and duplicate records from the dataset.

Once cleaned for completeness the malpractice data was extracted by gender (gender = F) and inpatients (patient type = I). These data was then filtered by obstetrics related malpractice allegation group (allegation group = 50), and malpractice payment (record type = P). Severities were sorted and any unknowns or values of 10 were removed. The pregnancy population data was extracted by gender (gender = F) and patient age 15 – 49. These data was then filtered to only include the ICD-9-CM procedure and diagnosis codes as well as DRG codes that are found in Appendix A. Once appropriately cleaned and the data set extracted, the continuous variables were analyzed to ensure that there were no outliers. The number of delivery and postpartum hospitalizations and days of care were sorted and analyzed by age group, race, principal expected of payment and hospital demographics. The malpractice data was reviewed to ensure that every record had a payment and a severity. Any outliers were adjusted accordingly. Once cleaned the patient age variable was grouped into age categories of 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49 as noted by Martin et al (2013) in the 2012 final National Vital Statistics Reports. The malpractice states were aligned with their appropriate region and the variable MAL_REGION was created to identify the region of the malpractice allegation. The two datasets for malpractice and the pregnancy population were then be combined by MAL_REGION and REGION to create one dataset to examine the relationship between OBGYNs who engaged in defensive medicine avoidance behaviors defined by obstetrics related malpractice allegations and the severity of the malpractice injuries and its influence on maternal morbidities and severe maternal morbidities, after adjusting for hospital characteristics such as bed size, ownership, and location and patient days of stay.

Research Questions and Hypotheses

The research questions were designed to address the likelihood that OBGYNs avoided high-risk females age 15-49 through defensive medicine practices defined by obstetrics related malpractice allegations and the severity of the malpractice injuries who are Black/African American or have a primary insurance of Medicaid or Medicare. This avoidance behavior increases their risk for adverse patient outcomes found in Appendices B and C. The study also adjusted for hospital characteristics such as hospital region, bed size, and ownership, and patient days of care. Callaghan et al (2008) found that women with a length of stay of three days or more or a postpartum transfer had a greater likelihood of a severe maternal morbidity than women who stayed in the hospital for two days or less.

Descriptive Questions

RQ1.What is the average percentage of obstetrics malpractice allegations per region year?

RQ2. What is the average severity of obstetrics malpractice allegations per region year?

RQ3. What proportion of obstetrics malpractice allegations led to permanent injury (severity injury rank 5 – 8) per region year?

RQ4. What proportion of obstetrics malpractice allegations let to death (severity injury rank 9) per region year?

RQ5. What proportion of delivery and postpartum hospitalizations are high-risk defined by race and insurance status (principal expected source of payment) per region year?

RQ6. What proportion of delivery and postpartum hospitalizations has one or more maternal morbidity, measured using the ICD-9-CM discharge codes found in Appendix B and severe maternal morbidity diagnosis, measured using the ICD-9-CM discharge codes found in Appendix C per region year?

RQ7. What percentage of high-risk pregnancy maternal morbidities is severe, measured using the ICD-9-CM discharge codes found in Appendix C per region year?

RQ8. Which hospital characteristics, such as hospital region, bed size, ownership, or patient days of care are strongly associated with maternal morbidities, measured using the ICD-9-CM discharge codes found in Appendix B and severe maternal morbidities, measured using the ICD-9-CM discharge codes found in Appendix C in the high-risk pregnancy population per region year?

Relationship Questions

RQ9. Is there a relationship between OBGYN physician avoidance behaviors (obstetrics related malpractice allegations and the severity of the malpractice injuries) and maternal morbidities?

H9_0: There is no relationship between OBGYN physician avoidance behaviors (obstetrics related malpractice allegations and the severity of the malpractice injuries) and maternal morbidities.

H9_A: There is a relationship between OBGYN physician avoidance behaviors (obstetrics related malpractice allegations and the severity of the malpractice injuries) and maternal morbidities.

To evaluate the research questions and hypotheses, the following variables were analyzed per their level of measurement as shown in Table 1. Multiple Linear Regression and data analyses was performed in SPSS version 21.0 (IBM Corp, 2012). All statistical tests were evaluated using an overall significance value of $p < 0.05$, and 95% confidence intervals (CI).

Table 1

Variables, Level of Measurement, and Data Level

Variable	Level of measurement	Data level
Maternal morbidities (dependent)	Ordinal	Individual
Severe maternal morbidities (dependent)	Ordinal	Individual
Patient age (independent)	Interval	Individual
Race (independent)	Nominal	Individual
Principal expected source of payment (independent)	Nominal	Individual
Malpractice allegations (independent)	Nominal	Individual
Malpractice allegation severity (independent)	Ordinal	Individual
Hospital region (Control)	Nominal	Individual
Hospital ownership (Control)	Nominal	Individual
Hospital bed size (Control)	Ordinal	Individual
Days of care (Control)	Continuous	Individual

Statistical Analysis

Univariate analyses or Descriptive statistics. Measures of central tendency were calculated for all variables. Measures of central tendency describe the frequency distribution of data which include mean, mode, and median (Frankfort-Nachmias & Nachmias, 2008). Mean, mode, and median were reported for all continuous variables: days of care, deliveries, maternal morbidities and severe maternal morbidities. Inter-quartile range and standard deviation, measures of dispersion were also calculated for the continuous variables. Mode was reported for all categorical variables.

Bivariate analyses – Partial correlation to test for association. To evaluate the relationship among the independent and dependent variables while controlling the effect of the hospital characteristics, i.e. bed size, region, and ownership. A partial correlation test allows the evaluation of the variables by partialling out the effects of control variables. The partial correlation (r_p), an effect size index, indicates the degree that two variables are linearly related within the sample population (Green & Salkind, 2011). There are two assumptions that must be met for this test; the variables must be multivariately normally distributed and the sample population must be random with scores independent of each other (Field, 2009; Green & Salkind, 2011).

Multivariate Analyses – Logistic regression to estimate the odds probability. To estimate the odds of the dependent variables occurring as the independent variables changes while controlling for hospital characteristics and patient days of care. The odds ratio (Exp(B))**,** is an indicator of change in the odds of the depending variable occurring due to a unit change in the predictor or the independent variable. Logistic regression predicts categorical outcomes based on predictor variables (Field, 2009). There are three assumptions that must be met for logistic regression; there is linear relationships between the variables, the cases of data are not related, and that there is multicollinearity within the predictor variables (Field, 2009).

Table 2

Statistical Analysis Table

Research Questions	Variables	Methods
What is the average percentage of obstetrics malpractice allegations per region year?	IV: Obstetrics malpractice allegations	Univariate analysis of obstetrics malpractice allegations
What is the average severity of obstetrics malpractice allegations per region year?	IV: Malpractice allegation severity	Univariate analysis of obstetrics malpractice allegation severity
What proportion of obstetrics malpractice allegations led to permanent injury (severity injury rank 5-8) per region year?	IV: Obstetrics malpractice allegations DV: Malpractice allegation severity	Frequency distributions of the severity of the obstetrics malpractice allegations.
What proportion of obstetrics malpractice allegations led to death (severity injury rank 9) per region year?	IV: Obstetrics malpractice allegations DV: Malpractice allegation severity	Frequency distributions of the severity of the obstetrics malpractice allegations.
What proportion of delivery and postpartum hospitalizations are high-risk defined by race and insurance status per region year?	IV: Delivery and postpartum hospitalizations	Univariate analysis of delivery and postpartum hospitalizations
What proportion of delivery and postpartum hospitalizations has one or more maternal morbidity and severe maternal morbidity diagnosis per region year?	IV: Delivery and postpartum hospitalizations DV: Maternal morbidities DV: Severe maternal morbidities	Frequency distributions of the maternal morbidities and severe maternal morbidities.
What percentage of high-risk pregnancy maternal morbidities is severe per region year?	DV: Maternal morbidities and Severe maternal morbidities	Univariate analysis of maternal morbidities and severe maternal morbidities

Which hospital characteristics, such as hospital region, bed size, ownership, or patient days of care are strongly with associated maternal morbidities within the high-risk population per region year?	IV: Hospital characteristics (region, bed size, ownership, patient days of care) DV: Maternal morbidities	Logistic regression will be used to determine the relationship between maternal morbidities and the hospital characteristics within the high-risk population
Is there a relationship between OBGYN physician avoidance behaviors (obstetrics malpractice allegations and the severity of the malpractice injury) and maternal morbidities per region year?	IV: Delivery and postpartum hospitalizations DV: Maternal morbidities and Severe Maternal morbidities	Logistic regression will be used to determine the relationship between maternal morbidities and obstetrics malpractice allegations and the severity of the malpractice injury within the high-risk population

Threats to Validity

Validity addresses the study's ability to measure what it is intended to measure and its ability to influence the conclusion of the study. There are two types of threats to validity, internal and external. Internal validity threats the experimental procedures, treatments or experiences of the participants which can cause the researcher to draw incorrect inferences from the population in the experiment (Creswell, 2009). External threats to validity arise when researchers draw incorrect inferences from data to other persons, settings, and situations (Creswell, 2009). This study was cross-sectional, which strengths its external validity compared to an experimental study (Frankfort-Nachmias & Nachmias, 2008). Steps will be taken to ensure the validity of the study.

Each hospital sends the NHDS data file through data abstraction electronic submission. There were some facilities in 2007 (27%) and 2008 (16%) that manually abstracted data their own data, which were prone to errors. The other facilities used the electronic system to send the data to NHDS. The U.S. Bureau of the Census worked with NCHS to complete and validate the coding and data entry forms that were completed manually to ensure its validity (USDHHS 2011, 2010). Once these files were validated there were several manual changes made by the NHDS staff to ensure the validity of the ICD-9-CM diagnosis and procedure code data. Within each sample patient only a maximum of seven ICD-9-CM diagnosis codes and a maximum of four ICD-9-CM procedure codes were assigned (USDHHS, 2011, 2010).

The National Practitioner Data Bank (NPDB) maintains a comprehensive security system and is consistent with recognized standards and guidelines. Malpractice payments and adverse actions are required to be reported to the NPDB under Title IV of Public Law 99-660, the Health Care Quality Improvement Act of 1986 (Title IV); Section 1921 of the Social Security Act (Section 1921); Section 1258E of the Social Security Act (Section 1128E; and their implementing relations found at 45 CFR Part 60 (USDHHS, 2017). When data is reported in the NPDB system it is processed in the same way it was reported and the reporter must make any changes or corrections. Once the NPDB processes a report the subject of the report, which includes health care practitioners, entities, providers, and suppliers are notified. A copy of the report is made available for verification and instructions on obtaining an official copy of the report through the NPDB website (USDHHS, 2017). The subject of the report is instructed to review the report for accuracy, including demographic information.

In any survey, there are systematic or random errors that occur. Frankfort-Nachmias and Nachmias (2008) referred to systematic errors as errors that appear consistently when a measuring instrument is used; when the issue starts to affect the study validity techniques must be used to reduce the measurement errors. The NHDS Codebook noted that the 2007 and 2008 files (USDHHS, 2011, 2010) were subject to non-sampling or measurement errors due to hospital nonresponse, missing abstracts, incomplete or inaccurate records on abstract forms, and processing errors. In both years, less than one percent of the discharge records did not include the sex, age, or date of birth of the patient (USDHHS, 2011, 2010). If the hospital record did not include the age or sex of the patient, these data was imputed based on other variable information (USDHHS, 2011, 2010). In very cases the age or sex was edited because it was inconsistent with the patient diagnosis (USDHHS, 2011, 2010). The RACE data was missing for 31% of the discharges in 2008 (USDHHS, 2011) and 30% of discharges for 2007 (USDHHS, 2010); and no attempts were made to impute these missing values.

The NHDS survey methodology is sound and has been used for nearly 50 years. The survey takes a sample of inpatient discharge records from national probability non-Federal, short-stay hospitals in all 50 states, and excludes Federal, military, and Veterans Administration hospitals to not skew these data (USDHHS, 2010, 2011). Only hospitals with an average length of stay for all patients of less than 30 days or with a specialty of general, medical, surgical, or children's general are included, and the facilities must have at least six or more beds staffed for patient use (USDHHS 2010, 2011). These methods helped to ensure that this sample data was representative and generalizable within the 50 states.

Ethical Procedures

Walden University Institutional Review Board (IRB) approval was granted for this study, under IRB approval number 03-28-17-0142556. The 2007 and 2008 data sets were obtained from the ICPSR website, which are only available to university and students who are members of the consortium. The 2007 and 2008 data was cleaned, manipulated, and recoded for research use. All patient identifiable information was removed from the ICPSR dataset to ensure their anonymity. For data security, the NHDS data was maintained on a password-protected computer and only the researcher had access to the computer and data files. All data was stored as described above and will be destroyed upon completion of the project and associated analyses, for a minimum of five years after the dissertation is completed.

Summary

This study was a retrospective cross-sectional analysis of the relationship between OBGYNs who engaged in defensive medicine avoidance behaviors defined by obstetrics related malpractice allegations and the severity of the malpractice injuries and its influence on maternal morbidities and severe maternal morbidities in high-risk patients, after adjusting for hospital characteristics such as bed size, ownership, and location and patient days of stay. Individual-level data from the 2007and 2008 National Hospital Discharge Survey from the United States Department of Health of and Human Services as well as regional 2006 and 2007 malpractice data from the National Practitioner Data Bank Public Use Data File, 2017 obtained from the National Practitioner Data Bank was used to address the research questions and hypotheses. The impact of maternal morbidities and severe maternal morbidities on women in the United States has been shown in previous retrospective cross-sectional studies (Berg et al., 2009; Callaghan et al., 2008, 2012; Kuklina et al., 2008) however none of the researchers addressed high-risk populations, defined by race and insurance status or the influence of physicians.

In the next chapter, chapter 4, the assumptions of the statistical tests are evaluated and the statistical test results are discussed using the appropriate confidence intervals. The chapter also includes a summary of each of the research questions and hypothesis results.

Chapter 4: Results

Introduction

The purpose of this study was to examine the relationship between OB-GYNs who engaged in defensive medicine avoidance behaviors defined by obstetrics-related malpractice allegations and the severity of the malpractice injuries and the influence this relationship had on maternal morbidities and severe maternal morbidities, after adjusting for hospital characteristics such as bed size, ownership, and location and patient days of stay. I obtained secondary data from the NHDS, NPDB, as well as the NPPES. In Chapter 3, I outlined the methodology and analytical approaches for this study. In this chapter, I discuss my decision to expand the NHDS data to include 2006 and add the NPPES data. Chapter 4 also contains the study analysis methods and results. It is divided into seven sections: data collection, data analysis, National Plan and Provider population demographics, OBGYN population demographics and univariate analyses and malpractice population demographics and univariate analyses, study results, and a summary

Data Collection

The OB-GYN study population included female participants ages 15-49 who had an inpatient delivery or postpartum hospitalization as defined in Appendix A and whose ICD-9-CM procedure diagnosis codes or DRG codes are included in the National Discharge Survey data for years 2007 and 2008. The 2006 National Discharge Survey data also needed to be used to establish a baseline pregnancy population. The malpractice study population included all inpatient female participant with an obstetrics-related malpractice allegation, malpractice injury, and a malpractice payment included in the National Practitioner Data Bank Public Use Data File, 2017 (NPDB-PUDF) for years 2006 and 2007. I also used data from the USDHHS, CMS, and the NPPES to establish a baseline of all practicing OB-GYNs during the 2006-2008 study period using the physician's unique National Provider Indicator Standard number (NPI), as well as account for the proportion of physicians who had a malpractice reported in the NPDB data file for years 2006 and 2007.

Revision to Data Collection

While collecting the 2007 and 2008 data sets from the ICPSR website, the National Hospital Discharge Survey, 2006 (ICPSR 22745) was also selected for the study. The NHDS series was available for years 1987-2008 for free, and the questions remained unchanged for years 2006-2008. ICPSR provided the 2006 datasets in SAS, SPSS, Stata, ASCII, and Delimited formats, as well as the documentation of the measures within the file and codebook, which document how the codes were cleaned, manipulated, recorded, and or missing within each measure.

The most recent National Plan and Provider data was obtained from the CMS website. CMS (2018) provides free downloadable monthly refreshed data as well as weekly incremental updates. The file included all physicians who were given an NPI as well as any deactivated NPIs with their deactivation dates. The most recent February 2018 monthly data was used and available as a .CSV file as well as the codebook with documentation of the measures. CMS began disclosing the NPPES health care provider data under the Freedom of Information Act to the public in September 2007 (USDHHS, 2018). These data have been reviewed by CMS for accuracy, and physicians are urged to review the files routinely and report any discrepancies (USDHHS, 2018).

National Hospital Discharge Survey data collection. The NHDS is conducted annually by the National Center for Health Statistics since 1965 to collect medical and demographic information from a sample of inpatient discharge records selected from a national probability sample of nonfederal, short-stay hospitals (USDHHS, 2008, 2010, 2011). The NHDS data included discharges from noninstitutional hospitals excluding federal, military, and Veterans Administration hospitals, located in the 50 states and the District of Columbia (USDHHS, 2008, 2010, 2011). Only hospitals with an average length of stay for all patients of less than 30 days or with a specialty of general, medical, surgical, or children's general are included in the survey. Hospitals send the data manually through data abstraction electronic submission. In 2006, of the hospitals that manually abstracted data, 25% of the data obtained was performed by their own medical records departments; other hospitals opted to allow the U.S. Census Bureau to abstract the data for them on behalf of NHDS (USDHHS, 2008). Appendix D displays the Medical Abstract Form that the manual and automatic systems completed. The 2006 NHDS contained the same variables as 2007 and 2008 that are listed in Chapter 3.

Medical coding edits and data cleaning. Within each sample patient only a maximum of seven ICD-9-CM diagnosis codes and a maximum of four ICD-9-CM procedure codes were assigned (USDHHS, 2008, 2010, 2011). The diagnoses and procedures are normally presented in the way they were ordered in the patient abstract, and as such women with delivery procedure and diagnosis codes would normally appear last on a discharge abstract, therefore the diagnoses and procedures in dataset was edited prior to public. Women with a code of V27, which normally appears last on a discharge abstract, were entered as the first listed code within the patient sample dataset, with the appropriate accompanying delivery code listed second designating either normal or abnormal delivery (USHHS, 2008, 2010, 2011). These manual changes made by the NHDS staff were noted in the Codebook documentation. Once edits on the manual and automated system files were completed, these data were merged. Data that were received from the manual system were first entered into a computer file and combined with the automated data files. Medical edits were conducted by computer inspection, followed by a manual review of the rejected records. Once cleaned, the 2006 data contained 501 sample hospital records; however, 23 facilities were found to be out-of-scope or ineligible to meet the NHDS criteria. Of the 478 sample hospitals, 438 responded to the survey for a 92% response rate (USDHHS, 2008).

National Plan and Provider Data file collection. The National Plan and Provider Data (NPPD) contained selected variables from the most recent February 13, 2018 file (USDHHS, 2018). These data contained 5,476,146 cases on healthcare practitioners and organizations (USDHHS, 2018). Each NPI record was stored as comma separated values in a single row. New rows were created for each NPI record (USDHHS, 2018). The USDHHS began disclosing the National Plan and Provider data to the public in September 2007, however this identification system was established in July 1993 by CMS (Federal Register, 2004). In 1993, CMS developed the identification system to meet the needs of the Medicare and Medicaid programs and in turn it met the needs of all healthcare providers nationally (Federal Register, 2004). The identification system developed a unique National Provider Identifier (NPI) for all healthcare providers and organizations (Federal Register, 2004). A provider NPI is the acceptable standard in identifying all physicians and organizations that practice medicine and is used by Federal and State agencies, and private health plans (Federal Register, 2004). Congress further included provisions to address the need for the standardization and use of NPIs in the Administrative Simplification provisions of the Health Insurance Portability and Accountability Act of 1996 (HIPPA) which was enacted on August 21, 1996 (Federal Register, 2004). CMS reviewed this data for accuracy and physicians are urged to review the files routinely and report any discrepancies (USDHHS, 2018). The National Plan and Provider Data variables contained in the dataset as listed within the codebook documentation and are listed as follows:

(1) NPI (coded as the practitioner's unique physician number)

(2) Entity type code (coded as I = Individual, O = Organization)

(3) Replacement NPI (coded as the practitioner's replacement unique physician number)

(4) Employer identification number (coded as the employer's unique number)

(5) Provider organization name (coded as the provider’s legal business name)

(6) Provider last name (coded as the provider’s legal last name)

(7) Provider first name (coded as the provider’s first name)

(8) Provider middle name (coded as the provider’s middle name)

(9) Provider name prefix text (coded as the provider’s prefix name)

(10) Provider name suffix text (coded as the provider’s suffix name)

(11) Provider credential text (coded as the provider’s credentials)

(12) Provider other organization name (coded as the provider’s other organization name)

(13) Provider other last name (coded as the provider’s other last name)

(14) Provider other first name (coded as the provider’s other first name)

(15) Provider other middle name (coded as the provider’s other middle name)

(16) Provider other name prefix text (coded as the provider’s other name prefix)

(17) Provider other name suffix text (coded as the provider’s other name suffix)

(18) Provider other credential text (coded as the provider’s other credentials)

(19) Provider other last name type code (coded as the provider’s other last name type code)

(20) Provider first line business mailing address (coded as the provider’s first line business mailing address)

(21) Provider second line business mailing address (coded as the provider's second line business mailing address)

(22) Provider business mailing address city name (coded as the provider's business mailing address city)

(23) Provider business mailing address state name (coded as the provider's business mailing address state)

(24) Provider business mailing address postal code (coded as the provider's business mailing address postal code)

(25) Provider business mailing address country code (coded as the provider's business mailing address country code if outside U.S.)

(26) Provider business mailing address telephone number (coded as the provider's business mailing address telephone number)

(27) Provider business address fax number (coded as the provider's business address fax number)

(28) Provider first line business practice location address (coded as the provider's first line business practice location address)

(29) Provider second line business practice location address (coded as the provider's second line business practice location address)

(30) Provider business practice location address city name (coded as the provider's business practice location city)

(31) Provider business practice location address state name (coded as the provider’s business practice state)

(32) Provider business practice location address postal code (coded as the provider’s business practice postal code)

(33) Provider business practice location address country code (coded as the provider’s business practice country code if outside the U.S.)

(34) Provider business practice location address telephone number (coded as the provider’s business practice telephone number)

(35) Provider business practice location address fax number (coded as the provider’s business practice fax number)

(36) Provider enumeration date (coded as the assignment date of the provider’s NPI)

(37) Last update date (coded as the date of the last updated file)

(38) NPI deactivation reason code (coded for the reason the NPI code is no longer active)

(39) NPI deactivation date (coded as the date of the NPI code deactivation)

(40) NPI reactivation date (coded as the date the NPI code reactivation)

(41) Provider gender code (coded as F = female, M = male)

(42) Authorized official last name (coded as the authorized official last name)

(43) Authorized official first name (coded as the authorized official first name)

(44) Authorized official middle name (coded as the authorized official middle name)

(45) Authorized official title or position (coded as the authorized official title or position)

(46) Authorized official telephone number (coded as the authorized official telephone number)

(47) Healthcare provider taxonomy code_1 -11 (coded as the healthcare provider's taxonomy code)

(48) Provider license number_1 – 15 (coded a the provider's license number)

(49) Provider license number state code_1 – 15 (coded as the provider's license number state code)

(50) Healthcare provider taxonomy switch_1 – 15 (coded as the healthcare provider's taxonomy switch code)

(51) Other provider identifier_1 – 50 (coded as the other provider's identifier code)

(52) Other provider identifier type code_1 – 50 (coded as the other provider's identifier type code)

(53) Other provider identifier state_1 – 50 (coded as the other provider's identifier state)

(54) Other provider identifier issuer_1 – 50 (coded as the other provider's identifier code issuer)

(55) Is sole proprietor (coded as the sole proprietor flag)

(56) Is organization subpart (coded as the provider organization subpart flag)

(57) Parent organization LBN (coded as the provider organization LBN)

(58) Parent organization TIN (coded as the provider organization TIN)

(59) Authorized official name prefix text (coded as the authorized official name prefix)

(60) Authorized official name suffix text (coded as the authorized official name suffix)

(61) Authorized official credential text (coded as the authorized official credential)

(62) Healthcare provider taxonomy group_1 – 15 (coded as the healthcare provider’s taxonomy group)

Data Analysis

SAS Enterprise Guide (EG) version 7.12 was used for the analyses of all data files in addition to IBM SPSS. The 2006, 2007, and 2008 NHDS files were downloaded into SAS EG from the ICPSR website individually by year. These data were then appended into one SAS EG dataset for analysis of the OBGYN population. The hospital survey year was used as a primary key to identify the separate dataset years. The 2006 and 2007 NPDB PUDF files were downloaded from the NPDB website and uploaded to SAS EG for analysis. The malpractice year (MALYEAR1) and region (MAL_REGION) were used as primary identifiers. The most recent (February 13, 2018) healthcare provider data was downloaded from the CMS website and uploaded to SAS EG for analysis. The National Provider Indicator Standard number (NPI) was used as the primary identifier.

The National Plan and Provider dataset was filtered to only include individuals with an NPI number (Entity Type Code = 1), OBGYN providers (Healthcare Provider Taxonomy Code = 207V00000X), with a United States mailing address (Provider Business Mailing A_03 = US). These data were further filtered to exclude providers with a NPI deactivation date (NPI Deactivation Date - is missing) and providers that were assigned an NPI number after 2008 (Provider Enumeration Date <= 12/31/2008). A provider region variable (PROV_REGION) was created to identify provider's regions. The region was created utilizing the same methodology as the pregnancy population datasets (USDHHS, 2011, 2010, and 2008).

In the OBGYN population dataset years 2006, 2007, and 2008 were appended. In the combined dataset newborns were excluded (newborns < > 2) and females (gender = F) and patients age 15 – 49 were extracted and then filtered to only include patients that had either an ICD-9-CM diagnosis, procedure, or DRG code found in Appendix A. A patient age group variable (AGE_GROUP) was then created to group ages into categories of 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49 as noted by Martin et al (2013) in the 2012 final National Vital Statistics Reports. Days of stay less than 1 day as well as unknown or not stated races and principal expected source of payment were removed. Two additional binary variables were added to the dataset to indicate patients that had an ICD-9-CM diagnosis code of a maternal morbidity or severe maternal morbidity as found in Appendix B and C. The variable MALYEAR1 was created to identify the 2007 OBGYN discharges as 2006 malpractice allegations and 2008 discharges as 2007 malpractice allegations to examine the relationship between the 2006 allegations with 2007 discharges and 2007 allegations with 2008 discharges.

The malpractice data was sorted and filtered by patient gender (gender = F) and inpatient (patient type = I) as well as by obstetrics related malpractice allegation group (allegation group = 50), and malpractice payment (record type = P) for malpractice years 2006 and 2007. Malpractice severities were sorted and unknowns or values of 10 were removed. A malpractice region variable (MAL_REGION) was created to identify the region of the malpractice allegation. The region was created utilizing the same methodology as the pregnancy population datasets (USDHHS, 2011, 2010, and 2008). The national provider and malpractice datasets were then combined by state abbreviation by provider business mailing address (Provider Business Mailing A_001) and provider license state (LICNSTAT) to determine the proportion of physicians that had a malpractice case for years 2006 and 2007. Providers that were issued a NPI in years 2007 and 2008 were removed from the analysis for 2006 malpractice cases. All providers who were issued a NPI prior to 2009 remained for the analysis of 2007 malpractice cases. These data was used with the combination of the summary malpractice and the OBGYN population by MAL_REGION and REGION to create one dataset to examine the relationship between OBGYNs who engage in defensive medicine avoidance behaviors defined by obstetrics related malpractice allegations and the severity of the malpractice injuries and its influence on maternal morbidities and severe maternal morbidities, after adjusting for hospital characteristics such as bed size, ownership, and location and patient days of stay. All SAS EG data was then exported into SPSS for additional analysis.

National Plan and Provider Demographics

Summary statistics of the national provider data were examined independently using descriptive statistics. The dataset contained 5,476,146 physicians and organizations with a unique NPI. Once the data was filtered to only include active OBGYN providers in the United States assigned NPI number by 2008, 5,445,047 records were excluded. This reduced the sample population used for the data analyses (*n*= 31,099). A provider region variable (PROV_REGION) was created to identify provider's regions in the remaining dataset. The region was created utilizing the same methodology as the pregnancy population datasets (USDHHS, 2011, 2010, and 2008). The tables below summarize the demographic statistical analyses for the provider population by region and region year. Table 3 shows that there were 31,099 US OBGYN providers identified in the National Provider database with an assigned NPI prior to 2009, of which the majority providers were licensed in the South region, making up 34% of the OBGYN providers. Northeast had the smallest number of OBGYN providers, 21%.

Table 3

Provider Frequency and Percentage Summaries

Region	N	Percent

Midwest	6,813	21.91
Northeast	6,478	20.83
South	10,699	34.40
West	7,109	22.86
Total	31,099	

OBGYN Population Demographics

Demographics of the OBGYN study population and independent variables, age, race and principal expected source of payment were examined independently using descriptive statistics as well as the control variables, bed size, ownership and geographic area. The category of variable determined the type of analysis that was performed. Measures of central tendency, mean, median, and mode were used as were distribution/ frequency when appropriate for categorical variables and standard deviation was examined for continuous variables. The OBGYN population was composed of females (*n*=62,009) age 15-49 with a delivery or postpartum hospitalizations using the enhanced delivery identification method (Kuklina et al., 2008), as well as primary or secondary ICD-9-CM diagnosis code V24 for postpartum hospitalizations and diagnosis-related (DRG) delivery codes 376, 377, 769 or 776 (Callaghan et al., 2012) found in Appendix A. There was a total of 21,223 participants that were excluded from the study due to unknown race (race = 9) and principal expected source of payment (ESOP = 99) as well as any length of stay less than one day (LOS flag = 0). Additionally, the age of the participants were grouped into categories ae as noted by Martin et al (2013) in the 2012 final National Vital Statistics Reports as follows: 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49. Two additional binary variables were added to indicate patients that had an ICD-9-CM diagnosis code of a maternal morbidity or severe maternal morbidity. The variable MALYEAR1 was created to identify the 2007 OBGYN discharges as 2006 malpractice allegations and 2008 discharges as 2007 malpractice allegations. This reduced the sample population used for the data analyses (*n*= 40,786). Table 4 below summarize the demographic statistical analyses for the OBGYN study population by region and year.

Table 4

Region Frequency by Year

Region	2006	2007	2008	Total
Midwest	2,819	2,722	795	6,336
Northeast	4,473	3,776	593	8,842
South	7,677	7,235	2,736	17,648
West	3,556	4,062	342	7,960
Total	18,525	17,795	4,466	40,786

Patient Age and Number of Days of Care

Analyses for number of days of care and age were expressed in terms of mean, median and mode with confidence intervals (CI). The population, which consisted of 40,786 females age 15-49 had a mean age of 27 (*n=40,786, M=27.5 SD=6.1),* which was consistent in years 2006 (*n=18,525, M=27.5 SD=6.1),* 2007 (*n=17,795, M=27.5 SD=6.1),* and 2008 (*n=4,466, M=27.1 SD=6.3)*. The population was also evenly distributed across all years for an adequate yearly sample, with exception to the limited patient data for 2008. Most of the OBGYN population were in the 25-29 age group (27.8%) followed by individuals age 20-24 (24.6%) and 30-34 (22.9%). There was a mean number of 2 days of care *(n=40,786, M=2.3 SD=2.3)* for all patients with at least one day of care. Which is also shown by year, 2006 *(n=18,525, M=2.3 SD=1.3,* 2007 *(n=17,795, M=2.3 SD=3.1),* 2008 *(n=4,466, M=2.3 SD=1.8)*.

Race and Principal Expected Source of Payment

The other independent variables in this study from the 2006- 2008 National Hospital Discharge Survey (USDHHS, 2011, 2010, and 2008), were race and principal expected source of payment. The two largest races in the OBGYN populations were White (70.5%) and Black/African American (17.3%); Other (8.3%) was the third highest race. There were only 80 individuals that identified as Native Hawaiian/Other Pacific Islander (0.2%). Tables 5 and 6 show the race frequency and percentage for the OBGYN population. Whites and Black/African Americans made up 70% and 17% of the population respectively for years 2006 and 2007. In 2008 due to the limitations of the dataset, Whites represented 59.6% and Black African Americans 21.6% of the populations.

Table 5

Race Frequency and Percentage Summaries

Race	N	Percent
American Indian/ Alaskan Native	281	0.69
Asian	1,186	2.91
Black/ African American	7,048	17.28
Multiple Race Indicated	63	0.15
Native Hawaiian/ Other Pacific Islander	80	0.20
Other	3,392	8.32
White	28,736	70.46

Table 6

Race Frequency by Year

Race	2006	2007	2008
American Indian/ Alaskan Native	107	131	43
Asian	412	599	175
Black/ African American	3,118	2,964	966
Multiple Race Indicated	15	22	26
Native Hawaiian/ Other Pacific Islander	49	20	11
Other	1,677	1,133	582
White	13,147	12,926	2,663

The majority of OBGYN population had a principal expected source of payment of Medicaid (38.3%) followed by HMO/PPO (29.6%) and Blue Cross/ Blue Shield (14.16%). There were only 244 individuals who had Medicare (0.6%) as their primary insurance. Tables 7 and 8 show the complete breakdown of the principal expected source of payment for the OBGYN population and by year.

Table 7

Principal Expected Source of Payment Frequency and Percentage Summaries

Principal Expected Source of Payment	N	Percent
Blue Cross/ Blue Shield	5,776	14.16
HMO/PPO	12,059	29.57
Medicaid	15,615	38.29
Medicare	244	0.60
No Charge	38	0.09
Other	1,485	3.64
Other Government	427	1.05
Other Private Insurance	3,886	9.53
Self-Pay	1,249	3.06
Worker's Compensation	7	0.02

Table 8

Principal Expected Source of Payment Frequency by Year

Principal Expected Source of Payment	2006	2007	2008
Blue Cross/ Blue Shield	2,639	2,498	639
HMO/PPO	5,525	5,397	1,137
Medicaid	6,835	6,789	1,991
Medicare	79	135	30
No Charge	20	16	2
Other	891	559	35
Other Government	194	174	59
Other Private Insurance	1,782	1,668	436
Self-Pay	559	553	137
Worker's Compensation	1	6	0

The study compared the effects of malpractice allegations on high-risk patients defined as patients who were Black/African Americans or had a principal expected source of payment of Medicare or Medicaid. Fifty-four percent of the OBGYN patients were high-risk compared to 46.2% of non-high-risk patients as shown below it table 9. The number of high-risk patients were consistent in years 2006 (*n*=8,269) and 2007 (*n*=8,186), however decreased to *n*=2375 in 2008 due to the dataset limitations.

Table 9

OBGYN Patients

OBGYN Patients	N	Percent
High-risk Patients	18,830	46.17
Non-high-risk Patients	21,956	53.83

Hospital Deliveries and Postpartum Hospitalizations

Using the enhanced delivery identification method as defined by Kuklina et al. (2008), as well as primary or secondary ICD-9-CM diagnosis code V24 for postpartum hospitalizations and diagnosis-related (DRG) delivery codes 376, 377, 769 or 776 (Callaghan et al., 2012) ninety percent (*n*=18,068) of the study had a primary diagnosis of a delivery and 808 patients (0.4%) had a primary diagnosis of a postpartum care event representing the majority of the population. Table 10 shows a representation of the majority of the primary diagnosis frequency and percentage for the OBGYN population. Most of the population had DRG 373 (73.5%) – uncomplicated vaginal delivery. Table 11 shows the DRG frequency and percentage of the population.

Table 10

Primary ICD-9 Diagnosis Frequency and Percentage Summaries

ICD-9 Diagnosis Description	N	Percent
DELIVER-SINGLE LIVEBORN	16634	87.18
OUTCOME OF DELIVERY NOS	1207	6.33
MAJOR PUERP INF-POSTPART	130	0.68
DELIVER-TWINS, BOTH LIVE	123	0.64
DELIVER-SINGLE STILLBORN	104	0.55
OB SURG COMP NEC-POSTPAR	98	0.51
PUERP COMPL NEC-POSTPART	93	0.49
DELAY P/PART HEM-POSTPAR	60	0.31
GU INFECTION-POSTPARTUM	56	0.29
OTH CURR COND-POSTPARTUM	47	0.25
MENTAL DISORDER-POSTPART	46	0.24
MILD/NOS PREECLAMP-P/P	41	0.21
POSTPART CARE AFTER DEL	28	0.15
CV DIS NEC-POSTPARTUM	24	0.13
PERIPARTUM CARD-POSTPART	23	0.12
SEV PREECLAMP-POSTPARTUM	22	0.12
DEEP VEIN THROMB-POSTPAR	19	0.10
DEL W 2 DEG LAC-POSTPART	19	0.10
DISRUPT C-SECT-POSTPART	18	0.09
MASTITIS-POSTPARTUM	18	0.09
TRANS HYPERTEN-POSTPART	17	0.09
PREG COMPL NEC-POSTPART	16	0.08

Table 11

Diagnosis-related Group (DRG) Frequency and Percentage Summaries

Diagnosis-related Group (DRG)	N	Percent
Uncomplicated vaginal delivery (373)	29,848	73.45
Vaginal delivery w/o complicating diagnoses (775)	3,600	8.86
Complicated vaginal delivery (372)	3,503	8.62
Uncomplicated vaginal delivery w/sterilization (374)	1,242	3.06
Postpartum w/ complications (376)	678	1.67
Vaginal delivery w/ complicating diagnoses (774)	322	0.79
Post abortion w/o OR procedure (769, 776)	202	0.50
Postpartum w/o complications (377)	187	0.46

Hospital Bed Size, Ownership and Geographic Region

The control variables for this study were bed size, ownership and geographic region. Most of the OBGYN population had a stay in hospitals with 300-499 beds (31.86%), followed by hospitals with bed sizes 100-199 (26.4%) and 200-299 (22.42%) as shown in Tables 12 and 13. This was consistent with years 2006, 300-499 beds (33.6%), 100-199 (28.6%) and 200-299 (19.9%) and 2007 with 300-499 beds (32.9%), 100-199 (25.4%) and 200-299 (22.3%), however in 2008, most of the OBGYN population had a stay in hospitals with 200-299 beds (33.6%), followed by hospitals with 100-199 (21.1%) size beds, 300-499 beds (20.7%), and 500 or more beds (17.1%).

Table 12

Hospital Bed Size Frequency and Percentage Summaries

Bed Size	N	Percent
66-99	2,520	6.18
100-199	10,752	26.36
200-299	9,144	22.42
300-499	12,996	31.86
500 and over	5,374	13.18

Table 13

Hospital Bed Size Frequency by Year

Bed Size	2006	2007	2008
66-99	969	1,216	335
100-199	5,289	4,523	940
200-299	3,680	3,963	1,501
300-499	6,226	5,845	925
500 and over	2,361	2,248	765

Table 14 shows that 75.6% of the hospitals were non-profit, 13.2% proprietary, with the least ownership being government (11.2%). This is further shown in Table 15 by year where non-profit hospitals represent at least 70-75% of the ownership and an even distribution between proprietary and government ownership. When looking at geographic region, most hospitals were in the South (43.3%), which aligned with the provider data in National Provider dataset as well as the OBGYN delivery and postpartum hospitalizations. There was even distribution between Northeast (21.7%) and the West (19.5%). The Midwest (15.5%) had the lowest with 6,336 facilities.

Table 14

Hospital Ownership Frequency and Percentage Summaries

Ownership	N	Percent
Government	4,558	11.18
Non-profit, including church	30,829	75.59
Proprietary	5,399	13.24

Table 15

Hospital Ownership Frequency by Year

Ownership	2006	2007	2008
Government	1,948	1,886	724
Non-profit, including church	14,131	13,555	3,143
Proprietary	2,446	2,354	599

Maternal Morbidities

The dependent variables for this study were maternal morbidities and several maternal morbidities as found in Appendix B and C. Maternal morbidities are ICD-9-CM procedures or diagnoses codes that indicate physical or psychological conditions that result from or are aggravated by pregnancy and have an adverse effect on women's health (CDC, 2014). These complications can increase length of stay. Severe maternal morbidities, such as septicemia (038) are the morbidities that are the most severe and are potentially life-threatening. These ICD-9-CM codes are coded during a patient's hospital stay and reported and charted on their medical record at discharge. For this study, this variable was analyzed as a binary variable, maternal, or severe morbidity. Of the 40,786 OBGYN patients for 2006, 2007, and 2008, 5,661 (13.9%) had either a diagnosis of a maternal morbidity (n=5,454) or severe maternal morbidity (n=313). Several patients had a diagnosis or procedure that was both a maternal morbidity and a severe maternal morbidity. Both the maternal and severe maternal morbidities decreased significantly from 2006 (n=2,465 maternal morbidity and n=143 severe maternal morbidity) to 2008 (n=639 maternal morbidity and n=48 severe maternal morbidity). The number of maternal morbidities decreased 4.9% from 2006 to 2007 and severe maternal morbidities were down by 17.2%. The number of maternal morbidities and severe maternal morbidities decreased from 2006-2007 within the Black/African American population as well by 3.5%. The decreases from 2007 to 2008 can be attributed to the data limitations of the 2008 NHDS dataset.

Black/ African Americans were the second largest race with 17.3% in the OBGYN population and had the second largest number and percentage of the maternal morbidities (*n*=1,026, 18.8%) and severe maternal morbidities (*n*=99, 31.7%) as seen in Tables 16 and 17. Whites made up 70% of the OBGYN population and as such the maternal morbidities (*n*=3,717 and 68.2%). Thirty-six percent of the maternal morbidities and 40.3% of severe maternal morbidities had a principal expected source of payment of Medicaid, followed by HMO/PPO (30.9% maternal morbidities; 29.07% severe maternal morbidities, Blue Cross/Blue Shield (15% maternal morbidities; 12.8% severe maternal morbidities), as seen in Tables 18 and 19.

Table 16

Maternal Morbidity Summaries by Race

Race	N	Percent
American Indian/ Alaskan Native	42	0.77
Asian	178	3.26
Black/ African American	1,026	18.81
Multiple Race Indicated	9	0.17
Native Hawaiian/ Other Pacific Islander	15	0.28
Other	467	8.56
White	3,717	68.15

Table 17

Severe Maternal Morbidity Summaries by Race

Race	N	Percent
American Indian/ Alaskan Native	4	1.28
Asian	7	2.24
Black/ African American	99	31.63
Multiple Race Indicated	0	0.0
Native Hawaiian/ Other Pacific Islander	3	0.96
Other	20	6.39
White	180	57.51

Table 18

Maternal Morbidities by Principal Expected Source of Payment

Principal Expected Source of Payment	2006	2007	2008	Total	
	N	*N*	*N*	*N*	*Percent*
Blue Cross/ Blue Shield	371	342	103	816	14.96
HMO/PPO	759	754	174	1,687	30.93
Medicaid	863	855	247	1,965	36.03
Medicare	9	24	3	36	0.66
No Charge	4	1	0	5	0.09
Other	120	66	8	194	3.56
Other Government	23	28	13	64	1.17
Other Private Insurance	260	224	68	552	10.12
Self-Pay	54	55	23	132	2.42
Worker's Compensation	1	2	0	3	0.06

Table 19

Severe Maternal Morbidities by Principal Expected Source of Payment

Principal Expected Source of Payment	2006	2007	2008	Total	
	N	*N*	*N*	*N*	*Percent*
Blue Cross/ Blue Shield	17	16	7	40	12.78

HMO/PPO	43	35	13	91	29.07
Medicaid	62	52	12	126	40.26
Medicare	1	2	4	7	2.24
No Charge	1	1	0	2	0.64
Other	5	1	1	7	2.24
Other Government	2	1	0	3	0.96
Other Private Insurance	9	7	7	23	7.35
Self-Pay	3	7	4	14	4.47
Worker's Compensation	0	0	0	0	0.00

Malpractice Population Demographics

Demographics of the malpractice study population and independent variables, malpractice allegation group (ALGNNATR) and the severity of the alleged malpractice injury (OUTCOME) were examined independently using descriptive statistics as well as the malpractice region (MAL_REGION). The category of variable determined the type of analysis that was performed. Measures of central tendency, mean, median, and mode were used as were distribution/ frequency when appropriate for categorical variables. The malpractice population consisted of 574 inpatient obstetrics allegations for years 2006 and 2007 in which payments were made. All allegation severities were sorted and unknowns or values of 10 were removed. A malpractice region variable (MAL_REGION) was created from the provider licensed state (LICNSTAT) to identify the region of the malpractice allegation. The region was created utilizing the same methodology as the pregnancy population datasets (USDHHS, 2011, 2010, and 2008).

The total count of obstetrics related malpractice allegations for years 2006 and 2007 were evenly split with 287 allegations in each year. The majority of the obstetrics allegations were found in the Northeast (42.5%) and the South (31.4%). The severity of those allegations, which are interval variables were coded as follows: (1) Emotional

Injury Only, (2) Insignificant Injury, (3) Minor Temporary Injury, (4) Major Temporary Injury, (5) Minor Permanent Injury, (6) Significant Permanent Injury, (7) Major Permanent Injury, (8) Quadriplegic, Brian Damage, Lifelong Care and (9) Death. The total allegations resulted in a mean allegation severity *(n=574, M=6.8 SD=2.1)* of significant permanent and major permanent injury for all obstetrics malpractice allegations with payments. Each region had at least one obstetrics related malpractice allegation ranging from 1 – emotional injury only to 9 – death. Each region averaged a severity of 7, major permanent injury, Northeast *(n=244, M=6.6 SD=2.2),* South *(n=180, M=7.1 SD=2.1),* Midwest *(n=87, M=7.0 SD=1.8),* and West *(n=63, M=6.7 SD=2.2).* The South had the highest severity, followed by the Midwest, West, and Northeast, even though the Northeast had the largest number of obstetrics related malpractice allegations.

National Providers

The national provider and malpractice datasets were further analyzed by region, by joining the provider business mailing address (Provider Business Mailing A_001) in the national provider dataset and provider license state (LICNSTAT) in the malpractice dataset to determine the proportion of physicians that had a malpractice case for years 2006 and 2007. All providers that were issued an NPI in years 2007 and 2008 were removed from national provider dataset for the analysis for 2006 malpractice cases, resulting in a sample population of 23,977 practicing providers. All providers who were issued a NPI prior to 2009 remained in the national provider dataset for the analysis of 2007 malpractice cases, *n*=31,099.

The majority of the providers that were issued an NPI prior to 2007 were in the South (34.6%), while the remaining regions were fairly evenly distributed, Midwest (22.5%), West (21.7%), and Northeast (21.2%). The majority of all providers that were issued a NPI prior to 2009 were also in the South (34.4%), followed by the West (22.9%), the Midwest (21.9%) and Northeast (20.8%). Since there was an even split of obstetrics related malpractice allegations that received a payment in 2006 and 2007, of the 23,977 total obstetric physicians that were issued an NPI, less than 2% had an allegation for each malpractice year.

Most of the obstetrics allegations were found in the Northeast (42.5%) and the South (31.4%). In 2006 there was an even distribution of obstetrics related malpractice allegations in the Northeast (38.3%) and South (35.9%), however the percentage of obstetrics malpractice allegations in 2007 increased to 46.7% in the Northeast and decreased in the South (26.83%). The percentage of allegations remained constant in 2006 and 2007 in the Midwest (14.9% and 15.3%) and the West (10.8% and 11.2%). These data was used with the combination of the summary malpractice and the OBGYN population by MAL_REGION and REGION to create one dataset to examine the relationship between OBGYNs who engaged in defensive medicine avoidance behaviors defined by obstetrics related malpractice allegations and the severity of the malpractice injuries and its influence on maternal morbidities and severe maternal morbidities, after adjusting for hospital characteristics such as bed size, ownership, and location and patient days of stay.

Research Questions

Descriptive Questions

RQ1. What is the average percentage of obstetrics malpractice allegations per region year? In 2006 and 2007 the average percentage of obstetrics malpractice allegations were 50%. There were 287 malpractice allegations in both 2006 and 2007. The majority of the obstetrics allegations were found in the Northeast (*n*=244, 42.5%) and the South (*n*=180, 31.4%) as shown in Table 20. In 2006 there was an even distribution of obstetrics related malpractice allegations in the Northeast (38.3%) and South (35.9%), however the percentage of obstetrics malpractice allegations in 2007 increased to 46.7% in the Northeast and decreased in the South (26.83%). The percentage of allegations remained constant in 2006 and 2007 in the Midwest (14.9% and 15.3%) and the West (10.8% and 11.2%).

Table 20

Malpractice Allegations by Region and Year

Region	2006	2007	Total
Midwest	43	44	87
Northeast	110	134	244
South	103	77	180
West	31	32	63
Total	287	287	574

RQ2. What is the average severity of obstetrics malpractice allegations per region year? In years 2006 and 2007 the average severity of obstetrics malpractice allegations was 7 (*n=574, M=6.8 SD=2.1)*, major permanent injury as seen in Table 21.

Each region had at least one death, allegatio*n*=9 for both 2006 and 2007. In 2006 the South *(n=103, M=7.1 SD=2.2),* West *(n=31, M=7 SD=2.4)* and the Midwest (*n=43, M=6.9 SD=2)* regions had the highest mean malpractice allegation severity, however the Northeast *(n=110, M=6.7 SD=2.0),* had the most obstetrics malpractice allegations of all regions. In 2007, the Midwest *(n=44, M=7.1 SD=1.5)* and South *(n=77, M=7.1 SD=2.1)* had the highest mean malpractice allegation severity, followed by the Northeastern *(n=134, M=6.7 SD=2.3),* region which also had the highest number of allegations compared to all regions again in 2007. The West *(n=32, M=6.4 SD=2.0),* had the lowest mean obstetrics malpractice allegation severity as well as the lowest number of allegations in 2007.

Table 21

Descriptive Statistics for Malpractice Allegations by Region and Year (N = 574)

Region	2006			2007		
	n	*M*	*SD*	*n*	*M*	*SD*
Midwest	43	6.93	1.96	44	7.14	1.53
Northeast	110	6.60	2.01	134	6.71	2.26
South	103	7.07	2.20	77	7.06	2.06
West	31	6.97	2.44	32	6.44	2.00

RQ3. What proportion of obstetrics malpractice allegations led to permanent injury (severity injury rank 5 – 8) per region year? There were 323 (56.3%) obstetrics related malpractice allegations that led to permanent injury in 2006 and 2007 has shown in Table 22. In 2006 the Northeast (62.7%) had the highest percentage of injuries, while the Midwest (75%) had the highest in 2007. There were

slightly more injuries in 2007 (*n*=167), compared to 2006 (*n*=156) as seen in Tables 22 and 23. Most of the injuries occurred in the Northeast *(n=142, M=6.8, SD=1.1).* The lowest number of injuries and the highest mean severity occurred in the West *(n=36, M=6.9, SD=1.1).*

Table 22

Permanent Injury Malpractice Allegation Summary by Region and Year (N = 323)

Region	2006 (*n*=156)		2007 (*n*=167)	
	N	*Percent*	*N*	*Percent*
Midwest	25	58.14	33	75.00
Northeast	69	62.73	73	54.48
South	47	45.63	40	51.95
West	15	48.39	21	65.63

Table 23

Descriptive Statistics for Permanent Injury Malpractice Allegations by Region and Year (N = 323)

Region	2006			2007			Total		
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
Midwest	25	6.80	1.00	33	6.88	1.02	58	6.84	1.01
Northeast	69	6.62	1.06	73	6.89	1.09	142	6.76	1.08
South	47	6.70	1.10	40	6.65	1.03	87	6.68	1.06
West	15	7.40	0.83	21	6.52	1.08	36	6.77	1.06

RQ4. What proportion of obstetrics malpractice allegations led to death (severity injury rank 9) per region year? There were 166 (28.9%) obstetrics related malpractice allegations that led to death in 2006 and 2007. There were more deaths in

2006 (*n*=87), compared to 2007 (*n*=79) as seen in Table 24. Many of the deaths occurred in the South (*n*=69) and Northeast (*n*=60). The South also had the highest percentage of deaths overall with 41.6%.

Table 24

Malpractice Allegation Led to Death Summary by Region and Year (N = 166)

Region	2006 (*n*=87)		2007 (*n*=79)	
	N	*Percent*	*N*	*Percent*
Midwest	12	27.90	9	20.45
Northeast	24	21.81	36	26.86
South	41	39.80	28	36.36
West	10	32.25	6	18.75

RQ5. What proportion of delivery and postpartum hospitalizations are high-risk defined by race and insurance status (principal expected source of payment) per region year? There were 18,830 (46.2%) of high-risk patients in the OBGYN population. Although the number of high-risk patients decreased from 2006-2008, the percent of high-risk patients increased to 53.2% in 2008. The South had the highest number of overall OBGYN and high-risk patients. The South had 50.3% of high-risk patients, followed by the West (48.6%) and Midwest (48.1%). The Northeast had the smallest percentage of high-risk patients with 34.4% as shown in Table 25. The percentage of high-risk patients gradually increased in the Midwest, Northeast and South each year, even as their number of overall OBGYN and high-risk patients decreased as shown in Table 26. In the West the number of overall OBGYN and high-risk patients increased each year, except for 2008 due to the limited number of hospitals available in

the 2008 dataset and the percentage of high-risk patients increased from 2006 (48.5%) to 2007 (49.5%). Each year at least 40% of the population were high-risk in each region with exception to the data limitations in 2008.

Table 25

High-risk Delivery and Postpartum Hospitalizations Summary by Region (N = 18,830)

Region	Total OBGYN Patients (*n*=40,786)	Total OBGYN High Risk Patients (*n*=18,830)	Percent
Midwest	6,336	3,048	48.11
Northeast	8,842	3,041	34.39
South	17,648	8,874	50.28
West	7,960	3,867	48.58

Table 26

High-risk Delivery and Postpartum Hospitalizations Summary by Region and Year (N = 18,830)

Region	Total OBGYN Patients			Total OBGYN High Risk Patients		
	2006	*2007*	*2008*	*2006*	*2007*	*2008*
Midwest	2,819	2,722	795	1,315	1,307	426
Northeast	4,473	3,776	593	1,477	1,321	243
South	7,677	7,235	2,736	3,754	3,547	1,573
West	3,556	4,062	342	1,723	2,011	133

RQ6. What proportion of delivery and postpartum hospitalizations has one or more maternal morbidity, measured using the ICD-9-CM discharge codes found in Appendix B and severe maternal morbidity diagnosis, measured using the ICD-9-CM discharge codes found in Appendix C per region year? There were 5,661

(13.9%) of maternal and severe maternal morbidities as categorized in Appendix B and C. The South (46.9%) and Northeast (20.9%) had the highest percentage of maternal and severe maternal morbidities as seen in Table 27. The South (*n*=2,653, 46.9%) had the highest number of morbidities. The West (*n*=925, 16.3%) and Midwest (*n*=901, 15.9%) had the least number and percentage of morbidities. Table 28 shows that the number and percentage of maternal and severe maternal morbidities in each region steadily decreased each year except for the West whose total maternal morbidities and percentage increased from 2006 (*n*=398, 7.0%) to 2007 (*n*=477, 8.4%). Due to the data limitations in the 2008 dataset all total morbidities decreased in 2008 and the percentage increased as a result.

Table 27

Maternal Morbidity Summary by Region (N = 5,661)

Region	Total OBGYN Patients (*n*=40,786)	Total Maternal Morbidities (*n*=5,661)	Percent
Midwest	6,336	901	15.92
Northeast	8,842	1,182	20.88
South	17,648	2,653	46.86
West	7,960	925	16.34

Table 28

Maternal Morbidity Summary by Region and Year (N = 5,661)

Region	Total OBGYN Patients			Total Maternal Morbidities		
	2006	*2007*	*2008*	*2006*	*2007*	*2008*
Midwest	2,819	2,722	795	403	379	119
Northeast	4,473	3,776	593	603	482	97
South	7,677	7,235	2,736	1,160	1,090	403
West	3,556	4,062	342	398	477	50

RQ7. What percentage of high-risk pregnancy maternal morbidities is severe, measured using the ICD-9-CM discharge codes found in Appendix C per region year? Forty-six percent of the OBGYN population were high-risk. Within the high-risk population (*n*=18,830) 0.9% (*n*=175) of the maternal morbidities were severe as outlined in Appendix C. In other words, nearly 10% of the high-risk patients had a diagnosis of severe maternal morbidities. There were (*n*=313), severe maternal morbidities in the OBGYN population for years 2006-2008, 175 (55.9%) of them were from high-risk patients. Black/African Americans or patients with Medicaid or Medicare as their principal expected payment source made up more than half of the severe maternal morbidities. The South had the highest number of severe maternal morbidities within high-risk patients (*n*=97, 55.4%) followed by the Midwest (*n*=37, 21.1%) and Northeast (*n*=24, 13.7%). The West (*n*=17, 9.7%) had the smallest number and percentage of severe maternal morbidities. Table 29 shows the number and percentage of severe maternal morbidities by region year. Each region showed an increase in the number and percentage from 2006 to 2007, except for the South. The South had a decrease in severe maternal morbidities in the high-risk population from 2006 (*n*=51, 29.1%) to 2007 (*n*=32, 18.3%). Each region had a decrease in 2008 due to the dataset limitations.

Table 29.

High-risk Severe Maternal Morbidity Summary by Region and Year (N = 175)

Region	Total OBGYN High Risk Patients (*n*=18,830)	Total High Risk Severe Maternal Morbidities (*n*=175)

	2006	*2007*	*2008*	*2006*	*2007*	*2008*
Midwest	1,315	1,307	426	14	16	7
Northeast	1,477	1,321	243	10	11	3
South	3,754	3,547	1,573	51	32	14
West	1,723	2,011	133	7	9	1

RQ8. Which hospital characteristics, such as hospital region, bed size, ownership, or patient days of care are strongly associated with maternal morbidities, measured using the ICD-9-CM discharge codes found in Appendix B and severe maternal morbidities, measured using the ICD-9-CM discharge codes found in Appendix C in the high-risk pregnancy population per region year? There were 18,830 females in the high-risk population, thirteen percent (n = 2,371) had a maternal morbidity, 0.6% (n = 110) had a severe maternal morbidity, while 0.3% (n = 65) had a diagnosis of both a maternal and severe maternal morbidity. Tables 30-32 show the independent variables bed size, region, ownership, and patient days of care and its effect on maternal morbidities multinomial variable (0-no, 1 –maternal morbidity, 2 – severe maternal morbidity, 3 – both a maternal and severe maternal morbidity diagnosis). Multinomial logistic regression result showed that the independent variables of bed size 500 and over (Wald(1) = 9.86, $p < 0.01$) as well as bed size 200 – 299 (Wald(1) = 7.22, $p < 0.01$) and bed size 300-499 (Wald(1) = 4.04, $p = 0.04$ had significant effects or are significantly related to maternal morbidities. The same was true for the Midwest (Wald(1) = 14.05, $p < 0.01$), South (Wald(1) = 29.18, $p < 0.01$), and Northeast (Wald(1) = 8.00, $p < 0.01$). There were no significant effects in maternal morbidities and hospital ownership. There were no significant effects on the independent variables and severe

maternal morbidities as seen in Table 31, however region was significantly related to patients that had a diagnosis of both maternal and severe maternal morbidities in the South (Wald(1) = 8.14, $p < 0.01$) and Midwest (Wald(1) = 5.10, $p = 0.02$) as shown in Table 32.

The coefficient of the odds ratio statistics of Exp(B) of the significant independent variable was investigated to determine change in the log odds of the dependent variable maternal morbidities for a one unit increase in the values independent variables. This determined the odds that the population had a maternal morbidity. Looking at the log odds of Exp(B), having a stay in a higher bed size facility resulted in an increase in the odds of having a maternal morbidity by 1.39%. The odds of having a maternal morbidity in the Midwest were increased by 1.35%, as was the South (1.42%) and Northeast (1.26%). The odds of having a maternal and severity morbidity in the South were increased by 4.60%, and 3.73% in the Midwest. Therefore, the multinomial logistic regression results supported that both hospital bed size and region are strongly associated with both maternal morbidities and severe maternal morbidities in the high-risk pregnancy population, which is also shown in the Likelihood Ratio test in Table 33. Logistic Regression was also used in Table 34 to show the results of the independent categorical variables, of maternal morbidity (1), severe maternal morbidity (2), and patients with both a maternal morbidity and severe maternal morbidity on patient days of care (DOC), which all showed a significant association at $p < 0.01$.

Table 30

Multinomial Logistic Regression Results of Hospital Characteristics on Maternal Morbidities

	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq	Exp(B)
Maternal Morbidities						
Bed Size = 66-99	0	0	.	.	.	.
Bed Size = 100-199	1	0.14	0.10	2.61	0.15	1.15
Bed Size = 200 - 299	1	0.26	0.10	7.22	<0.01	1.30
Bed Size = 300 - 499	1	0.19	0.09	4.09	0.04	1.21
Bed Size = 500 and over	1	0.33	0.10	9.86	<0.01	1.39
Region = Midwest	1	0.30	0.08	14.04	<0.01	1.35
Region = Northeast	1	0.23	0.08	7.95	<0.01	1.26
Region = South	1	0.35	0.07	29.18	<0.01	1.42
Region = West	0	0	.	.	.	.
Ownership = Government	1	0.11	0.08	1.83	0.18	1.12
Ownership = Non-profit, including church	1	0.02	0.07	0.06	0.82	1.02
Ownership = Proprietary	0	0	.	.	.	.

Table 31

Multinomial Logistic Regression Results of Hospital Characteristics on Severe Maternal Morbidities

	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq	Exp(B)
Severe Maternal Morbidities						

Bed Size = 66-99	0	0	.	.	.	.
Bed Size = 100-199	1	-0.68	0.37	3.34	0.07	0.51
Bed Size = 200 - 299	1	-0.67	0.37	3.23	0.07	0.51
Bed Size = 300 - 499	1	-0.36	0.33	1.14	0.29	0.70
Bed Size = 500 and over	1	0.02	0.35	0.00	0.95	1.02
Region = Midwest	1	0.60	0.36	2.73	0.10	1.82
Region = Northeast	1	0.52	0.37	2.02	0.16	1.69
Region = South	1	0.49	0.32	2.27	0.13	1.63
Region = West	0	0	.	.	.	.
Ownership = Government	1	0.65	0.40	2.62	0.11	1.91
Ownership = Non-profit, including church	1	0.42	0.36	1.37	0.24	1.52
Ownership = Proprietary	0	0	.	.	.	.

Table 32

Multinomial Logistic Regression Results of Hospital Characteristics on Maternal and Severe Maternal Morbidities

	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq	Exp(B)
Maternal and Severe Maternal Morbidities						
Bed Size = 66-99	0	0	.	.	.	.
Bed Size = 100-199	1	0.68	0.79	0.74	0.39	1.97
Bed Size = 200 - 299	1	1.15	0.76	2.30	0.13	3.14

Bed Size = 300 - 499	1	1.26	0.74	2.90	0.09	3.53
Bed Size = 500 and over	1	1.44	0.76	3.60	0.06	4.22
Region = Midwest	1	1.32	0.58	5.10	0.02	3.73
Region = Northeast	1	0.04	0.71	0.00	0.96	1.04
Region = South	1	1.53	0.54	8.14	<0.01	4.60
Region = West	0	0	.	.	.	.
Ownership = Government	1	0.73	0.52	2.00	0.16	2.08
Ownership = Non-profit, including church	1	0.54	0.45	1.45	0.23	1.72
Ownership = Proprietary	0	0	.	.	.	.

Table 33

Multinomial Logistic Regression Likelihood Ratio Test

	Chi-Square	DF	Pr > ChiSq
Bedsize	28.19	12	<0.01
Region	52.91	9	<0.01
Ownership	7.46	6	0.28

Table 34

Logistic Regression Results of Patient Days of Care on Maternal and Severe Maternal Morbidities

	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
1 – Maternal Morbidities	1	2.35	0.04	4441.09	<0.01

2 - Severe Maternal Morbidities	1	5.21	0.08	3772.36	<0.01
3 - Maternal and Severe Morbidities	1	6.21	0.13	2309.09	<0.01

Relationship Questions

RQ9. Is there a relationship between OBGYN physician avoidance behaviors (obstetrics related malpractice allegations and the severity of the malpractice injuries) and maternal morbidities?

***H*9$_0$: There is no relationship between OBGYN physician avoidance behaviors (obstetrics related malpractice allegations and the severity of the malpractice injuries) and maternal morbidities.**

***H*9$_A$: There is a relationship between OBGYN physician avoidance behaviors (obstetrics related malpractice allegations and the severity of the malpractice injuries) and maternal morbidities.** There were 574 malpractice allegations within the study population. To assess the relationship of OBGYN avoidance behaviors on maternal morbidities, the 2006 malpractice allegations were used on the 2007 patient discharged morbidities and 2007 allegations were used on the 2008 discharges; 2006 discharges were removed from the analysis. Morbidities were then categorized as maternal morbidities (1), severe maternal morbidities (2), and patients with both a maternal morbidity and severe maternal morbidity. There is a perfect balance of cases in each of the morbidity categories as shown in Table 35 and therefore no associations can be found. With this result, the null hypothesis for research question nine that “There is no relationship between OB-GYN physician avoidance behaviors (obstetrics related malpractice allegations and the severity of the malpractice injuries) and maternal morbidities" was not rejected.

Table 35

Descriptive Statistics Summaries of Study Variables (N = 574)

	N	Percentage
1 – Maternal Morbidities	24	25%
2 - Severe Maternal Morbidities	24	25%
3 - Maternal and Severe Morbidities	24	25%

Summary

There was a total of 40,786 OBGYN patients from the 2006 – 2008 National Hospital Discharge Survey that were used for this analysis along with the 574 obstetrics related malpractice allegations from the 2007 - 2008 National Practitioner Data Bank and 31,099 OBGYN providers the 2006-2008 National Plan and Provider database. An analysis of the OBGYN data showed a mean age of 27.5 with a mean length of care of 2 days. Whites made up the majority of the population at 70%, followed by Black/African Americans (17.3%). Medicaid (38.3%) and HMO/PPO (29.6%) were the largest principal expected source of income. There were only 244 (0.6%) of patients with Medicare as their principal expected source of income. Using the enhanced delivery method to identify deliveries and postpartum hospitalizations, 93.5% of the patients had a primary or secondary diagnosis code of V27. The majority of the hospitalizations were in non-profit (75.6%) owned facilities and in 300-499 bed facilities (31.9%). Forty-three percent of the facilities were in the South as were the majority of the OBGYN providers (34.40%).

There was an even number of obstetrics related malpractice allegations (*n*=574) in the years 2006-2007 (*n*=287). Most of the allegations were in the Northeast (42.5%) and the South (31.4%), as were the delivery and postpartum hospitalizations for 2006-2008, South (43.3%) and Northeast (21.7%). The study compared the effects of malpractice allegations on high-risk patients defined as patients who were Black/African Americans or had a principal expected source of payment of Medicare or Medicaid. Fifty-four percent of the OBGYN patients were high-risk (*n*=18,830) compared to 46.2% of non-high-risk patients (*n*=21,956). There were 5,661 (13.9%) OBGYN patients that had either a diagnosis of a maternal morbidity (*n*=5,454) or severe maternal morbidity (*n*=313). Several patients had a diagnosis or procedure that was both a maternal morbidity and a severe maternal morbidity. Nearly 10% of the high-risk population had a severe maternal morbidity. Black/African Americans or patients with Medicaid or Medicare as their principal expected payment source made up 55.9% of the severe maternal morbidities. This supports the research, specifically Creanga, et al. (2014) and Callaghan, et al. (2008) findings on the proportion of non-White women and women using public insurance being more likely to have a maternal or severe maternal morbidity. Callaghan, et al. (2008) also found that women in the South and Northeast were at a greater risk of having a severe maternal morbidity diagnosis, which was found during this study as well. Of the 5,661 maternal morbidities, 46.9% of them were found in the South followed by the Northeast, 20.9%. Thirty-six percent of the maternal morbidities and 40.3% of severe maternal morbidities in the high-risk population had a principal expected source of payment of Medicare. Fifty percent of the high-risk patients resided in the South.

The results of research question 8 did find a statistically significant association between hospital bed size and maternal morbidities for beds 500 and over ($p < 0.01$) as well as bed sizes 200 -299 ($p < 0.01$) and 300-499 ($p = 0.04$). There was also a statistically significant association in certain regions, the Midwest ($p < 0.01$), South ($p < 0.01$), and Northeast ($p < 0.01$). There were no significant effects in maternal morbidities and hospital ownership. There were no significant effects on the independent variables and severe maternal morbidities, however region was significantly related to patients that had a diagnosis of both maternal and severe maternal morbidities in the South ($p < 0.01$) and Midwest ($p = 0.02$. There was also a statistically significant association between patient days of care and maternal morbidities ($p < 0.01$) and severe maternal morbidities ($p <0.01$), where patients with longer days of stay were more likely to have a maternal morbidity or a severe maternal morbidity than not having a morbidity. The results of questions 9 did not find any association between the number and the severity of the obstetrics related malpractice allegation and maternal morbidities, because the number of allegations remained constant as did the severity of the allegations.

While there was no relationship between maternal or severe maternal morbidities within the combined datasets this study did support the findings of Creanga (2014) and

Callaghan, et al. (2008) on the proportion of non-White women and women using public insurance being more likely to have a maternal or severe maternal morbidity. Black/African American women with a principal expected payment source of Medicare or Medicaid made up the majority (56%) of the severe maternal morbidities in the OBGYN population. Furthermore, this study supported their findings that women in the South (46.9%) or Northeast (20.9%) were at a greater risk of having a severe maternal morbidity diagnosis (Callaghan et al., 2008).

In the next chapter, chapter 5, the analysis and interpretation the findings within the context of the theoretical framework are discussed. A description of the study limitations and recommendations for further research will also be presented.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

Severe maternal morbidities affect over 50,000 women each year in the United States (CDC, 2014) and are 50 times more common than maternal death (Callaghan et al., 2008). The prevalence of severe maternal morbidities in the United States is increasing (National Hospital Discharge Survey, 2014). Negative defensive medicine practices are comprised of avoidance behaviors such as eliminating procedures that are more prone to complications or refusing to treat patients who have complex medical problems such as diabetes, obesity, congestive heart failure, heart failure, or other heart conditions because these conditions pose a higher risk of having medical complications (Studdert et al., 2005). Researchers have found that women of lower socioeconomic class are more affected by negative defensive medicine practices (Bruce et al., 2012; Bryant, Worjoloh, Caughey, & Washington, 2010; Cabacungan, Ngui, & McGinley, 2012; Callaghan, MacKay, & Berg, 2008; Creanga, Bateman, Kuklina, & Callaghan, 2014; de Jongh, Locke, Paul, & Hoffman, 2012; Fridman et al., 2014; Gray, Wallace, Nelson, Reed, & Schiff, 2012; Messer et al., 2008; Nagahawatte & Goldenberg, 2008; Nanyonjo et al., 2008; O’Campo et al., 2008; Shen & Wei, 2008; Stulberg, Zhang & Lindau, 2011; Zhang et al., 2013). Despite efforts to reduce racial and social class disparities in the United States, women of lower socio-economic status and non-Hispanic Black women have significantly higher rates of adverse maternal outcomes (Bruce et al., 2012; Bryant et al., 2010; Cabacungan et al., 2012; Callaghan et al., 2008; Creanga et al., 2014; de Jongh et al., 2012; Fridman et al., 2014; Gray et al., 2012; Messer et al., 2008; Nagahawatte & Goldenberg, 2008; Nanyonjo et al., 2008; O'Campo et al., 2008; Shen & Wei, 2008; Zhang et al., 2013).

This study examined the relationship between OB-GYNs who engaged in defensive medicine avoidance behaviors defined by obstetrics-related malpractice allegations and the severity of the malpractice injuries and the influence on maternal morbidities and severe maternal morbidities, after adjusting for hospital characteristics such as bed size, ownership, and location and patient days of stay. The research variables were based on ICD-9-CM procedure and diagnosis codes, DRG codes, and selected variables from the 2006-2008 NHDS, the 2006 and 2007 NPDB PUDF, and the NPPES datasets. The dependent variables were maternal morbidities and severe maternal morbidities, and the independent variables included age, race, insurance status defined by principal expected source of payment, and the number of delivery and postpartum hospitalizations. I chose these data because they included over 500 sample hospitals and 1 million health care practitioners with potential malpractice cases across the United States. In addition, the data were available for use. The results of the study did find a relationship found between the number and the severity of morbidities and hospital bed size and patient days of care, however there was not one between the number and severity of the obstetrics related malpractice allegations and maternal or severe maternal morbidities.

In this chapter, I evaluate the results obtained in this study compared to previous research and make recommendations for future research. Study and data limitations are also included in this chapter as well as a conclusion for the study.

Interpretation of Findings

There were a total of 40,786 OB-GYN patients included in the study, of which the majority were White (70%), followed by Black/African Americans (17.3%), Other (8.3%), and Asian (2.9%). American Indian/Alaskan Native, Native Hawaiian/Other Pacific Islander, and Multiple Races made up the remaining 1% of the population. Medicaid (38.3%) and HMO/PPO (29.6%) were the largest principal expected source of income. There were only 244 (0.6%) of patients with Medicare as their principal expected source of income. The majority of the hospitalizations were in nonprofit-owned facilities (75.6%) and in 300-499 bed facilities (31.9%). Forty-three percent of the facilities were in the South as were the majority of the OB-GYN providers (34.40%). Black/ African Americans had the second largest number and percentage of the maternal morbidities (n = 1,026, 18.8%); however Black/African Americans (n = 99, 31.6%) and patients with a principal expected payment of Medicaid (n = 126, 40.3%) had most of the severe maternal morbidities.

I compared the effects of malpractice allegations on high-risk patients who were defined as patients who were Black/African Americans or had a principal expected source of payment of Medicare or Medicaid. Fifty-four percent of the OB-GYN patients were high-risk. Of the 13.9% (n = 18,830) of the OB-GYN patients who had either a diagnosis of a maternal morbidity or a severe maternal morbidity, 46.2% of them were high-risk and 55.9% of their maternal morbidities were severe. Nearly 10% of the high-risk population had a severe maternal morbidity. Black/African Americans or patients with Medicaid or Medicare as their principal expected payment source made up 55.9% of the severe maternal morbidities. This finding supports previous research showing that non-White women are more likely to have a maternal or severe maternal morbidity. Non-Hispanic Black women are 3-4 times more likely to die from a pregnancy-related complication compared to non-Hispanic White women, researchers have found (Bruce et al., 2012; Creanga et al., 2014; Nagahawatte & Goldenberg, 2008). Callaghan et al. (2008) found that women in the U.S. South and Northeast were at a greater risk of having a severe maternal morbidity diagnosis. Of the 5,661 maternal morbidities, 5.52% were severe. The majority of the maternal morbidities were found in the South (46.9%) and in the Northeast (20.9%) regions of the United States.

However, there was no relationship between the number and severity of the obstetrics-related malpractice allegations and maternal ($p = 1.00$) or severe ($p = 1.00$) maternal morbidities. The lack of association can be attributed to both the number of allegations and the severity of allegations remaining constant. There were 574 obstetrics-related malpractice allegations which were split 50/50 between years 2006 and 2007. Most of the allegations were in the Northeast (42.5%) and the South (31.4%), as were the delivery and postpartum hospitalizations for 2006-2008: South (43.3%) and Northeast (21.7%).

Using the enhanced delivery method to identify deliveries and postpartum hospitalizations, 93.5% of the patients had a primary or secondary diagnosis code of V27. This proven delivery and hospitalization identification method developed by Callaghan et al (2008) and further defined in his later research (Callaghan et al., 2012) has been used in earlier research to identify the most appropriate ICD-9-CM codes and DRG diagnoses and OBGYN hospital activity. This study showed 5,661 (13.9%) of overall maternal and severe maternal morbidities, which decreased each year, with the exception of the West whose morbidities increased compared to the research that showed a trend of increased activity. The trend of maternal morbidities or poor and adverse outcomes have increased over the past several years (Berg et al., 2009; Bruce et al., 2008, 2012; Bryant et al., 2010; Cabacungan et al., 2012; Callaghan, et al 2008, 2012; CDC, 2014; Creanga et al., 2014; Fridman et al., 2014; Gray et al., 2012; Kuklina et al., 2008, 2009; Shen & Wei, 2008; Zhang et al., 2013). Maternal morbidities or complications can increase hospital length of stay (Callaghan et al., 2012; CDC, 2014; Gray et al., 2012) however, the study found that the average length of stay for the population was 2 days.

Past studies have shown that minorities and individuals of lower socioeconomic status have poorer outcomes and are at a greater risk of having an adverse event. As such, this study used the primary expected source of payment variable of Medicare and Medicaid from the NHDS as a proxy for socioeconomic status. Within the study population Medicaid (38.3%) and HMO/PPO (29.6%) were the largest expected principal source of payment in the study population. Sixty-seven percent of the Black/African

Americans in the study had a principal expected source of payment of Medicare, HMO/PPO (29.7%), followed by Government (25%). Furthermore, patients with Medicaid as their principal expected source of payment had the majority of the maternal morbidities (36.0%) and severe maternal morbidities (40.3%) in the study population. Individuals on public insurance such as Medicaid or Medicare have also been found to be at a greater risk of having adverse outcomes (Bruce et al., 2012; Bryant et al., 2010; Cabacungan et al., 2012; Callaghan et al., 2008; Creanga et al., 2014; de Jongh et al., 2012; Dhankhar & Khan, 2009; Dubay et al., 2001; Fridman et al., 2014; Gray et al., 2012; Messer et al., 2008; Nagahawatte & Goldenberg, 2008; Nanyonjo et al., 2008; O'Campo et al., 2008; Shen & Wei, 2008; Stulberg et al., 2011; Zhang et al., 2013). This supports the research findings of Black/African Americans and those on public insurance within the OBGYN population having most of the severe maternal morbidities. Race/ethnicity, age, socioeconomic status (SES), and insurance are important factors in determining adverse birth and maternal outcomes (de Jongh et al., 2013; Shen & Wei, 2008; Zhang et al., 2013).

According to Reason (1995), adverse events or occurrences are directly or indirectly the result of human errors or factors. According to Human Factory Theory, errors are natural consequences, of system breakdowns not the causes (Shouhed et al., 2012). The study found a statistically significant association between hospital bed size and maternal ($p = 0.02$) and severe maternal morbidities ($p = 0.05$) within the OBGYN population. The higher the bed size hospital (500 and over) the greater the risk of having a morbidity. There was also a statistically significant association between patient days of care and maternal morbidities (*p* < 0.01) and severe maternal morbidities (*p* < 0.01), where patients with longer days of stay were more likely to have a maternal morbidity or a severe maternal morbidity than not having a morbidity. Many of the hospitalizations were in non-profit (75.6%) owned facilities. Forty-three percent of the facilities were in the South. The quality of care offered and received by Medicare patients can differ by hospital ownership (Bayindir, 2012; Horwitz & Nichols, 2009; Sloan, Picone, Taylor, & Chou, 2001). This study focused on physician violations, which are deliberate deviations from standard procedures (Amalberti, Vincent, Auroy & de Saint Maurice, 2006; Reason, 1995) and found that these defensive avoidance behaviors negatively affect patients in higher bed hospitals. Violations have been the cause of serious healthcare incidents (Reason, Parker and Lawton (1998). Routine violations occur when the person takes the path of least effort and cuts corners to save time, or when their personal goals do not align with the overall patient goals. Reason (1995) referred to these as opportunist violations by the responsible party to deviate from established rules and procedures for selfish gain.

While there was a relationship found between the number and the severity of morbidities and hospital bed size and patient days of care there was not one between the number and severity of the obstetrics related malpractice allegations and maternal (*p* = 1.00) or severe maternal (*p* = 1.00) morbidities. Although there was no relationship found between morbidities and malpractice allegations to support the presence of OBGYN defensive medicine practices influencing patient outcomes the study did support the findings of Callaghan, et al. (2008) and Creanga (2014) on the proportion of non-White women or women of lower socioeconomic status being more likely to have a severe maternal morbidity as well as morbidities being heavily concentrated in the South and Northeast.

Limitations

There were limitations to the study regarding the study design and the use of the secondary datasets of NHDS, NPDP, and NPPES. Administrative data is often rich in information and generally free, however it may be difficult to locate the correct measures or variables for the research questions. The study was limited to the available data within the three datasets as well as the quality of the data.

There was a possibility of incorrect or missing ICD-9-CM procedure and diagnosis coding within the National Hospital Discharge Survey (NHDS). To address this limitation the NHDS study data was edited by hospital and NHDS staff as well as computer software for completeness and accuracy and all incomplete and duplicate records were removed as well as any hospitals that were out of the scope of the survey (USDHHS, 2011, 2010). Within the dataset all data was checked to ensure that missing records were removed from the final dataset before analysis.

The study was also limited by any inconsistencies found in the National Practitioner Data Bank (NPDB) or the National Plan and Provider Enumeration System (NPPES) data. The NPDB and NPPES maintains a comprehensive security system and is consistent with recognized standards and guidelines. To address this limitation, the dataset was checked to ensure that any incomplete or duplicate records were removed before joining the individual datasets together.

The sample size of the NHDS data may not have been large enough to determine the relationship between OBGYNs who engage in defensive medicine avoidance behaviors and its influence on maternal morbidities and severe maternal morbidities. The estimated sample of 2007 and 2008 hospitalized deliveries were 40,033 and 16,234 respectively, which averaged to 10,000 deliveries per region year for 2007 and 4,058 deliveries per region year for 2008. Previous research studies have used at least ten years of data to determine significance. Callaghan et al. (2008) conducted a study from 1991-2003 with a sample size of 425,715 delivery hospitalizations, an average of 35,476 records per year that met their exclusion criteria and found both a practical and statistically significant ($p = 0.002$) trend in the severe morbidity rate. Berg et al, (2009) later compared 2001-2005 NHDS data with their previously published 1993-1997 analysis and found an increase in maternal morbidity using only the V27 method identifying 183,431 unweighted sampled delivery hospitalizations or 36,686 annually (Berg et al., 2009). In addition to sample size limitations, this study was also limited to using regional data and not being able to attribute any potential malpractice allegation to specific healthcare practitioners.

Recommendations

Since the study findings failed to support the initial hypotheses, this section will only discuss recommendations with research design and data collection. While this study has added to the literature on OBGYNs who engage engaged in defensive medicine avoidance behaviors and its influence on maternal morbidities and severe maternal morbidities in high-risk females age 15-49 who are Black/African American or have Medicaid or Medicare as their principal expected source of payment, there are opportunities for further research.

One recommendation is to increase the time-period to at least five years with average delivery hospitalizations of at least 35,000 per year. A second recommendation would be to use a dataset where the healthcare practitioners are identified to properly associate their hospital activity with the NPDB malpractice data. The most recent Nationwide Inpatient Sample (NIS) and National Practitioner Data Bank (NPDB) datasets can be combined by practitioner and state to get a more accurate association of hospital and malpractice activity. These two recommendations of increasing the delivery hospitalization time-period and average records per year, and combining datasets such as the NIS and NPDB should improve the probability of finding a statistically signification association between OBGYN defense medicine practices and maternal morbidity.

Implications

Since 2010, the United States has had a Healthy People 2020 goal to reduce maternal illness and complications due to pregnancy, however prior studies have found that the rate of maternal complication or morbidity continues to increase and disproportionally affect non-Hispanic Black women and women of lower socioeconomic status more than others. Callaghan et al, (2008) found that during 1991-2003, 5 out of every 1,000 women who delivered babies in the United States had at least one severe maternal morbidity during their hospitalization. This means that approximately 20,000 women each year had a severe maternal morbidity. In 2012, Callaghan conducted another study utilizing 1998-2009 data and found that 5,600 women die during a delivery or a postpartum hospitalization, which suggests that for 4,000,000 births in the United States, 129 episodes of severe maternal morbidity will affect an estimated 52,000 women. Despite these alarming data there is limited research on maternal morbidity and severe maternal morbidity in the U.S. (Gray et al., 2012) and its risk factors.

In the United States, non-Hispanic Black women and women of lower social economics are significantly disproportionately affected when compared to non-Hispanic White women specifically preterm birth, infant mortality, and low birth weight (Messer et al., 2008; O'Campo et al., 2008). Zhang et al, (2013) found that among Medicaid pregnancies, non-Hispanic Black women still have poorer outcomes compared to non-Hispanic White or Hispanic women. Maternal morbidities affect thousands in the United States, but there are still large racial disparities and very few quantitative population-based studies that investigate the rate of maternal complications and morbidity by race or insurance status.

While this study did not find a statistical significant association between previous OBGYN malpractice allegations and maternal and severe maternal morbidities on Black/African American females age 15-49 who have Medicaid or Medicare as their principal expected source of payment, previous research shows us that there is still work to do done in this area. The study did however find a significant association between the number of maternal and severe maternal morbidities and hospital bed size which can suggest that defensive medicine exist.

Any information on the underlying relationship between independent factors and maternal morbidities and severe morbidities has the potential to be used for clinical reviews, development of quality-of-care indicators, and identifying future research priorities in obstetrics and/or quality of care. It is the hope that this research can be used to further study these relationships. It is unlikely that defensive medicine practices will be eliminated (Adwok and Kearns (2013); however, major policy changes in the current medical liability system could positively influence its practice. Acknowledging the patient outcomes of physician avoidance behaviors may be the bridge between medical liability and health policy.

Conclusion

The purpose of this study was to examine the relationship between OBGYNs who engaged in defensive medicine avoidance behaviors defined by obstetrics related malpractice allegations and the severity of the malpractice injuries and its influence on maternal morbidities and severe maternal morbidities in high-risk females age 15-49 who are Black/African American or have Medicaid or Medicare as their principal expected source of payment. While this study has added to the literature on OBGYNs who engage in defensive medicine behaviors and its influence on maternal and severe maternal morbidities there are opportunities for further research. Hospital bed size and region were found to be significantly associated with the number of maternal and severe maternal morbidities among Black/African American females age 15-49 who have Medicaid or Medicare as their principal expected source of payment. However, the study found that previous OBGYN malpractice allegations with payments did not have an influence on maternal and severe maternal morbidities in the study population.

Previous studies found a relationship between OBGYN defensive medicine avoidance behaviors and adverse patient outcomes. Future research on maternal morbidities and malpractice allegations could be done on more comprehensive datasets that do not have data limitations such as this study. This study did support previous research conducted by Callaghan, et al., 2008 and Creanga et al., 2014 who both found that non-White women or women of lower socioeconomic status were more likely to have a severe maternal morbidity. Creanga et al. (2014) conducted a study of inpatient hospitalizations within seven states using the enhanced delivery identification method to examine racial/ethnical disparities and found that severe maternal morbidities disproportionately affect minority women. According to Callaghan et al. (2008), non-Hispanic Black women who are less than 20 years old or greater than 40 years of age and are residents of the South or Northeast are at a greater risk of having a severe maternal morbidity diagnosis and a cesarean delivery.

While this study added to previous research of minority women being at a greater risk for a maternal morbidity or severe maternal morbidity as well as morbidities being heavily concentrated in the South and Northeast there wasn't a statistically significant statistical significant association between previous OBGYN malpractice allegations and maternal and severe maternal morbidities within the study population. Future research should be conducted on minorities and their higher propensity for maternal morbidities.

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Appendix A: Primary and Secondary Delivery and Postpartum Hospitalization

Procedures and Diagnoses

Description	Code(s)
Outcome of delivery	ICD-9-CM = V27
Postpartum care and examination	+ICD-9-CM = V24
Normal delivery	ICD-9-CM = 650
Diagnosis-related group (DRG) delivery codes	*370 (complicated cesarean section), *371 (uncomplicated cesarean section), 372 (complicated vaginal delivery), 373 (uncomplicated vaginal delivery) 374 (uncomplicated vaginal delivery with sterilization and/or dilatation & curettage) 375 (vaginal delivery with operation room procedure except sterilization and/or dilatation & curettage) +376, 377, 769, 776 Postpartum & post abortion diagnoses without O.R. Procedure
Selected delivery related procedures	ICD-9-CM = 720, 721, 7221, 7229, 7231, 7239, 724, 726 (forceps) 7251, 7252, 7253, 7254 (breech extraction) 7271, 7279 (vacuum extraction) 728, 729 (other specified and unspecified delivery) 7322 (internal and combined version and extraction) 7359 (other manually assisted deliveries) 736 (episiotomy) *740, 741, 742, 744, 7499 (cesarean section) *370, 371,740, 741, 742, 744, 7499 (cesarean section)

(*table continues*)

Description	Code(s)
Exclusions	*ICD-9 -CM 630 (hydatidiform mole)* *631 (other abnormal product of conception)* *633 (ectopic pregnancy)* *632, 634, 635, 636, 637, 638, 639, 69.01, 69.51, 74.91, 75.0 (abortion)*

Note. Reprinted from "An Enhanced Method for Identifying Obstetric Deliveries: Implications for Estimating Maternal Morbidity," by Kuklina et al., 2008, *Journal of Maternal Child Health, 12*, p. 471.

* Cesarean procedures are considered assurance behaviors and as such were not included in the patient population (Sakala et al., 2013b).

[+]Postpartum hospitalization diagnosis codes and procedures. (Callaghan et al., 2012)

Appendix B: Maternal Morbidity ICD-9 Diagnoses

Description	Code(s)
Antepartum hemorrhage (placenta previa, abruption placenta, hemorrhage with DIC, other and unspecified hemorrhage) excludes hemorrhage in early pregnancy	641.0–641.9
Postpartum hemorrhage (third-stage hemorrhage, other postpartum hemorrhage including atony, delayed/secondary postpartum hemorrhage)	All 666
Mild and unspecified preeclampsia, severe preeclampsia and eclampsia	642.4–642.7
Transient hypertension of pregnancy	642.3
Major perineal laceration (third- and fourth-degree perineal lacerations, vulvar and perineal hematoma)	664.2, 664.3, 664.5
Other obstetric trauma (includes inversion of uterus, cervical laceration, high vaginal laceration, other injury to pelvic organs, joints, or ligaments, pelvic hematoma)	665.2–665.9
Ruptured uterus	665.0–665.1
Genitourinary infection (pyelonephritis, urinary tract infection)	646.6, 590, 599.0
Amnionitis	658.4
Other infection (unspecified pneumonia, unspecified bacterial infection, abscess)	486, all 041, 682

(table continues)

Description	Code(s)
Fever (maternal pyrexia during labor, unspecified)	659.2
Pyrexia of unknown origin in the puerperium	672
Sepsis (generalized infection/septicemia during labor)	659.3
Gestational diabetes (abnormal glucose tolerance test)	648.8
Other major puerperal conditions (includes hepatorenal syndrome, postpartum cardiomyopathy, sudden death, fluid/electrolyte abnormality, purpura)	674.8–674.9, all 276, 287
Peripartum cardiomyopathy (2003–2005)	674.5
Other major complications of labor and delivery (includes maternal distress, shock, hypotension, arrest, renal failure, pulmonary insufficiency, surgical complications)	669.0–669.4, all 998
Anesthetic complications	All 668, 349
Wound complication	674.1–674.3
Deep venous thrombosis	671.3–671.4
Gestational liver disease	646.7
Late vomiting of pregnancy	643.2
Obstetric pulmonary embolism (includes blood clot embolism, amniotic fluid embolism, air embolism)	All 673
Cerebrovascular accident (includes cerebral hemorrhage, embolism, and thrombosis)	671.5, 674.0, 430, 431, 436, all 432, 433, 434

(table continues)

Description	Code(s)
Chronic hypertension	642.0–642.2, 642.7, 642.9, all 401
Cardiac disease (excludes cerebral complications)	648.5–648.6, all 424, 425
Asthma	All 493
Preexisting diabetes mellitus (excludes abnormal glucose tolerance test)	648.0, all 250
Renal disease (unspecified renal disease in pregnancy without mention of hypertension)	646.2
*Cesarean delivery	74.0–74.2, 74.4, 74.99, 669.70–669.71

Note. Adapted from "Overview of Maternal Morbidity During Hospitalization for Labor and Delivery in the United States, 1993-1997 and 2001-2005," by Berg et al., 2009, *Obstetrics & Gynecology, 113(5),* p. 1081.

* Cesarean procedures are considered assurance behaviors and as such were not included in the patient population (Sakala et al., 2013b).

Appendix C: Severe Maternal Morbidity ICD-9 Diagnosis and Procedures Codes

Table C 1

Severe Maternal Morbidity ICD-9 Diagnosis

Description	Code(s)
Acute renal failure	584, 586, 669.30- 669.34
Acute and subacute necrosis of the liver	570
Respiratory failure	518.4, 518.5, 518.81-518.84, 799.1
Obstetric shock	669.10 – 669.14
Cerebrovascular accident/ hemorrhage	430 – 434, 436, 671.50 – 671.54, 674.00-674.04,
Pulmonary embolism (obstetric and other)	673.00-673.04, 673.2-673.24, 673.30-673.34, 673.80-673.84, 415.11, 415.19
Amniotic fluid embolism	673.10 – 673.14
Eclampsia	642.60 – 642.64
Septicemia	038
Obstetric codes for complications of anesthesia	668.00-668.04, 668.1-668.14, 668.21-668.24

Note. Reprinted from "Identification of Severe Maternal Morbidity During Delivery Hospitalizations, United States, 1991-2003," by Callaghan et al., 2008, *American Journal of Obstetrics and Gynecology, 199*, pp. 133e7-133e8.

Table C 2

Severe Maternal Morbidity ICD-9 Procedures

Description	Codes
Cardiac events/procedures	425, 428, 427.5, 410, 99.60, 99.62, 99.62, 99.63, 99.64, 99.69
Mechanical ventilation	96.70-96.72
Transfusion	99.03, 99.04
Hysterectomy	68.3, 68.4, 68.9
Invasive hemodynamic monitoring	89.60-89.64

Note. Adapted from “Identification of Severe Maternal Morbidity During Delivery Hospitalizations, United States, 1991-2003,” by Callaghan et al., 2008, *American Journal of Obstetrics and Gynecology, 199*, p. 133e8.

Appendix D: National Hospital Discharge Survey, Medical Abstract

OMB No. 0920-0212: Approval Expires 08/31/2008

FORM **HDS-1** (12-15-2006)

U.S. DEPARTMENT OF COMMERCE
Economics and Statistics Administration
U.S. CENSUS BUREAU
ACTING AS COLLECTING AGENT FOR
DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION
NATIONAL CENTER FOR HEALTH STATISTICS

7299901

MEDICAL ABSTRACT NATIONAL HOSPITAL DISCHARGE SURVEY

Notice – All information which would permit identification of an individual or an establishment will be held confidential, will be used only by persons engaged in and for the purposes of the survey, and will not be disclosed or released to other persons or used for any other purpose. Public reporting burden of this collection of information is estimated to average 4 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to CDC/ATSDR Reports Clearance Officer; 1600 Clifton Road, MS D-74, Atlanta, GA 30333, ATTN: PRA (0920-0212).

A. PATIENT IDENTIFICATION

1. Hospital number . . . . ☐☐☐☐

2. HDS number . . . . ☐☐☐☐

3. *(Item deleted)*

4. Date of admission . . . . . . Month ☐☐ - Day ☐☐ - Year ☐☐☐☐

5. Date of discharge . . . . . . ☐☐ - ☐☐ - ☐☐☐☐

6. Residence ZIP Code . . . . ☐☐☐☐☐

B. PATIENT CHARACTERISTICS

7. Date of birth — Month ☐☐ - Day ☐☐ - Year ☐☐☐☐

8. Age – Complete only if date of birth not given — Units ☐☐☐ — 1 ☐ Years 2 ☐ Months 3 ☐ Days

9. Sex – *Mark (X) one*
1 ☐ Male 2 ☐ Female 3 ☐ Not stated

10. Ethnicity – *Mark (X) one*
1 ☐ Hispanic or Latino 2 ☐ Not Hispanic or Latino 3 ☐ Not stated

11. Race – *Mark all that apply*
1 ☐ White
2 ☐ Black or African American
3 ☐ American Indian or Alaska Native
4 ☐ Asian
5 ☐ Native Hawaiian or Other Pacific Islander
6 ☐ Other – *Specify* ⤓
7 ☐ Not stated

12. Marital status – *Mark (X) one*
1 ☐ Married 3 ☐ Widowed 5 ☐ Separated
2 ☐ Single 4 ☐ Divorced 6 ☐ Not stated

C. ADMINISTRATIVE INFORMATION

13. Type of Admission – *Mark (X) one*
1 ☐ Emergency 3 ☐ Elective 5 ☐ Items not available/unknown
2 ☐ Urgent 4 ☐ Newborn

14. Source of Admission – *Mark (X) one*
1 ☐ Physician referral
2 ☐ Clinical referral
3 ☐ HMO referral
4 ☐ Transfer from a hospital
5 ☐ Transfer from SNF
6 ☐ Transfer from other health facility
7 ☐ Emergency room
8 ☐ Court/Law enforcement
9 ☐ Other – *Specify* ⤓
10 ☐ Item not available

15. Status/Disposition of patient – *Mark (X) appropriate box(es)*

Status — Disposition
1 ☐ Alive ⟶ **a.** ☐ Routine discharge/discharged home
b. ☐ Left against medical advice
c. ☐ Discharged, transferred to another short-term hospital
d. ☐ Discharged, transferred to long-term care institution
e. ☐ Other disposition/not stated
2 ☐ Died
3 ☐ Status not stated

16. Expected source(s) of payment

	Principal *Mark one only*	Other additional sources *Mark all that apply*
1. Worker's compensation	☐	☐
2. Medicare	☐	☐
3. Medicaid	☐	☐
4. Other government payments	☐	☐
5. Blue Cross/Blue Shield	☐	☐
6. HMO/PPO	☐	☐
7. Other private or commercial insurance	☐	☐
8. Self pay	☐	☐
9. No charge	☐	☐
10. Other – *Specify* ⤓	☐	☐

☐ No source of payment indicated

(Over)

D. MEDICAL INFORMATION

17. Admitting Diagnosis

	ICD-9-CM Code	Description
Admitting diagnosis		

18. Final diagnoses (up to 7 diagnoses including E-codes) *(Enter ICD-9-CM codes as well as narrative if available.)*

Diagnosis	ICD-9-CM Code	Description	Present on admission
Principal diagnosis			1☐ Yes 2☐ No 3☐ Unknown 4☐ Clinically undetermined 5☐ No information on face sheet
Diagnosis 2			1☐ Yes 2☐ No 3☐ Unknown 4☐ Clinically undetermined 5☐ No information on face sheet
Diagnosis 3			1☐ Yes 2☐ No 3☐ Unknown 4☐ Clinically undetermined 5☐ No information on face sheet
Diagnosis 4			1☐ Yes 2☐ No 3☐ Unknown 4☐ Clinically undetermined 5☐ No information on face sheet
Diagnosis 5			1☐ Yes 2☐ No 3☐ Unknown 4☐ Clinically undetermined 5☐ No information on face sheet
Diagnosis 6			1☐ Yes 2☐ No 3☐ Unknown 4☐ Clinically undetermined 5☐ No information on face sheet
Diagnosis 7			1☐ Yes 2☐ No 3☐ Unknown 4☐ Clinically undetermined 5☐ No information on face sheet

19. Surgical and Diagnostic Procedures (up to 4 procedures) *(Enter ICD-9-CM codes as well as narrative if available.)*

Procedure	ICD-9-CM Code	Description	Date of Procedure(s)		
			Month	Day	Year
Principal procedure					
Procedure 2					
Procedure 3					
Procedure 4					

☐ **No procedures**

Comments

Completed by	Date