2014

An Evaluation of Prenatal Care Clinic Selection and the Association with Subsequent Process/Outcome Measures among Medicaid Beneficiaries

Lynn VanderWielen
Virginia Commonwealth University

An Evaluation of Prenatal Care Clinic Selection and the Association with Subsequent Process/Outcome Measures among Medicaid Beneficiaries

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

Lynn M. VanderWielen
MPH, Johns Hopkins Bloomberg School of Public Health, 2010
BNS, Biology, University of Wisconsin – Madison, 2007

Director: Gloria J. Bazzoli, PhD
Bon Secours Professor
Department of Health Administration

Virginia Commonwealth University
Richmond, Virginia
April 2014

Acknowledgements

From the moment I came into this world I was taught the importance of an education. I was, and still am, my dad's faithful sidekick. From our journeys to the Wolf River to see the duck hatchlings, to fixing anything broken in our house, he has taught me to question everything and to admire the natural order in our world. He introduced me to the concept of the scientific method and always encouraged my sister and I to think outside of the box. My mom exposed me to volunteering and taught me to appreciate everything I have been fortunate to have in my life. She brought me with my Nana during their weekly tradition of volunteering together at the local clothing resource for the poor. Meanwhile my sister has supported my interests and encouraged my passions, even when they led me abroad to work in Mexico at the dismay of many around me. She is a cornerstone in my life, offering inspiration and unwavering encouragement. My husband is the steadfast foundation of my graduate studies. Together we have trekked together through our doctoral degrees, and without his boundless love I would not be the person I am today.

I love you Mom, Dad, Beth and Alex. Thank you for being in my life.

This work and training would not have been possible without the guidance and support of my dissertation committee. Dr. Gloria Bazzoli has offered expert direction to this work in addition to mentorship beyond the classroom. I am forever grateful for her agreement to serve as my dissertation chair and her support of my research interests. Dr. Saba Masho has proven an invaluable mentor throughout my PhD training. She allowed me the experience of collecting primary data and working with others dedicated to improving the health of underserved populations in our nation and abroad. Dr. Patricia Edinboro has offered ongoing guidance and encouragement, especially when challenges seem insurmountable. Her thoughtful critique inspires one to observe issues and questions from a different perspective, in turn strengthening one's understanding of a topic. Dr. Dave Harless has offered his detailed insight into study design and has non-judgmentally corrected my many mistakes along the way. I aspire to emulate this ability in my life.

In addition to those serving on my committee, I have been very fortunate to have support from many others. Thank you to Dr. Jan Clement for supporting all of the PhD students throughout their time in the Department and beyond. Thank you to professors Drs. Ameringer, Graboyes, Kovec, Luke, McCue, McClelland, Mick, Ozcan and White for your time in the classroom and your commitment to education. Thank you to Dr. DeShazo for letting me use your super computer. Thank you to Carolyn Wells for your help along the way and your listening ear. Thank you to Beth Ayers for always taking a moment to say hello, and to Rochelle Clark for making sure I had everything I needed on my computer to get through the day.

Thank you to my brother-in-law Josh Jurrens, who has offered his impeccable talent for design and style to create and improve figures throughout my dissertation work and beyond.

Finally, thank you to the many colleagues and friends I have gained along the way. Thank you to Patrick Shay for supporting me during my first teaching experience and to Marisa Roczen for always taking the time to brainstorm with me. Thank you to Amy Pakyz for the countless hours spent together and the many lunches we have shared. Thank you to

Jennifer Early, Tina Highfill and Matt Depuccio for your support and kindness. I am honored and grateful to have crossed paths with you all.

Table of Contents

List of Tables

List of Figures

Abstract

AN EVALUATION OF PRENATAL CARE CLINIC SELECTION AND THE ASSOCIATION WITH SUBSEQUENT PROCESS/OUTCOME MEASURES AMONG MEDICAID BENEFICIARIES

By Lynn M. VanderWielen, PhD, MPH

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University

Virginia Commonwealth University, 2014

Director: Gloria J. Bazzoli, PhD
Bon Secours Professor, Department of Health Administration

In 2010 Medicaid financed approximately 48% of all births in the United States and nearly 30% of all births in Virginia. Due to strict state-specific eligibility criteria, many low-income women qualify for Medicaid coverage exclusively as a result of pregnancy status. As the nation moves forward with the Patient Protection and Affordable Care Act (PPACA), state-elected Medicaid expansion has the potential to expand services to women of reproductive age that would precede pregnancy events and offer continuous access to care postpartum. Despite this potential influx of newly insured women, little is known about how this population may make decisions regarding reproductive healthcare services and if these selections influence process and outcome measures.

This study examines two research aims that provide insight into these knowledge gaps. First, utility theory and discrete choice modeling is used to examine clinic and patient level factors associated with clinic type choice. Specifically, this study examines the role of

high risk pregnancy status and travel distance to clinic as associated with clinic selection. Second, Donabedian's Structure, Process, Outcome framework provides a conceptual lens to examine if clinic selection is associated with maternal and infant measures. The linear probability model and logistic regression models are employed to examine two process measures, including prenatal care inadequacy and postpartum visit nonattendance, and three outcome measures including maternal long acting reversible contraceptive method (LARC) use and infant birthweight and gestational age.

Results examining clinic type selection reveal significant associations between independent and dependent variables. Women experiencing a high risk pregnancy are significantly more likely to select a hospital based clinic for care, compared to women experiencing a normal risk pregnancy. However, when specifically examining women experiencing their first pregnancy, this association is no longer significant. Additionally, as distance to clinic type increase, women are significantly less likely to select that clinic type for prenatal care.

Clinic selection was found to be significantly associated with maternal measures, but not significantly associated with infant outcomes. Selecting a public health department or Federally Qualified Health Center for prenatal care services was associated with a significant decrease in inadequate prenatal care, postpartum visit nonattendance, and non-LARC use compared to a private physician office. Clinic type selection, however, was not found to be significantly associated with infant outcomes including preterm birth and low birthweight babies.

Results from Research Aim 1 have a variety of implications for clinic and public policy and offer guidance for future research. Clinics that seek to provide care to pregnant

Medicaid beneficiaries should examine local residential patterns of current and potential future pregnant Medicaid recipients and consider how these might affect decisions about future clinic locations. Results suggest that women are more likely to attend clinic types closer to their area of residence, and this close proximity may have additional implications beyond shorter travel time to clinic including the minimization of transportation and childcare issues.

Results from Research Aim 2 analyses offer a variety of public policy implications and guidance for future research. This research provides evidence that public health facilities including public health departments and FQHCs have improved prenatal care adequacy and postpartum visit attendance compared to private physician offices, providing evidence that public funding should continue for these facility types. As the United States moves forward with PPACA, healthcare organization administration should turn to the public facilities in their communities to learn how to manage and improve the health of these patient populations and ultimately aim to improve access and quality care among the nation's most vulnerable populations.

Chapter 1 - Introduction

Background and Significance

In March 2010 President Obama signed the historical Patient Protection and Affordable Care Act (PPACA) into legislation. Since, one major provision, Medicaid expansion, has been delegated to states to decide its fate. As of March 2014, the Commonwealth of Virginia has elected to not expand Medicaid eligibility services to the hundreds of thousands of low-income uninsured Virginians who currently do not meet eligibility criteria but would qualify based on new standards. Virginia has one of the strictest general Medicaid eligibility criteria in the United States, allowing for individuals who earn less than 30% of the Federal Poverty Level, amongst other requirements, to receive coverage. However, these criteria are expanded to 133% of the FPL for pregnant women or 200% of the FPL for enrollment in the Family Access to Medical Insurance Security (FAMIS) Medicaid Plan (Department of Medical Assistance Services, 2012).

In 2012 over nearly 4 million births were registered in the United States alone (J. Martin, Hamilton, Osterman, Curtin, & Matthews, 2014). In 2006, Medicaid was the primary payer for approximately 48% of births in the United States and 30% of births in Virginia (Sonfield, Kost, Gold, & Finer, 2011). Medicaid insurance provides qualifying low-income women with access to prenatal and postpartum care, and disproportionately covers the poorest and sickest populations in the United States (The Henry J. Kaiser Family Foundation, 2012). A number of studies have evaluated maternal/child health programs including pregnant Medicaid beneficiaries, yet researchers have called for further evaluations to help appropriately target resources and improve maternal/child health (Taylor & Nies, 2012).

National groups have advocated for improvements to maternal and infant health outcomes. For example, Healthy People 2020, the 10-year national initiative launched by the Department of Health and Human Services, focus on a variety of health indicators including those aimed at mothers and children. These heath indicators include goal 10.2 that aims to increase the proportion of pregnant women who receive early and adequate prenatal care, goal 19 that intends to increase the proportion of women who attend a postpartum visit, goals 8.1-8.2 that intend to reduce low birth weight and very low birthweight babies, and goals 9.1 through 9.4 that aim to reduce preterm birth (Department of Health and Human Services, 2010). Federal policy makers have also targeted improved access to prenatal care among uninsured women with the use of maternal-child health block grants and improved coverage through the Children's Health Insurance Program (Behrman & Butler, 2007).

Potential Medicaid expansion in response to the PPACA will theoretically offer eligible uninsured women of reproductive age Medicaid benefits that could precede pregnancy events and offer continuous access to care postpartum. This newly insured population would begin to make decisions on where to receive reproductive healthcare. Despite this potential influx of newly insured women, little is known about how this population would make healthcare decisions for reproductive healthcare and the subsequent consequences of these decisions. This research offers insight into decision-making criteria of pregnant Medicaid beneficiaries in the Commonwealth of Virginia and the association between type of clinic selected for prenatal care and maternal/infant processes and outcomes of care.

Research Aims

This study examines Virginia Medicaid beneficiaries to provide insight into two research aims that concentrate on maternal and infant health. The first research aim intends to describe the clinic and patient level factors that are associated with prenatal care setting type by Medicaid beneficiaries. Clinic types are divided into public health departments, Federally Qualified Health Centers, hospital-based clinics and private physician offices (non-hospital based). The second research aim investigates the role of prenatal care clinic type in maternal and infant process and outcome measures. Maternal measures include inadequate prenatal care, postpartum nonattendance and non-long acting reversible contraceptive (LARC) use. Infant outcomes include preterm birth and low birthweight status.

- Research Aim 1. Describe clinic and patient factors that are associated with choice of prenatal care setting by Medicaid beneficiaries.
- Research Aim 2. Is prenatal care setting associated with infant and maternal health outcomes and/or maternal health care utilization?

Theoretical and Conceptual Framework

As this research is divided into two distinct aims, each aim utilizes a specific theoretical or conceptual framework. First, utility theory and discrete choice modeling frames research aim one and its two respective hypotheses. These hypotheses specifically examine the role of distance to clinic and high risk status among Medicaid beneficiaries. The second aim employs Donabedian's (1966) Structure, Process, Outcome (SPO) framework to conceptually frame the analysis for Research Aim 2 which examines if prenatal care clinic type is associated with a variety of maternal and infant measures.

Analytical Approaches

Two distinct analyses are used to provide insight into the two research aims. First, discrete choice methods are explored. Ultimately a nested logit model is selected to provide insight into these hypotheses and results demonstrate that both distance to clinic type and high risk status are associated with clinic selection, to varying degrees. Second, a linear probability model (LPM) is applied to maternal measures with the use of instrumental variables (IVs) generated in Research Aim 1 for actual clinic type choice. Infant outcomes are evaluated using a logistic regression model with actual choice as the main independent variables of interest.

In addition to the main analysis, a number of sensitivity analyses are also conducted. As guided by relevant literature and the SPO framework, maternal process measures are examined to describe potential mediating effects present between clinic type selection and study outcomes. Evidence suggests that postpartum visit attendance mediates clinic type selection and non-LARC use, and prenatal care adequacy mediates the association between clinic type selection and infant outcomes including preterm birth and low birthweight. Other sensitivity analyses provide insight into study robustness.

Several limitations are discussed in relation to each study aim, in addition to relevant policy implications of study results. Individual clinics that currently provide reproductive healthcare services to Medicaid beneficiaries, or those who aim to meet the needs of the potential influx of newly covered Medicaid beneficiaries pending Medicaid expansion, can use these results as guidance for appropriate locations of new clinic sites and clinic characteristics that are attractive to this population. In addition, state policy makers can use findings to enhance the current public health infrastructure to provide care to underserved populations, including Medicaid beneficiaries.

Organization of Subsequent Chapters

This paper is organized into six chapters. This chapter (Chapter 1) provided a brief introduction to the study and outlined how the dissertation is organized. Chapter 2 provides an in-depth discussion of relevant literature and background material to frame the research aims. Chapter 3 describes and applies utility theory and Donabedian's (1966) Structure, Process, Outcome framework to develop three study hypotheses. Chapter 4 describes the study data in addition to the two methodologies employed to evaluate the three hypotheses. Additionally, Chapter 4 describes the sensitivity analyses that are undertaken. Chapter 5 provides results from the analyses, and Chapter 6 provides a detailed discussion of study results in addition to study limitations and policy implications.

Chapter Two – Literature Review

Introduction

This chapter presents themes in the research literature that provide a unique understanding of the two study research aims:

- Research Aim 1. Describe clinic and patient factors that are associated with choice of prenatal care setting type by Medicaid beneficiaries.
- Research Aim 2. Is prenatal care setting associated with infant and maternal health outcomes and/or maternal health care utilization?

The themes discussed in this chapter are divided into two sections. First, literature related to prenatal care clinic selection is reviewed. Topics of interest include literature related to differences in care between primary care organization types, hospital selection, and obstetric and primary care physician. Second, literature related to perinatal care processes and outcomes are reviewed. These include maternal and infant-specific process measures (i.e. prenatal and postpartum care attendance) and outcome measures (i.e. birthweight, gestational age and long-term reversible contraceptive use).

Part One: Clinic Selection

The two research aims intend to provide insight into clinic selection among pregnant Medicaid beneficiaries. For this study, clinic selections of interest include Public Health Departments, Federally Qualified Health Centers, non-hospital based private physician offices, and hospital-based clinics. It is important to understand how care may vary across different organizational settings as a precursor to examining patient choice of setting. This section explores this area first before examining what existing literature reveals about the clinical factors associated with prenatal care selection.

Primary Care Organizations and the Relevance of Healthcare Setting.

Primary care organization types have been documented to provide varied care and produce different outcomes among different patient populations and disease conditions. For example when comparing private physician offices to public family planning facilities, it was found that contraceptive education, general medical care and patient satisfaction varied between organization types (Radecki & Bernstein, 1989). Similarly, risk-adjusted birth outcomes differ between private clinics and public health departments (Simpson, Korenbrot, & Greene, 1997). Additional primary care organization differences have been demonstrated between general and specialty mental health care (Wells, Rogers, Burnam, Greenfield, & Ware Jr, 1991), and private versus academic pediatric clinics when examining infant sleep position instruction (Ray, Metcalf, Franco, & Mitchell, 1997).

Organization type is especially relevant for prenatal and postpartum care. Although public clinics that provide care to low-income women often provide a wide variety of ancillary services important to this population, public clinics often suffer staff shortages, time pressures and often utilize scheduling practices inconvenient for low-income individuals (Oropesa, Landale, & Kenkre, 2002). Women have demonstrated preferences for clean, relaxed settings with informal environments conducive to interaction (Blackwell, 2002; Handler, Raube, Kelley, & Giachello, 1996; Handler, Rosenberg, Raube, & Lyons, 2003; Novick, 2009; Sword, 2003), and such environments may vary across organization types due to varying resources. Low-income prenatal care recipients prefer continuity among healthcare professionals (Sheppard, Zambrana, & O'Malley, 2004) yet some prenatal care clinics do not foster a patient/provider relationship with any one clinician over the course of the pregnancy.

The above literature reveals that healthcare organization types may provide varied care. Next, the focus turns to the factors associated with healthcare services selection, specifically, hospital selection. The hospital selection literature serves as a methodological guide to evaluating perinatal care clinic selection. This methodology, introduced below, will be further described in Chapter Four.

Healthcare Setting Choice: Hospital Selection.

Hospital selection, has been examined using a variety of economic theories including utility theory and demand theory, and has been widely evaluated in the academic literature, especially as related to hospital choice in rural areas. The understanding of hospital selection is especially pertinent in rural areas since rural patients often bypass the nearest rural hospital and seek care in urban facilities and other rural hospitals. This phenomenon has been associated with declining volume and increasing closures among rural hospitals (Radcliff, Brasure, Moscovice, & Stensland, 2008). To examine hospital choice, scholars have applied McFadden's Conditional Logit model, which evaluates hospital and patient characteristics that are associated with hospital choice (Adams, Houchens, Wright, & Robbins, 1991; Bronstein & Morrisey, 1991; Escarce & Kapur, 2009; Luft et al., 1990; Phibbs et al., 1993; Roh, 2007; Tai, Porell, & Adams, 2004). While conducting these evaluations, the assumption of independence of irrelevant alternatives is tested before committing of one model of choice. In the cited literature above, the IIA was not violated, so the research utilized McFadden's Conditional Logit. However, if this assumption had been violated the researchers would have applied a nested logit model.

Several factors have been found to be associated with patient hospital selection. These include hospital characteristics such as quality (Luft et al., 1990; Phibbs et al., 1993), scope of service (Adams et al., 1991), teaching status (Adams et al., 1991; Luft et al., 1990; Phibbs et al., 1993), wait times (Monstad, Engesæter, & Espehaug, 2006), number of beds (Tai et al., 2004)and ownership status (Luft et al., 1990; Phibbs et al., 1993). Patient characteristics that are associated with hospital choice include severity of illness (Adams et al., 1991; Phibbs et al., 1993), health status (Tai et al., 2004), distance to hospital (Luft et al., 1990; Tai et al., 2004), age (Adams et al., 1991), marital status (Tai et al., 2004), and sex (Tai et al., 2004). Studies have also examined hospital selection by subsets of patients including Medicare enrollees (Adams et al., 1991; Tai et al., 2004), and pregnant women (Bronstein & Morrisey, 1991; Phibbs et al., 1993).

Hospital selection among pregnant women is especially pertinent to this study. Phibbs et al. (1993) examined hospital delivery selection among pregnant individuals in the San Francisco Bay area and focused on associations between risk status and choice among Medicaid beneficiaries compared to the privately insured. The team postulated that high and low-risk women would make different choices regarding hospital selection, hypothesizing that high risk women would be more likely than low-risk women to travel longer distances and seek hospitals with more resources, as measured by neonatal intensive care unit (NICU) level and teaching status. As anticipated, results of the analysis demonstrated that high risk women were more likely to deliver in high-resource hospitals. However, high risk Medicaid beneficiaries were less likely than their high risk, privately insured counterparts to deliver in hospitals providing specialized care for newborns, and were more likely to deliver in hospitals with worse perinatal outcomes (measured by z-scores calculated from vital records data). The authors suggested that high risk Medicaid beneficiaries face additional barriers to appropriate delivery locations, such as transportation issues (Phibbs et al., 1993).

Bronstein and Morrisey (1991) examined rural hospital bypass for obstetrical care, and found that distance to care and travel time were important factors when determining hospital choice. When specifically examining low-income and Medicaid populations they found that "economically accessible care", i.e. short travel distance, was a statistically significant factor. The Institute of Medicine advises that geographic accessibility of prenatal care is one of the most important factors associated with pregnancy outcomes (Institute of Medicine, 1988).

Healthcare Setting Choice: Obstetric and Primary Care Providers.

Patients demonstrate a preference for obstetric provider based on the provider's gender and experience (Zuckerman, Navizedeh, Feldman, McCalla, & Minkoff, 2002), and overall provider preferences based on provider age, race, language fluency (Garcıa, Paterniti, Romano, & Kravitz, 2003) and interpersonal skills (Phillips, Chiriboga, & Jang, 2012). Provider/patient racial concordance has been found to be associated with patient satisfaction (Laveist & Nuru-Jeter, 2002), physician selection (Traylor, Schmittdiel, Uratsu, Mangione, & Subramanian, 2010a), and medication adherence (Traylor, Schmittdiel, Uratsu, Mangione, & Subramanian, 2010b). Nevertheless, contradictory and non-conclusive evidence regarding racial concordance has also been published (Kumar, Schlundt, & Wallston, 2009; Meghani et al., 2009; Schnittker & Liang, 2006).

Dobie et al. (1994) specifically examined prenatal care provider selection between high and low-risk pregnancies, assuming that high risk women would be more likely select specialists (OB/GYN) versus family physicians for prenatal care. However, they found that women did not select providers based on risk status as hypothesized. Instead, high risk women were more likely to select family physicians rather than specialists, particularly rural women. The authors concluded that medical and obstetric risks were not primary factors that influenced provider choice and suggested that patient economics and geography were more important factors (Dobie, Hart, Fordyce, & Rosenblatt, 1994).

Contribution to the Literature.

This study will contribute to the literature by connecting the above research and filling in knowledge gaps related to clinic selection. As described above, it is understood that individuals make healthcare selection decisions based on a variety of clinic-specific and individual-specific characteristics. When examining hospital selection, the literature suggests that the role of travel distance and risk-status among pregnant women are important factors associated with clinic choice. Despite this understanding, the role of these factors, to the author's knowledge, has yet to be examined when focusing on perinatal clinic selection. This study will specifically address these questions and provide insight into selection of perinatal care clinic among Medicaid beneficiaries.

Part Two: Outcomes and Processes of Care

To further examine the potential role of clinic selection, the following section describes clinical and individual factors associated with several infant and maternal perinatal processes and outcomes. These descriptions will serve to select appropriate covariates for examining each outcome of interest. The potential association between clinic selection and process and outcomes of care are of importance to clinicians, administrators and policy makers as the healthcare industry seeks to improve access and quality of care with the Patient Protection and Affordable Care Act.

Infant Outcomes: Birthweight.

Very low birthweight infants (weighing 1,500 grams or less), and extremely low birthweight infants (weighing less than 1,000 grams) are at risk to develop a myriad of short and long-term health problems (Eichenwald & Stark, 2008). Low birthweight infants are admitted to neonatal intensive care units at higher rates than normal birthweight babies, are more vulnerable to illnesses, including respiratory distress (McIntire, Bloom, Casey, & Leveno, 1999) and face an increased risk of hospital readmission following initial discharge from the hospital (Brooten et al., 1986; Doyle, Ford, & Davis, 2003; Luu, Lefebvre, Riley, & Infante-Rivard, 2010). Low birthweight and small for gestational age survivors experience learning challenges and high rates of school failure (Chaikind & Corman, 1991; Moster, Lie, & Markestad, 2008) in addition to increased risk of adult coronary heart disease and stroke (Rich-Edwards et al., 1997). Low birth weight is determined by gestational duration and the fetal growth rate, therefore low birthweight is a result of preterm birth and/or intrauterine growth restriction (IUGR) (Kramer, 1987).

Risk factors for IUGR include cigarette smoking or exposure to second or third hand tobacco smoke (Wu Wen et al., 1990), alcohol/drug use (Windham, Fenster, Hopkins, & Swan, 1995), race, short stature, low BMI (Neggers & Goldenberg, 2003; Osrin & de L Costello, 2000), low weight gain during pregnancy (Alexander & Korenbrot, 1995; Kramer, Seguin, Lydon, & Goulet, 2000), and poor maternal nutrition (Gertler & Boyce, 2001). Prenatal care clinicians therefore aim to reduce IUGR through screening for, and subsequently addressing, modifiable risk factors such as cigarette smoking, low BMI, low weight gain during pregnancy and maternal nutrition (Rosen, 1989). Clinicians also consider the implications of non-modifiable factors such as maternal race when determining treatment, as such factors have been shown to be associated with maternal stress among African American mothers.

Additional research suggests that the racial disparities related to maternal and infant health outcomes may be associated with stress specific to African-American women. Stress can be conceptualized into two components when examining maternal and infant health racial disparities: the cumulative lifetime effect of stress (allostatic load) (McEwen, 1998) and stress during the prenatal care period (Lobel et al., 2008; Rosenthal & Lobel, 2011). There are three unique sources of stress for pregnant African American women that accumulate and elevate risk for poor birth outcomes: the frictional history between the African-American community and the medical system, contradictory social pressures on African-American reproduction, and stereotypes and racism related to African-American sexuality and sexual behavior (Giscombé & Lobel, 2005; Lobel et al., 2008).

Research has demonstrated that everyday racial discrimination is associated with low birthweight babies, mediated by depressive symptoms (Earnshaw et al., 2013). Health disparity researchers have also examined the interaction of lifetime racism and blood pressure, as associated with birthweight. Hilmert et al. demonstrated that experiencing racism as a child is associated with increased diastolic blood pressure during pregnancy, subsequently associated with lower birthweight babies (Hilmert et al., 2013). Pregnancy-specific stress has also been shown to be directly associated with an increased odds of very low birthweight babies (Collins et al., 1998).

Neighborhood and environmental factors are also associated with infant birthweight. Environmental factors have been measured using neighborhood level variables such as poverty, unemployment, socioeconomic status, rent, percentage of African-American residents, percentage of young residents and the crowded housing rate (O'Campo, Xue, Wang, & Caughy, 1997; Roberts, 1997). Neighborhood level indicators in Chicago metropolitan area, including housing cost and community economic hardship, have been demonstrated to be significantly positively associated with low-birthweight (Roberts, 1997). Research has also demonstrated that individual risk factors for low birthweight babies interact with neighborhood characteristics (O'Campo et al., 1997). Stressful living environments, measured by violent crime and reduced volunteerism in Chicago neighborhoods, are reported to be significant predictors of birthweight (Morenoff, 2003). Researchers examining mother's perception of neighborhood factors as associated with birth outcomes found that women who indicated a negative perception of their neighborhood, as related to police protection, safety, friendliness, cleanliness, quietness and educational opportunities, were more likely to deliver lower birthweight babies (Collins et al., 1998). Pearl et al. also reported a decline in birthweight associated with higher unemployment levels among African-Americans in California (Pearl, Braveman, & Abrams, 2001).

To isolate the potential hereditary and social factors associated with infant birthweight, researchers have utilized extensive data sets comparing infant birthweight s of infants born to US-born White women, US-born black women, and African-born black women. David and Collins (1997) utilized Illinois Department of Public Health birth-certificate data from 1980 to 1995, and found that when adjusting for known maternal risk factors, infants born to recent black immigrants from Africa weighed more than infants born to black US-born women. In fact, birthweight among infants with African-born mothers more closely resembled birthweight of US-born White women (David & Collins, 1997).

Infant Outcomes: Gestational Age (preterm birth).

Preterm birth, occurring before 37 weeks of gestation, accounts for approximately 12.5% of US births (Eichenwald & Stark, 2008; Goldenberg, Culhane, Iams, & Romero, 2008a). Preterm birth attributes to more than 70% of perinatal mortality among infants without fetal anomalies (Guyer et al., 1999). Although most preterm infants survive, preterm birth is associated with an increased risk for gastrointestinal, respiratory and neurodevelopmental impairments and complications (Goldenberg et al., 2008a). Preterm birth is also associated with developmental disabilities and behavioral problems during early childhood and adolescence (Saigal & Doyle, 2008).

A number of maternal factors are associated with preterm birth including maternal race (Vintzileos, Ananth, Smulian, Scorza, & Knuppel, 2002), multiple births (J. A. Martin et al., 2008), previous preterm births, periodontal disease (Goldenberg, Culhane, Iams, & Romero, 2008b; Jeffcoat et al., 2001), bacterial vaginosis infection (Hillier et al., 1995), antenatal depression (Dayan et al., 2006), maternal stress (Wadhwa, Sandman, Porto, Dunkel-Schetter, & Garite, 1993), exposure to environmental toxins such as carbon monoxide (Ritz, Wilhelm, Hoggatt, & Ghosh, 2007), and socioeconomic disadvantage (Beard et al., 2009). Additionally, women who are born preterm are more likely to have preterm deliveries (Emanuel, Filakti, Alberman, & Evans, 1992; Mattsson & Rylander, 2012; Muglia & Katz, 2010; Swamy, Østbye, & Skjærven, 2008). An evaluation of preterm birth of subgroups of black populations in New York City revealed that self-identified African-American women had the highest rates of preterm birth compared to a variety of subgroups including West Indian and Brazilian Black, South and Central American Black, African Black, Puerto Rican Black, European Black, Asian Black, Cuban Black, and US-Born non-Hispanic American White (Howard, Marshall, Kaufman, & Savitz, 2006). Pregnancy-specific stress has also been shown to be directly associated with preterm delivery as measured with the Perinatal Distress Questionnaire (Lobel et al., 2008). Prenatal care services have also been associated with preterm birth, including the number of prenatal visits (Cox, Zhang, Zotti, & Graham, 2011; Herbst, Mercer, Beazley, Meyer, & Carr, 2003; Krueger & Scholl, 2000; Masho, Chapman, & Ashby, 2010; Vintzileos et al., 2002).

Neighborhood and environmental factors have been demonstrated to be associated with preterm birth. Neighborhood disparities may be linked to environmental health risks, such as air pollutants (Parker, Woodruff, Basu, & Schoendorf, 2005) and subsequently to preterm birth. In fact, minority mothers (Hispanic and African-American) are statistically more likely to live in counties with higher mean levels of air pollution when compared to white mothers. Environmental health scholars have postulated that geospatial factors may enhance susceptibility to contaminant exposure (Morello-Frosch & Shenassa, 2006), and health economists have demonstrated that a reduction in traffic congestion reduces prematurity and low birthweight among mothers living within two kilometers of toll plazas (Currie & Walker, 2009). Other researchers have demonstrated associations between ambient air pollution, including exposure to carbon monoxide, and preterm birth (Ritz et al., 2007) and cleanup of toxic waste and congenital abnormalities (Currie, Greenstone, & Moretti, 2011).

Maternal Processes of Care: Prenatal Care Attendance.

The goals of prenatal care include the identification of high risk patients to anticipate and prevent problems before occurrence, patient education and communication, and ensuring a healthy birth outcome (The American Congress of Obstetricians and Gynecologists, 2012). Low-income women also view prenatal services as an opportunity to reduce stress and increase social support

Factors associated with prenatal care attendance and retention include race (Cox et al., 2011; Maupin et al., 2004; Tough, Siever, & Johnston, 2007), education (Maupin et al., 2004), smoking status (Maupin et al., 2004; Tough et al., 2007), insurance status (Maupin et al., 2004), parity (Friedman, Heneghan, & Rosenthal, 2009; Maupin et al., 2004), age (Tough et al., 2007), income(Tough et al., 2007), and history of substance abuse (Friedman et al., 2009; Maupin et al., 2004; Schempf & Strobino, 2009). Barriers to timely prenatal care initiation include unplanned pregnancy, ER utilization for primary care, stress and health insurance issues (A. A. Johnson et al., 2011). Distance, or proximity to clinic, is likely to be associated with prenatal and postpartum care attendance as the shorter the travel distance, the more accessible it is to users (Calvo & Marks, 1973). This is especially relevant to Medicaid beneficiaries who face significant transportation barriers when compared to the privately insured (Cheung, Wiler, Lowe, & Ginde, 2012b). Martin et al. (2005) found that Non-Hispanic African-American women in Virginia were less likely than their non-Hispanic White counterparts to initiate care during the first trimester (77.3% and 90.4%, respectively), while they are more likely to initiate care during the third trimester or not at all (2.0% and 5.8%, respectively). Low-income women also report additional challenges and concerns related to the prenatal care environment, including feeling stereotyped as single mothers on welfare, and feeling objectified rather than respected (Sword, 2003).

In addition to the studies examining prenatal care cited above, Phillippi's 2009 literature review article examined the potential barriers, motivators and facilitators to prenatal care initiation within the general maternal population, including maternal, structural and societal factors. Common maternal barriers to prenatal care access included transportation, finances, needs of existing children and poor motivation to obtain care. Factors considered as poor motivation included unintended pregnancy, abortion considerations, depression, belief that prenatal care is unnecessary and fear of medical procedures. Structural barriers stemmed from clinic and provider issues, including clinic location, hours, delay for initial appointment, wait time, staff attitudes and cost of care. Factors related to provider barriers included poor communication skills, insensitive attitudes, cultural sensitivity, language barriers and lack of a consistent individual provider. Societal barriers included culture, finances, partner characteristics and the significant others' belief about pregnancy and healthcare (Phillippi, 2009).

Maternal Processes of Care: Postpartum Care.

The postpartum visit takes place between 21 and 56 days after delivery and is an essential opportunity for practitioners to engage with women to discuss breastfeeding, transitioning back to work, and postpartum contraceptive use (K. Johnson et al., 2006). Postpartum attendance rates for Medicaid beneficiaries were estimated to be as much as 20% lower than women with private insurance (National Committee for Quality Assurance, 2007).

Bennett et al. qualitatively examined key factors related postpartum visit attendance among mothers experiencing gestational diabetes, and identified key barriers and facilitators to care. Barriers included adjusting to the new baby, concerns of postpartum health and logistics accessing care. Facilitators included childcare availability and patient interest to express concerns or ask questions (Bennett et al., 2011). Women in Healthy Start project areas experiencing unstable housing, provider communication issues, transportation barriers and current receipt of government assistance were less likely to attend their postpartum visit, while women in households earning greater than $15,000, those who received an office reminder for attendance, and those with chronic health conditions were more likely to attend their postpartum visit (Bryant, Haas, McElrath, & McCormick, 2006).

Maternal Outcomes of Care: Postpartum Long Acting Reversible Contraceptive (LARC) Use.

Short interpregnancy intervals are associated with an increased risk of preterm birth (DeFranco, Stamilio, Boslaugh, Gross, & Muglia, 2007; Klerman, Cliver, & Goldenberg, 1998; Zhu, Haines, Le, McGrath-Miller, & Boulton, 2001), low birth weight (Zhu et al., 2001), small for gestational age babies (Zhu et al., 2001), uterine rupture among women with previous low transverse cesarean delivery (Bujold, Mehta, Bujold, & Gauthier, 2002; Esposito, Menihan, & Malee, 2000; Shipp, Zelop, Repke, Cohen, & Lieberman, 2001; Stamilio et al., 2007), premature rupture of membranes, birth defects (Kwon, Lazo-Escalante, Villaran, & Li, 2012), third-trimester bleeding (Conde-Agudelo & Belizan, 2000), and maternal morbidity and mortality (Conde-Agudelo & Belizan, 2000; Conde-Agudelo, Rosas-Bermudez, & Kafury-Goeta, 2007; Erickson & Bjerkedal, 1979). To optimize minimum interpregnancy intervals (to 18-24 months), women are counseled to utilize contraceptive measures.

Long-acting, reversible contraceptive (LARC) methods are the most effective form of reversible birth control and have low failure rates: etonogestrel contraceptive implant (failure rate: 0.001%), lovonorgestrel intrauterine system (IUD) (failure rate: 0.14%), the copper IUD (failure rate: 0.7%) and injectables (Hairon, 2008; Winner et al., 2012). All of these products are available to Medicaid beneficiaries. However, since Medicaid benefits terminate postpartum (for individuals who do not qualify based on other criteria), providers likely consider the implications of employing LARC methods with this population since injections and IUDs require follow-up care that may not be covered.

Long-term reversible contraception use is associated with provider practice patterns (Harper et al., 2008; Madden, Allsworth, Hladky, Secura, & Peipert, 2010), women's knowledge (J. D. Forrest, 1996; A. Glasier, Scorer, & Bigrigg, 2008) and high up-front costs (Trussell et al., 2009). However, when financial barriers are removed women are more likely to select LARC methods (Secura, Allsworth, Madden, Mullersman, & Peipert, 2010).

Contribution to the Literature.

The ultimate goal of perinatal care is to optimize mother and infant health by assessing and mitigating risk through the provision of quality care (American College of Obstetricians and Gynecologists, 2012). The above literature review described quantifiable process and outcome measures to provide insight into quality of care delivered in perinatal clinic settings. To the author's knowledge, this study is the first to examine potential associations between process and outcomes of care, and perinatal clinic selection. This understanding is important to the programing and policy discussions surrounding the provision of care through government-funded programs. Medicaid finances a large proportion of pregnancy care in the United States and specifically provides care to women who would otherwise be uninsured. As the United States moves forward with the Patient Protection and Affordable Care Act and an increased number of women are potentially covered by Medicaid services for pregnancy services, clinician, administrators and policy makers alike will be increasingly interested in how Medicaid funds are spent and the broadly defined outcomes in which they achieve.

Chapter Three - Methodology

Introduction

This chapter provides a theoretical and conceptual foundation for the two research aims:

- Research Aim 1. Describe clinic and patient factors that are associated with choice of prenatal care setting by Medicaid beneficiaries.
- Research Aim 2. Is prenatal care setting associated with infant and maternal health outcomes and/or maternal health care utilization?

First, utility theory is explored to guide the analysis of prenatal clinic selection. This theory, inextricably tied to McFadden's Conditional Logit and nested logit models (described in detail in Chapter 4), describes individual and choice specific attributes that affect patient choice. Two hypotheses are developed from utility theory for this study. Second, the Structure, Process, Outcome framework for evaluation of quality care, is examined. This framework was originally described by Donabedian and has been commonly used to assess quality of care (Donabedian, 1966). This framework is used to propose one additional hypothesis.

Part One: Utility Theory and Clinic Selection

The theoretical framework for the first research question postulates that individuals make selections to maximize utility based on their valuation of the relative attractiveness of available choice options (Akiva & Lerman, 1985; Goldman & Romley, 2008; Tai et al., 2004) and to maximize their utility function. Patient *i* is assumed to choose a clinic j to maximize the utility function:

$$U_{ij} = \beta_j * Z_{ij} + \gamma_j * (Z_{ij*} x_i) + \epsilon_{ij}$$

Therefore the patient will choose clinic with highest utility U_{ij}, when $U_{ij} \geq U_{ij'}$ where $j' \neq j$.

Prenatal care clinic choice options include public health departments, Federally Qualified Health Centers (FQHC), hospital-based clinics and private physician offices (non-hospital based). The framework assumes that each individual has a defined choice set of providers and the individual makes a selection by considering two distinct characteristic sets. First, choice depends on a vector that includes clinic characteristics (vector Z_{ij}). Second, choice depends on individual patient characteristics (vector x_i). An individual will maximize their utility based on their evaluation of options based on these two vectors (Terry Long, 2004) comparing all available alternatives (Lancsar & Savage, 2004). Unlike other choice theories, McFadden's conditional logit and nested logit models allow for varied choice sets among participants. In other words, if an alternative is not available to an individual, this choice will not be taken into account (Hoffman & Duncan, 1988).

In conjunction with other patient-level characteristics that will be described below and in Chapter 4, of great importance is pregnancy risk-status. As noted in Chapter 2, prior research has examined risk-status in conjunction with hospital and provider selection and compared privately insured individuals to Medicaid beneficiaries. When researchers examined hospital delivery selection, it was concluded that high risk Medicaid beneficiaries were less likely than their high risk privately insured counterparts to deliver in high-resource settings (Phibbs et al., 1993). Similarly, high risk Medicaid beneficiaries were less likely to select specialized physicians than their high risk, privately insured counterparts (Dobie et al., 1994). These researchers concluded that other unobserved factors, such as geography, confounded the tested associations. Since, this study will include previously omitted covariates including measures of travel distance, the following is hypothesized:

H1: High risk status among Medicaid beneficiaries is positively associated with selection of hospital-based clinics or non-hospital based private physician offices for prenatal care services.

The second patient-characteristic covariate of particular interest to this study is distance to clinic. Medicaid beneficiaries face significant transportation barriers (Bishop & Brodkey, 2006; Cheung et al., 2012b; Hakim & Bye, 2001) and often rely on public transportation, rides from others, and Medicaid-provided transportation (Raphael, 2001). Increased travel distance, or travel time, incurs a higher opportunity cost for individuals, including time off from employment and childcare.

Travel distance, or travel time, has been found to be associated with spatial patterns of care utilization. For example, travel distance has been found to be associated with hospital utilization and selection (Bronstein & Morrisey, 1991; McGuirk & Porell, 1984), mammography screening (Hyndman, Holman, & Dawes, 2000; Maheswaran, Pearson, Jordan, & Black, 2006), and oncology post-operative radiation therapy (Athas, Adams-Cameron, Hunt, Amir-Fazli, & Key, 2000). Therefore, the following hypothesis is proposed:

H2: Increased distance to a given prenatal care clinic type will be negatively associated with the choice of that clinic option among Medicaid beneficiaries.

Additional individual level and clinic level characteristics will also be examined. These variables will be extensively described in Chapter 4. Briefly, individual level characteristics include demographic information and clinic level characteristics, including clinic capacity and clinician characteristics.

Although this analysis is guided by utility theory and prior literature that have used this framework, concepts in behavioral economics suggest that individuals may not maximize utility when making a complicated and complex choice (Frank, 2004; Thaler & Sunstein, 2003). The standard economic model assumes that humans as economic agents act with unbounded rationality. However, behavioral economics argues economic agents act with bounded rationality as individuals are unable to appropriately identify options with the highest utility given available information (Mullainathan & Thaler, 2000). Economic agents often make decisions based on heuristics, or mental shortcuts, focusing on only a few aspects of the choice set rather than the entirety of the problem (Kahneman, 2003). This is likely the situation given the vast array of changes that take place during pregnancy. Not only are expecting mothers experiencing major bodily changes, but also pregnancies can strain social support structures, present challenges to living situations and create added financial tension. Given this, concepts grounded in behavioral economics will be explored as appropriate to assist in interpreting empirical findings derived from analysis for Research Aim 1.

Part Two: Structure, Process, Outcome Conceptual Framework

The second research aim examined in this study considers prenatal and maternal care and health outcomes and is informed by a conceptual framework guided by Aday and colleagues' "Structure, Process, Outcome" (SPO) model for evaluating the healthcare system

(Aday, Begley, Lairson, & Balkrishnan, 2004), originally developed by Donabedian (Donabedian, 1966). Several researchers have applied the SPO framework to examine perinatal care quality suggesting it is an appropriate framework for assessing perinatal processes and outcomes (Lindmark & Langhoff-Roos, 2004; Oropesa et al., 2002; Peabody, Gertler, & Leibowitz, 1998; Profit, Zupancic, Gould, & Petersen, 2007).

The SPO framework describes structures, processes and outcomes of care as three categories of variables that may impact quality of care. Structures refer to the organization, patient characteristics, the availability and financing of health system resources, and environmental factors such as those related to the economical, social and physical environment. Processes include all the technical and interpersonal interactions between patients, providers and other healthcare actors. Finally, outcomes include the consequences of healthcare on individual patients or patient populations. Structures, processes and outcomes of care are unidirectionally associated with one another, as structures influence processes, and processes influence outcomes of care (Aday et al., 1999; Aday et al., 2004; Donabedian, 1980). Figure 1 provides a visual representation of the SPO framework specific for this study.

The study's second research aim examines the role of structures on the outcomes and processes of care. In particular, infant outcomes include gestational age and birthweight. One maternal outcome of interest includes long-acting reversible contraceptive (LARC) use. Processes of care of interest to this study include prenatal and postpartum care as these visits provide an opportunity for the patient and provider engagement to potentially modify and improve maternal and infant outcomes (S. M. Campbell, Roland, & Buetow, 2000).

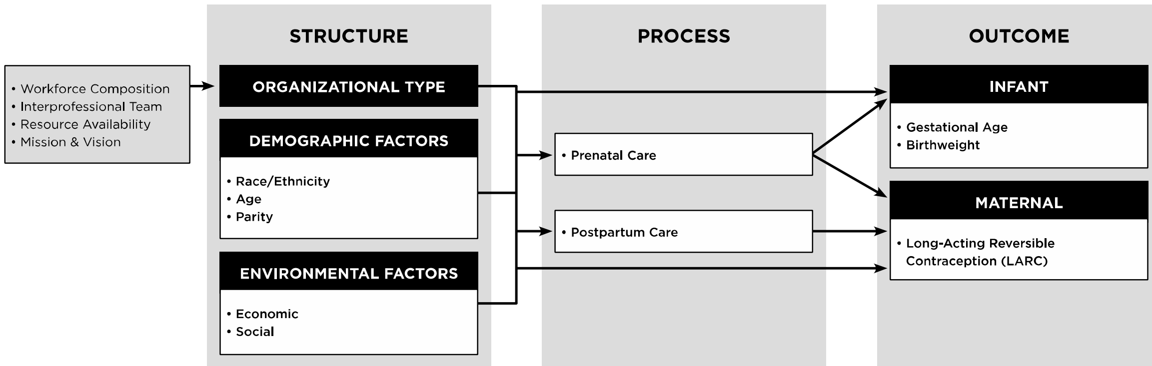

Figure 1. Conceptual Framework as guided by Donabedian (1966).

The structures of perinatal care are of particular interest to this study as it relates to the type of clinic selected by a pregnant woman. Previous literature has examined how *specific components* of a health care organization (e.g., clinic cleanliness) are associated with maternal and infant care processes and outcomes. However, this study aims to evaluate the *overall* organizational setting rather than the specific components of the organizational setting. Therefore, the prenatal care setting should be considered as a package of internal structures, as indicated in Figure 2 and described here. Four discrete differences between organization types include workforce composition, reliance on an interprofessional team, resource availability and the mission and vision of the organization.

Prenatal care settings vary in regards to workforce composition and use of the multidisciplinary/interprofessional team (Simpson et al., 1997). For example, FQHCs must provide an array of primary care services on site or under contract, including pharmacy, dental, preventative health, case management, radiological and basic lab services (US Department of Health and Human Services, 2006), and therefore utilize an interprofessional team approach to care delivery. Public health departments employ physicians, nurse practitioners, nurses and social workers to work in prenatal care populations. Private clinics are staffed with medical personnel with extensive training to handle clinical complications (Abel, 1994), but often do not employ interprofessional support services, such as social workers and dieticians, to meet the unique needs of low-income populations (Simpson et al., 1997). For example, studies have shown that pregnant women are more likely to receive targeted health education, such as drug counseling, in public parental care settings after controlling for patient demographic characteristics. This may result from the comprehensive and multidisciplinary nature of such clinics (Freda, Andersen, Damus, & Merkatz, 1993; Gilbert et al., 2007; Kogan, Alexander, Kotelchuek, & Nagey, 1994).

Prenatal care clinics offer a variety of supplementary resources to clients, but the nature of these resources vary by clinic type. As noted above, by mandate, FQHCs mandatorily offer a wide variety of services. Public Health Departments, such as the Richmond City Health District, offer on-site access to a number of programs such as health promotion, the Richmond Family and Fatherhood Initiative, and the Women, Infant and Children (WIC) supplemental food program (Virginia Department of Health, 2013). Resource availability and enhanced prenatal care support services such as health education and nutrition information in public practice settings has been associated with improved prenatal and maternal health outcomes (Freda et al., 1993; Gilbert et al., 2007; Kogan et al., 1994). Hospital based clinics typically offer a variety of specialty services in close proximity of prenatal care services, including advanced laboratory and imaging capabilities.

Finally, organization missions vary between clinic settings. Federally Qualified Health Centers are required to provide care in medically underserved areas and intentionally focus on the provision of care to uninsured populations. The mission of FQHCs are specifically patient centered, in fact, all FQHC board of directors are composed of a majority of FQHC patients. These organization-specific missions are important structural components that contribute to the variety of services provided and the composition of clinic clientele. This leads to the following hypothesis:

> H3: Maternal and infant processes of care and outcomes will vary for Medicaid beneficiaries based on the setting in which women receive prenatal care, ceteris paribus.

Donabedian's SPO framework also provides insight into relevant covariates for this analysis. As indicated in Figure 1, additional structural characteristics include demographic and neighborhood factors. Included covariates are discussed extensively in Chapter 4, and are specific to the outcome and process measures as guided by the respective literature.

Summary

This chapter developed a theoretical and conceptual framework for studying the two research aims. First, utility theory was explored to guide analysis of perinatal clinic selection. This theory describes individual and choice specific attributes required of modeling choice, and was used to propose two hypotheses. Under guidance from this theory and the respective literature described in Chapter Two, two hypotheses were generated. These hypotheses examine the role of pregnancy risk-status and distance to care on clinic choice.

Second, the Structure, Process, Outcome framework for evaluation of maternal processes/outcomes of care and infant outcomes was examined. This framework was originally described by Donabedian and has been commonly used to assess quality of care

(Donabedian, 1966). This framework was then used in conjunction with the academic literature to propose one additional hypothesis examining the role of perinatal care setting on quality of care. The next chapter will describe the methods used to provide insight into the research aims.

Chapter Four - Results

Introduction

This chapter describes the empirical methods used to evaluate the three proposed hypotheses in Chapter 3. First, this chapter describes research data and sources that are used to examine Research Aims 1 and 2. Second, McFadden's Conditional Logit and Nested Logit models are described. These two approaches serve to evaluate prenatal care clinic selection among Medicaid beneficiaries. Third, the Linear Probability Model (LPM) is described to evaluate perinatal outcomes for Research Aim 2. Sensitivity analyses are also discussed, which will alter certain LPM assumptions to provide insight into the robustness of study findings.

Study Data and Sample

Data to evaluate the two study aims and the three proposed hypotheses are primarily obtained from two sources: a Medicaid managed care organization operating in Virginia and the American Community Survey, a national survey of the US Census Bureau. Virginia Premier Health Plan, Inc., is a managed care organization that contracts with the Virginia Department of Medical Assistance Services to provide Medicaid services to Virginia residents who meet the state's eligibility criteria. Owned by the Virginia Commonwealth University Medical Center, Virginia Premier was created in 1995 and now has the largest Medicaid Service Area among Medicaid plans in Virginia (Virginia Premier

Health Plan, 2013). In November 2013, Virginia Premier provided care to 170,000 individual beneficiaries in seven Virginia regions encompassing 106 counties (Virginia Premier Health Plan, 2013).

Data from Virginia Premier include individual-level service use data involving inpatient, outpatient and prescription drug claims from April 2006 to 2013. This data also include beneficiary demographic information, including race, date of birth, and address (house number, street name, city, state and ZIP code). Virginia Premier data also includes a file with information on the types of clinics at which pregnant women received care (public health departments, Federally Qualified Health Centers, Hospital-based clinics and non-hospital based private physician offices), including information such as the number of health care providers practicing at a clinic and the physical clinic address.

Publically available Zip Code Tabulation Area (ZCTA) data is obtained from the US Census Bureau's American Community Survey. The American Community Survey is an ongoing nationwide survey that randomly selects addresses for survey completion and collects information regarding demographic, social, economic and housing characteristics of the United States' population (United States Census Bureau, 2013). Data is released as one-year, three-year, and five-year estimates. This research utilizes the 2008-2012 five-year data estimate, which included 55,488 Virginia residences and obtained a 97.6% response rate. Five-year estimates utilize 60 months of collected data, provide data on all area types (as one and three-year estimates only include data on areas with populations of over 65,000 and 20,000 people, respectively), and are the most reliable of all estimates (United States Census Bureau, 2013). Data from 2008 to 2012 also align with the 2006 to 2013 timeframe of Virginia Premier beneficiary and clinic data. American Community

Survey data obtained for this research include ZCTA-level race, female-headed households and neighborhood education. These variables will act as neighborhood level control variables for Research Aim 2.

Several exclusion criteria are utilized for this study. First, women are excluded if they are under the age of 18 at time of prenatal care initiation, as adolescent decision making strategies are known to differ from adult processes (Reyna & Farley, 2006). Second, women are excluded if address data is missing, a PO Box address is indicated as physical address or they live in a rural area. Rural addresses are defined as those addresses not located in a Metropolitan Statistical Area (MSA). Missing and PO Box addresses are excluded as a physical address provides the foundation for calculating travel distance to clinic, which is a key explanatory variable. Rural domiciles are excluded as the hospital choice literature suggests that individuals in rural areas select healthcare providers differently than their urban counterparts (Bronstein & Morrisey, 1991). Third, study participants are required to have a clear choice of clinic. This is defined by examining prenatal care visit location frequency. If a women attends more than one clinic for prenatal care, she is excluded from the study if she did not attend one clinic with a higher frequency than her other selections.

An outlier analysis of travel distance is also conducted. This step aims to remove individuals who have erroneously listed addresses and those in atypical circumstances that are not representative of average Medicaid beneficiaries. To compute travel distance, patient and clinic addresses are geocoded using ArcMap10.1. This software allows the user to connect geographical coordinates to a physical address, and subsequently measure distances from the assigned coordinate system. Straight-line distance is calculated between each patient and her selected clinic for prenatal care. The 75th percentile of distance is selected for each Virginia MSA to remove travel distance outliers (Morrisey, Sloan, & Valvona, 1988). Additional, these 75th percentile travel distances by MSA are utilized to define each individual woman's choice set. For example, if the 75th percentile of travel distance in the Richmond MSA is 15 miles, all clinics within 15 miles of each individual living in the Richmond MSA are considered included in her choice set, creating a unique choice set for every study participant.

Clinic designations including public health departments, Federally Qualified Health Centers, hospital clinics and non-hospital based private clinics were identified. Federally Qualified Health Centers are identified using the master file of Federally Qualified Health Centers from the U.S. Department of Health and Human Services, Health Resources and Service Administration (Health Resources and Services Administration, 2014). Clinics are identified as a hospital clinic if they are located on a hospital campus. Public Health Departments are identified by name. Private clinics are designated as such if they did not fit any of the above criteria.

Study data are divided into two parts to avoid simultaneously defining an individual's choice set given a women's specific choice of prenatal care clinic. The first sequential 1/3rd of the sample (pre-analysis) is used to define control variables including clinic specific attributes required for Research Aim 1, while the remaining 2/3rds (study sample) is utilized to obtain estimates for research aims 1 and 2, as described below. For instance, the clinics selected by the individual women included in the pre-analysis sample are considered the available clinics from which to choose. Therefore the clinic characteristics (annual average number of Medicaid beneficiaries and annual number of clinicians providing care to Medicaid beneficiaries) are defined using the pre-analysis data. These variables are utilized to estimate results for research aims 1 and 2. Also to avoid potential endogeneity, the study sample (2/3rds of data) is used to estimate Linear Probability Models to assess potential associations between choice variables and maternal/infant process and outcomes measures. The details regarding these variables are further described below.

Research Aim 1

Study Approach.

To conduct the analysis for Research Aim 1 that focuses on choice of prenatal clinic, a McFadden's Conditional Logit model (McFadden, 1973) is examined followed by a nested model, as the nested model is a direct generalization of the conditional logit model. These cross sectional models include alternative-specific regressors (the vector Z_{ij}) and patient-specific regressors (the vector x_i) (Cameron & Trivedi, 2009), with the advantage that the model considers characteristics of the selected option in addition to the rejected alternatives (Luft et al., 1990). Clinic specific attributes differ by study participant and include information on only the available choices for the individual (Kessler & McClellan, 2000).

Two explanatory variables of interest are evaluated in Research Aim 1: travel distance and risk status. Although travel distance is conceptually defined as a clinic specific variable, travel distance varies by individual and is defined using clinic location for those clinics within the individual's defined choice set and the addresses (house number, street, city, state and ZIP) of the women in the study sample.

As McFadden's Conditional Logit and nested models require a variable for each individual by clinic type, travel distance to each clinic type option is required. Since some clinic types are more numerous than others, specific attention is given to these calculations. For example, one public health department is available per county or major city. Therefore these travel distances are straight forward as the individual has only one choice of public health department. Private physician offices, however, are numerous and an individual has a variety of private physician offices to select from. As this research aim examines *clinic type* selection, rather than *specific clinic* selection, a weighted average clinic distance is calculated. This weighted average incorporates data from each of the private physician offices located in the women's choice set and is tabulated by $\sum_{0}^{i} x_i (\frac{n_i}{N})$. In this equation x represents the distance to clinic i, n_i represents the number of Medicaid beneficiaries at clinic i, and N represents the total number of Medicaid beneficiares attending the clinic type of interest in the specific women's unique choice set. The weighted average is calculated using the location of clinics from the pre-analysis sample and the individual women's address from the analysis sample. The values of n and N are obtained from the pre-analysis sample.

Pregnancy risk status is defined by the American College of Obstetricians and Gynecologists, and includes women with a variety of conditions including hypertension, diabetes, positive HIV status, and Hepatitis C. The ICD-9 coding system utilized by clinicians includes prenatal care visits specific to high risk women and is indicated with the diagnoses codes V23.0 through V23.9 as indicated in Table 1. If a woman has an indication of any of the high risk diagnoses codes, she is considered high risk.

Table 1. *Research Aim 1 Variables*

Explanatory Variables

			Dataset
	Diagnosis Code	**Indication**	
High risk pregnancy Status	V23.0	Supervision of high risk pregnancy with history of infertility	Virginia Premier Claims Data
	V23.1	Supervision of high risk pregnancy with history of trophoblastic disease	
	V23. 2	Supervision of high risk pregnancy with history of abortion	
	V23.3	Supervision of high risk pregnancy with grand multiparity	
	V23.4	Supervision of high risk pregnancy with other poor obstetric history	
	V23.41	Supervision of high risk pregnancy with history of pre-term labor	
	V23.42	Pregnancy with a history of ectopic pregnancy	
	V23.49	Supervision of high risk pregnancy with other poor obstetric history	
	V23.5	Supervision of high risk pregnancy with other poor reproductive history	
	V23.7	Supervision of high risk pregnancy with insufficient prenatal care	
	V23.8	Supervision of high risk pregnancy Supervision of other high risk pregnancy	
	V23.81	Supervision of high risk pregnancy with elderly primigravida	
	V23.82	Supervision of high risk pregnancy with elderly multigravida	
	V23.83	Supervision of high risk pregnancy with young primigravida	
	V23.84	Supervision of high risk pregnancy with young multigravida	
	V23.89	Supervision of other high risk pregnancy	
	V23.9	Supervision of high risk pregnancy Supervision of unspecified high risk pregnancy	

Table 1. *Continued*

	Definition	
Travel Distance to Clinic	$$\sum_{1}^{C} x_i (\frac{n_i}{N})$$ x = distance to clinic i n_i = number of Medicaid beneficiaries at clinic i N = total number of Medicaid beneficiares attending the clinic type of interest in the specific women's choice set.	Virginia Premier Demographic File and Virginia Premier Physician File
Control Variables		
Race	White (referent) and non-white	Virginia Premier Demographic File
Race * Travel Distance	Race * travel distance to clinic (Interaction variable)	
Age	Date of first prenatal care visit – Date of birth	
Parity	Supervision of normal first pregnancy (ICD-9 code V22.0)	
Medicaid Clinic Capacity	Annual average number of Medicaid beneficiaries per clinic (pre-analysis sample)	
Weighted Available Clinicians	$$\sum_{1}^{C} x_i (\frac{n_i}{N})$$ x = number of clinicians (MDs, PA, NP) at clinic i n_i = number of Medicaid beneficiaries at clinic i N = total number of Medicaid beneficiares attending the	
Number of options	Number of available clinics in choice set of each clinic type	

Control variables include other factors that may influence clinic selection among Medicaid beneficiaries, including clinic and individual characteristics. First, since not all clinics are required to accept Medicaid insurance and some clinics focus service on underserved populations including Medicaid beneficiaries, the average annual clinic attendance for Medicaid beneficiaries controls for likeliness of accepting a new Medicaid beneficiary for prenatal care, i.e. clinic capacity. Second, the weighted number of clinicians treating Medicaid beneficiaries controls for the number of available clinicians. Individual control characteristics of interest include patient race, age and parity. These control variables are also found in Table 1.

Analytical Approach.

As noted in Chapter 3, the McFadden Conditional Logit and nested logit models of provider choice are based on a random utility function (equation 1) where patient i's choice is based on clinic j's characteristics (X_{ij}) and the patient's individual level characteristics (Z_i), and an error term ε_{ij}. The probability that an individual will select clinic j over an alternative clinic (j') is defined in equation 2. The odds ratio of alternatives j and j' is defined in equation 3.

Equation 1: $$U_{ij} = \beta X_{ij} + \gamma_j Z_i + \varepsilon_{ij}$$

Equation 2: $$P_{ij} = \frac{\exp(\beta X_{ij} + \gamma_j Z_i)}{\sum \exp(\beta X_{ij} + \gamma_j Z_i)}$$

Equation 3: $$\frac{P_{ij}}{P_{ij'}} = \frac{\exp(\beta X_{ij} + \gamma_j Z_i)}{\exp(\beta X_{ij'} + \gamma_j Z_i)}$$

Coefficients from the estimated model (β and γ) allow for the assessment of hypotheses one and two. Hypothesis one postulates that high risk status among Medicaid beneficiaries is positively associated with selection of hospital-based clinics or non-hospital based private physician offices, while hypothesis two proposes that increased distance to a given clinic type will be negatively associated with the choice of that clinic option. In the context of this research, six coefficients are of interest to the related hypotheses: average marginal effects of high risk women selecting an FQHC, health department or hospital-based clinic and average marginal effects of travel distance on selecting and FQHC, health department of hospital-based clinic. The category non-hospital based, private physician office serves as the reference category in the calculation of the average marginal effects.

To specifically examine the role of choice among women experiencing their first pregnancy, a subset of the data including only first pregnancies is examined. The described conditional and nested logit models are then estimated, as appropriate, removing the parity control variable. These estimates provide insight into the factors associated with prenatal care selection among women without the knowledge and experience gained from a prior pregnancy.

The conditional logit model requires an assumption of independence of irrelevant alternatives (IIA). If this assumption is violated, the nested logit model is appropriate as it does not require this assumption but is based on the same theory and discrete choice situation. The IIA assumes that the relative odds of choosing one alternative over another alternative is independent of the absence or presence of a third alternative (McFadden, 1973). In the context of this study, the IIA assumption implies that the relative odds of choosing one type of clinic is not influenced by the absence or presence of other clinic types. A specification test developed by McFadden is used to test the IIA assumption (McFadden, 1987). The hypothesized nested logit model structure (Cameron & Trivedi, 2009) is hypothesized in Figure 2.

In summary, Research Aim 1 utilizes McFadden's Conditional Logit or a nested logit to examine the clinic and individual characteristics associated with prenatal care clinic choice among Medicaid beneficiaries. Two explanatory variables including patient risk-status and distance to clinic are of particular interest and are specifically examined in hypotheses one and two. McFadden's Conditional Logit assumes the independence of

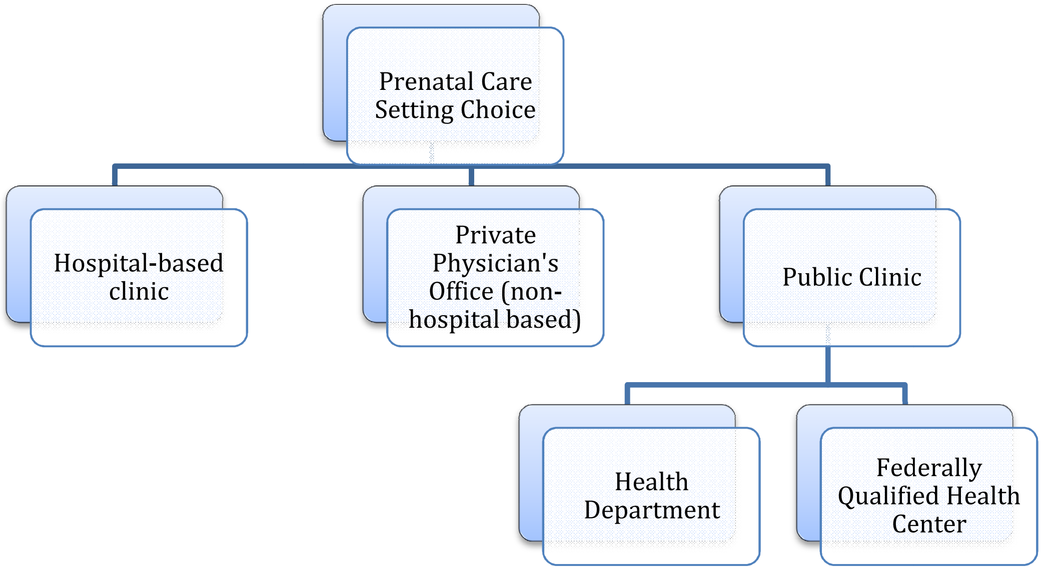

Figure 2. Hypothesized nested structure

irrelevant alternatives, which is tested prior to committing to the use of McFadden's Conditional Logit, and if violated, the nested logit is used.

Research Aim 2

Study Approach.

The second research aim evaluates associations between clinic choice and maternal/infant processes and outcomes of care. Based on the literature review discussed in Chapter 2, this study examines two infant outcomes including birth weight and gestational age and three maternal processes and outcomes of care including adequacy of prenatal care, postpartum visit attendance and postpartum Long Acting Reversible Contraceptive (LARC) use. The key explanatory variable of interest is the type of clinic selected.

Clinic type selection is defined as selecting a Health Department, Federally Qualified Health Center, hospital-based clinic or private physician office for prenatal care. Public Health Departments are identified by name. Federally Qualified Health Centers are identified using the master file of Federally Qualified Health Centers from the U.S. Department of Health and Human Services, Health Resources and Service Administration (Health Resources and Services Administration, 2014). Clinics are identified as a hospital clinic if the clinic is located on a hospital campus. Private clinics are designated as such if they did not fit any of the above criteria. Due to endogeneity, the model's variables for a women's actual clinic type choice will be instrumented using the predicted probability of each clinic type from Research Aim 1.

Each of these dependent binary variables are defined using respective ICD-9 coding available in the Medicaid claims data and are indicated in Table 2. Infant outcomes are defined as low birthweight if the baby is born weighing less than 1,500 grams and/or as preterm if born before 37 weeks gestation. Maternal process and outcomes are defined according to a modified version of the Kotelchuck Index (described below), postpartum visit attendance is defined by physician claims data and as a LARC users are defined as those women that received a prescription for an Intrauterine Device (IUD), injectable contraceptive or implant postpartum.

Prenatal care adequacy has been evaluated with a variety of measurements, including the Kotelchuck or Adequacy of Prenatal Care Utilization Index (APNCU) (Kogan et al., 1998; Kotelchuck, 1994). The Kotelchuck index assigns prenatal care utilization to four categories including inadequate, intermediate, adequate and adequate plus based on two factors: prenatal care initiation and utilization. Utilization measures compare visit

Table 2. *Research Aim 2 Variables*

			Dataset
Dependent Variables			
	Diagnosis Code	**Indication**	
Infant Outcomes			
Low birth weight (including extremely low and very low birth weight indications)	765.01	Extreme immaturity, less than 500 grams	Virginia Premier Claims Data
	765.02	Extreme immaturity, 500 – 749 grams	
	765.03	Extreme immaturity, 750 – 999 grams	
	765.04	Extreme immaturity, 1,000 – 1,249 grams	
	765.05	Extreme immaturity, 1,250 – 1,499 grams	
	765.06	Extreme immaturity, 1,500 – 1,749 grams	
	765.07	Extreme immaturity, 1,750 – 1,999 grams	
	765.08	Extreme immaturity, 2,000 – 2,499 grams	
	765.10	Other preterm infants, unspecified [weight]	
	765.11	Other preterm infants, less than 500 grams	
	765.12	Other preterm infants, 500 – 749 grams	
	765.14	Other preterm infants, 1,000 – 1,249 grams	
	765.15	Other preterm infants, 1,250 – 1,499 grams	
	765.16	Other preterm infants, 1,500 – 1,749 grams	
	765.17	Other preterm infants, 1,750 – 1,999 grams	
	765.18	Other preterm infants, 2,000 – 2,499 grams	
Preterm birth	765.00	Extreme immaturity, unspecified [weight]	
	765.01	Extreme immaturity, less than 500 grams	
	765.02	Extreme immaturity, 500 – 749 grams	

Table 2. *Continued*

Preterm birth	765.03	Extreme immaturity, 750 – 999 grams	Virginia Premier Claims Data
	765.04	Extreme immaturity, 1,000 – 1,249 grams	
	765.05	Extreme immaturity, 1,250 – 1,499 grams	
	765.06	Extreme immaturity, 1,500 – 1,749 grams	
	765.07	Extreme immaturity, 1,750 – 1,099 grams	
	765.08	Extreme immaturity, 2,000 – 2,499 grams	
	765.09	Extreme immaturity, 2,500 grams and over	
	765.10	Other preterm infants, unspecified [weight]	
	765.11	Other preterm infants, less than 500 grams	
	765.12	Other preterm infants, 500 – 749 grams	
	765.13	Other preterm infants, 750 – 999 grams	
	765.14	Other preterm infants, 1,000 – 1,249 grams	
	765.15	Other preterm infants, 1,250 – 1,499 grams	
	765.16	Other preterm infants, 1,500 – 1,749 grams	
	765.17	Other preterm infants, 1,750 – 1,9099 grams	
	765.18	Other preterm infants, 2,000 – 2,499 grams	
	765.19	Other preterm infants, 2,500 grams and over	
	765.21	Less than 24 completed weeks of gestation	
	765.22	24 completed weeks of gestation	
	765.23	25 – 26 completed weeks of gestation	
	765.24	27 – 28 completed weeks of gestation	
	765.25	29 – 30 completed weeks of gestation	

Table 2. *Continued*

	765.26	31 – 32 completed weeks of gestation	
	765.27	33 – 34 completed weeks of gestation	
	765.28	35 – 36 completed weeks of gestation	
Maternal Process Measures			
Prenatal Care Visit	V22.0	Supervision of normal first pregnancy	Virginia Premier Claims Data
	V22.1	Supervision of normal pregnancy	
	V22.2	Normal pregnancy pregnant state, incidental	
	V23.0	Supervision of high risk pregnancy with history of infertility	
	V23.1	Supervision of high risk pregnancy with history of trophoblastic disease	
	V23. 2	Supervision of high risk pregnancy with history of abortion	
	V23.3	Supervision of high risk pregnancy with grand multiparity	
	V23.4	Supervision of high risk pregnancy with other poor obstetric history	
	V23.41	Supervision of high risk pregnancy with history of pre-term labor	
	V23.49	Supervision of high risk pregnancy with other poor obstetric history	
	V23.5	Supervision of high risk pregnancy with other poor reproductive history	
	V23.7	Supervision of high risk pregnancy with insufficient prenatal care	
	V23.8	Supervision of high risk pregnancy Supervision of other high risk pregnancy	
	V23.9	Supervision of high risk pregnancy Supervision of unspecified high risk pregnancy	
Postpartum care and examination	V24.1	Postpartum care and examination of lactating mother	
	V24.2	Routine postpartum follow-up	

Table 2. *Continued*

Maternal Outcome Measure			
Long Acting Reversible Contraceptive Method Use	Prescription for Intrauterine Device (IUD), Injectable contraceptives or contraceptive implant.		Virginia Premier Pharmacy Claims
Explanatory Variables			
Clinic Choice	Actual clinic choice (instrumented by predicted probabilities derived in Research Aim 1 analysis)		Instrumented from Research Aim 1
Control Variables			
Risk Status	**Diagnosis Code**	**Indication**	Virginia Premier Claims Data
	V23.0	Supervision of high risk pregnancy with history of infertility	
	V23.1	Supervision of high risk pregnancy with history of trophoblastic disease	
	V23. 2	Supervision of high risk pregnancy with history of abortion	
	V23.3	Supervision of high risk pregnancy with grand multiparity	
	V23.4	Supervision of high risk pregnancy with other poor obstetric history	
	V23.41	Supervision of high risk pregnancy with history of pre-term labor	
	V23.42	Pregnancy with a history of ectopic pregnancy	
	V23.49	Supervision of high risk pregnancy with other poor obstetric history	
	V23.5	Supervision of high risk pregnancy with other poor reproductive history	
	V23.7	Supervision of high risk pregnancy with insufficient prenatal care	

Table 2. *Continued*

	V23.7	Supervision of high risk pregnancy with insufficient prenatal care	
	V23.8	Supervision of high risk pregnancy Supervision of other high risk pregnancy	
	V23.89	Supervision of other high risk pregnancy	
	V23.9	Supervision of high risk pregnancy Supervision of unspecified high risk pregnancy	
Parity	V22.0	Supervision of normal first pregnancy	Virginia Premier Claims Data
Distance	Distance to attended clinic		Virginia Premier Demographic Data and Virginia Premier Physician Data
Race	White or Non-white (reference group)		Virginia Premier Demographic Data
Age	Date of first prenatal care visit – Date of Birth		
Residential Segregation	Majority of white residents versus majority of non-white residency (referent group)		American Community Survey
Race * Residential Segregation	Interaction between race binary variable and residential segregation binary variable		American Community Survey and Virginia Premier Demographic Data
Neighborhood Education	% of ZCTA with a high school equivalent education		American Community Survey
Community level single parents	% of ZCTA with a female-headed household		

frequency to expected visit frequency as recommended by the American Congress of Obstetricians and Gynecologists (ACOG). Utilization is assigned as inadequate if care is initiated after the 4th month or the patient receives fewer than 50% of the recommend visits, intermediate if care is initiated prior to the 4th month and the patient receives 50-79% of the recommended visits, adequate if prenatal care is initiated prior to the 4th month and the patient receives 80-109% of recommended visits, and adequate plus if care is initiated by the 4th month and patient receives 110% or more of recommended visits (Kotelchuck, 1994). Figure 3 provides visual representation of the Kotelchuck Index. However, due to data limitations, initiation of prenatal care services cannot be specifically determined. Therefore, this research defines inadequate prenatal care as individuals receiving fewer than 50% of recommended visits (seven or fewer visits) and adequate prenatal care as those who received greater than 50% of recommended visits (eight or more visits), regardless of care initiation. The modified index is provided in Figure 4.

Selection of control variables is guided by the literature review described in Chapter 2. First, risk-status and parity are defined utilizing claims data indicating high risk pregnancy status and first pregnancy, respectively. Second, maternal race and age are defined by demographic data. Third, distance to clinic data is defined using demographic data and physician practice data. Namely, straight distance calculations are measured from patient domicile to selected clinic address using calculations produced by ArcMAP 10.1. Finally, environmental factors including measures for residential segregation, neighborhood education and female-headed households are included. These data are pulled from the publically available American Community Survey's (ACS) 5-year estimate

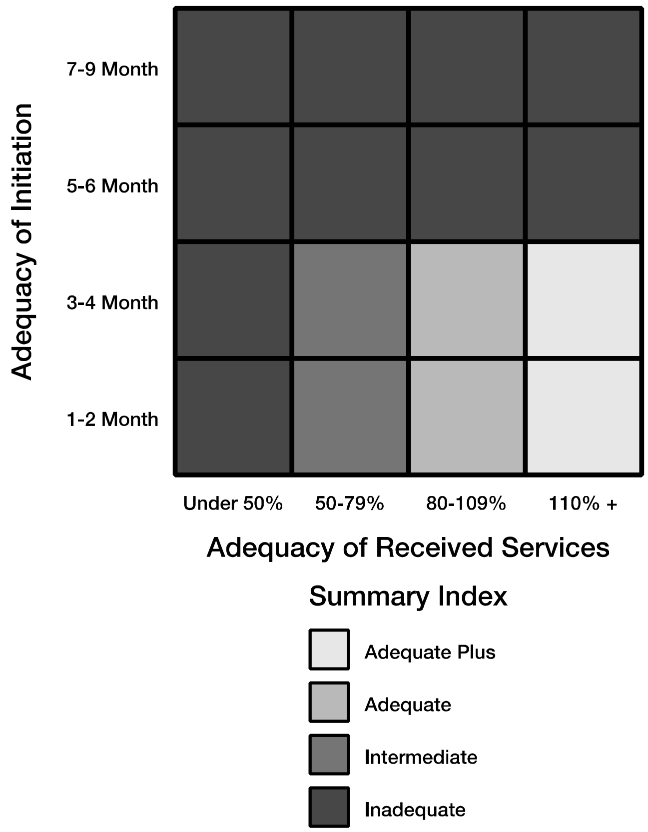

Figure 3. Depiction of the Kotelchuck Index.

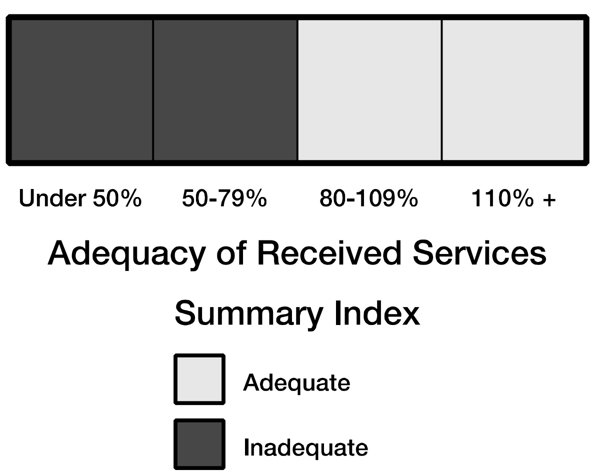

Figure 4. Modified Kotelchuck Index.

from 2012. Residential segregation is measured as a binary variable indicating if the neighborhood is a majority white population. These variables are interacted to produce estimates specifically evaluating the role of an individuals' race and the major race in her neighborhood (Gaskin, Dinwiddie, Chan, & McCleary, 2012). Neighborhood education is measured by the percentage of individuals in the ZCTA with a high school equivalent education or higher. Finally, the percentage of female-headed homes in the ZCTA is included. ZCTA data from the ACS data are linked to patient-level zip codes via the ZCTA crosswalk created by John Snow, Inc. (JSI) for use with the Uniform Data System (UDS) (The Health Foundation of Greater Cincinnati and the American Academy of Family Physicians, 2013).

Analytical Approach

Linear Probability Model (LPM).

As all dependent variables are binary (low birthweight versus normal birthweight, preterm birth versus term birth, inadequate prenatal care versus adequate prenatal care, postpartum non-attendance versus postpartum attendance, non-LARC use postpartum versus LARC use postpartum) it would appear that a logistic regression would appear to be the appropriate choice for study estimation. However, there is a strong suspicion that the binary regressors (ie. clinic choice) are endogenous. Therefore the only way to obtain a consistent estimate is to apply the Linear Probability Model (LPM). Additionally, to examine the role of clinic choice on the processes and outcomes of care, an instrument variable may be required for clinic selection. To address this, the LPMs will include actual clinic choice of the woman, instrumented by constructed predicted probabilities derived from Research Aim 1 (Dubin & McFadden, 1984).

Hypothesis three postulates that maternal and infant processes of care and outcomes will vary for Medicaid beneficiaries based on the setting in which women receive perinatal care, ceteris paribus. To test this hypothesis, coefficients δ_1, δ_2, and δ_3 are examined in each of the following equations:

Process measures: Prenatal care and postpartum nonattendance.

Prenatal Care Adequacy

$$P(inadequate\ prenatal\ care|x)$$

$$= \beta_{N_0} + \delta_1 Hosp + \delta_2\ HD + \delta_3 FQHC + \beta_{N_1}\ distance\ to\ clinic + \beta_{N_2}\ age$$

$$+ \beta_{N_3} minorty\ race + \beta_{N_4} minority\ neighborhood + \beta_{N_5} minority\ race$$

$$* minority\ neighborhood + \beta_{N_6} first\ pregnancy$$

$$+ \beta_{N_7} ZCTA female\ headed\ households + \beta_{N_8} ZCTA\ education$$

Postpartum Nonattendance

$$P(postpartum\ visit\ nonattendance|x)$$

$$= \beta_{PP_0} + \delta_1 Hosp + \delta_2\ HD + \delta_3 FQHC + \beta_{PP_1}\ distance\ to\ clinic + \beta_{PP_2}\ age$$

$$+ \beta_{PP_3} minorty\ race + \beta_{PP_4} minority\ neighborhood + \beta_{PP_5} minority\ race$$

$$* minority\ neighborhood + \beta_{PP_6} first\ pregnancy$$

$$+ \beta_{PP_7} ZCTA female\ headed\ households + \beta_{PP_8} ZCTA\ education$$

Outcome measures: LARC, gestational age, and birthweight.

LARC Use

$$P(non\ LARC\ use|x)$$

$$= \beta_{L_0} + \delta_1 Hosp + \delta_2\ HD + \delta_3 FQHC + \beta_{L_1}\ distance\ to\ clinic + \beta_{L_2}\ age$$

$$+ \beta_{L_3} minorty\ race + \beta_{L_4} minority\ neighborhood + \beta_{L_5} minority\ race$$

$$* minority\ neighborhood + \beta_{L_6} first\ pregnancy$$

$$+ \beta_{L_7} ZCTA female\ headed\ households + \beta_{L_8} ZCTA\ education$$

Gestational Age

$$P(preterm\ birth|x)$$

$$= \beta_{G_0} + \delta_1 Hosp + \delta_2\ HD + \delta_3 FQHC + \beta_{G_1}\ distance\ to\ clinic + \beta_{G_2}\ age$$

$$+ \beta_{G_3} minorty\ race + \beta_{G_4} minority\ neighborhood + \beta_{G_5} minority\ race$$

$$* minority\ neighborhood + \beta_{G_6} first\ pregnancy$$

$$+ \beta_{G_7} ZCTA female\ headed\ households + \beta_{G_8} ZCTA\ education$$

Birth weight

$$P(low\ birthweight|x)$$

$$= \beta_{BW_0} + \delta_1 Hosp + \delta_2\ HD + \delta_3 FQHC + \beta_{BW_1}\ distance\ to\ clinic$$

$$+ \beta_{BW_2}\ age + \beta_{BW_3} minorty\ race + \beta_{BW_4} minority\ neighborhood$$

$$+ \beta_{BW_5} minority\ race * minority\ neighborhood$$

$$+ \beta_{BW_6} first\ pregnancy + \beta_{BW_7} ZCTA female\ headed\ households$$

$$+ \beta_{BW_8} ZCTA\ education$$

Sensitivity Analyses

A variety of sensitivity analyses are conducted to examine the two research aims of this study. First, process measures are included in the analysis of outcomes of care. These sensitivity analyses are conducted to gain insights into the potential moderating effect of process measures on outcomes of care. However, this interpretation only holds under the assumption that the process measures are exogenous, if this assumption is false, these estimates produce the effect of introducing an endogenous regressor.

For the analyses in Research Aim 2 (association of choice and process/outcomes), several sensitivity analyses are used to examine binary dependent variables of interest. First, exogeneity of clinic choice is assumed and a logit model is estimated. Second, exogeneity is assumed and the LPM is estimated without the instrumental variables approach described above. These models allow for a direct comparison of the estimated marginal effects of the explanatory variables on various dependent variables between logit and LPM. Third, clinic choice is assumed to be endogenous and the predicted probabilities from Research Aim 1 analysis are utilized as instrument variables for clinic choice and is estimated using a logit model. Wooldridge describes this as a "forbidden regression" and states that this estimation will produce inconsistent estimators (Wooldridge, 2010). Nonetheless, the results of this analysis can serve as a point of comparison to what was derived in other models.

Finally, an additional sensitivity analysis that examines adequacy of prenatal care is also considered. Since data limitations forbid the full use of the Kotelchuck Index, inadequate prenatal care can be variously defined. The study utilizes a definition of inadequate prenatal care when a women attends <50% of recommended visits. The sensitivity analysis defines inadequate prenatal care at those who attend fewer than 79% of recommended prenatal care visits.

Summary

In summary, distinct methodologies are employed to examine prenatal clinic selection and health care processes and outcome measures. McFadden's Conditional logit and nested logit models, utilizing both individual-specific and clinic-specific variables, are used to assess patient choice. The Linear Probability Model is utilized for process and outcome measurements of care quality. These regressions also include instrument variables from Research Aim 1 analysis. Finally, a number of sensitivity analyses are used to assess the robustness of study findings.

Chapter 5

Introduction

This dissertation examines two Research Aims: Aim 1 examines clinic and patient level factors associated with prenatal care clinic type selection among pregnant Medicaid beneficiaries that belong to Virginia Premier Health Plan; and Aim 2 assesses maternal and infant measures associated with clinic type selection. Overall, a total of 10,057 women were included in the study, including 3,122 individuals in the pre-analysis sample and 6,935 women in the final analysis dataset.

Figure 5 provides a geographical display of clinic locations and patient residence, and Figure 6 provides additional information on the available clinic types. Figure 1 includes the 6,935 individuals in the final dataset and the 172 clinics selected by those in the pre-analysis sample. Individual beneficiaries tend to cluster around cities including Richmond, Norfolk, Virginia Beach, Stafford, Roanoke and Blacksburg. Individuals residing in Southwest Virginia tend to be more dispersed throughout the region whereas beneficiaries residing in the Metropolitan Statistical Areas of Virginia Beach/Norfolk/Newport News, and Richmond are more condensed around the city centers. Private physician offices are the most common clinic type and these sites are located throughout the state. The choice set includes eight FQHCs that are located throughout Virginia. Health Department sites are dispersed throughout the state and include one per locality. Finally, hospital-based clinics tend to be located in urban areas within each of the MSAs.

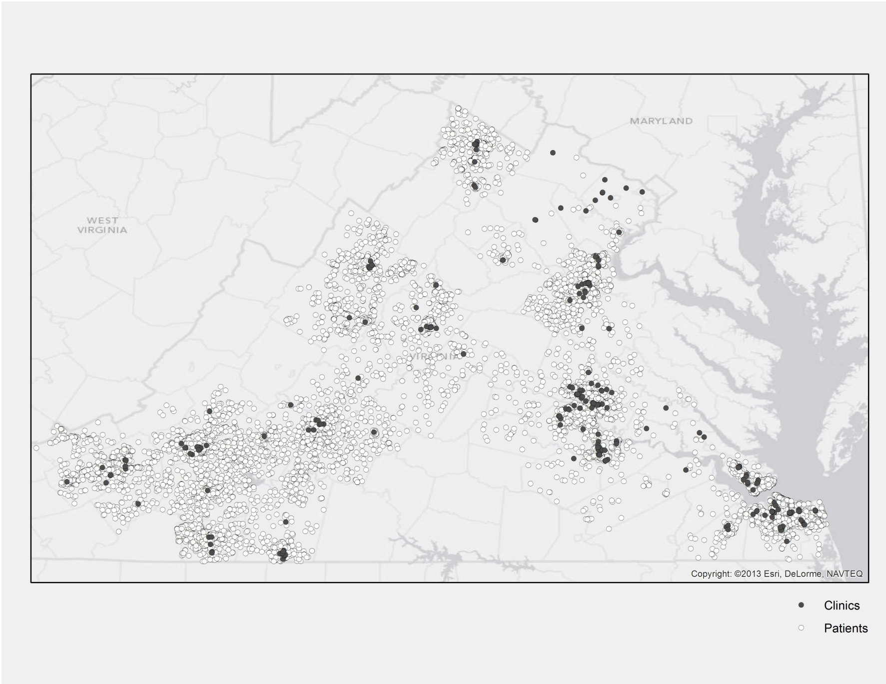

Figure 5. Study Sample Clinics and Individuals

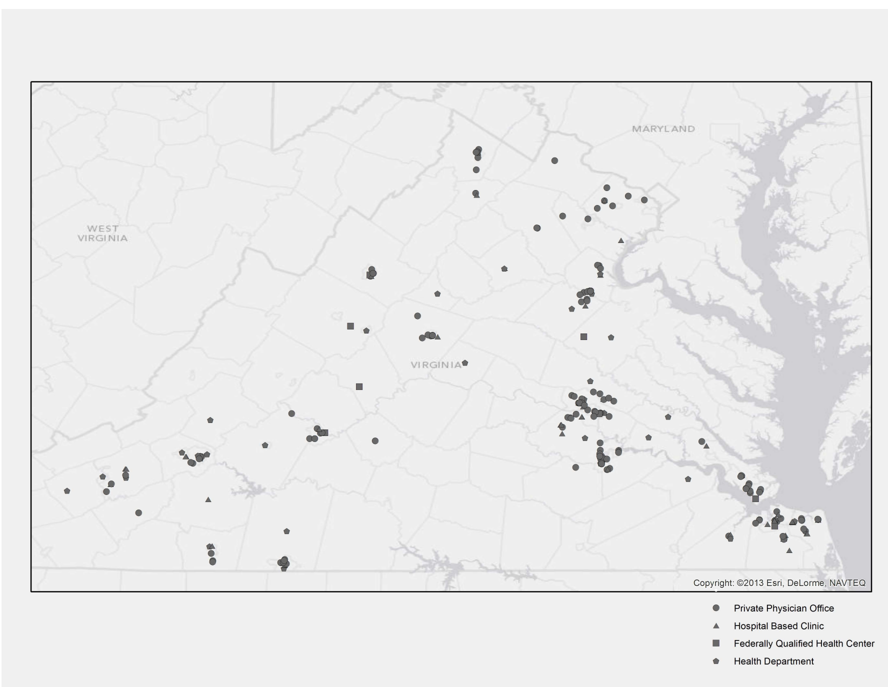

Figure 6. Additional Detail on Study Clinics

Descriptive Statistics on Research Aim 1

Statistics pertaining to clinic-type level and patient level attributes are provided in Tables 3 and 4. Clinic level statistics are presented as applicable to the four clinic types within each individual's market. Private physician offices are the most abundant clinic type, with 87 options throughout the Commonwealth of Virginia. Hospital clinics have the highest mean number of beneficiaries, whereas private physician offices have the highest mean number of weighted clinicians (by clinic-type within each individual's market). Health departments have the lowest average weighted miles to individuals. Patients most frequently select private physician offices for prenatal care services. Approximately one-fourth of the study sample has a high risk pregnancy status. Additionally, approximately one-fourth of the study sample is a primigravada pregnancy. Finally, the study sample is roughly evenly divided between White and non-White women.

Table 3. *Research Aim 1 Clinic-level Descriptive Statistics*

	Health Department	Federally Qualified Health Center	Hospital-based Clinic	Private Physician Office (non-hospital based)
Number of Clinics	23	8	54	87
Beneficiaries				
Mean	7	41	283	233
Standard Deviation	4.60	30.88	311.69	110.22
Minimum	1	1	2	1
Maximum	15	172	872	411
Weighted Clinicians				
Mean	26	41	75	49
Standard Deviation	24.4	46.0	71.9	49.5
Minimum	1.0	1.0	12.0	1.0
Maximum	120.0	133.0	415.0	317.0
Weighted Miles				
Mean	7.93	11.67	11.32	8.87
Standard Deviation	7.43	7.20	5.78	5.60
Minimum	0.04	0.18	0.28	0.18
Maximum	26.90	26.88	26.89	26.74

Table 4. *Research Aim 1 Patient-Level Descriptive Statistics*

	N	%
Clinic Choice		
Health department	218	3.14
Federally Qualified Health Center	476	6.85
Hospital-based clinic	3,003	43.24
Private physician office (non-hospital based)	3,248	46.77
Risk Status		
High risk	1,810	26.10
Normal risk	5,135	74.04
Gravida		
First pregnancy	1,755	25.3
Not first pregnancy	5,190	74.7
Race		
Non-White	3,508	50.5
White	3,437	49.5

Research Aim 1

Research Aim 1 evaluates the clinic and patient level characteristics associated with clinic type choice. Hypothesized results are displayed in Table 5. As described in Chapter 4, Research Aim 1, McFadden's Conditional Logit model was evaluated. This model relies on the assumption of the Independence of Irrelevant Alternatives (IIA), which in the context of this study means that the relative odds of choosing one type of clinic is not influenced by the absence or presence of other clinic types. To test whether the IIA assumption is valid, the full conditional logit is estimated along with generating three additional sets of estimations excluding one of the four alternatives. Estimates from these models are used to conduct Hausman specification tests with the null hypothesis that there are no systematic differences between the two sets of estimations under examination. The results of these tests indicated that the study data violated the IIA assumption, as the resulting chi squared statistics indicated rejection of the null hypothesis that the coefficients from the full and

Table 5. *Hypotheses 1 and 2: Expected Findings*

	Variables	Expected Findings
Aim 1		
Hypothesis 1		
High risk status among Medicaid beneficiaries is positively associated with selection of hospital-based clinics or non-hospital based private physician offices.	High risk Status	+
Hypothesis 2		
Increased distance to a given clinic type will be negatively associated with the choice of that clinic option among Medicaid beneficiaries.	Distance to clinic	-

abbreviated models were equal ($p \leq 0.0001$). Given these results, a nested logit model is a preferred approach to examining the clinic and patient level factors associated with prenatal care clinic selection, as this model relaxes the IIA assumption. The nested structure, described in Chapter 4, groups FQHCs and health departments into one branch termed "Public", whereas private physician offices and hospital-based clinics each singularly form a degenerate branch. This branching structure assumes that the unobserved shocks that may influence a women's decision making strategies of public options is concomitant. In other words, there are unobserved factors that may impact selecting public facilities that do not impact selecting a hospital based clinic or private physician office.

Nested model estimations are presented in Table 6, which includes coefficients for the entire final analysis sample (N=6,935) and includes estimates based on the described nesting structure. This analysis will be referred to as the general nested model as it provides the overall associations between the three general branches (private physician

Table 6. *Nested Logit Estimation: All Pregnancies*

	Coefficient	Standard Error	Z	P>|z|	95% Confidence Interval	
Clinic Choice						
Number of Options	0.15910	0.0090	17.620	0.000	0.1414	0.1768
Number of Beneficiaries	0.00045	0.0002	2.410	0.016	0.0001	0.0008
Number of Clinicians	0.00195	0.0002	12.160	0.000	0.0016	0.0023
Weighted Miles	-0.11671	0.0060	-19.450	0.000	-0.1285	-0.1050
Non-White Status * Weighted Miles	0.02574	0.0079	3.260	0.001	0.0103	0.0412
Hospital Based-Clinic						
Age	0.00162	0.0025	0.660	0.510	-0.0032	0.0064
High Risk Status	0.44280	0.0692	6.400	0.000	0.3072	0.5784
Non-White	0.00642	0.0675	0.100	0.924	-0.1258	0.1386
First Pregnancy	-0.02930	0.0695	-0.420	0.673	-0.1656	0.1070
Public Clinic						
Age	-0.04080	0.0036	-11.400	0.000	-0.0478	-0.0338
High Risk Status	0.19294	0.1129	1.710	0.088	-0.0284	0.4143
Non-White	0.66004	0.0947	6.970	0.000	0.4744	0.8457
First Pregnancy	0.51683	0.0953	5.420	0.000	0.3301	0.7036

Table 7. *Nested Logit Average Marginal Effects All Pregnancies: Clinic Characteristics*

	AME FQHC	AME HD	AME Hosp	AME PP
Number of Options				
PP increase by 5 options	-0.0036	-0.0029	-0.0276	0.0341
Hosp increase by 5 options	-0.0016	-0.0015	0.0287	-0.0256
FQHCs increase by 5 options	0.0050	0.0012	-0.0017	-0.0045
Number of Beneficiaries				
PP increase by 20 beneficiaries	-0.000011	-0.000009	-0.000077	0.000097
Hosp increase by 20 beneficiaries	-0.000004	-0.000004	0.000084	-0.000076
FQHCs increase by 20 beneficiaries	0.000012	0.000003	-0.000004	-0.000011
HD increase by 20 beneficiaries	0.000003	0.000010	-0.000004	-0.000009
Number of Clinicians				
PP increase by 20 clinicians	-0.000047	-0.000039	-0.000331	0.000418
Hosp increase by 20 clinicians	-0.000018	-0.000017	0.000364	-0.000330
FQHCs increase by 20 clinicians	0.000051	0.000014	-0.000018	-0.000048
HD increase by 20 clinicians	0.000014	0.000043	-0.000017	-0.000040
Weighted Miles White Women				
PP increase by 5 Miles	0.0126	0.0104	0.0960	-0.1190
Hosp increase by 5 Miles	0.0037	0.0034	-0.1091	0.1020
FQHCs increase by 5 Miles	-0.0108	-0.0035	0.0036	0.0107
HD increase by 5 Miles	-0.0034	-0.0085	0.0032	0.0087
Weighted Miles non-White Women				
PP increase by 5 Miles	0.0160	0.0138	0.0888	-0.1186
Hosp increase by 5 Miles	0.0055	0.0054	-0.1071	0.0962
FQHCs increase by 5 Miles	-0.0157	-0.0044	0.0054	0.0148
HD increase by 5 Miles	-0.0043	-0.0131	0.0051	0.0123

office, hospital-based clinic and public facility). Table 7 provides average marginal effects (AMEs) for clinic level characteristics at the base of the nested structure, which provides additional insight between probabilities of selecting the two different public options. The AME calculation relates to the changes in probability of selecting that particular option by utilizing the individuals specific circumstances and then incrementing the regressor up to find the change in probability of clinic type selection. Rather than examining a change related to the standard deviation of each variable, an incremental change to each variable was selected that could be meaningfully applied to each clinic type as the value of the regressors greatly vary by clinic type. AMEs calculated for clinic level variables included an increase of five options by clinic type, 20 beneficiaries attending the clinic type, 20 clinicians in the clinic type, and an increase in five weighted miles to the individuals home address. Table 8 provides AMEs for individual level characteristics at the base of the nested structure, which provides additional insight between probabilities of selecting the two different public options.

Table 8. *Nested Logit Average Marginal Effects All Pregnancies: Patient Characteristics*

	AME FQHC	AME HD	AME Hosp	AME PP
Age	-0.0014	-0.0012	0.0010	0.0015
Non-White Status	0.0219	0.0188	-0.0099	-0.0308
High Risk	0.0021	0.0015	0.0792	-0.0828
First Pregnancy	0.0186	0.0163	-0.0152	-0.0197

Parameter estimates for the general nested logit results indicate a number of significant clinic and patient level characteristics associated with clinic type choice. Clinic level characteristics include the number of options, number of beneficiaries, number of clinicians, and weighted miles whereas patient characteristics include age, risk status, non-White status and first pregnancy, although the significance of these patient level associations vary by clinic type. Calculated AMEs indicate the magnitudes of these associations. An increase in private physician offices by 5 additional options is associated with a 3.4% increased percentage point change of selecting a private physician office. An increase in 5 weighted miles among White women to private physician offices is associated with an 11.9% decreased percentage point change of selecting a private physician office. Among patient level characteristics, non-White status is associated with a 3.1% decreased percentage point change of selecting a private physician office and a 2.2% increased percentage point change of selecting an FQHC. High risk women experience a 7.9%

increased percentage point change of selecting a hospital-based clinic and a 8.3% decreased probability of selecting a private physician office compared to normal risk women.

Hypotheses one and two examine associations between one clinic characteristic, travel distance, and one patient level characteristic, high risk status on clinic type selection. The general nested logit model for all pregnancies reveal that independent variables are significantly associated with prenatal care clinic type choice. First, weighted miles are significantly associated with clinic selection. As weighted distance to clinic type increases, women are significantly less likely to select that clinic type ($p \leq 0.0001$). Second, high risk status is significantly associated with an increase in selecting a hospital-based clinic compared to a private physician office ($p \leq 0.0001$).

Four clinic level control variables are also significantly associated with clinic choice, including a positive association between number of options of the clinic type in the given market ($p \leq 0.0001$), average number of beneficiaries attending the clinic types in the given market ($p=0.016$), average number of clinicians available in the clinic type ($p \leq 0.0001$), and an interaction term between weighted miles and non-White status ($p=0.001$). This interaction variable indicates that White and non-white women are more likely to attend clinics with a decreased travel distance, although non-white women are less influenced by travel distance than white women.

Several patient-level control variables are also significantly associated with clinic choice. Race is associated with clinic type selection as non-White women are more likely to select a public facility compared to a private physician office ($p \leq 0.0001$), but not more likely to select a hospital-based clinic compared to a private physician office ($p=0.924$).

Older women are less likely to select a public clinic compared to a private physician office ($p \leq 0.0001$), whereas age is not significantly associated with selection of a hospital based clinic ($p=0.510$). Finally, women experiencing their first pregnancy are more likely to select a public facility for prenatal care services ($p \leq 0.0001$), compared to private physician offices.

Average Marginal Effects (AMEs) provided in Tables 7 and 8 offer insight into the magnitude of these associations, namely as noted above, they indicate the change in probability of the selection of a clinic type given a change in a particular explanatory variable. To specifically examine the role of distance and clinic selection among White and non-White individuals, two separate AME calculations were conducted. As weighted distance to private physician offices increases by 5 miles, both White and non-White women are 11.9% less likely to select a private physician office; white women are 9.6% more likely to select a hospital, 1.0% more likely to select an FQHC and 1.3% more likely to select a health department whereas non-White women are 8.9% more likely to select a hospital, 1.4% more likely to select an FQHC and 1.3% more likely to select a health department. High risk status has a significant positive association with selecting a hospital according to the general nested logit models. The respective AMEs reveal that high risk compared to normal risk women are 8.3% less likely to select a private physician office, 7.9% more likely to select a hospital-based clinic, and 0.2% more likely to select a health department or FQHC.

A number of control variables are also shown to be significantly associated with clinic selection in the general nested logit estimation and the AMEs provide insight into the magnitude of these associations. First, when the number of options among private physician offices increases by five, there is a 3.4% increase in the probability that a woman selects a private physician office, 2.8% decrease in the probability of selecting a hospital-based clinic, 0.30% decrease in selecting a health department and 0.4% decrease in selecting an FQHC. Second, despite significant association indicated by the nested logit parameter estimate between the number of beneficiaries and the number of clinicians and clinic selection, respective AME's reveal that these marginal effects are related to less than a 0.00001% increase or decrease in clinic selection. Third, an increase in age by one year is associated with a 0.2% increase in selecting a private physician office, 0.1% increase in selecting a hospital-based clinic, a 0.1% decrease in selecting a health department and a 0.1% decrease in selecting an FQHC. Fourth, non-White status is associated with a 3.1% decrease in selecting a private physician office, 1.0% decrease in selecting a hospital-based clinic, 1.9% increase in selecting a health department and 2.2% increase in selecting an FQHC. Finally, a woman experiencing her first pregnancy is 2.0% less likely to select a private physician office, 1.5% less likely to select a hospital-based clinic, 1.6% more likely to select a health department and 1.9% more likely to select an FQHC.

A sensitivity analysis utilizing data from 1,755 primigravada women was conducted to investigate the decision-making patterns among women inexperienced with the prenatal care system, as their clinic type selection may be driven by different factors compared to women who have delivered previous babies. Relevant nested logit models are reported in Table 9. These models reveal that high risk pregnancy status among these women is not significantly associated with clinic selection, unlike what we saw in the analysis above examining all pregnancies. However, associations between travel distance and clinic type

Table 9. *Nested Logit Estimation: First Pregnancy*

	Coefficient	Standard Error	Z	P>|z|	95% Confidence Interval	
Clinic Choice						
Number of Options	0.0729	0.0171	4.270	0.000	0.0394	0.1063
Number of Beneficiaries	-0.0001	0.0004	-0.200	0.843	-0.0009	0.0007
Number of Clinicians	0.0028	0.0003	8.070	0.000	0.0021	0.0034
Weighted Miles	-0.1308	0.0118	-11.100	0.000	-0.1539	-0.1077
Non-White Status * Weighted Miles	0.0537	0.0153	3.510	0.000	0.0237	0.0838
Hospital Based-Clinic						
Age	-0.0054	0.0053	-1.000	0.316	-0.0158	0.0051
High Risk Status	0.0236	0.1639	0.140	0.886	-0.2976	0.3448
Non-White	-0.3335	0.1430	-2.330	0.020	-0.6137	-0.0532
Public Clinic						
Age	-0.0276	0.0064	-4.320	0.000	-0.0401	-0.0151
High Risk Status	-0.1589	0.2262	-0.700	0.482	-0.6023	0.2845
Non-White	0.5499	0.1627	3.380	0.001	0.2310	0.8688

selection persist, namely women experiencing first pregnancies are more likely to attend clinics with a shorter travel distance, and non-white women are less influenced by travel distance than white women. A number of clinic and patient level control variables are significant in the sensitivity analysis as well. First, clinic-level factors statistically associated with choice include clinic types with an increased number of options ($p \leq 0.0001$) and increased number of clinicians ($p \leq 0.0001$). Race is also associated with clinic type selection as minority women are more likely to select a public facility ($p = 0.001$), or a hospital-based clinic ($p=0.020$) compared to a private physician office. Finally, older women are less likely to attend a public clinic ($p \leq 0.0001$) compared to a private physician office.

Tables 10 and 11 provide the respective AMEs for nested logit estimations examining first pregnancies. When the number of options among private physician offices increases by five options, there is a 1.1% increase in the probability of selecting a private physician office, 0.1% decrease in selecting a hospital-based clinic, 0.1% decrease in selecting a health department and 0.3% decrease in selecting an FQHC. Despite significant associations between the number of beneficiaries and the number of clinicians and clinic selection, respective AME's reveal that these marginal effects are related to less than a 0.001% increase or decrease in clinic selection. Among primigravada women, a one-year increase in age is associated with a 2.3% decrease in selecting a private physician office, 1.9% increase in selecting a hospital-based clinic, a 0.5% increase in selecting a health department and a 0.02% decrease in selecting an FQHC. Non-White status is associated with a 1.3% increase in selecting a private physician office, 7.6% decrease in selecting a

Table 10. *Nested Logit Average Marginal Effects First Pregnancy: Clinic Characteristics*

	AME FQHC	AME HD	AME Hosp	AME PP
Number of Options				
PP increase by 5 options	-0.00250	-0.00089	-0.00746	0.01084
Hosp increase by 5 options	-0.00103	-0.00003	0.01663	-0.01557
FQHCs increase by 5 options	0.00375	0.00195	0.00237	-0.00806
Number of Beneficiaries				
PP increase by 20 beneficiaries	0.000064	0.000291	0.000943	-0.001298
Hosp increase by 20 beneficiaries	0.000062	0.000290	0.000917	-0.001270
FQHCs increase by 20 beneficiaries	0.000058	0.000288	0.000933	-0.001278
HD increase by 20 beneficiaries	0.000060	0.000286	0.000933	-0.001279
Number of Clinicians				
PP increase by 20 clinicians	-0.000044	0.000211	0.000521	-0.000688
Hosp increase by 20 clinicians	0.000014	0.000244	0.001430	-0.001687
FQHCs increase by 20 clinicians	0.000185	0.000319	0.000883	-0.001387
HD increase by 20 clinicians	0.000091	0.000383	0.000886	-0.001360
Weighted Miles White Women				
PP increase by 5 Miles	0.0208	0.0148	0.0854	-0.1211
Hosp increase by 5 Miles	0.0083	0.0079	-0.1171	0.1009
FQHCs increase by 5 Miles	-0.0198	-0.0058	0.0075	0.0181
HD increase by 5 Miles	-0.0057	-0.0141	0.0067	0.0131
Weighted Miles non-White Women				
PP increase by 5 Miles	0.0218	0.0160	0.0596	-0.0973
Hosp increase by 5 Miles	0.0176	0.0175	-0.1117	0.0766
FQHCs increase by 5 Miles	-0.0327	-0.0065	0.0158	0.0233
HD increase by 5 Miles	-0.0061	-0.0254	0.0147	0.0167

Table 11. *Nested Logit Average Marginal Effects First Pregnancy: Clinic Characteristics*

	AME FQHC	AME HD	AME Hosp	AME PP
Age	-0.0002	0.0046	0.0186	-0.0230
Non-White Status	0.0346	0.0283	-0.0756	0.0128
High Risk	-0.0089	-0.0072	0.0094	0.0068

hospital-based clinic, 12.8% increase in selecting a health department and 3.5% increase in selecting an FQHC.

The above section provides results pertaining to Aim 1 of this study. General nested model estimations provide insight into significance and general directionality and provide support for the two hypotheses related to Research Aim 1. First, high risk pregnancy status is associated with selection of a hospital-based clinic among all women, but this association does not persist when specifically examining primigravada pregnancies. This result may be associated with the knowledge gained from experience with engaging with the prenatal care system for previous pregnancies. Reported AMEs provide support for hypothesis two as it is found that distance to clinic type is associated with clinic election. As weighted distance to clinic type increases, women are less likely to select the respective clinic type.

Research Aim 2

Research Aim 2 assesses the hypothesis regarding prenatal care setting and its potential associations with maternal and infant measures. The hypothesis for Research Aim 2 suggests that maternal and infant process and outcomes measures will vary based on the setting in which a woman receives prenatal care, ceteris paribus. Patient demographics associated with Research Aim 2 are presented in Table 12. Study participants are, on average, 25 years old and live 8.1 miles from their selected prenatal clinic. Forty-six percent of patients received adequate prenatal care, whereas 42.7% attended a postpartum visit. Twenty-five percent of women utilized a LARC method postpartum. Most infants were born healthy when examining gestational age and birthweight as 7.0% were born preterm and 4.2% with a low birthweight status.

Results from Linear Probability Models (LPM) utilizing instrumental variables for choice of clinic type, which were generated from Research Aim 1 results, are presented first along with tests for endogeneity. These results are followed by logistic regression analysis

Table 12. *Research Aim 2: Patient Descriptive Statistics*

	N	%
Independent Variables		
Clinic Choice		
Health department	218	3.1
Federally Qualified Health Center	476	6.9
Hospital-based clinic	3,003	43.3
Private physician office (non-hospital based)	3,248	46.8
Dependent Variables		
Prenatal Care Adequacy		
Inadequate	3,729	53.7
Adequate	3,216	46.3
Postpartum Visit Attendance		
Nonattendance	3,983	57.4
Attendance	2,962	42.7
Long Acting Reversible Contraception (LARC)		
Non-LARC use	5,191	74.7
LARC use	1,754	25.3
Gestational Age		
Preterm birth	485	7.0
Term birth	6,460	93.0
Birthweight		
Low birthweight	288	4.2
Normal birthweight	6,657	95.9
Control Variables		
Risk Status		
High risk	1,810	26.1
Normal risk	5,135	74.0
Gravida		
First pregnancy	1,755	26.1
Not first pregnancy	5,190	74.8
Race		
Non-White	3,508	50.5
White	3,437	49.5
Neighborhood Race		
Majority Non-White	1,873	27.0
Majority White	5,072	73.0
Age (years)		

Table 12. *Continued*

Mean	25.2
Standard Deviation	5.3
Minimum	18.0
Maximum	46.8
Distance to Clinic (miles)	
Mean	8.1
Standard Deviation	8.1
Minimum	0.2
Maximum	26.8
Neighborhood female headed households (%)	
Mean	9.3
Standard Deviation	4.4
Minimum	0.0
Maximum	23.7
Neighborhood High School education or equivalent (%)	
Mean	29.4
Standard Deviation	6.4
Minimum	10.3
Maximum	57.7

using actual choice of clinic type as an explanatory variable for those instances when the endogeneity tests failed to reject the hypothesis that the clinic choice variables were exogenous. Finally, results from sensitivity analysis are presented.

To produce estimates for the five maternal/infant measures, LPMs were estimated with instrumental variables (LPM IV) for all pregnancies. Each of these analyses used the predicted probability of clinic type selection generated from the nested logit results for Research Aim 1as instrumental variables for clinic selection. Additionally, standard errors adjusted for non-independence within clusters using ZCTAs were calculated. This approach accounts for the clustering of the values of key variables at the ZCTA level. Because the nested logit analyses' predicted probability post estimation generates predicted probabilities for cases that include no missing clinic options, the resulting sample size for the LPM IV models is 4,028 women.

Table 13 displays the LPM results associated with inadequate prenatal care attendance. These results demonstrate that two independent variables and one control variable is significantly associated with inadequate prenatal care (p=0.05). Selection of a health department for prenatal care is associated with an 84.2 decrease in percentage points of inadequate prenatal care (ie. improved prenatal care) (p=0.010) compared to selection of a private physician office. Selection of a FQHC for prenatal care is associated with an 82.2 percentage point decrease in inadequate prenatal care (ie. improved prenatal care) (p=0.002) compared to selection of a private physician office. Selection of a hospital-based clinic compared to a non-hospital based private physician office is not associated with inadequate prenatal care (p=0.133). The race control variable is also associated with prenatal care inadequacy. Non-white women are 5.2% more likely than white women to experience inadequate prenatal care services (p=0.032). The regression based test for endogeneity indicates rejection of the null hypothesis that the regressors are exogenous when examining the role of clinic type on prenatal care inadequacy (p=0.0001).

Table 14 displays LPM results for postpartum care nonattendance. These results demonstrate that two independent variables and two control variables are significantly associated with postpartum visit nonattendance (p=0.05). Selection of a health department for prenatal care is associated with a 90.4 percentage point decrease that a woman does not attend a postpartum visit (p=0.033) compared to selection of a private physician office. Selection of a FQHC for prenatal care is associated with an 130 percentage point decrease of not attending this postpartum visit (p=0.001) compared to selection of a private physician office. This second figure of an 130 percentage point decrease exhibits one of the

Table 13. *Linear Probability Results utilizing Instrumental Variables for Prenatal Clinic Choice: Inadequate Prenatal Care*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	0.1440	0.0957	1.50	0.133	-0.0437	0.3316
Choice Health Department	-0.8424	0.3268	-2.58	0.01	-1.4829	-0.2018
Choice FQHC	-0.8224	0.2601	-3.16	0.002	-1.3321	-0.3127
Miles	-0.0092	0.0054	-1.69	0.09	-0.0198	0.0014
Age	-0.0022	0.0019	-1.16	0.246	-0.0058	0.0015
Non-White Status	0.0528	0.0246	2.14	0.032	0.0045	0.1010
Non-White Neighborhood Residence	0.0613	0.0340	1.80	0.071	-0.0053	0.1278
Non-White*Non-White Neighborhood	-0.0135	0.0414	-0.33	0.744	-0.0948	0.0677
First Pregnancy	-0.0265	0.0375	-0.71	0.480	-0.0999	0.0469
% Female Headed Household	-0.0013	0.0040	-0.33	0.740	-0.0092	0.0065
% High School Equivalency	0.0007	0.0032	0.23	0.819	-0.0055	0.0070
Constant	0.5606	0.1041	5.38	0.000	0.3566	0.7647
Test of endogeneity						
H_0: variables are exogenous						
Robust regression F(3,125) = 25.2178 (p=0.0000)						

Table 14. *Linear Probability Results utilizing Instrumental Variables for Prenatal Clinic Choice: Postpartum Visit Nonattendance*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval
Choice Hospital	0.0025	0.1146	0.02	0.983	-0.2221 0.2270
Choice Health Department	-0.9044	0.4250	-2.13	0.033	-1.7374 -0.0714
Choice FQHC	-1.3049	0.3804	-3.43	0.001	-2.0505 -0.5594
Miles	-0.0139	0.0060	-2.3	0.022	-0.0257 -0.0020
Age	-0.0018	0.0018	-0.97	0.332	-0.0053 0.0018
Non-White Status	0.0830	0.0292	2.84	0.005	0.0257 0.1403
Non-White Neighborhood Residence	0.0858	0.0498	1.72	0.085	-0.0119 0.1834
Non-White*Non-White Neighborhood	-0.0699	0.0579	-1.21	0.228	-0.1834 0.0437
First Pregnancy	-0.0082	0.0403	-0.20	0.839	-0.0872 0.0708
% Female Headed Household	-0.0032	0.0056	-0.58	0.564	-0.0141 0.0077
% High School Equivalency	0.0043	0.0037	1.16	0.245	-0.0030 0.0116
Constant	0.6044	0.1230	4.91	0.000	0.3633 0.8455

Test of endogeneity
H_0: variables are exogenous

Robust regression F(3,125) = 7.89388 (p=0.0001)

limitations of the LPM as coefficient estimates may be greater than 1 or less than 0 even if though such values are conceptually inappropriate. Selection of a hospital-based clinic compared to a non-hospital based private physician office is not associated with the probability of postpartum visit attendance (p=0.983). Two control variables are statistically associated with nonattendance. First, non-white women are 8.3% more likely to exhibit postpartum nonattendance (p=0.005). Second, for every one mile increase in distance to clinic a women is 13.9% less likely to attend a postpartum visit (p=0.022). The regression based test for endogeneity indicates to reject the null hypothesis that the regressors used in the IV estimation are exogenous when examining the role of clinic type on postpartum visit nonattendance (p=0.0001).

Table 15 displays LPM results for the first outcome measure of non-long term reversible contraceptive (LARC) method use. This estimation produced two significant independent variables of interest and two significant control variables. Selection of a health department for prenatal care is associated with a 70.4 percentage point decrease that a woman does not use LARC (p=0.033) when compared to women selecting a private physician office. Selection of an FQHC for prenatal care is associated with a 54.1 percentage point decrease that the women is not using LARC (p=0.018) compared to selection of a private physician office. This estimation also indicates that age is associated with non-LARC use as a one year increase in age is associated with a 1.1 percentage point increase in non-LARC use (p=0.000). Finally, for every percentage increase in female-headed households in the individuals ZCTA is associated with a 0.7 percentage point decrease in non-LARC use (p=0.048). The regression based test for endogeneity indicates rejection of the null

Table 15. *Linear Probability Results utilizing Instrumental Variables for Prenatal Clinic Choice: Non Long Acting Reversible Contraceptive (LARC) Use*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.0300	0.0717	-0.42	0.676	-0.1706	0.1106
Choice Health Department	-0.7041	0.3310	-2.13	0.033	-1.3528	-0.0553
Choice FQHC	-0.5408	0.2296	-2.36	0.018	-0.9909	-0.0908
Miles	-0.0047	0.0038	-1.22	0.221	-0.0121	0.0028
Age	0.0112	0.0014	8.15	0.000	0.0085	0.0139
Non-White Status	0.0162	0.0232	0.70	0.484	-0.0292	0.0617
Non-White Neighborhood Residence	-0.0269	0.0331	-0.81	0.417	-0.0918	0.0381
Non-White*Non-White Neighborhood	0.0066	0.0412	0.16	0.873	-0.0742	0.0874
First Pregnancy	0.0200	0.0288	0.69	0.489	-0.0366	0.0765
% Female Headed Household	-0.0074	0.0037	-1.98	0.048	-0.0147	-0.0001
% High School Equivalency	0.0027	0.0027	1.00	0.317	-0.0026	0.0080
Constant	0.5170	0.0917	5.64	0.000	0.3373	0.6966

Test of endogeneity

H_0: variables are exogenous

Robust regression F(3,125) = 4.83723 (p=0.0032)

hypothesis that the regressors are exogenous when examining the role of clinic type on non-LARC use (p=0.0032).

Table 16 displays the results for the second outcome of interest, preterm birth, which is also the first of two infant outcomes. This estimation demonstrates no significant association between prenatal care clinic type and preterm birth. However, two control variables are significantly associated with preterm birth. First, age is associated with preterm birth as for every one-year increase in maternal age a woman is 0.2% more likely to deliver a preterm baby (p=0.041). Second, women experiencing a high risk pregnancy are 5.8% more likely to deliver a preterm baby (p≤0.0001).

However, regression based tests for endogeneity failed to reject null hypothesis that the regressors are exogenous (p=0.1351). Therefore, the logistic regression utilizing actual choice in prenatal care clinic type is presented on Tables 17 and 18 as this offers a more efficient estimation (Cameron & Trivedi, 2009). Since this model utilizes actual choice rather than the predicted probabilities from aim 1, the entire sample (N=6,935) is included in the estimation. Results from this estimation demonstrate no significant association between prenatal care clinic type and preterm birth. However, two control variables are found to be significantly associated with preterm birth. Women experiencing a high risk pregnancy are 5.7% more likely to deliver a preterm baby (p≤0.0001) and women experiencing their first pregnancy are 1.5% less likely to deliver a preterm baby (p=0.050).

Table 19 displays the LPM results for the final outcome of interest, low birthweight infants, which is also an infant outcome. The results from this model demonstrate no significant association between prenatal care clinic type and low birthweight. However, the

Table 16. *Linear Probability Results utilizing Instrument Variables for Prenatal Clinic Choice: Preterm Birth*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.0479	0.0346	-1.390	0.166	-0.1156	0.0199
Choice Health Department	-0.0418	0.1144	-0.370	0.715	-0.2659	0.1824
Choice FQHC	0.0208	0.0871	0.240	0.811	-0.1500	0.1915
Miles	0.0008	0.0016	0.520	0.601	-0.0023	0.0040
Age	0.0017	0.0008	2.050	0.041	0.0001	0.0034
High Risk Status	0.0577	0.0108	5.330	0.000	0.0365	0.0790
Non-White Status	0.0173	0.0109	1.580	0.113	-0.0041	0.0387
Non-White Neighborhood Residence	-0.0097	0.0165	-0.590	0.557	-0.0421	0.0227
Non-White*Non-White Neighborhood	0.0144	0.0165	0.880	0.381	-0.0178	0.0467
First Pregnancy	-0.0112	0.0107	-1.040	0.296	-0.0322	0.0098
% Female Headed Household	0.0009	0.0018	0.540	0.591	-0.0025	0.0044
% High School Equivalency	-0.0010	0.0010	-0.990	0.322	-0.0030	0.0010
Constant	0.0393	0.0375	1.050	0.295	-0.0343	0.1128

Test of endogeneity

H_0: variables are exogenous

Robust regression F(3,125) = 1.887 (p=0.1351)

Table 17. *Logistic Regression: Preterm Birth*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.1488	0.1020	-1.460	0.145	-0.3486	0.0511
Choice Health Department	0.1400	0.2623	0.530	0.594	-0.3741	0.6540
Choice FQHC	0.0644	0.2277	0.280	0.777	-0.3819	0.5106
Miles	0.0089	0.0071	1.250	0.210	-0.0050	0.0228
Age	0.0166	0.0098	1.700	0.090	-0.0026	0.0357
High Risk Status	0.7898	0.0975	8.100	0.000	0.5987	0.9809
Non-White Status	0.2184	0.1241	1.760	0.078	-0.0249	0.4617
Non-White Neighborhood Residence	-0.1199	0.2084	-0.580	0.565	-0.5283	0.2885
Non-White*Non-White Neighborhood	0.1666	0.2066	0.810	0.420	-0.2384	0.5716
First Pregnancy	-0.2622	0.1425	-1.840	0.066	-0.5415	0.0171
% Female Headed Household	-0.0046	0.0177	-0.260	0.794	-0.0393	0.0301
% High School Equivalency	0.0104	0.0093	1.120	0.262	-0.0078	0.0287
Constant	-3.6285	0.3904	-9.300	0.000	-4.3937	-2.8634

Table 18. *Logistic Regression Marginal Effects: Preterm Birth*

	Marginal Effect	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.0089	0.0060	-1.470	0.140	-0.0207	0.0029
Choice Health Department	0.0089	0.0177	0.500	0.614	-0.0258	0.0436
Choice FQHC	0.0040	0.0144	0.280	0.782	-0.0242	0.0321
Miles	0.0005	0.0004	1.250	0.210	-0.0003	0.0014
Age	0.0010	0.0006	1.690	0.091	-0.0002	0.0022
High Risk Status	0.0568	0.0080	7.090	0.000	0.0411	0.0725
Non-White Status	0.0132	0.0075	1.760	0.079	-0.0015	0.0278
Non-White Neighborhood Residence	-0.0071	0.0120	-0.590	0.555	-0.0305	0.0164
First Pregnancy	-0.0150	0.0076	-1.960	0.050	-0.0299	0.0000
% Female Headed Household	-0.0003	0.0011	-0.260	0.794	-0.0024	0.0018
% High School Equivalency	0.0006	0.0006	1.120	0.262	-0.0005	0.0017

Table 19. *Linear Probability Results utilizing Instrument Variables for Prenatal Clinic Choice: Low Birthweight Infant*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.0084	0.0258	-0.330	0.744	-0.0590	0.0422
Choice Health Department	-0.0263	0.0775	-0.340	0.734	-0.1783	0.1256
Choice FQHC	0.0832	0.0767	1.080	0.278	-0.0672	0.2336
Miles	0.0001	0.0012	0.070	0.941	-0.0023	0.0025
Age	0.0006	0.0007	0.770	0.442	-0.0009	0.0020
High Risk Status	0.0374	0.0073	5.100	0.000	0.0230	0.0517
Non-White Status	0.0155	0.0079	1.970	0.049	0.0001	0.0310
Non-White Neighborhood Residence	-0.0112	0.0107	-1.040	0.297	-0.0321	0.0098
Non-White*Non-White Neighborhood	0.0045	0.0127	0.350	0.724	-0.0203	0.0293
First Pregnancy	-0.0087	0.0091	-0.960	0.338	-0.0265	0.0091
% Female Headed Household	0.0014	0.0012	1.120	0.263	-0.0010	0.0038
% High School Equivalency	-0.0006	0.0009	-0.660	0.511	-0.0022	0.0011
Constant	0.0151	0.0314	0.480	0.630	-0.0464	0.0767

Test of endogeneity

H_0: variables are exogenous

Robust regression $F(3,125) = 1.535$ ($p=0.2087$)

hypothesis that the regressors are exogenous when examining the role of clinic type on non-LARC use ($p=0.0032$). One control variable, high risk status, is significantly associated with low birthweight as women with a high risk pregnancy status experience a 3.7%increase in low birthweight delivery ($p\leq0.0001$).

As was the case for pre-term birth, the low birthweight model results suggested that the null hypothesis that choice of prenatal setting was exogenous could not be rejected ($p=0.2087$). Therefore, the logistic regression utilizing actual choice in prenatal care clinic type is presented on Tables 20 and 21. As above, because this model utilizes actual choice rather than the predicted probabilities from aim 1, the entire sample (N=6,935) is included in the estimation. As with the LPM IV estimation, these results demonstrate no significant association between prenatal care clinic type and low birthweight. However, this estimation demonstrates two control variables of significance. First, women experiencing a high risk pregnancy have a 4.0% increase in low birth weight babies ($p\leq0.0001$). Second, non-White women experience a 1.5% increase in delivering a low birthweight baby compared to White women ($p=0.003$).

Several sensitivity analyses were conducted to provide insight into the robustness of study findings. These analyses include the following:

- An alternate definition of prenatal care
- Potential mediating effects
- Logistic regression with actual choice
- Linear probability model with actual choice
- Linear probability model with predicted probabilities

Table 20. *Logistic Regression: Low Birth Weight*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.1605	0.1383	-1.160	0.246	-0.4316	0.1106
Choice Health Department	-0.1142	0.3608	-0.320	0.752	-0.8213	0.5930
Choice FQHC	0.0820	0.2594	0.320	0.752	-0.4265	0.5904
Miles	0.0103	0.0070	1.470	0.142	-0.0035	0.0241
Age	0.0061	0.0142	0.430	0.666	-0.0217	0.0339
High Risk Status	0.8936	0.1091	8.190	0.000	0.6798	1.1073
Non-White Status	0.4282	0.1387	3.090	0.002	0.1564	0.7001
Non-White Neighborhood Residence	0.0058	0.2592	0.020	0.982	-0.5023	0.5138
Non-White*Non-White Neighborhood	-0.0706	0.2685	-0.260	0.793	-0.5968	0.4556
First Pregnancy	-0.1358	0.1794	-0.760	0.449	-0.4875	0.2159
% Female Headed Household	0.0156	0.0204	0.760	0.444	-0.0243	0.0555
% High School Equivalency	0.0037	0.0126	0.290	0.772	-0.0211	0.0284
Constant	-4.0793	0.5550	-7.350	0.000	-5.1670	-2.9916

Table 21. *Logistic Regression Marginal Effects: Low Birth Weight*

	Marginal Effect	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.0057	0.0049	-1.160	0.247	-0.0153	0.0039
Choice Health Department	-0.0039	0.0117	-0.330	0.739	-0.0268	0.0190
Choice FQHC	0.0030	0.0099	0.310	0.759	-0.0163	0.0224
Miles	0.0004	0.0003	1.490	0.137	-0.0001	0.0009
Age	0.0002	0.0005	0.430	0.666	-0.0008	0.0012
High Risk Status	0.0398	0.0058	6.830	0.000	0.0284	0.0513
Non-White Status	0.0154	0.0051	3.010	0.003	0.0054	0.0254
Non-White Neighborhood Residence	0.0002	0.0093	0.020	0.982	-0.0180	0.0184
First Pregnancy	-0.0047	0.0060	-0.780	0.434	-0.0165	0.0071
% Female Headed Household	0.0006	0.0007	0.760	0.446	-0.0009	0.0020
% High School Equivalency	0.0001	0.0005	0.290	0.772	-0.0008	0.0010

Alternate definition of prenatal care.

The first sensitivity analysis examines the definition of inadequate prenatal care. In the above main regression in Table 13, inadequate prenatal care is defined as attending 7 or fewer prenatal care visits. The sensitivity analysis, displayed in Table 22, defines inadequate prenatal care as attending 5 or fewer visits and is estimated using the LPM model with predicted probability of clinic choice generated from Research Aim 1 as an instrumental variable for clinic selection. This sensitivity analysis demonstrates that the estimates do not significantly differ based on this minor change to the definition of inadequate prenatal care services.

Potential mediating effects

The next set of sensitivity analyses evaluates the potential mediating effects of certain process measures on maternal and child outcomes, as guided by the Donabedian's SPO framework in Chapter 3. Each of these estimations should be interpreted with caution as the addition of process measures may introduce endogeneity into the model. First, related to non-LARC use, Table 23 displays estimates of the LPM model with instrumental variables incorporating postpartum visit attendance as an explanatory variable. Second, on Table 24 and Table 25, preterm birth is estimated as above, but incorporating a measure for adequate prenatal care as an explanatory variable. Finally, Tables 26 and 27 present estimates of low birthweight infant outcomes including the explanatory variable of prenatal care adequacy. Process measures were found to be significantly associated with outcome measures. Postpartum visit attendance is significantly associated with a 13.8% decrease in non-LARC use ($p \leq 0.0001$). The process measure of adequate prenatal service is

Table 22. *Linear Probability Results utilizing Instrumental Variables for Prenatal Clinic Choice: Inadequate Prenatal Care defined by Attending Five or Fewer Prenatal Care Visits*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	0.1654	0.1008	1.640	0.101	-0.0322	0.3630
Choice Health Department	-0.8094	0.3551	-2.280	0.023	-1.5055	-0.1134
Choice FQHC	-0.5755	0.2511	-2.290	0.022	-1.0676	-0.0833
Miles	-0.0041	0.0046	-0.890	0.373	-0.0130	0.0049
Age	-0.0026	0.0015	-1.730	0.084	-0.0056	0.0004
Non-White Status	0.0491	0.0220	2.230	0.026	0.0059	0.0922
Non-White Neighborhood Residence	0.0721	0.0392	1.840	0.066	-0.0048	0.1489
Non-White*Non-White Neighborhood	-0.0384	0.0451	-0.850	0.394	-0.1267	0.0499
First Pregnancy	-0.0804	0.0344	-2.330	0.020	-0.1479	-0.0129
% Female Headed Household	-0.0030	0.0043	-0.700	0.484	-0.0114	0.0054
% High School Equivalency	0.0006	0.0032	0.200	0.845	-0.0057	0.0070
Constant	0.4300	0.0984	4.370	0.000	0.2372	0.6227

Test of endogeneity

H_0: variables are exogenous

Robust regression $F(3,125) = 12.5622$ ($p = 0.0000$)

Table 23. *Linear Probability Results utilizing Instrumental Variables for Prenatal Care Clinic Choice: Mediating effect of Postpartum Attendance on non-LARC use*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.0303	0.0635	-0.480	0.633	-0.1549	0.0942
Choice Health Department	-0.5791	0.2956	-1.960	0.050	-1.1585	0.0003
Choice FQHC	-0.3605	0.1893	-1.900	0.057	-0.7315	0.0106
Miles	-0.0027	0.0033	-0.830	0.405	-0.0092	0.0037
Age	0.0115	0.0014	8.480	0.000	0.0088	0.0141
Non-White Status	0.0048	0.0217	0.220	0.826	-0.0377	0.0472
Non-White Neighborhood Residence	-0.0387	0.0312	-1.240	0.214	-0.0998	0.0223
Non-White*Non-White Neighborhood	0.0163	0.0381	0.430	0.670	-0.0584	0.0910
First Pregnancy	0.0211	0.0259	0.820	0.414	-0.0296	0.0718
% Female Headed Household	-0.0070	0.0032	-2.200	0.028	-0.0131	-0.0008
% High School Equivalency	0.0021	0.0024	0.870	0.383	-0.0026	0.0069
Postpartum Visit Attendance	-0.1382	0.0192	-7.190	0.000	-0.1759	-0.1005
Constant	0.5716	0.0821	6.960	0.000	0.4107	0.7326

Table 24. *Logistic Regression: Mediating effect of Prenatal Care Adequacy on Preterm Birth*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.2221	0.1050	-2.120	0.034	-0.4279	-0.0164
Choice Health Department	0.0427	0.2676	0.160	0.873	-0.4819	0.5672
Choice FQHC	-0.0679	0.2248	-0.300	0.763	-0.5085	0.3728
Miles	0.0024	0.0072	0.330	0.738	-0.0117	0.0165
Age	0.0180	0.0098	1.840	0.065	-0.0011	0.0371
High Risk Status	0.8445	0.0957	8.820	0.000	0.6568	1.0321
Non-White Status	0.2018	0.1274	1.580	0.113	-0.0478	0.4514
Non-White Neighborhood Residence	-0.1514	0.2127	-0.710	0.477	-0.5684	0.2656
Non-White*Non-White Neighborhood	0.1776	0.2070	0.860	0.391	-0.2281	0.5833
First Pregnancy	-0.2144	0.1403	-1.530	0.126	-0.4893	0.0605
% Female Headed Household	-0.0060	0.0181	-0.330	0.742	-0.0415	0.0296
% High School Equivalency	0.0123	0.0093	1.330	0.184	-0.0059	0.0306
Prenatal Care Adequacy	-0.6040	0.1054	-5.730	0.000	-0.8106	-0.3975
Constant	-3.3788	0.3863	-8.750	0.000	-4.1359	-2.6216

Table 25. *Logistic Regression Marginal Effects: Mediating effect of Prenatal Care Adequacy on Preterm Birth*

	Marginal Effect	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.0128	0.0060	-2.150	0.032	-0.0245	-0.0011
Choice Health Department	0.0025	0.0162	0.160	0.875	-0.0292	0.0343
Choice FQHC	-0.0039	0.0125	-0.310	0.758	-0.0284	0.0207
Miles	0.0001	0.0004	0.330	0.738	-0.0007	0.0010
Age	0.0011	0.0006	1.840	0.065	-0.0001	0.0022
High Risk Status	0.0597	0.0079	7.540	0.000	0.0442	0.0753
Non-White Status	0.0118	0.0074	1.590	0.113	-0.0028	0.0264
Non-White Neighborhood Residence	-0.0086	0.0117	-0.730	0.463	-0.0315	0.0143
First Pregnancy	-0.0120	0.0074	-1.620	0.105	-0.0264	0.0025
% Female Headed Household	-0.0003	0.0011	-0.330	0.742	-0.0024	0.0017
% High School Equivalency	0.0007	0.0005	1.320	0.185	-0.0003	0.0018
Prenatal Care Adequacy	-0.0349	0.0060	-5.860	0.000	-0.0466	-0.0233

Table 26. *Logistic Regression: Mediating effect of Prenatal Care Adequacy on Low Birthweight*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.2420	0.1426	-1.700	0.090	-0.5214	0.0374
Choice Health Department	-0.2270	0.3629	-0.630	0.532	-0.9382	0.4843
Choice FQHC	-0.0567	0.2641	-0.210	0.830	-0.5743	0.4609
Miles	0.0029	0.0070	0.410	0.680	-0.0108	0.0166
Age	0.0081	0.0142	0.570	0.568	-0.0198	0.0360
High Risk Status	0.9555	0.1062	9.000	0.000	0.7474	1.1637
Non-White Status	0.4089	0.1421	2.880	0.004	0.1304	0.6874
Non-White Neighborhood Residence	-0.0288	0.2609	-0.110	0.912	-0.5402	0.4825
Non-White*Non-White Neighborhood	-0.0605	0.2675	-0.230	0.821	-0.5848	0.4639
First Pregnancy	-0.0774	0.1793	-0.430	0.666	-0.4287	0.2740
% Female Headed Household	0.0142	0.0211	0.670	0.501	-0.0272	0.0556
% High School Equivalency	0.0058	0.0127	0.460	0.646	-0.0190	0.0306
Prenatal Care Adequacy	-0.7089	0.1427	-4.970	0.000	-0.9886	-0.4292
Constant	-3.8096	0.5477	-6.960	0.000	-4.8830	-2.7361

Table 27. *Logistic Regression Marginal Effects: Mediating effect of Prenatal Care Adequacy on Low Birthweight*

	Marginal Effect	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.0081	0.0048	-1.690	0.091	-0.0176	0.0013
Choice Health Department	-0.0070	0.0102	-0.690	0.490	-0.0270	0.0129
Choice FQHC	-0.0019	0.0086	-0.220	0.826	-0.0188	0.0150
Miles	0.0001	0.0002	0.410	0.679	-0.0004	0.0006
Age	0.0003	0.0005	0.570	0.567	-0.0007	0.0012
High Risk Status	0.0413	0.0057	7.260	0.000	0.0302	0.0525
Non-White Status	0.0140	0.0050	2.790	0.005	0.0042	0.0238
Non-White Neighborhood Residence	-0.0010	0.0088	-0.110	0.911	-0.0182	0.0162
First Pregnancy	-0.0026	0.0059	-0.440	0.660	-0.0141	0.0089
% Female Headed Household	0.0005	0.0007	0.670	0.501	-0.0009	0.0019
% High School Equivalency	0.0002	0.0004	0.460	0.646	-0.0006	0.0010
Prenatal Care Adequacy	-0.0240	0.0048	-5.010	0.000	-0.0333	-0.0146

significantly associated with both infant outcomes as an indication of adequate prenatal care services is associated with a 3.5% decrease in preterm birth (p≤0.0001), and a 2.4% decrease in low birthweight (p≤0.0001). These potential mediating roles will be elaborated on in Chapter 6.

Logistic regression with actual choice.

A third second set of sensitivity analyses assume that clinic choice is exogenous and examines prenatal care clinic type choice on process and outcome measures with a logit model. As described above, this approach is the main approach utilized for infant outcomes as the regression based tests for endogeneity failed to reject the null hypotheses that the IV estimations were exogenous. Tables 28 through 33 display logistic regression results and corresponding estimated marginal effects.

These analyses are inconsistent with the main analyses presented above and these inconsistencies are likely due to omitted variables bias. Prior tests have demonstrated that choice is endogenous to prenatal care inadequacy, postpartum nonattendance and non-LARC use, and this endogeneity is mitigated with the use of instrumental variables. Additional explanation attributing to this inconsistency is discussed in Chapter 6.

Linear probability model with actual choice.

The next set of sensitivity analysis utilizes the LPM and assumes exogeneity. Therefore these LPM models include actual clinic choice of prenatal care clinic rather than utilizing predicted probabilities generated from Research Aim 1 as instrumental variables for prenatal care clinic selection. The sample size of these estimates (N=6,935) reflects all women from the sample dataset as prior sample size reductions utilized for the LPM

Table 28. *Logistic Regression Actual Choice: Inadequate Prenatal Care*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	0.3873	0.1047	3.7	0.000	0.1821	0.5926
Choice Health Department	0.6249	0.1410	4.43	0.000	0.3485	0.9012
Choice FQHC	0.9778	0.3145	3.11	0.002	0.3613	1.5943
Miles	0.0121	0.0008	14.82	0.000	0.0105	0.0137
Age	-0.0054	0.0059	-0.92	0.355	-0.0169	0.0061
Non-White Status	0.1104	0.0828	1.33	0.182	-0.0519	0.2728
Non-White Neighborhood Residence	0.2973	0.1624	1.83	0.067	-0.0210	0.6155
Non-White*Non-White Neighborhood	-0.1489	0.1369	-1.09	0.277	-0.4173	0.1194
First Pregnancy	-0.2735	0.0764	-3.58	0.000	-0.4232	-0.1238
% Female Headed Household	0.0079	0.0125	0.63	0.526	-0.0166	0.0325
% High School Equivalency	-0.0125	0.0081	-1.53	0.125	-0.0284	0.0035
Constant	0.0476	0.2945	0.16	0.872	-0.5296	0.6249

Table 29. *Logistic Regression Marginal Effects Actual Choice: Inadequate Prenatal Care*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	0.0954	0.0256	3.72	0.000	0.0452	0.1456
Choice Health Department	0.1462	0.0307	4.77	0.000	0.0861	0.2064
Choice FQHC	0.2193	0.0586	3.74	0.000	0.1045	0.3341
Miles	0.0030	0.0002	14.46	0.000	0.0026	0.0034
Age	-0.0013	0.0015	-0.93	0.355	-0.0042	0.0015
Non-White Status	0.0273	0.0205	1.34	0.182	-0.0128	0.0675
Non-White Neighborhood Residence	0.0729	0.0394	1.85	0.064	-0.0043	0.1501
First Pregnancy	-0.0680	0.0190	-3.58	0.000	-0.1052	-0.0308
% Female Headed Household	0.0020	0.0031	0.63	0.526	-0.0041	0.0081
% High School Equivalency	-0.0031	0.0020	-1.53	0.126	-0.0070	0.0009

Table 30. *Logistic Regression: Postpartum Care Nonattendance*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	0.5259	0.0990	5.31	0.000	0.3320	0.7199
Choice Health Department	0.6635	0.1677	3.96	0.000	0.3348	0.9923
Choice FQHC	-0.2566	0.0956	-2.68	0.007	-0.4441	-0.0692
Miles	0.0138	0.0010	14.15	0.000	0.0119	0.0157
Age	-0.0017	0.0050	-0.35	0.730	-0.0116	0.0081
Non-White Status	0.0691	0.0672	1.03	0.304	-0.0626	0.2007
Non-White Neighborhood Residence	0.3850	0.2050	1.88	0.060	-0.0168	0.7869
Non-White*Non-White Neighborhood	-0.4182	0.1778	-2.35	0.019	-0.7668	-0.0697
First Pregnancy	-0.2327	0.0697	-3.34	0.001	-0.3694	-0.0960
% Female Headed Household	0.0111	0.0177	0.62	0.533	-0.0237	0.0458
% High School Equivalency	-0.0120	0.0069	-1.75	0.080	-0.0255	0.0015
Constant	0.1349	0.2635	0.51	0.609	-0.3815	0.6513

Table 31. *Logistic Regression Marginal Effects: Postpartum Care Nonattendance*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	0.1250	0.0233	5.37	0.000	0.0794	0.1707
Choice Health Department	0.1461	0.0332	4.4	0.000	0.0811	0.2111
Choice FQHC	-0.0628	0.0236	-2.66	0.008	-0.1090	-0.0166
Miles	0.0033	0.0002	13.74	0.000	0.0028	0.0038
Age	-0.0004	0.0012	-0.35	0.730	-0.0028	0.0019
Non-White Status	0.0166	0.0162	1.03	0.304	-0.0151	0.0483
Non-White Neighborhood Residence	0.0907	0.0470	1.93	0.054	-0.0015	0.1828
First Pregnancy	-0.0565	0.0171	-3.3	0.001	-0.0901	-0.0229
% Female Headed Household	0.0027	0.0043	0.63	0.532	-0.0057	0.0110
% High School Equivalency	-0.0029	0.0017	-1.75	0.080	-0.0061	0.0003

Table 32. *Logistic Regression: Non-LARC Use*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.0148	0.0911	-0.16	0.871	-0.1934	0.1639
Choice Health Department	0.8196	0.2187	3.75	0.000	0.3909	1.2483
Choice FQHC	-0.2634	0.1085	-2.43	0.015	-0.4761	-0.0507
Miles	0.0028	0.0010	2.87	0.004	0.0009	0.0048
Age	0.0596	0.0060	9.98	0.000	0.0479	0.0713
Non-White Status	0.0566	0.0689	0.82	0.411	-0.0784	0.1915
Non-White Neighborhood Residence	-0.0874	0.1396	-0.63	0.531	-0.3610	0.1862
Non-White*Non-White Neighborhood	-0.1033	0.1308	-0.79	0.430	-0.3598	0.1531
First Pregnancy	-0.0672	0.0716	-0.94	0.348	-0.2075	0.0731
% Female Headed Household	-0.0216	0.0147	-1.47	0.142	-0.0503	0.0072
% High School Equivalency	-0.0077	0.0070	-1.11	0.268	-0.0214	0.0059
Constant	0.0197	0.2734	0.07	0.943	-0.5162	0.5556

Table 33. *Logistic Regression Marginal Effects: Non-LARC Use*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Choice Hospital	-0.0027	0.0168	-0.16	0.871	-0.0357	0.0303
Choice Health Department	0.1215	0.0254	4.78	0.000	0.0716	0.1713
Choice FQHC	-0.0514	0.0222	-2.31	0.021	-0.0949	-0.0078
Miles	0.0005	0.0002	2.88	0.004	0.0002	0.0009
Age	0.0110	0.0011	9.78	0.000	0.0088	0.0132
Non-White Status	0.0104	0.0127	0.82	0.411	-0.0145	0.0353
Non-White Neighborhood Residence	-0.0163	0.0263	-0.62	0.536	-0.0678	0.0352
First Pregnancy	-0.0125	0.0135	-0.93	0.354	-0.0389	0.0139
% Female Headed Household	-0.0040	0.0027	-1.47	0.141	-0.0093	0.0013
% High School Equivalency	-0.0014	0.0013	-1.11	0.267	-0.0039	0.0011

models with instrument variables were the result of predicted probability estimates from aim 1. Tables 34 through 38 present LPM results with actual choice as independent variables.

These analyses are inconsistent with the main analyses examining prenatal care inadequacy, postpartum visit nonattendance and non-LARC use, but are consistent with results from the logistic regression sensitivity analyses with actual choice an independent variables. As described above, prior tests have demonstrated that choice is endogenous to these measures, and this endogeneity is mitigated with the use of instrumental variables.

These sensitivity analyses are consistent with main estimations examining the two infant outcomes of preterm birth and low birthweight as choice of prenatal care clinic type is not associated with infant outcomes. These results suggest that the main analyses examining infant outcomes are robust to model specifications.

Linear probability model with predicted probabilities.

The final set of sensitivity analyses assume endogeneity of the type of clinic chosen and estimates the logit model with the predicated probabilities from Research Aim 1 as independent variables of interest. Wooldridge (2009) refers to this as the forbidden regression, and results should be interpreted with great caution. These estimates and corresponding marginal effects are presented in tables 39 through 48.

Results utilizing predicted probabilities as independent variables offer consistent results to findings offered in the main analysis. Namely, significant associations are demonstrated between prenatal care clinic selection and prenatal care inadequacy, postpartum visit nonattendance and non-LARC use whereas no significant associations between prenatal care clinic of choice and infant outcomes are demonstrated.

Table 34. *Linear Probability Model with Actual Choice: Inadequate Prenatal Care*

	Coefficient	Robust Standard Error	t	P>|t|	95% Confidence Interval	
Choice Hospital	0.0971	0.0257	3.780	0.000	0.0465	0.1478
Choice Health Department	0.1531	0.0343	4.470	0.000	0.0856	0.2206
Choice FQHC	0.2358	0.0718	3.280	0.001	0.0943	0.3773
Miles	0.0024	0.0002	13.790	0.000	0.0020	0.0027
Age	-0.0012	0.0013	-0.920	0.357	-0.0038	0.0014
Non-White Status	0.0247	0.0189	1.310	0.192	-0.0125	0.0619
Non-White Neighborhood Residence	0.0665	0.0372	1.790	0.075	-0.0067	0.1397
Non-White*Non-White Neighborhood	-0.0338	0.0312	-1.080	0.280	-0.0952	0.0277
First Pregnancy	-0.0623	0.0175	-3.560	0.000	-0.0968	-0.0278
% Female Headed Household	0.0020	0.0028	0.720	0.475	-0.0036	0.0076
% High School Equivalency	-0.0028	0.0018	-1.530	0.126	-0.0065	0.0008
Constant	0.5055	0.0667	7.570	0.000	0.3740	0.6370

Table 35. *Linear Probability Model with Actual Choice: Postpartum Visit Nonattendance*

	Coefficient	Robust Standard Error	t	P>|t|	95% Confidence Interval	
Choice Hospital	0.1301	0.0240	5.420	0.000	0.0828	0.1774
Choice Health Department	0.1609	0.0395	4.070	0.000	0.0831	0.2387
Choice FQHC	-0.0657	0.0226	-2.910	0.004	-0.1103	-0.0212
Miles	0.0022	0.0002	13.480	0.000	0.0019	0.0025
Age	-0.0004	0.0011	-0.350	0.730	-0.0025	0.0018
Non-White Status	0.0148	0.0147	1.010	0.313	-0.0141	0.0438
Non-White Neighborhood Residence	0.0816	0.0427	1.910	0.058	-0.0026	0.1658
Non-White*Non-White Neighborhood	-0.0896	0.0374	-2.400	0.017	-0.1633	-0.0159
First Pregnancy	-0.0521	0.0156	-3.340	0.001	-0.0829	-0.0214
% Female Headed Household	0.0025	0.0040	0.640	0.521	-0.0053	0.0104
% High School Equivalency	-0.0026	0.0015	-1.650	0.099	-0.0056	0.0005
Constant	0.5282	0.0577	9.150	0.000	0.4145	0.6419

Table 36. *Linear Probability Model with Actual Choice: Non-LARC use*

	Coefficient	Robust Standard Error	t	P>|t|	95% Confidence Interval	
Choice Hospital	-0.0030	0.0171	-0.170	0.863	-0.0367	0.0308
Choice Health Department	0.1206	0.0260	4.640	0.000	0.0694	0.1718
Choice FQHC	-0.0551	0.0225	-2.450	0.015	-0.0993	-0.0108
Miles	0.0005	0.0002	2.820	0.005	0.0001	0.0008
Age	0.0100	0.0010	10.420	0.000	0.0081	0.0118
Non-White Status	0.0103	0.0121	0.850	0.395	-0.0135	0.0342
Non-White Neighborhood Residence	-0.0153	0.0273	-0.560	0.575	-0.0690	0.0384
Non-White*Non-White Neighborhood	-0.0216	0.0256	-0.840	0.399	-0.0719	0.0288
First Pregnancy	-0.0145	0.0140	-1.030	0.302	-0.0420	0.0131
% Female Headed Household	-0.0042	0.0029	-1.460	0.146	-0.0098	0.0015
% High School Equivalency	-0.0012	0.0012	-1.010	0.314	-0.0037	0.0012
Constant	0.5681	0.0478	11.880	0.000	0.4739	0.6624

Table 37. *Linear Probability Model with Actual Choice: Preterm Birth*

	Coefficient	Robust Standard Error	t	P>|t|	95% Confidence Interval	
Choice Hospital	-0.0092	0.0063	-1.450	0.149	-0.0216	0.0033
Choice Health Department	0.0103	0.0201	0.510	0.610	-0.0294	0.0499
Choice FQHC	0.0041	0.0148	0.280	0.782	-0.0250	0.0332
Miles	0.0006	0.0005	1.260	0.211	-0.0004	0.0016
Age	0.0012	0.0007	1.680	0.094	-0.0002	0.0026
High Risk Status	0.0592	0.0081	7.280	0.000	0.0432	0.0753
Non-White Status	0.0139	0.0081	1.710	0.088	-0.0021	0.0299
Non-White Neighborhood Residence	-0.0066	0.0120	-0.550	0.584	-0.0302	0.0170
Non-White*Non-White Neighborhood	0.0107	0.0123	0.870	0.387	-0.0136	0.0349
First Pregnancy	-0.0143	0.0076	-1.870	0.062	-0.0293	0.0007
% Female Headed Household	-0.0004	0.0012	-0.310	0.755	-0.0026	0.0019
% High School Equivalency	0.0007	0.0006	1.150	0.251	-0.0005	0.0018
Constant	0.0020	0.0261	0.080	0.940	-0.0494	0.0533

Table 38. *Linear Probability Model with Actual Choice: Low Birthweight*

	Coefficient	Robust Standard Error	t	P>|t|	95% Confidence Interval	
Choice Hospital	-0.0064	0.0054	-1.190	0.236	-0.0170	0.0042
Choice Health Department	-0.0054	0.0142	-0.380	0.702	-0.0333	0.0225
Choice FQHC	0.0031	0.0102	0.300	0.762	-0.0170	0.0233
Miles	0.0004	0.0003	1.470	0.143	-0.0002	0.0011
Age	0.0003	0.0006	0.450	0.651	-0.0009	0.0015
High Risk Status	0.0417	0.0058	7.160	0.000	0.0302	0.0532
Non-White Status	0.0164	0.0058	2.840	0.005	0.0050	0.0277
Non-White Neighborhood Residence	-0.0005	0.0092	-0.050	0.957	-0.0186	0.0176
Non-White*Non-White Neighborhood	-0.0013	0.0101	-0.130	0.894	-0.0212	0.0185
First Pregnancy	-0.0047	0.0062	-0.750	0.452	-0.0169	0.0076
% Female Headed Household	0.0006	0.0009	0.700	0.484	-0.0011	0.0023
% High School Equivalency	0.0001	0.0005	0.310	0.758	-0.0008	0.0011
Constant	0.0061	0.0223	0.280	0.783	-0.0377	0.0500

Table 39. *Logistic Regression Predicted Probabilities: Inadequate Prenatal Care*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Predicted Probability Hospital	0.2116	0.2488	0.850	0.395	-0.2761	0.6993
Predicted Probability Health Department	-1.2300	1.0853	-1.130	0.257	-3.3572	0.8972
Predicted Probability FQHC	-3.5231	0.6778	-5.200	0.000	-4.8515	-2.1946
Miles	0.0010	0.0129	0.080	0.938	-0.0243	0.0263
Age	-0.0172	0.0069	-2.510	0.012	-0.0306	-0.0037
Non-White Status	0.1993	0.0879	2.270	0.023	0.0271	0.3715
Non-White Neighborhood Residence	0.1533	0.1137	1.350	0.178	-0.0696	0.3762
Non-White*Non-White Neighborhood	-0.1435	0.1371	-1.050	0.295	-0.4121	0.1252
First Pregnancy	-0.2714	0.1117	-2.430	0.015	-0.4904	-0.0525
% Female Headed Household	0.0017	0.0094	0.180	0.855	-0.0167	0.0202
% High School Equivalency	-0.0070	0.0075	-0.930	0.351	-0.0218	0.0077
Constant	0.6283	0.3059	2.050	0.040	0.0287	1.2278

Table 40. *Logistic Regression Predicted Probabilities' Marginal Effects: Inadequate Prenatal Care*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Predicted Probability Hospital	0.0529	0.0622	0.850	0.395	-0.0690	0.1748
Predicted Probability Health Department	-0.3074	0.2713	-1.130	0.257	-0.8391	0.2243
Predicted Probability FQHC	-0.8806	0.1694	-5.200	0.000	-1.2126	-0.5486
Miles	0.0003	0.0032	0.080	0.938	-0.0061	0.0066
Age	-0.0043	0.0017	-2.510	0.012	-0.0076	-0.0009
Non-White Status	0.0498	0.0219	2.270	0.023	0.0069	0.0926
Non-White Neighborhood Residence	0.0383	0.0284	1.350	0.177	-0.0173	0.0940
First Pregnancy	-0.0676	0.0276	-2.450	0.014	-0.1218	-0.0134
% Female Headed Household	0.0004	0.0024	0.180	0.855	-0.0042	0.0050
% High School Equivalency	-0.0018	0.0019	-0.930	0.351	-0.0054	0.0019

Table 41. *Logistic Regression Predicted Probabilities: Postpartum Care Nonattendance*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Predicted Probability Hospital	-0.1667	0.3295	-0.510	0.613	-0.8125	0.4791
Predicted Probability Health Department	0.0830	1.1516	0.070	0.943	-2.1739	2.3400
Predicted Probability FQHC	-5.7684	1.4790	-3.900	0.000	-8.6672	-2.8696
Miles	-0.0020	0.0109	-0.180	0.857	-0.0233	0.0193
Age	-0.0172	0.0062	-2.780	0.005	-0.0293	-0.0051
Non-White Status	0.2926	0.0964	3.040	0.002	0.1037	0.4814
Non-White Neighborhood Residence	0.2689	0.1889	1.420	0.155	-0.1013	0.6391
Non-White*Non-White Neighborhood	-0.4717	0.2056	-2.290	0.022	-0.8747	-0.0688
First Pregnancy	-0.2211	0.0941	-2.350	0.019	-0.4056	-0.0366
% Female Headed Household	-0.0128	0.0199	-0.640	0.522	-0.0517	0.0262
% High School Equivalency	0.0104	0.0118	0.880	0.379	-0.0128	0.0336
Constant	0.6688	0.3981	1.680	0.093	-0.1114	1.4490

Table 42. *Logistic Regression Predicted Probabilities' Marginal Effects: Postpartum Care Nonattendance*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Predicted Probability Hospital	-0.0415	0.0821	-0.510	0.613	-0.2024	0.1193
Predicted Probability Health Department	0.0207	0.2868	0.070	0.943	-0.5415	0.5829
Predicted Probability FQHC	-1.4368	0.3693	-3.890	0.000	-2.1606	-0.7129
Miles	-0.0005	0.0027	-0.180	0.857	-0.0058	0.0048
Age	-0.0043	0.0015	-2.770	0.006	-0.0073	-0.0013
Non-White Status	0.0729	0.0240	3.040	0.002	0.0259	0.1198
Non-White Neighborhood Residence	0.0667	0.0466	1.430	0.152	-0.0246	0.1581
First Pregnancy	-0.0552	0.0235	-2.350	0.019	-0.1012	-0.0091
% Female Headed Household	-0.0032	0.0050	-0.640	0.522	-0.0129	0.0065
% High School Equivalency	0.0026	0.0030	0.880	0.379	-0.0032	0.0084

Table 43. *Logistic Regression Predicted Probabilities: Non-LARC Use*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Predicted Probability Hospital	-0.3026	0.2947	-1.030	0.305	-0.8801	0.2750
Predicted Probability Health Department	-2.1491	1.3342	-1.610	0.107	-4.7641	0.4660
Predicted Probability FQHC	-1.6558	0.9571	-1.730	0.084	-3.5316	0.2200
Miles	0.0083	0.0135	0.620	0.538	-0.0181	0.0348
Age	0.0534	0.0076	7.000	0.000	0.0385	0.0684
Non-White Status	0.0821	0.1125	0.730	0.466	-0.1385	0.3027
Non-White Neighborhood Residence	-0.2067	0.1586	-1.300	0.192	-0.5175	0.1041
Non-White*Non-White Neighborhood	-0.0919	0.1590	-0.580	0.563	-0.4036	0.2198
First Pregnancy	-0.0301	0.1040	-0.290	0.773	-0.2339	0.1738
% Female Headed Household	-0.0360	0.0168	-2.150	0.032	-0.0689	-0.0032
% High School Equivalency	0.0126	0.0116	1.090	0.277	-0.0101	0.0353
Constant	-0.0389	0.4106	-0.090	0.925	-0.8437	0.7659

Table 44. *Logistic Regression Predicted Probabilities' Marginal Effects: Non-LARC Use*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Predicted Probability Hospital	-0.0603	0.0587	-1.030	0.304	-0.1754	0.0547
Predicted Probability Health Department	-0.4285	0.2664	-1.610	0.108	-0.9506	0.0936
Predicted Probability FQHC	-0.3302	0.1903	-1.740	0.083	-0.7031	0.0428
Miles	0.0017	0.0027	0.610	0.539	-0.0036	0.0070
Age	0.0107	0.0015	6.980	0.000	0.0077	0.0136
Non-White Status	0.0164	0.0227	0.730	0.468	-0.0280	0.0608
Non-White Neighborhood Residence	-0.0416	0.0323	-1.290	0.197	-0.1048	0.0216
First Pregnancy	-0.0060	0.0209	-0.290	0.774	-0.0470	0.0350
% Female Headed Household	-0.0072	0.0033	-2.160	0.031	-0.0137	-0.0007
% High School Equivalency	0.0025	0.0023	1.090	0.277	-0.0020	0.0070

Table 45. *Logistic Regression Predicted Probabilities: Preterm Birth*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Predicted Probability Hospital	-0.6572	0.3999	-1.640	0.100	-1.4410	0.1267
Predicted Probability Health Department	-1.6036	1.9665	-0.820	0.415	-5.4579	2.2506
Predicted Probability FQHC	1.2015	1.2276	0.980	0.328	-1.2046	3.6076
Miles	0.0101	0.0201	0.500	0.617	-0.0294	0.0495
Age	0.0227	0.0117	1.940	0.052	-0.0002	0.0456
High Risk Status	0.8014	0.1243	6.450	0.000	0.5578	1.0450
Non-White Status	0.2913	0.1694	1.720	0.085	-0.0406	0.6232
Non-White Neighborhood Residence	-0.1880	0.2981	-0.630	0.528	-0.7721	0.3962
Non-White*Non-White Neighborhood	0.2099	0.2960	0.710	0.478	-0.3701	0.7900
First Pregnancy	-0.2141	0.1713	-1.250	0.211	-0.5498	0.1216
% Female Headed Household	0.0084	0.0238	0.350	0.725	-0.0383	0.0551
% High School Equivalency	-0.0071	0.0137	-0.520	0.603	-0.0340	0.0197
Constant	-3.1595	0.5085	-6.210	0.000	-4.1561	-2.1630

Table 46. *Logistic Regression Predicted Probabilities' Marginal Effects: Preterm Birth*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Predicted Probability Hospital	-0.0402	0.0250	-1.610	0.108	-0.0892	0.0088
Predicted Probability Health Department	-0.0981	0.1195	-0.820	0.412	-0.3323	0.1362
Predicted Probability FQHC	0.0735	0.0735	1.000	0.317	-0.0706	0.2175
Miles	0.0006	0.0012	0.500	0.619	-0.0018	0.0030
Age	0.0014	0.0007	1.980	0.048	0.0000	0.0028
High Risk Status	0.0592	0.0109	5.460	0.000	0.0380	0.0805
Non-White Status	0.0174	0.0098	1.780	0.075	-0.0018	0.0365
Non-White Neighborhood Residence	-0.0113	0.0176	-0.640	0.520	-0.0457	0.0231
First Pregnancy	-0.0125	0.0095	-1.320	0.188	-0.0311	0.0061
% Female Headed Household	0.0005	0.0015	0.350	0.725	-0.0023	0.0034
% High School Equivalency	-0.0004	0.0008	-0.520	0.604	-0.0021	0.0012

Table 47. *Logistic Regression Predicted Probabilities: Low Birthweight*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Predicted Probability Hospital	-0.3510	0.5038	-0.700	0.486	-1.3384	0.6364
Predicted Probability Health Department	-3.2192	2.8375	-1.130	0.257	-8.7807	2.3423
Predicted Probability FQHC	3.1008	1.7788	1.740	0.081	-0.3856	6.5873
Miles	-0.0149	0.0262	-0.570	0.570	-0.0663	0.0365
Age	0.0122	0.0168	0.730	0.468	-0.0207	0.0451
High Risk Status	0.8277	0.1282	6.460	0.000	0.5765	1.0790
Non-White Status	0.4584	0.1829	2.510	0.012	0.1000	0.8168
Non-White Neighborhood Residence	-0.3769	0.4043	-0.930	0.351	-1.1692	0.4155
Non-White*Non-White Neighborhood	0.2191	0.4079	0.540	0.591	-0.5803	1.0186
First Pregnancy	-0.2316	0.2317	-1.000	0.317	-0.6857	0.2225
% Female Headed Household	0.0327	0.0254	1.280	0.199	-0.0172	0.0825
% High School Equivalency	-0.0069	0.0202	-0.340	0.734	-0.0465	0.0328
Constant	-3.8003	0.7227	-5.260	0.000	-5.2168	-2.3838

Table 48. *Logistic Regression Predicted Probabilities' Marginal Effects: Low Birthweight*

	Coefficient	Robust Standard Error	Z	P>|z|	95% Confidence Interval	
Predicted Probability Hospital	-0.0129	0.0189	-0.680	0.494	-0.0499	0.0241
Predicted Probability Health Department	-0.1184	0.1033	-1.150	0.252	-0.3209	0.0841
Predicted Probability FQHC	0.1141	0.0624	1.830	0.068	-0.0083	0.2364
Miles	-0.0005	0.0010	-0.570	0.571	-0.0024	0.0013
Age	0.0004	0.0006	0.730	0.463	-0.0007	0.0016
High Risk Status	0.0377	0.0071	5.280	0.000	0.0237	0.0517
Non-White Status	0.0162	0.0065	2.510	0.012	0.0036	0.0289
Non-White Neighborhood Residence	-0.0134	0.0139	-0.970	0.334	-0.0405	0.0138
First Pregnancy	-0.0081	0.0076	-1.060	0.289	-0.0230	0.0069
% Female Headed Household	0.0012	0.0010	1.270	0.205	-0.0007	0.0031
% High School Equivalency	-0.0003	0.0008	-0.340	0.735	-0.0017	0.0012

Summary

In summary, Research Aim 2 resulted in a number of interesting findings. Selection of a health department or FQHC was associated with significant decreases in prenatal care inadequacy, postpartum visit nonattendance and non-LARC when utilizing LPM IV estimations. However, these associations were attenuated or experienced a change in sign when actual clinic choice was examined as the key independent variables in LPM or logistic regression estimations. Clinic selection had no significant associations with infant outcomes including preterm birth and low birthweight infants. These findings remained consistent when estimated with various sensitivity models. Finally, results suggest that process measures mediate outcome measures as described in Chapter 3.

Chapter 6

Introduction

This research explored two distinct research aims to examine the clinic and patient specific factors associated with clinic type selection and subsequent process and outcome measures associated with clinic type selection. Research Aim 1 employed utility theory to frame two hypotheses including 1) high risk status among Medicaid beneficiaries is positively associated with selection of hospital-based clinics or non-hospital based private physician offices and 2) increased distance to a given clinic type is negatively associated with the choice of that clinic option among Medicaid beneficiaries. Research Aim 2 utilized Donabedian's Structure, Process, Outcome (SPO) framework to frame one additional hypothesis which conjectures that maternal and infant processes and outcomes of care vary for Medicaid beneficiaries based on the setting in which women receive prenatal care services, ceteris paribus. This chapter is divided into two sections to uniquely discuss findings and implications of these two aims and relevant hypotheses. Each section will conclude with a discussion of limitations, policy implications and future research. A discussion of overall conclusions and general limitations will follow these two sections. Expected and actual results stemming from these hypotheses are displayed in Table 49.

Table 49. *Hypothesized Compared to Expected Findings*

	Variables	Expected Findings	Actual Findings
Aim 1			
Hypothesis 1			
High risk status among Medicaid beneficiaries is positively associated with selection of hospital-based clinics or non-hospital based private physician offices.	High risk Status	+	+/-
Hypothesis 2			
Increased distance to a given clinic type will be negatively associated with the choice of that clinic option among Medicaid beneficiaries.	Distance to clinic	-	-
Aim 2			
Hypothesis 3			
Maternal and infant processes of care and outcomes will vary for Medicaid beneficiaries based on the setting in which women receive perinatal care, ceteris paribus.	Selected Clinic Type	Significant Associations	Significant Associations

Research Aim 1

The United States is at a critical juncture in healthcare policy and delivery of healthcare services as individual states elect to expand Medicaid programs. Previous research has examined hospital selection patterns of Medicaid beneficiaries (Escarce & Kapur, 2009; Phibbs et al., 1993; Roh, 2007), however little is known regarding factors associated with clinic selection among the same population. Results from Research Aim 1 provide understanding to clinic choice among pregnant Medicaid beneficiaries living in Metropolitan Statistical Areas in the Commonwealth of Virginia.

The first hypothesis in aim one examined the role of high risk pregnancy status on clinic selection. Results partially support this hypothesis. As concluded from the nested logit model estimations, high risk beneficiaries are significantly more likely to select hospital-based clinics ($p \leq 0.0001$) compared to non-hospital based private physician offices. Average Marginal Effect (AME) calculations demonstrate that compared to normal risk women, high risk women have a 8.3% decreased probability of selecting a private physician office and a 7.9% increased probability of selecting a hospital-based clinic. This hypothesis was guided by previously described rationale regarding healthcare decision making patterns suggesting that high-resource hospital settings and specialized physicians are the most appropriate source of care for clinically high risk women (Dobie et al., 1994; Phibbs et al., 1993). However, this rationale may not be entirely comprehensive when examining selection of prenatal care clinic type among Medicaid beneficiaries.

Medicaid beneficiaries likely have multifaceted needs that layer beyond the narrow clinical definition of high risk pregnancy. This research defined high risk status based on clinical indications in Medicaid claims data. However, this definition overlooks non-clinical aspects of pregnancies that may increase risk such as maternal stress, living arrangement including safety in the home, parental education, financial status and social support. These social factors could not be accounted for in available data. Prenatal care clinics offer a variety of supplementary resources to clients, and it is plausible that some clinic types are more adept to address these non-clinical risk factors. As described in Chapter 3, public health departments, such as the Richmond City Health District, offer on-site access to a number of programs such as health promotion, the Richmond Family and Fatherhood Initiative, and the Women, Infant and Children (WIC) supplemental food program (Virginia Department of Health, 2013). These services are available to all Medicaid beneficiaries, but onsite provision offers the added benefit of enrollment and attendance while receiving traditional prenatal care services. Federally Qualified Health Centers, another public clinic form, intentionally focuses on the provision of care to uninsured and underserved populations, therefore providers in these setting may be more attuned to address these social determinants of health relevant to many Medicaid beneficiaries.

The second hypothesis of Research Aim 1 postulated that increased distance to a given clinic type is negatively associated with the choice of that clinic option among Medicaid beneficiaries. As indicated in Table 48, this hypothesis is supported. When the weighted distance to clinic type increases, women are less likely to select that type of clinic. For example when weighted distance to private physician office is increased by 5 miles, women have a 11.9% decreased probability of selecting a private physician office for prenatal care services. Similar patterns are found among hospital-based clinics, health departments and FQHCs.

A number of control variables, both clinic and patient level, were also found to be statistically significant when examining all pregnancies. Clinic level variables included the number of options per clinic type, clinic capacity for Medicaid beneficiaries and number of providers. Average Marginal Effects demonstrate, however, that only a change in the number of options has a practical association with clinic selection. When the number of clinicians is increased by 20, the largest change in clinic selection is a 0.04% increase in selecting a private physician office. Therefore these results suggest that despite statistically significant associations, these correlations have little practical significance. However, when the number of options is increased by 5, practical changes in selection patterns emerge. For example, when the number of private physician options is increased by 5, women have an increased probability of selecting a private physician office and decreased probability of selecting other clinic types. Overall, these findings suggest that a woman is more likely to select a clinic type in their market if there are an increased number of options of this clinic type.

Significant patient level control variables included race, age, and first pregnancy status. First, non-white women were more likely to select a public facility compared to private physician offices. In fact, a non-White woman had a 2.2% increased probability of selecting an FQHC, 1.9% increased probability of selecting a health department, 1.0% decreased probability of selecting a hospital-based clinic and a 3.1% decreased probability of selecting a private physicians office compared to White women. One plausible explanation for these patterns includes an understanding of an individuals' social network structure. Prior research has demonstrated that social network structure is associated with prenatal care utilization patterns (St Clair, Smeriglio, Alexander, & Celentano, 1989), and that individuals generally have significant contact with others like themselves in their social networks (similar race, ethnicities, class, background, education, etc.) (McPherson, Smith-Lovin, & Cook, 2001). It is therefore plausible that social networks are at the root of these racial differences in clinic type selection.

Secondly, age was found to be significantly associated with clinic choice. This association potentially could be attributed to experience with the healthcare system and adverse views of public facilities learned over time. This analysis controls for first pregnancy, but older women would likely have increased experience related to non-pregnancy health concerns and this experience would inform prenatal care clinic choice.

Finally, nested logit models indicated a significant association between first pregnancy and prenatal care clinic type. Calculated AMEs demonstrate that a first pregnancy is associated with a 2.0% decreased probability in selecting a private physician office, 1.5% decreased probability of selecting a hospital-based clinic, 1.6% increased probability of selecting a health department and a 1.9% increased probability of selecting an FQHC for prenatal care services. To further examine associations among variables for primigravada pregnancies, an additional nested logit model is estimated as a sensitivity analysis utilizing only data from primigravada women (N=1,755).

Contrary to the overall significant findings examining high risk pregnancy status among all pregnancies, high risk pregnancy status among primigravada women was not significantly associated with clinic type selection. A variety of circumstances may account for this difference. First, first time mothers are likely not as knowledgeable about the medical system women with more births (Lazarus, 1994), and may not be aware of the variety of clinic types available to them. Many of the Medicaid beneficiaries included in the study likely obtained benefits due to the pregnancy since the Virginia Medicaid program has stringent requirements to obtain benefits outside of pregnancy status (Department of Medical Assistance Services, 2012; Virginia Department of Social Services, 2013). Therefore these women may attend a clinic for pregnancy confirmation and continue to attend the same clinic regardless of risk status. However, since the sensitivity analysis examining women experiencing their first pregnancy had reduced sample size (N=1,755), of which 271 (15.4%) demonstrated clinical evidence of a high risk pregnancy, it is plausible that the analysis failed to have enough power to identify significant associations between risk status and clinic type selection in this analysis. Additional research is needed to understand the patters behind clinic selection among primigravada women to examine if high risk status indeed plays a role in clinic selection. Other clinic and patient level factors that were significant were consistent with findings in models that examined all pregnancies.

Limitations.

Research Aim 1 has a variety of limitations. First, since this research examined clinic *type* choice, rather than individual clinic choice, clinics were grouped based on type. However, the within-type variation was not examined. This may be most relevant for private physician office settings and hospital-based clinics, as public health departments and FQHCs operate on strict criteria including government funding and acceptance of all insurance types, including the uninsured. Further investigation into these variations may indicate that some private physician offices specifically target underserved populations whereas others select a majority of privately insured with only a few Medicaid beneficiaries allowed per year. If this is the case, these fundamentally different private physician offices should be teased apart, and advanced nesting structures should be considered. Additional nesting structures may also be relevant for hospital-based clinics such as academic versus non-academic settings. Future research is merited to understand these potential variations.

Second, variable definitions provide study limitations. For instance, women were required to have selected one clinic type for prenatal care. This was defined by looking at visit frequency to define selected clinic type. Future research should examine potential changes in clinic selection and how these patterns may be associated with care as a whole. Additionally, high risk pregnancy was clinically defined by ICD-9 codes and appeared as a binary variable high risk and normal risk. This definition overlooks the many social determinants of health that increase pregnancy risks and fails to examine a risk gradient or risk severity. Despite this limitation, study results demonstrate that clinic type choice is sensitive to risk status for all pregnancies, but is not associated with clinic type choice among first pregnancies.

Policy Implications and Additional Guidance for Future Research.

Results from Research Aim 1 have a variety of implications for clinic and public policy and offer guidance for future research. Clinics that seek to provide care to pregnant Medicaid beneficiaries should examine local residential patterns of current and potential future pregnant Medicaid recipients and consider how these might affect decisions about future clinic locations. Results suggest that women are more likely to attend clinic types closer to their area of residence, and this close proximity may have additional implications beyond shorter travel time to clinic, and a few are discussed below for Research Aim 2. Evidence suggests that a variety of barriers impede clinic attendance including issues related to transportation (Cheung, Wiler, Lowe, & Ginde, 2012a; Phibbs et al., 1993) and childcare (Phillippi, 2009). Clinics that are located closer to home minimize transportation issues as close proximity may mean access to direct bus lines, increased ease in finding a ride, or walking to appointments. Additionally, if a clinic is located closer to home an individual can likely complete her visit in an overall shorter time period subsequently reducing the time she would need to find childcare for existing children.

Clinics interested in providing care to Medicaid beneficiaries should also investigate the clinical qualities associated with selection patterns to maximize attractiveness. For example, nested logit estimations suggest that the number of clinicians is associated with a woman's selection of clinic type. Future studies could aim to gather rich qualitative data to understand the desirable clinic characteristics of pregnant Medicaid beneficiaries. Published literature suggests that factors such as clinic cleanliness are associated with clinic choice (Blackwell, 2002; Handler et al., 1996; Handler et al., 2003; Novick, 2009; Sword, 2003), but other considerations such as provider types, use of patient-centered teams, and childcare services would inform clinic administration of potentially desirable clinic characteristics and future marketing strategies.

Public policy makers may want to encourage clinics to provide care in underserved areas and specifically target current and future Medicaid recipients. Existing policy provides incentives to establish Federally Qualified Health Centers, but additional thought may be required to locate reproductive health clinics in such communities. Clinics providing targeted reproductive health services may focus on the treatment and prevention of sexually transmitted infections (STI), pregnancy-related services or a combination of the two. These service lines require varying clinical expertise and equipment and may target specific patient populations depending on community needs.

Reproductive health clinics focusing on STIs need to consider the stigma associated with STI infections and create an environment conducive to patient attendance, and/or explore the use of mobile clinics. The provision of in-house STI services might deter women seeking prenatal care services as individuals seeking STI services often feel a sense of shame and stigma associated with testing (Fortenberry et al., 2002). Some clinics, such as the Richmond City Health District, have mitigated this challenge with the use of separate clinic space for prenatal care patients and varying hours for different service lines.

Finally, it would be of importance to specifically examine clinic selection patterns among only high risk women. It is of particular interest to understand the role of travel distance and risk status as these individuals may be less deterred by increased distance to attend clinics that may be most appropriate for their needs. This analysis could take a similar form to the sensitivity analysis for primigravada women.

Research Aim 2

Prior research has demonstrated that perinatal outcomes vary by clinic type. For example, Simpson, Korenbrot & Green (1997) examined preterm birth and low birthweight status among Medicaid beneficiaries in California in 1990 and found that individuals attending health departments, community clinics and private hospital settings had increased odds of low birthweight babies and preterm birth, when risk adjusted for medical risk, obstetrical risk, prenatal care attendance and smoking status. Radecki and Bernstein (1989) demonstrated that women attending public family planning facilities received increased contraceptive counseling when compared to private family planning facilities whereas private office attendees expressed higher satisfaction. Despite these findings, research examining process and outcomes of perinatal care by clinic type are sparse. Results from Research Aim 2 address this gap as this aim examines if prenatal care setting is associated with maternal and infant measures.

The main analyses for Research Aim 2 included two different approaches. First, analyses utilized measures for prenatal care inadequacy, postpartum visit nonattendance and non-LARC use in LPM models with predicted probabilities of clinic choice instrumenting for actual clinic choice (LPM IV). Regression based specification tests rejected the hypotheses that the clinic choice variables used in the LPM models were exogenous. However, similar tests examining preterm birth and low birthweight infants failed to reject this null hypothesis of exogeneity. Therefore logistic regression estimations for these two outcome measures are considered the main analyses as these estimations are considered more efficient (Wooldridge, 2009).

Maternal Measures.

Maternal measures of interest included two process measures and one outcome measure. The two process measures examined in Research Aim 2 included prenatal care inadequacy and postpartum visit nonattendance. Results indicate that attending a health department is associated with an 84.2% decrease in the probability of inadequate prenatal care compared to a private physician office, holding all else constant. Similarity, attending an FQHC for prenatal care is associated with an 82.2% decrease in the probability of postpartum care nonattendance compared to a private physician office, holding all else constant. One sensitivity analysis designed to specifically address finding robustness of prenatal care inadequacy utilized an alternate definition of inadequate prenatal care. The main analysis defined inadequate prenatal care as seven or fewer visits as guided by modified work by Kotelchuck whereas the sensitivity analysis defined inadequate prenatal care as five or fewer visits. The sensitivity analysis yielded similar findings in terms of the direction of associations and significance. However, due to data limitations, these analyses failed to account for prenatal care initiation, as included in the full Kotelchuck index (Kotelchuck, 1994).

A number of explanations may be relevant for these findings in prenatal care inadequacy and postpartum visit attendance. The number of prenatal care visits is standardized by the American Congress of Obstetricians and Gynecologists (ACOG), therefore inadequate prenatal care can be both the result of delayed initiation of prenatal care and missed appointments. Delayed prenatal care initiation has been associated with barriers such as transportation, lack of knowledge that care should begin in the first trimester of pregnancy, unplanned pregnancies, and unknown pregnancy status (Delgado-Rodríguez, Gómez-Olmedo, Bueno-Cavanillas, & Gálvez-Vargas, 1997; Feijen-de Jong et al., 2012; Goldenberg, Patterson, & Freese, 1992). However, such factors associated with delayed prenatal care initiation do not provide insight into the differences in care adequacy between clinic types. It is plausible that appointment availability and delay differs by clinic type, although to the author's knowledge this has not been examined in the literature. Therefore it is more conceivable that prenatal care and postpartum visit attendance by clinic type is related to the role of missed appointments rather than care initiation.

The epidemiology of missed appointments has been extensively explored in the literature. A number of factors are associated with missed appointments including age (Neal et al., 2001), socioeconomic status (Waller & Hodgkin, 2000) and neighborhood factors (George & Rubin, 2003; Neal et al., 2001). This dissertation research addresses all of these known correlations as this study only examines Medicaid beneficiaries (and therefore controls for many factors of socioeconomic status), and controls for factors such as age and neighborhood level characteristics. However, additional non-patient level factors could also be associated with missed appointments. Since health departments and FQHCs have improved prenatal care adequacy and postpartum attendance, it is possible that these organizations have optimized clinic attendance.

A variety of studies assessed interventions that are effective in reducing missed appointments. One 1992 meta-analysis examined effective strategies for improved compliance with clinic appointments, and concluded that telephone prompts, mailed prompts, orientation statements, and contracting with patients were associated with improved appointment compliance (Macharia, Leon, Rowe, Stephenson, & Haynes, 1992). Orientation statements included the provision of information to patients describing the reason for the appointment in addition to general clinic information (Kluger & Karras, 1983; Swenson & Pekarik, 1988) whereas patient contracts included a formal agreement to attend future appointments (Levy & Clark, 1980). A more recent 1998 meta analysis described that comprehensive interventions that combined a variety of components were more effective at improving appointment compliance than single interventions (Roter et al., 1998). Finally, articles published in the past few years describe the use of cell phones, text messaging services and email messages to improve appointment compliance (Finkelstein, Liu, Jani, Rosenthal, & Poghosyan, 2013; Stubbs, Geraci, Stephenson, Jones, & Sanders, 2012; Wei, Hollin, & Kachnowski, 2011). It is possible that health departments and FQHCs have maximized techniques to reduce appointment non-compliance. Future research should examine practices utilized in these clinics in comparison to hospital based and non-hospital based private physician offices to provide insight into this possibility.

It also may be that public clinics such as health departments and FQHCs have an increased financial pressure to reduce non-attendance by Medicaid beneficiaries that may not be as burdensome in hospital-based and private physician clinics. Publicly funded clinics such as public health departments and FQHCs disproportionally depend on federal, state, and local revenues in addition to Medicaid payments and other fees (C. B. Forrest & Whelan, 2000; Wall, 1998) compared to private facilities. In 2008, national FQHC payer mix included 36% Medicaid and 38% uninsured which resulted in a 62% obtained revenue from Medicaid and 10% of revenue obtained from the uninsured (Pohl, Tanner, Pilon, & Benkert, 2011). In 1994, 39.7% of all Medicaid visits were to Community Health Centers, which were defined as an organization that receives funding through section 330 of the Public Health Service Act (C. B. Forrest & Whelan, 2000). Since Medicaid payments provide a larger percentage of funding to public clinics, administration at such clinics may be more keenly aware of methods to improving attendance compliance among these patients to ensure financial stability, potentially accounting for improved prenatal and postpartum attendance.

A number of control variables were found to be significantly associated with prenatal inadequacy and postpartum nonattendance. Non-White status was associated with prenatal care inadequacy and postpartum visit nonattendance and distance to clinic was found to be associated with postpartum visit nonattendance. These findings are consistent with previous research (Alexander, Kogan, & Nabukera, 2002; Bennett et al., 2011; LaVeist, Keith, & Gutierrez, 1995).

Similar factors were found to be associated with clinic selection and Long Acting Reversible Contraceptives (LARC). These contraceptive methods, including sub-dermal implants, IUDs and injectables, optimize minimum interpregnancy intervals following a pregnancy and have low failure rates relative to other methods (Winner et al., 2012). Results indicate that attending a health department is associated with a decrease in the probability of non-LARC use compared to a private physician office, holding all else constant. Similarly, attending an FQHC for prenatal care is associated with a decrease in the probability of non-LARC use compared to a private physician office, holding all else constant. Potential explanations for these findings include the availability of LARC methods on site, timing of contraceptive counseling and clinic provider experience and views of LARC use.

Research has demonstrated that on-site availability of LARC methods remains a barrier to utilization. One study conducted by the Centers for Disease Control and Prevention (2011) surveyed federally funded Title X clinics, which provide reproductive healthcare services, and office-based physicians (obstetrics/gynecology, family medicine and adolescent medicine clinics) throughout the United States and found that LARC methods are not ubiquitously available in either clinic type. Levonorgestrel-releasing IUDs were available on site in 56.4% of office-based physician offices and in 46.6% of Title X clinics. Copper IUDs were available in 53.5% of office-based physician offices and 59.7% of Title X clinics. Implants were available on site in 32.0% of office-based physician offices and 35.7% of Title X clinics (Centers for Disease Control and Prevention (CDC), 2011). On site LARC availability eliminates the need for a patient referral or requiring patients to find an alternative clinic site for insertion and may improve the use of such methods among underserved populations (Beeson et al., 2013). In fact, availability of same-day IUD placement increases IUD use (Schwarz et al., 2014). In FQHCs, it has been demonstrated that large clinics (greater than 20,000 patients per year) and those that receive Title X funding are more likely to provide LARC methods on site (Beeson et al., 2013; Park, Rodriguez, Hulett, Darney, & Thiel de Bocanegra, 2012). As related to this study, it is known that the Virginia Department of Health receives Title X funding, yet research by the Guttmacher Institute reveals that public health departments are the least likely to provide LARC methods on site compared to Planned Parenthood services and FQHCs (Frost, Gold, Frohwirth, & Blades, 2012). Based on this evidence, it is possible that individuals attending FQHCs and health departments for prenatal care have increased access to LARC methods on-site and are subsequently more likely to have reduced non-LARC use. Future research regarding onsite LARC services in Virginia clinics (health departments, FQHCs, hospital-based clinics and non-hospital private physician offices) is warranted to examine if this is the case.

Statistically significant differences in non-LARC use may also be the result of contraceptive counseling practices by clinic type. Professional associations and the US Preventative Services Task Force recommend periodic contraceptive counseling for all men and women at risk for unintended pregnancy (Weisman, Maccannon, Henderson, Shortridge, & Orso, 2002) and this counseling is an important component of postpartum care (DePiñeres, Blumenthal, & Diener-West, 2005; Smith, van der Spuy, Cheng, Elton, & Glasier, 2002). However, the antenatal period can also be considered for opportune contraceptive counseling moments to optimize contraceptive use postpartum (Glasier, Logan, & McGlew, 1996; Hernandez, Sappenfield, Goodman, & Pooler, 2012). LARC education and knowledge has been shown to be strongly associated with LARC use as one study of underserved women demonstrated that women appropriately counseled regarding LARC use increase usage by 67% (56% choosing and IUD and 11% selecting a subdermal implant) (Secura et al., 2010). This earlier study also addressed the financial barriers associated with the upfront cost of LARC use, but this aspect is not relevant to the present study as all individuals receive Medicaid coverage. Therefore, it is plausible that clinic types have varied clinic protocol regarding comprehensiveness of contraceptive counseling and some clinics may utilize both the antenatal and postpartum period to provide consistent messages about contraceptive use. Future research could examine contraceptive counseling by clinic type to provide insight into this potential explanation of the reduction of non-LARC use by clinic type.

Finally, research has demonstrated that provider characteristics are associated with LARC counseling, especially as related to IUDs. In fact, many clinicians have restrictive views on IUD candidates, contrary to the World Health Organization Medical Eligibility Criteria (Harper et al., 2008; Vaaler, Kalanges, Fonseca, & Castrucci, 2012; World Health Organization, 2004). More specifically, a variety of characteristics predispose providers to discuss IUDs as a viable contraceptive method including younger providers and physicians trained to insert IUDs during residency (Harper et al., 2008). Additionally, factors such as fear of litigation contribute to provider reluctance to discuss IUD as a viable contraceptive method (Stanwood, Garrett, & Konrad, 2002). Due to data limitations this study does not examine the provider characteristics among clinics frequently prescribing LARC methods compared to clinics that infrequently prescribe LARC methods. Future research should examine the provider profiles of health departments, FQHCs, hospital-based clinics and non-hospital based private physician offices to examine potential correlations between clinic provider profiles and LARC prescriptions and insertion/injection patterns.

In addition to the statistically significant independent variables associated with non-LARC use, two control variables were found to have significant associations including age and percent of female-headed households in patient's ZCTA. Older women demonstrated a decreased probability of utilizing a LARC method postpartum, which is consistent with previous literature (Weisman et al., 2002). Additionally, women residing in neighborhoods with increased percentages of female-headed households are more likely to utilize LARC methods. This correlation may be due to a variety of factors including neighborhood level pressures to reduce unintended pregnancies (Barber & Olsen, 1997; Miller, Benson, & Galbraith, 2001). For example, it is plausible individuals living in areas with increased numbers of female-headed households where families are not run in a partnership of committed individuals, feel added pressure to reduce unintended pregnancies following a pregnancy. Due to data limitations, this study did not include a control variable for marital status or involvement in a long-term committed relationship. Future studies should further examine neighborhood level pressures on unintended pregnancy and LARC use postpartum.

One sensitivity analysis examined the potential mediation role of postpartum visit attendance on non-LARC use. As described earlier in Chapter 6 in addition to Chapter 2, contraceptive counseling is typically offered during the postpartum visit (DePiñeres et al., 2005; Smith et al., 2002). If postpartum visit attendance indeed fully mediated the association between clinic selection and non-LARC use, one would expect that the independent variables of interest (clinic choice) would no longer be significantly associated with non-LARC use after including postpartum visit attendance into the analysis. Additionally, if a fully mediating effect were present, the postpartum attendance variable would be significantly associated with non-LARC use in this second estimation. In fact, these changes occur when examining postpartum visit attendance, clinic selection, and non-LARC use for the clinic type of FQHC, but public health department continues to be a significant factor. Therefore, there is partial support for postpartum visit attendance being a mediator for this dependent variable.

Logit analyses utilizing actual prenatal care clinic type were used as sensitivity analyses for examining measures of inadequate prenatal care, postpartum visit nonattendance and non-LARC use. As previously discussed, regression-based endogeneity tests demonstrated that clinic choice was endogenously related to these maternal process and outcome measures and this endogeneity is mitigated with the use of instrument variables generated from Research Aim 1. An omitted variable bias stemming from a women's engagement in her care is likely associated with clinic selection and process/outcome measures. If this engagement bias plausibility is true and the model is estimated assuming exogeneity (logistic regression with actual clinic choice), one would expect that the estimates and marginal effects to be biased upward. This bias would surface as an attenuated estimate or a positive association instead of a negative association. In fact, these anticipated biases are found in all of these logistic regression sensitivity analyses estimations where actual choice is an independent variable as associated with inadequate prenatal care, postpartum visit nonattendance and non-LARC use.

Infant Measures.

This study also examined prenatal care clinic type as associated with infant outcomes including preterm birth and low birthweight status. The first models utilizing instrumental variables for clinic type selection revealed that one could not reject the hypotheses that clinic choice was exogenous. Therefore, logistic regression results were used to interpret infant birth outcome findings. Overall the main analysis and all sensitivity analysis demonstrated that clinic type was not significantly associated with either infant outcome at p=0.05.

Literature examining preterm birth and infant birthweight typically focus on predisposing factors that are likely not modifiable during the prenatal period, as the mere increase in prenatal care visits may not be sufficient to improve infant birthweight and gestation age (Buescher & Ward, 1992). For example, the following set of factors have been found to be associated with poor birth outcomes: maternal race (Vintzileos et al., 2002), multiple births (J. A. Martin et al., 2008), previous preterm births, periodontal disease (Goldenberg et al., 2008b; Jeffcoat et al., 2001), bacterial vaginosis infection (Hillier et al., 1995), antenatal depression (Dayan et al., 2006), maternal stress (Wadhwa et al., 1993),exposure to environmental toxins (Ritz et al., 2007), socioeconomic disadvantage(Beard et al., 2009), and mothers who were born preterm (Emanuel et al., 1992; Mattsson & Rylander, 2012; Muglia & Katz, 2010; Swamy et al., 2008).

Results indicating insignificant associations between prenatal care clinic type and infant outcomes may also be the result of an inadequate sample size. Infant outcomes including preterm birth and low birthweight are much more rare events than maternal measures included in this study. Therefore it is plausible that prenatal care clinic type is associated with infant outcomes, but the sample size lacked the power to adequately identify these associations.

Despite no significant associations between prenatal care clinic type and low birthweight infants, a number of control variables were significantly associated with these infant outcomes. Women experiencing a high risk pregnancy had increased probabilities of delivering preterm and low birthweight babies. Primigravada women had a decreased probability of preterm delivery. Finally, non-White women had increased probabilities of delivering preterm and low birthweight babies. These racial disparities have been documented previously in the literature (Anum, Retchin, Garland, & Strauss, 2010; Brown, Adera, & Masho, 2008; Goldenberg et al., 2008a; Kistka et al., 2007; Lu & Chen, 2004).

Sensitivity analysis examining the potential mediating role of prenatal care adequacy on infant outcomes demonstrated evidence that such mediation does not occur. When prenatal care adequacy is introduced into the equations examining infant outcomes as guided by the SPO framework, prenatal care adequacy is found to be significantly associated with preterm birth and low birthweight babies. However, clinic choice is not found to be directly associated with infant outcomes. This evidence suggests that prenatal care adequacy does not mediate the relation between clinic selection and infant outcomes including preterm birth and low birthweight.

Policy Implications and Guidance for Future Research.

Results from Research Aim 2 analyses offer a variety of public policy implications and guidance for future research. This research provides evidence that public health facilities including public health departments and FQHCs have improved prenatal care adequacy and postpartum visit attendance compared to private physician offices, providing evidence that public funding should continue for these facility types. As the ACO model is utilized as a result of the PPACA, ACO staff and administration should turn to the public facilities in their communities to learn how to manage and improve the health of these patient populations.

Significant racial disparities between White and non-White women are demonstrated in this research. Attention should be afforded to this issue with the intention to close the health disparity gap in *all* clinic types. Efforts should target clinicians and patients alike as this research cannot provide insight into why non-White women experience increased prenatal care inadequacy and postpartum nonattendance. Until this causality can be addressed, educational efforts should be aimed at both providers and non-White communities, but additional, non-education based, resources may be necessary. In particular, improved public transportation services to healthcare organizations and subsidized childcare services for women in non-White communities may be important to reducing disparities. As described above, a number of barriers to prenatal care have been described in the literature including transportation and childcare. It is plausible that these barriers disproportionately affect non-White communities, therefore resources targeting these barriers may be useful in improving process and outcome measures within these communities.

Policy makers should also be thoughtful of the varied populations that encompass non-White women. For example, despite the robust public transportation infrastructure in one of the study areas (namely, Richmond, VA) bus routes may fail to connect certain communities or require a number of transfers to arrive at a destination of interest. This may be one of the most significant barriers in some Richmond communities whereas other communities may be well connected via public transportation but few childcare services are available in the community. Virginia HMOs including Virginia Premier offer transportation services to beneficiaries, but these services may be suboptimal. When utilizing these services beneficiaries are required to wait for pickup during a designated time span that can be as long as a two hour window, and additional wait time is required when their clinical visit is complete. Future studies should examine individuals utilizing Medicaid-supplied transportation to see if such usage is associated with improved clinic attendance.

In addition to maternal process measures, policy implications can be derived from the evaluation of maternal outcomes such as non-LARC use. To improve LARC use among postpartum women, healthcare providers require continued education regarding the safety and efficacy of these methods in addition to ongoing IUD insertion training. This research demonstrates that public clinics including health departments and FQHCs were more likely to reduce non-LARC use, whereas hospital clinics were not significantly associated with a reduction in non-LARC use compared to private providers. Hospital-based clinics often serve as training sites for students and residents therefore such sites should be sure to offer comprehensive training for IUD insertion, effective birth spacing counseling and effective contraceptive counseling for both LARC and non-LARC techniques.

Finally, study results offer policy relevance related to infant outcomes including preterm birth and low birthweight. Despite no significant findings between clinic types and infant outcomes, future studies should further investigate these associations as a larger sample size may be required to offer increased statistical power. Of the 6,945 individuals included in this analysis, only 485 (7.0%) delivered a preterm baby and 288 (4.9%) delivered a low birthweight baby. These percentages are far below the national rates of 11.6 % of babies born preterm and 8.0% born with a low birthweight (J. Martin et al., 2014) and Virginian Medicaid rates of 10.2% babies born preterm (Anum et al., 2010). Therefore this may be a reflection of the study population, or more likely, due to under-identification in the claims data. Future studies should examine these two possibilities.

General Limitations and Future Studies

This study utilized cross-sectional data from one Medicaid provider in the Commonwealth of Virginia from 2006 to 2012 among women living in Metropolitan Statistical Areas. Therefore, study results may not be indicative of clinic choice selection in other geographies, other time periods or for the Virginia Medicaid population at large. Future studies should examine prenatal clinic selection among rural individuals, as past research has demonstrated rural residents follow different healthcare selection patterns than urban residents (Tai et al., 2004). As with all cross-sectional models, results offer insight into correlation between variables but cannot assess causal relationships.

Study data include administrative Medicaid claims data that was not collected for research purposes, and such data brings strengths and weaknesses to the research process. Claims data are considered generally reliable and valid and the diagnosis relevant to this study were straightforwardly ascertained. However, such data may be biased as specific complications and indications may be consistently underreported (P. G. Campbell et al., 2011). This may mean that indications of process and outcomes measure may have been overlooked, subsequently weakening potentially significant associations. For example, since study data included the first 10 diagnoses codes per claim, subsequent codes containing indications of high risk status would be unobserved.. Additionally, these administrative data cannot elucidate interpersonal quality of care (Iezzoni, 1997) or assess the provider patient interactions. A qualitative evaluation of provider patient relationships by clinic setting would be a valuable component of future research and would likely provide a rich and deep understanding of factors potentially associated with improved maternal and infant outcomes.

Finally, prenatal care visits completed prior to Medicaid enrollment are unaccounted for in the assessment of prenatal care adequacy. The inability to capture these visits suggests that the number of prenatal care visits is underestimated and inadequate prenatal care is inappropriately overinflated. This may be of increased relevance in public clinic types including Public Health Departments and FQHCs since these clinic types will not turn a patient away due to uninsured status.

Conclusion

The research presented here was designed to investigate two core research aims. First, Research Aim 1 employed a nested logit model to investigate the clinic and patient-level factors associated with prenatal clinic type choice among Medicaid beneficiaries. This analysis found that pregnant Medicaid beneficiaries are more likely to attend clinic types that are closer to their home residence and high risk women are more likely to select a hospital based clinic for services compared to private physician offices. When specifically examining women experiencing her first pregnancy, high risk status was no longer associated with clinic type selection.

Research Aim 2 evaluated the potential role of clinic type selection on a variety of mother and infant process and outcome measures. It was found that attending public health departments and Federally Qualified Health Centers for prenatal care services was associated with a significant and meaningful decrease in inadequate prenatal care, postpartum nonattendance and non-LARC use postpartum. However, no significant association was found between prenatal care clinic type selection and infant outcomes including gestational age and birthweight.

A variety of sensitivity analyses were conducted to improve understanding of these associations. Since model specifications examining inadequate prenatal care, postpartum visit nonattendance and non-LARC use produced varying results, additional research is needed to fully understand potential associations between clinic type and maternal measures. Findings examining infant outcomes remained consistent despite varying model specifications, suggesting that these results are robust.

Despite the variety of study limitations, findings have policy relevance for clinic and state level policy. Individual clinics that intend to provide care to Medicaid beneficiaries can utilize these results as guidance for future studies to appropriately locate future clinics and reduce access to barriers faced by pregnant beneficiaries. State policy makers can likewise use the study findings to enhance the public health infrastructure that provides care to underserved populations such as Medicaid recipients. As states potentially elect to expand Medicaid eligibility as a result of the PPACA, an understanding of Medicaid beneficiary clinic selection and subsequent outcomes of care provides insight into the potential experiences of newly insured pregnant women.

References

Abel, C. H. (1994). Benefits and systems of care for maternal and child health under health care reform: Workshop highlights.

Adams, E. K., Houchens, R., Wright, G. E., & Robbins, J. (1991). Predicting hospital choice for rural Medicare beneficiaries: The role of severity of illness. *Health Services Research, 26*(5), 583.

Aday, L., Begley, C., Lairson, D., & Balkrishnan, R. (2004). *Evaluating the healthcare system: Effectiveness, efficiency, and equity* Health administration press Chicago.

Aday, L., Begley, C., Lairson, D., Slater, C., Richard, A., & Montoya, I. (1999). A framework for assessing the effectiveness, efficiency, and equity of behavioral healthcare. *Am J Managed Care, 5*, 25-44.

Akiva, M. E. B., & Lerman, S. R. (1985). *Discrete choice analysis: Theory and application to predict travel demand* The MIT press.

Alexander, G. R., & Korenbrot, C. C. (1995). The role of prenatal care in preventing low birth weight. *The Future of Children,* 103-120.

Alexander, G. R., Kogan, M. D., & Nabukera, S. (2002). Racial differences in prenatal care use in the United States: Are disparities decreasing? *American Journal of Public Health, 92*(12), 1970-1975.

American College of Obstetricians and Gynecologists. (2012). *Guidelines for perinatal care* (7th Edition ed.) ELK Grove Village (IL): American Academy of Pediatrics.

Anum, E. A., Retchin, S. M., Garland, S. L., & Strauss, J. F. (2010). Medicaid and preterm births in Virginia: An analysis of recent outcomes. *Journal of Women's Health (15409996), 19*(11), 1969-1975. doi:10.1089/jwh.2010.1955

Athas, W. F., Adams-Cameron, M., Hunt, W. C., Amir-Fazli, A., & Key, C. R. (2000). Travel distance to radiation therapy and receipt of radiotherapy following breast-conserving surgery. *Journal of the National Cancer Institute, 92*(3), 269-271.

Barber, B. K., & Olsen, J. A. (1997). Socialization in context connection, regulation, and autonomy in the family, school, and neighborhood, and with peers. *Journal of Adolescent Research, 12*(2), 287-315.

Beard, J. R., Lincoln, D., Donoghue, D., Taylor, D., Summerhayes, R., Dunn, T. M., . . . Morgan, G. (2009). Socioeconomic and maternal determinants of small-for-gestational age births: Patterns of increasing disparity. *Acta Obstetricia Et Gynecologica Scandinavica, 88*(5), 575-583. doi:10.1080/00016340902818170; 10.1080/00016340902818170

Beeson, T., Wood, S., Bruen, B., Goldberg, D. G., Mead, H., & Rosenbaum, S. (2013). Accessibility of long-acting reversible contraceptives (LARCs) in federally qualified health centers (FQHCs). *Contraception.*

Behrman, R. E., & Butler, A. S. (2007). *Preterm birth: Causes, consequences, and prevention* National Academies Press.

Bennett, W. L., Ennen, C. S., Carrese, J. A., Hill-Briggs, F., Levine, D. M., Nicholson, W. K., & Clark, J. M. (2011). Barriers to and facilitators of postpartum follow-up care in women with recent gestational diabetes mellitus: A qualitative study. *Journal of Women's Health, 20*(2), 239-245.

Bishop, G., & Brodkey, A. C. (2006). Personal responsibility and physician responsibility--west Virginia's Medicaid plan. *The New England Journal of Medicine, 355*(8), 756-758. doi:10.1056/NEJMp068170

Blackwell, D. A. (2002). Prenatal care services in the public and private arena. *Journal of the American Academy of Nurse Practitioners, 14*(12), 562-567.

Bronstein, J. M., & Morrisey, M. A. (1991). Bypassing rural hospitals for obstetrics care. *Journal of Health Politics, Policy and Law, 16*(1), 87-118.

Brooten, D., Kumar, S., Brown, L. P., Butts, P., Finkler, S. A., Bakewell-Sachs, S., . . . Delivoria-Papadopoulos, M. (1986). A randomized clinical trial of early hospital discharge and home follow-up of very-low-birth-weight infants. *The New England Journal of Medicine, 315*(15), 934-939. doi:10.1056/NEJM198610093151505

Brown, J. S.,Jr, Adera, T., & Masho, S. W. (2008). Previous abortion and the risk of low birth weight and preterm births. *Journal of Epidemiology and Community Health, 62*(1), 16-22. doi:10.1136/jech.2006.050369

Bryant, A. S., Haas, J. S., McElrath, T. F., & McCormick, M. C. (2006). Predictors of compliance with the postpartum visit among women living in healthy start project areas. *Maternal and Child Health Journal, 10*(6), 511-516.

Buescher, P. A., & Ward, N. I. (1992). A comparison of low birth weight among Medicaid patients of public health departments and other providers of prenatal care in North Carolina and Kentucky. *Public Health Reports, 107*(1), 54.

Bujold, E., Mehta, S. H., Bujold, C., & Gauthier, R. J. (2002). Interdelivery interval and uterine rupture. *American Journal of Obstetrics and Gynecology, 187*(5), 1199-1202.

Calvo, A. B., & Marks, D. H. (1973). Location of health care facilities: An analytical approach. *Socio-Economic Planning Sciences, 7*(5), 407-422.

Cameron, A. C., & Trivedi, P. K. (2009). *Microeconometrics using stata* Stata Press College Station, TX.

Campbell, P. G., Malone, J., Yadla, S., Chitale, R., Nasser, R., Maltenfort, M. G., . . . Ratliff, J. K. (2011). Comparison of ICD-9-based, retrospective, and prospective assessments of perioperative complications: Assessment of accuracy in reporting: Clinical article. *Journal of Neurosurgery: Spine, 14*(1), 16-22.

Campbell, S. M., Roland, M. O., & Buetow, S. A. (2000). Defining quality of care. *Social Science & Medicine (1982), 51*(11), 1611-1625.

Centers for Disease Control and Prevention (CDC). (2011). Contraceptive methods available to patients of office-based physicians and title X clinics - United States, 2009-2010. *MMWR.Morbidity and Mortality Weekly Report, 60*(1), 1-4.

Chaikind, S., & Corman, H. (1991). The impact of low birthweight on special education costs. *Journal of Health Economics, 10*(3), 291-311.

Cheung, P. T., Wiler, J. L., Lowe, R. A., & Ginde, A. A. (2012a). National study of barriers to timely primary care and emergency department utilization among Medicaid beneficiaries. *Annals of Emergency Medicine, 60*(1), 4-10. e2.

Cheung, P. T., Wiler, J. L., Lowe, R. A., & Ginde, A. A. (2012b). National study of barriers to timely primary care and emergency department utilization among Medicaid beneficiaries. *Annals of Emergency Medicine, 60*(1), 4-10.e2. doi:10.1016/j.annemergmed.2012.01.035; 10.1016/j.annemergmed.2012.01.035

Collins, J. W.,Jr, David, R. J., Symons, R., Handler, A., Wall, S., & Andes, S. (1998). African-American mothers' perception of their residential environment, stressful life events, and very low birthweight. *Epidemiology (Cambridge, Mass.), 9*(3), 286-289.

Conde-Agudelo, A., & Belizan, J. M. (2000). Maternal morbidity and mortality associated with interpregnancy interval: Cross sectional study. *BMJ (Clinical Research Ed.), 321*(7271), 1255-1259.

Conde-Agudelo, A., Rosas-Bermudez, A., & Kafury-Goeta, A. C. (2007). Effects of birth spacing on maternal health: A systematic review. *American Journal of Obstetrics and Gynecology, 196*(4), 297-308. doi:10.1016/j.ajog.2006.05.055

Cox, R. G., Zhang, L., Zotti, M. E., & Graham, J. (2011). Prenatal care utilization in Mississippi: Racial disparities and implications for unfavorable birth outcomes. *Maternal and Child Health Journal, 15*(7), 931-942.

Currie, J., Greenstone, M., & Moretti, E. (2011). Superfund cleanups and infant health. (No. w16844). National Bureau of Economic Research.

Currie, J., & Walker, W. R. (2009). Traffic congestion and infant health: Evidence from E-ZPass. (No. w15413). National Bureau of Economic Research.

David, R. J., & Collins, J. W.,Jr. (1997). Differing birth weight among infants of U.S.-born blacks, African-born blacks, and U.S.-born whites. *The New England Journal of Medicine, 337*(17), 1209-1214. doi:10.1056/NEJM199710233371706

Dayan, J., Creveuil, C., Marks, M. N., Conroy, S., Herlicoviez, M., Dreyfus, M., & Tordjman, S. (2006). Prenatal depression, prenatal anxiety, and spontaneous preterm birth: A prospective cohort study among women with early and regular care. *Psychosomatic Medicine, 68*(6), 938-946.

DeFranco, E. A., Stamilio, D. M., Boslaugh, S. E., Gross, G. A., & Muglia, L. J. (2007). A short interpregnancy interval is a risk factor for preterm birth and its recurrence. *American Journal of Obstetrics and Gynecology, 197*(3), 264.e1-264.e6. doi:10.1016/j.ajog.2007.06.042

Delgado-Rodríguez, M., Gómez-Olmedo, M., Bueno-Cavanillas, A., & Gálvez-Vargas, R. (1997). Unplanned pregnancy as a major determinant in inadequate use of prenatal care. *Preventive Medicine, 26*(6), 834-838.

Department of Health and Human Services. (2010). *Healthy people 2020: Maternal, infant, and child health*.

Department of Medical Assistance Services. (2012). *Medicaid and FAMIS plus handbook*.

DePiñeres, T., Blumenthal, P. D., & Diener-West, M. (2005). Postpartum contraception: The New Mexico pregnancy risk assessment monitoring system. *Contraception, 72*(6), 422-425.

Dobie, S. A., Hart, L. G., Fordyce, M., & Rosenblatt, R. A. (1994). Do women choose their obstetric providers based on risks at entry into prenatal care? A study of women in Washington state. *Obstetrics and Gynecology, 84*(4), 557-564.

Donabedian, A. (1966). Evaluating the quality of medical care. *The Milbank Memorial Fund Quarterly, 44*(3), 166-206.

Donabedian, A. (1980). The definition of quality and approaches to its assessment. explorations in quality assessment and monitoring. *Ann Arbor: Health Administration Press, 1*

Doyle, L. W., Ford, G., & Davis, N. (2003). Health and hospitalistions after discharge in extremely low birth weight infants. *Seminars in Neonatology : SN, 8*(2), 137-145. doi:10.1016/S1084-2756(02)00221-X

Dubin, J. A., & McFadden, D. L. (1984). An econometric analysis of residential electric appliance holdings and consumption. *Econometrica: Journal of the Econometric Society,* 345-362.

Earnshaw, V. A., Rosenthal, L., LMFT, J. B. L., Stasko, E. C., Tobin, J. N., Lewis, T. T., Ickovics, J. R. (2013). Maternal experiences with everyday discrimination and infant birth weight: A test of mediators and moderators among young, urban women of color. *Annals of Behavioral Medicine, 45*(1), 13-23.

Eichenwald, E. C., & Stark, A. R. (2008). Management and outcomes of very low birth weight. *New England Journal of Medicine, 358*(16), 1700-1711.

Emanuel, I., Filakti, H., Alberman, E., & Evans, S. J. (1992). Intergenerational studies of human birthweight from the 1958 birth cohort. Evidence for a multigenerational effect. *BJOG: An International Journal of Obstetrics & Gynaecology, 99*(1), 67-74.

Erickson, J. D., & Bjerkedal, T. (1979). Interval between pregnancies. *Lancet, 1*(8106), 52.

Escarce, J. J., & Kapur, K. (2009). Do patients bypass rural hospitals?: Determinants of inpatient hospital choice in rural California. *Journal of Health Care for the Poor and Underserved, 20*(3), 625-644.

Esposito, M. A., Menihan, C. A., & Malee, M. P. (2000). Association of interpregnancy interval with uterine scar failure in labor: A case-control study. *American Journal of Obstetrics and Gynecology, 183*(5), 1180-1183. doi:10.1067/mob.2000.109046

Feijen-de Jong, E. I., Jansen, D. E., Baarveld, F., van der Schans, C. P., Schellevis, F. G., & Reijneveld, S. A. (2012). Determinants of late and/or inadequate use of prenatal healthcare in high-income countries: A systematic review. *European Journal of Public Health, 22*(6), 904-913. doi:10.1093/eurpub/ckr164; 10.1093/eurpub/ckr164

Finkelstein, S. R., Liu, N., Jani, B., Rosenthal, D., & Poghosyan, L. (2013). Appointment reminder systems and patient preferences: Patient technology usage and familiarity with other service providers as predictive variables. *Health Informatics Journal, 19*(2), 79-90. doi:10.1177/1460458212458429; 10.1177/1460458212458429

Forrest, C. B., & Whelan, E. (2000). Primary care safety-net delivery sites in the United States: A comparison of community health centers, hospital outpatient departments, and physicians' offices. *JAMA, 284*(16), 2077-2083.

Forrest, J. D. (1996). US women's perceptions of and attitudes about the IUD. *Obstetrical & Gynecological Survey, 51*(12), 30S-34S.

Fortenberry, J. D., McFarlane, M., Bleakley, A., Bull, S., Fishbein, M., Grimley, D. M., Stoner, B. P. (2002). Relationships of stigma and shame to gonorrhea and HIV screening. *American Journal of Public Health, 92*(3), 378-381.

Frank, R. G. (2004). Behavioral economics and health economics. (No. w10881). *Behavioral Economics and Health Economics.*

Freda, M. C., Andersen, H. F., Damus, K., & Merkatz, I. R. (1993). Are there differences in information given to private and public prenatal patients? *American Journal of Obstetrics and Gynecology, 169*(1), 155.

Friedman, S. H., Heneghan, A., & Rosenthal, M. (2009). Characteristics of women who do not seek prenatal care and implications for prevention. *Journal of Obstetric, Gynecologic, & Neonatal Nursing, 38*(2), 174-181.

Frost, J. J., Gold, R. B., Frohwirth, L., & Blades, N. (2012). Variation in service delivery practices among clinics providing publicly funded family planning services in 2010.

Garcıa, J. A., Paterniti, D. A., Romano, P. S., & Kravitz, R. L. (2003). Patient preferences for physician characteristics in university-based primary care clinics. *Ethnicity & Disease, 13.*

Gaskin, D. J., Dinwiddie, G. Y., Chan, K. S., & McCleary, R. (2012). Residential segregation and disparities in health care services utilization. *Medical Care Research and Review, 69*(2), 158-175.

George, A., & Rubin, G. (2003). Non-attendance in general practice: A systematic review and its implications for access to primary health care. *Family Practice, 20*(2), 178-184.

Gertler, P., & Boyce, S. (2001). An experiment in incentive-based welfare: The impact of progresa on health in Mexico. *University of California, Berkeley*, 30-37.

Gilbert, P., Herzig, K., Thakar, D., Viloria, J., Bogetz, A., Danley, D. W., Gerbert, B. (2007). How health care setting affects prenatal providers' risk reduction practices: A qualitative comparison of settings. *Women & Health, 45*(2), 41-57.

Giscombé, C. L., & Lobel, M. (2005). Explaining disproportionately high rates of adverse birth outcomes among African Americans: The impact of stress, racism, and related factors in pregnancy. *Psychological Bulletin, 131*(5), 662.

Glasier, A. F., Logan, J., & McGlew, T. (1996). Who gives advice about postpartum contraception? *Contraception, 53*(4), 217-220.

Glasier, A., Scorer, J., & Bigrigg, A. (2008). Attitudes of women in Scotland to contraception: A qualitative study to explore the acceptability of long-acting methods. *Journal of Family Planning and Reproductive Health Care, 34*(4), 213-217.

Goldenberg, R. L., Culhane, J. F., Iams, J. D., & Romero, R. (2008a). Epidemiology and causes of preterm birth. *The Lancet, 371*(9606), 75-84.

Goldenberg, R. L., Patterson, E. T., & Freese, M. P. (1992). Maternal demographic, situational and psychosocial factors and their relationship to enrollment in prenatal care: A review of the literature. *Women & Health, 19*(2-3), 133-151.

Goldenberg, R. L., Culhane, J. F., Iams, J. D., & Romero, R. (2008b). Epidemiology and causes of preterm birth. *Lancet, 371*(9606), 75-84. doi:10.1016/S0140-6736(08)60074-4; 10.1016/S0140-6736(08)60074-4

Goldman, D., & Romley, J. (2008). Hospitals as hotels: The role of patient amenities in hospital demand. *NBER Working Paper Series, 14619*

Guyer, B., Hoyert, D. L., Martin, J. A., Ventura, S. J., MacDorman, M. F., & Strobino, D. M. (1999). Annual summary of vital statistics—1998. *Pediatrics, 104*(6), 1229-1246.

Hairon, N. (2008). Increasing use of long-acting reversible contraception. *Nursing Times, 104*(42), 23-24.

Hakim, R. B., & Bye, B. V. (2001). Effectiveness of compliance with pediatric preventive care guidelines among medicaid beneficiaries. *Pediatrics, 108*(1), 90-97.

Handler, A., Raube, K., Kelley, M. A., & Giachello, A. (1996). Women's satisfaction with prenatal care settings: A focus group study. *Birth (Berkeley, Calif.), 23*(1), 31-37.

Handler, A., Rosenberg, D., Raube, K., & Lyons, S. (2003). Prenatal care characteristics and African American women's satisfaction with care in a managed care organization.

Women's Health Issues : Official Publication of the Jacobs Institute of Women's Health, 13(3), 93-103.

Harper, C. C., Blum, M., de Bocanegra, H. T., Darney, P. D., Speidel, J. J., Policar, M., & Drey, E. A. (2008). Challenges in translating evidence to practice: The provision of intrauterine contraception. *Obstetrics & Gynecology, 111*(6), 1359-1369.

Health Resources and Services Administration. (2014). Data warehouse. Retrieved 09/12, 2013, from http://datawarehouse.hrsa.gov

Herbst, M. A., Mercer, B. M., Beazley, D., Meyer, N., & Carr, T. (2003). Relationship of prenatal care and perinatal morbidity in low-birth-weight infants. *American Journal of Obstetrics and Gynecology, 189*(4), 930-933.

Hernandez, L., Sappenfield, W., Goodman, D., & Pooler, J. (2012). Is effective contraceptive use conceived prenatally in Florida? the association between prenatal contraceptive counseling and postpartum contraceptive use. *Maternal & Child Health Journal, 16*(2), 423-429. doi:10.1007/s10995-010-0738-9

Hillier, S. L., Nugent, R. P., Eschenbach, D. A., Krohn, M. A., Gibbs, R. S., Martin, D. H., . . . Rao, A. V. (1995). Association between bacterial vaginosis and preterm delivery of a low-birth-weight infant. *New England Journal of Medicine, 333*(26), 1737-1742.

Hilmert, C. J., Dominguez, T. P., Schetter, C. D., Srinivas, S. K., Glynn, L. M., Hobel, C. J., & Sandman, C. A. (2013). Lifetime racism and blood pressure changes during pregnancy: Implications for fetal growth.

Hoffman, S. D., & Duncan, G. J. (1988). Multinomial and conditional logit discrete-choice models in demography. *Demography, 25*(3), 415-427.

Howard, D. L., Marshall, S. S., Kaufman, J. S., & Savitz, D. A. (2006). Variations in low birth weight and preterm delivery among blacks in relation to ancestry and nativity: New York City, 1998-2002. *Pediatrics, 118*(5), e1399-405. doi:10.1542/peds.2006-0665

Hyndman, J., Holman, C., & Dawes, V. (2000). Effect of distance and social disadvantage on the response to invitations to attend mammography screening. *Journal of Medical Screening, 7*(3), 141-145.

Iezzoni, L. I. (1997). Assessing quality using administrative data. *Annals of Internal Medicine, 127*(8_Part_2), 666-674.

Institute of Medicine. (1988). *Prenatal care: Reaching mothers, reaching infants*. Washington, DC: National Academies Press.

Jeffcoat, M. K., Geurs, N.C., Reddy, M.S., Cliver, S. P., Goldenberg, R.L., Hauth, J.C. (2001). Periodontal infection and preterm birth results of a prospective study. *The Journal of the American Dental Association, 132*(7), 875-880.

Johnson, K., Posner, S. F., Biermann, J., Cordero, J. F., Atrash, H. K., Parker, C. S., Curtis, M. G. (2006). Recommendations to improve preconception health and health care - United States. *Morbidity and Mortality Weekly Report, 55*(4)

Johnson, A. A., Wesley, B. D., El-Khorazaty, M. N., Utter, J. M., Bhaskar, B., Hatcher, B. J., . . . Laryea, H. A. (2011). African American and Latino patient versus provider perceptions of determinants of prenatal care initiation. *Maternal and Child Health Journal, 15 Suppl 1*, S27-34. doi:10.1007/s10995-011-0864-z; 10.1007/s10995-011-0864-z

Kahneman, D. (2003). Maps of bounded rationality: Psychology for behavioral economics. *The American Economic Review, 93*(5), 1449-1475.

Kessler, D. P., & McClellan, M. B. (2000). Is hospital competition socially wasteful? *The Quarterly Journal of Economics, 115*(2), 577-615.

Kistka, Z. A., Palomar, L., Lee, K. A., Boslaugh, S. E., Wangler, M. F., Cole, F. S., . . . Muglia, L. J. (2007). Racial disparity in the frequency of recurrence of preterm birth. *American Journal of Obstetrics and Gynecology, 196*(2), 131.e1-131.e6. doi:10.1016/j.ajog.2006.06.093

Klerman, L. V., Cliver, S. P., & Goldenberg, R. L. (1998). The impact of short interpregnancy intervals on pregnancy outcomes in a low-income population. *American Journal of Public Health, 88*(8), 1182-1185.

Kluger, M. P., & Karras, A. (1983). Strategies for reducing missed initial appointments in a community mental health center. *Community Mental Health Journal, 19*(2), 137-143.

Kogan, M. D., Alexander, G. R., Kotelchuek, M., & Nagey, D. A. (1994). Relation of the content of prenatal care to the risk of low birth weight: Maternal reports of health behavior advice and initial prenatal care procedures. *Obstetrical & Gynecological Survey, 49*(10), 667-668.

Kogan, M. D., Martin, J. A., Alexander, G. R., Kotelchuck, M., Ventura, S. J., & Frigoletto, F. D. (1998). The changing pattern of prenatal care utilization in the United States, 1981-1995, using different prenatal care indices. *JAMA: The Journal of the American Medical Association, 279*(20), 1623-1628.

Kotelchuck, M. (1994a). The adequacy of prenatal care utilization index: Its US distribution and association with low birthweight. *American Journal of Public Health, 84*(9), 1486-1489.

Kotelchuck, M. (1994b). An evaluation of the Kessner adequacy of prenatal care index and a proposed adequacy of prenatal care utilization index. *American Journal of Public Health, 84*(9), 1414-1420.

Kramer, M. S. (1987). Determinants of low birth weight: Methodological assessment and meta-analysis. *Bulletin of the World Health Organization, 65*(5), 663.

Kramer, M. S., Seguin, L., Lydon, J., & Goulet, L. (2000). Socio-economic disparities in pregnancy outcome: Why do the poor fare so poorly? *Paediatric and Perinatal Epidemiology, 14*(3), 194-210.

Krueger, P. M., & Scholl, T. O. (2000). Adequacy of prenatal care and pregnancy outcome. *JAOA: Journal of the American Osteopathic Association, 100*(8), 485-492.

Kumar, D., Schlundt, D. G., & Wallston, K. A. (2009). Patient-physician race concordance and its relationship to perceived health outcomes. *Ethnicity & Disease, 19*(3), 345.

Kwon, S., Lazo-Escalante, M., Villaran, M. V., & Li, C. I. (2012). Relationship between interpregnancy interval and birth defects in Washington State. *Journal of Perinatology: Official Journal of the California Perinatal Association, 32*(1), 45-50. doi:10.1038/jp.2011.49; 10.1038/jp.2011.49

Lancsar, E., & Savage, E. (2004). Deriving welfare measures from discrete choice experiments: Inconsistency between current methods and random utility and welfare theory. *Health Economics, 13*(9), 901-907.

LaVeist, T. A., Keith, V. M., & Gutierrez, M. L. (1995). Black/white differences in prenatal care utilization: An assessment of predisposing and enabling factors. *Health Services Research, 30*(1), 43-58.

Laveist, T. A., & Nuru-Jeter, A. (2002). Is doctor-patient race concordance associated with greater satisfaction with care? *Journal of Health and Social Behavior, 43*(3), 296-306.

Lazarus, E. S. (1994). What do women want?: Issues of choice, control, and class in pregnancy and childbirth. *Medical Anthropology Quarterly, 8*(1), 25-46.

Levy, R. L., & Clark, H. (1980). The use of an overt commitment to enhance compliance: A cautionary note. *Journal of Behavior Therapy and Experimental Psychiatry, 11*(2), 105-107.

Lindmark, G., & Langhoff-Roos, J. (2004). Regional quality assessment in perinatal care. *Seminars in Neonatology, , 9*(2) 145-153.

Lobel, M., Cannella, D. L., Graham, J. E., DeVincent, C., Schneider, J., & Meyer, B. A. (2008). Pregnancy-specific stress, prenatal health behaviors, and birth outcomes. *Health Psychology, 27*(5), 604.

Lu, M. C., & Chen, B. (2004). Racial and ethnic disparities in preterm birth: The role of stressful life events. *American Journal of Obstetrics and Gynecology, 191*(3), 691-699.

Luft, H. S., Garnick, D. W., Mark, D. H., Peltzman, D. J., Phibbs, C. S., Lichtenberg, E., & McPhee, S. J. (1990). Does quality influence choice of hospital? *JAMA: The Journal of the American Medical Association, 263*(21), 2899-2906.

Luu, T. M., Lefebvre, F., Riley, P., & Infante-Rivard, C. (2010). Continuing utilisation of specialised health services in extremely preterm infants. *Archives of Disease in Childhood.Fetal and Neonatal Edition, 95*(5), F320-5. doi:10.1136/adc.2009.173138; 10.1136/adc.2009.173138

Macharia, W. M., Leon, G., Rowe, B. H., Stephenson, B. J., & Haynes, R. B. (1992). An overview of interventions to improve compliance with appointment keeping for medical services. *Jama, 267*(13), 1813-1817.

Madden, T., Allsworth, J. E., Hladky, K. J., Secura, G. M., & Peipert, J. F. (2010). Intrauterine contraception in Saint Louis: A survey of obstetrician and gynecologists' knowledge and attitudes. *Contraception, 81*(2), 112-116.

Maheswaran, R., Pearson, T., Jordan, H., & Black, D. (2006). Socioeconomic deprivation, travel distance, location of service, and uptake of breast cancer screening in north derbyshire, UK. *Journal of Epidemiology and Community Health, 60*(3), 208-212.

Martin, J., Hamilton, B., Osterman, J., Curtin, S., & Matthews, T. (2014). Births: Final data for 2012. *National Vital Statistics Report, 62*(9).

Martin, J. A., Kung, H., Mathews, T., Hoyert, D. L., Strobino, D. M., Guyer, B., & Sutton, S. R. (2008). Annual summary of vital statistics: 2006. *Pediatrics, 121*(4), 788-801.

Masho, S. W., Chapman, D., & Ashby, M. (2010). The impact of paternity and marital status on low birth weight and preterm births. *Marriage & Family Review, 46*(4), 243-256.

Mattsson, K., & Rylander, L. (2012). Influence of maternal and paternal birthweight on offspring birthweight–a population-based intergenerational study. *Paediatric and Perinatal Epidemiology,* 27(2), 138-144.

Maupin, J., R, Lyman, R., Fatsis, J., Prystowiski, E., Nguyen, A., Wright, C., . . . Miller, J., J. (2004). Characteristics of women who deliver with no prenatal care. *Journal of Maternal-Fetal and Neonatal Medicine, 16*(1), 45-50.

McEwen, B. S. (1998). Stress, adaptation, and disease: Allostasis and allostatic load. *Annals of the New York Academy of Sciences, 840*(1), 33-44.

McFadden, D. (1973). Conditional logit analysis of qualitative choice behavior.

McFadden, D. (1987). Regression-based specification tests for the multinomial logit model. *Journal of Econometrics, 34*(1), 63-82.

McGuirk, M. A., & Porell, F. W. (1984). Spatial patterns of hospital utilization: The impact of distance and time. *Inquiry,* 84-95.

McIntire, D. D., Bloom, S. L., Casey, B. M., & Leveno, K. J. (1999). Birth weight in relation to morbidity and mortality among newborn infants. *The New England Journal of Medicine, 340*(16), 1234-1238. doi:10.1056/NEJM199904223401603

McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology,* 415-444.

Meghani, S. H., Brooks, J. M., Gipson-Jones, T., Waite, R., Whitfield-Harris, L., & Deatrick, J. A. (2009). Patient–provider race-concordance: Does it matter in improving minority patients' health outcomes? *Ethnicity & Health, 14*(1), 107-130.

Miller, B. C., Benson, B., & Galbraith, K. A. (2001). Family relationships and adolescent pregnancy risk: A research synthesis. *Developmental Review, 21*(1), 1-38.

Monstad, K., Engesæter, L. B., & Espehaug, B. (2006). Patients' preferences for choice of hospital. *Health Economics Bergen Working Paper,* (05/06)

Morello-Frosch, R., & Shenassa, E. D. (2006). The environmental "riskscape" and social inequality: Implications for explaining maternal and child health disparities. *Environmental Health Perspectives, 114*(8), 1150.

Morenoff, J. D. (2003). Neighborhood mechanisms and the spatial dynamics of birth weight1. *American Journal of Sociology, 108*(5), 976-1017.

Morrisey, M. A., Sloan, F. A., & Valvona, J. (1988). Defining geographic markets for hospital care. *Law and Contemporary Problems, 51*(2), 165-194.

Moster, D., Lie, R. T., & Markestad, T. (2008). Long-term medical and social consequences of preterm birth. *New England Journal of Medicine, 359*(3), 262-273.

Muglia, L. J., & Katz, M. (2010). The enigma of spontaneous preterm birth. *New England Journal of Medicine, 362*(6), 529-535.

Mullainathan, S., & Thaler, R. H. (2000). *Behavioral Economics,* (No. w7948). National Bureau of Economic Research.

National Committee for Quality Assurance. (2007). *The state of health care quality 2007*. Washington, DC.

Neal, R. D., Lawlor, D. A., Allgar, V., Colledge, M., Ali, S., Hassey, A., Wilson, A. (2001). Missed appointments in general practice: Retrospective data analysis from four practices. *The British Journal of General Practice: The Journal of the Royal College of General Practitioners, 51*(471), 830-832.

Neggers, Y., & Goldenberg, R. L. (2003). Some thoughts on body mass index, micronutrient intakes and pregnancy outcome. *The Journal of Nutrition, 133*(5), 1737S-1740S.

Novick, G. (2009). Women's experience of prenatal care: An integrative review. *Journal of Midwifery & Women's Health, 54*(3), 226-237.

O'Campo, P., Xue, X., Wang, M. C., & Caughy, M. (1997). Neighborhood risk factors for low birthweight in Baltimore: A multilevel analysis. *American Journal of Public Health, 87*(7), 1113-1118.

Oropesa, R. S., Landale, N. S., & Kenkre, T. S. (2002). Structure, process, and satisfaction with obstetricians: An analysis of mainland Puerto Ricans. *Medical Care Research and Review: MCRR, 59*(4), 412-439.

Osrin, D., & de L Costello, A. M. (2000). Maternal nutrition and fetal growth: Practical issues in international health. *Seminars in Neonatology : SN, 5*(3), 209-219. doi:10.1053/siny.2000.0024

Park, H., Rodriguez, M. I., Hulett, D., Darney, P. D., & Thiel de Bocanegra, H. (2012). Long-acting reversible contraception method use among title X providers and non-title X providers in California. *Contraception, 86*(5), 557-561.

Parker, J. D., Woodruff, T. J., Basu, R., & Schoendorf, K. C. (2005). Air pollution and birth weight among term infants in California. *Pediatrics, 115*(1), 121-128. doi:10.1542/peds.2004-0889

Peabody, J. W., Gertler, P. J., & Leibowitz, A. (1998). The policy implications of better structure and process on birth outcomes in Jamaica. *Health Policy (Amsterdam, Netherlands), 43*(1), 1-13.

Pearl, M., Braveman, P., & Abrams, B. (2001). The relationship of neighborhood socioeconomic characteristics to birthweight among 5 ethnic groups in California. *American Journal of Public Health, 91*(11), 1808-1814.

Phibbs, C. S., Mark, D. H., Luft, H. S., Peltzman-Rennie, D. J., Garnick, D. W., Lichtenberg, E., & McPhee, S. J. (1993). Choice of hospital for delivery: A comparison of high-risk and low-risk women. *Health Services Research, 28*(2), 201-222.

Phillippi, J. C. (2009). Women's perceptions of access to prenatal care in the United States: A literature review. *Journal of Midwifery & Women's Health, 54*(3), 219-225.

Phillips, K. L., Chiriboga, D. A., & Jang, Y. (2012). Satisfaction with care: The role of patient-provider racial/ethnic concordance and interpersonal sensitivity. *Journal of Aging and Health, 24*(7), 1079-1090. doi:10.1177/0898264312453068

Pohl, J. M., Tanner, C., Pilon, B., & Benkert, R. (2011). Comparison of nurse managed health centers with federally qualified health centers as safety net providers. *Policy, Politics & Nursing Practice, 12*(2), 90-99. doi:10.1177/1527154411417882

Profit, J., Zupancic, J. A., Gould, J. B., & Petersen, L. A. (2007). Implementing pay-for-performance in the neonatal intensive care unit. *Pediatrics, 119*(5), 975-982.

Radcliff, T. A., Brasure, M., Moscovice, I. S., & Stensland, J. T. (2008). Understanding rural hospital bypass behavior. *The Journal of Rural Health, 19*(3), 252-259.

Radecki, S. E., & Bernstein, G. S. (1989). Use of clinic versus private family planning care by low-income women: Access, cost, and patient satisfaction. *American Journal of Public Health, 79*(6), 692-697.

Raphael, D. (2001). Medicaid transportation: Assuring access to health care: A primer for states, health plans, providers and advocates. *Community Transportation Association of America. Retrieved August, 13*, 2004.

Ray, B. J., Metcalf, S. C., Franco, S. M., & Mitchell, C. K. (1997). Infant sleep position instruction and parental practice: Comparison of a private pediatric office and an inner-city clinic. *Pediatrics, 99*(5), E12.

Reyna, V. F., & Farley, F. (2006). Risk and rationality in adolescent decision making implications for theory, practice, and public policy. *Psychological Science in the Public Interest, 7*(1), 1-44.

Rich-Edwards, J. W., Stampfer, M. J., Manson, J., Rosner, B., Hankinson, S. E., Colditz, G. A., . . . Hennekens, C. H. (1997). Birth weight and risk of cardiovascular disease in a cohort of women followed up since 1976. *BMJ: British Medical Journal, 315*(7105), 396.

Ritz, B., Wilhelm, M., Hoggatt, K. J., & Ghosh, J. K. C. (2007). Ambient air pollution and preterm birth in the environment and pregnancy outcomes study at the University of California, Los Angeles. *American Journal of Epidemiology, 166*(9), 1045-1052.

Roberts, E. M. (1997). Neighborhood social environments and the distribution of low birthweight in Chicago. *American Journal of Public Health, 87*(4), 597-603.

Roh, C. (2007). Factors associated with hospital preference among rural Medicaid beneficiaries. *International Journal of Public Policy, 2*(3), 316-327.

Rosen, M. G. (1989). *Caring for our future: The content of prenatal care: A report of the public health service expert panel on the content of prenatal care* Public Health Service, Department of Health and Human Services.

Rosenthal, L., & Lobel, M. (2011). Explaining racial disparities in adverse birth outcomes: Unique sources of stress for black American women. *Social Science & Medicine, 72*(6), 977-983.

Roter, D. L., Hall, J. A., Merisca, R., Nordstrom, B., Cretin, D., & Svarstad, B. (1998). Effectiveness of interventions to improve patient compliance: A meta-analysis. *Medical Care, 36*(8), 1138-1161.

Saigal, S., & Doyle, L. W. (2008). An overview of mortality and sequelae of preterm birth from infancy to adulthood. *The Lancet, 371*(9608), 261-269.

Schempf, A. H., & Strobino, D. M. (2009). Drug use and limited prenatal care: An examination of responsible barriers. *American Journal of Obstetrics and Gynecology, 200*(4), 412. e1-412. e10.

Schnittker, J., & Liang, K. (2006). The promise and limits of racial/ethnic concordance in physician-patient interaction. *Journal of Health Politics, Policy and Law, 31*(4), 811-838. doi:10.1215/03616878-2006-004

Schwarz, E. B., Papic, M., Parisi, S. M., Baldauf, E., Rapkin, R., & Updike, G. (2014). Routine counseling about intrauterine contraception for women seeking emergency contraception. *Contraception.*

Secura, G. M., Allsworth, J. E., Madden, T., Mullersman, J. L., & Peipert, J. F. (2010). The contraceptive CHOICE project: Reducing barriers to long-acting reversible contraception. *American Journal of Obstetrics and Gynecology, 203*(2), 115. e1.

Sheppard, V. B., Zambrana, R. E., & O'Malley, A. S. (2004). Providing health care to low-income women: A matter of trust. *Family Practice, 21*(5), 484-491.

Shipp, T. D., Zelop, C. M., Repke, J. T., Cohen, A., & Lieberman, E. (2001). Interdelivery interval and risk of symptomatic uterine rupture. *Obstetrics and Gynecology, 97*(2), 175-177.

Simpson, L., Korenbrot, C., & Greene, J. (1997). Outcomes of enhanced prenatal services for Medicaid-eligible women in public and private settings. *Public Health Reports, 112*(2), 122.

Smith, K. B., van der Spuy, Z. M., Cheng, L., Elton, R., & Glasier, A. F. (2002). Is postpartum contraceptive advice given antenatally of value? *Contraception, 65*(3), 237-243.

Sonfield, A., Kost, K., Gold, R. B., & Finer, L. B. (2011). The public costs of births resulting from unintended pregnancies: National and state-level estimates. *Perspectives on Sexual & Reproductive Health, 43*(2), 94-102. doi:10.1363/4309411

St Clair, P. A., Smeriglio, V. L., Alexander, C. S., & Celentano, D. D. (1989). Social network structure and prenatal care utilization. *Medical Care, 27*(8), 823-832.

Stamilio, D. M., DeFranco, E., Pare, E., Odibo, A. O., Peipert, J. F., Allsworth, J. E., . . . Macones, G. A. (2007). Short interpregnancy interval: Risk of uterine rupture and complications of vaginal birth after cesarean delivery. *Obstetrics and Gynecology, 110*(5), 1075-1082. doi:10.1097/01.AOG.0000286759.49895.46

Stanwood, N. L., Garrett, J. M., & Konrad, T. R. (2002). Obstetrician-Gynecologists and the intrauterine device: A survey of attitudes and practice. *Obstetrics & Gynecology, 99*(2), 275-280.

Stubbs, N. D., Geraci, S. A., Stephenson, P. L., Jones, D. B., & Sanders, S. (2012). Methods to reduce outpatient non-attendance. *The American Journal of the Medical Sciences, 344*(3), 211-219. doi:10.1097/MAJ.0b013e31824997c6; 10.1097/MAJ.0b013e31824997c6

Swamy, G. K., Østbye, T., & Skjærven, R. (2008). Association of preterm birth with long-term survival, reproduction, and next-generation preterm birth. *JAMA: The Journal of the American Medical Association, 299*(12), 1429-1436.

Swenson, T. R., & Pekarik, G. (1988). Interventions for reducing missed initial appointments at a community mental health center. *Community Mental Health Journal, 24*(3), 205-218.

Sword, W. (2003). Prenatal care use among women of low income: A matter of "taking care of self". *Qualitative Health Research, 13*(3), 319-332.

Tai, W. T., Porell, F. W., & Adams, E. K. (2004). Hospital choice of rural Medicare beneficiaries: Patient, hospital attributes, and the patient-physician relationship. *Health Services Research, 39*(6 Pt 1), 1903-1922. doi:10.1111/j.1475-6773.2004.00324.x

Taylor, Y. J., & Nies, M. A. (2012). Measuring the impact and outcomes of maternal child health federal programs. *Maternal and Child Health Journal,* doi:10.1007/s10995-012-1067-y

Terry Long, B. (2004). How have college decisions changed over time? An application of the conditional logistic choice model. *Journal of Econometrics, 121*(1), 271-296.

Thaler, R. H., & Sunstein, C. R. (2003). Libertarian paternalism. *The American Economic Review, 93*(2), 175-179.

The American Congress of Obstetricians and Gynecologists. (2012). *Facts are important*.

The Health Foundation of Greater Cincinnati and the American Academy of Family Physicians. (2013). UDS mapper. Retrieved 05/06, 2013, from http://www.udsmapper.org/zcta-crosswalk.cfm

The Henry J. Kaiser Family Foundation. (2012). *Women's health insurance coverage.*

Tough, S. C., Siever, J. E., & Johnston, D. W. (2007). Retaining women in a prenatal care randomized controlled trial in Canada: Implications for program planning. *BMC Public Health, 7*(1), 148.

Traylor, A. H., Schmittdiel, J. A., Uratsu, C. S., Mangione, C. M., & Subramanian, U. (2010a). The predictors of Patient–Physician race and ethnic concordance: A medical facility Fixed-Effects approach. *Health Services Research, 45*(3), 792-805.

Traylor, A. H., Schmittdiel, J. A., Uratsu, C. S., Mangione, C. M., & Subramanian, U. (2010b). Adherence to cardiovascular disease medications: Does patient-provider race/ethnicity and language concordance matter? *Journal of General Internal Medicine, 25*(11), 1172-1177. doi:10.1007/s11606-010-1424-8; 10.1007/s11606-010-1424-8

Trussell, J., Lalla, A. M., Doan, Q. V., Reyes, E., Pinto, L., & Gricar, J. (2009). Cost effectiveness of contraceptives in the United States. *Contraception, 79*(1), 5.

United States Census Bureau. (2013). American community survey. Retrieved 06/15, 2013, from http://www.census.gov/acs/www/

US Department of Health and Human Services. (2006). Comparison of the rural health clinic and federally qualified health center programs.

Vaaler, M. L., Kalanges, L. K., Fonseca, V. P., & Castrucci, B. C. (2012). Urban–Rural differences in attitudes and practices toward long-acting reversible contraceptives among family planning providers in Texas. *Women's Health Issues, 22*(2), e157-e162.

Vintzileos, A. M., Ananth, C. V., Smulian, J. C., Scorza, W. E., & Knuppel, R. A. (2002). The impact of prenatal care in the United States on preterm births in the presence and absence of antenatal high-risk conditions. *American Journal of Obstetrics and Gynecology, 187*(5), 1254-1257.

Virginia Department of Health. (2013). Richmond city health district: Programs. Retrieved from http://www.vdh.virginia.gov/LHD/richmondcity/programs.htm.

Virginia Department of Social Services. (2013). *Medicaid manual*. Retrieved from http://www.dss.virginia.gov/benefit/medical_assistance/manual.cgi.

Virginia Premier Health Plan. (2013). About us. Retrieved 1/5, 2014, from https://www.vapremier.com/about-us/overview/

Wadhwa, P. D., Sandman, C. A., Porto, M., Dunkel-Schetter, C., & Garite, T. J. (1993). The association between prenatal stress and infant birth weight and gestational age at birth: A prospective investigation. *American Journal of Obstetrics and Gynecology, 169*(4), 858-865.

Wall, S. (1998). Transformations in public health systems. *Health Affairs (Project Hope), 17*(3), 64-80.

Waller, J., & Hodgkin, P. (2000). Defaulters in general practice: Who are they and what can be done about them? *Family Practice, 17*(3), 252-253.

Wei, J., Hollin, I., & Kachnowski, S. (2011). A review of the use of mobile phone text messaging in clinical and healthy behaviour interventions. *Journal of Telemedicine and Telecare, 17*(1), 41-48. doi:10.1258/jtt.2010.100322; 10.1258/jtt.2010.100322

Weisman, C. S., Maccannon, D. S., Henderson, J. T., Shortridge, E., & Orso, C. L. (2002). Contraceptive counseling in managed care: Preventing unintended pregnancy in adults. *Women's Health Issues, 12*(2), 79-95.

Wells, K. B., Rogers, W., Burnam, A., Greenfield, S., & Ware Jr, J. E. (1991). How the medical comorbidity of depressed patients differs across health care settings: Results from the medical outcomes study. *Am J Psychiatry, 148*(12), 1688-1696.

Windham, G. C., Fenster, L., Hopkins, B., & Swan, S. H. (1995). The association of moderate maternal and paternal alcohol consumption with birthweight and gestational age. *Epidemiology,* 591-597.

Winner, B., Peipert, J. F., Zhao, Q., Buckel, C., Madden, T., Allsworth, J. E., & Secura, G. M. (2012). Effectiveness of long-acting reversible contraception. *The New England Journal of Medicine, 366*(21), 1998-2007. doi:10.1056/NEJMoa1110855; 10.1056/NEJMoa1110855

Wooldridge, J. (2009). *Introductory econometrics*. United States: South-Western.

Wooldridge, J. (2010). 9.5.2 estimation. *Econometric analysis of cross section and panel data* (Second ed., pp. 235-237)

World Health Organization. (2004). *Medical eligibility criteria.* Geneva.

Wu Wen, S., Goldenberg, R. L., Cutter, G. R., Hoffman, H. J., Cliver, S. P., Davis, R. O., & DuBard, M. B. (1990). Smoking, maternal age, fetal growth, and gestational age at delivery. *American Journal of Obstetrics and Gynecology, 162*(1), 53-58.

Zhu, B. P., Haines, K. M., Le, T., McGrath-Miller, K., & Boulton, M. L. (2001). Effect of the interval between pregnancies on perinatal outcomes among white and black women. *American Journal of Obstetrics and Gynecology, 185*(6), 1403-1410. doi:10.1067/mob.2001.118307

Zuckerman, M., Navizedeh, N., Feldman, J., McCalla, S., & Minkoff, H. (2002). Determinants of women's choice of obstetrician/gynecologist. *Journal of Women's Health & Gender-Based Medicine, 11*(2), 175-180. doi:10.1089/152460902753645317

Vita

Lynn M. VanderWielen was born on May 12, 1985 in Appleton, Wisconsin. She graduated from Little Chute High School in 2003 and subsequently attended the University of Wisconsin where she obtained her Bachelors of Natural Science with honors degree. Following work in Guadalajara, Mexico at Villas Miravalle and a domestic violence agency in New Brunswick, New Jersey, Lynn attended The Johns Hopkins Bloomberg School of Public Health, where she obtained her Masters of Public Health degree. In August 2010 Lynn began her PhD studies at Virginia Commonwealth University, where she primarily worked with Dr. Gloria Bazzoli. Following graduation, Lynn, her husband Alexander Enurah, and beagle Dexter will move to Denver, Colorado, where Lynn will work as Research Faculty in the Department of Family Medicine at the University of Colorado.